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The International Magazine for the Wire & Cable Industries

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Rwanda's Internet – banking on youth

News stories about extended fibre optic networks and ever higher-speed Internet connections are frequent, but one network project has captured my imagination.

Sixteen years after the Genocide, the government of Rwanda is determined that its low-income country will be a middle-income country by 2020. Part of this initiative is the commitment to invest $50 million in a high-speed fibre optic backbone to serve the entire country, and to access this connection every child in the country will be given a laptop computer.

It's not simply the commitment to the network that engaged me; it's that, largely, children will lead the way to the possibilities of the Internet. In Rwanda, over 40% of the population is under 14 years old, and the most common habitation is a fairly isolated family settlement. The laptops will deliver general education, and advice on everything from health to animal husbandry, and it's the children who will form the conduit for ICT to many of their elders.

But the plan of the Rwandan government is not just education, vital though that is. High-speed Internet will link suppliers, producers, distributors and customers in a way previously unheard of in the region, opening up essential communication routes for business and commerce. There are other, less obvious ways (to me) that the economy of Rwanda will benefit. For example, banks and ATMs are scarce in Rwanda, making a rather limited cash-based business model the only one available. Internet banking, that most of us take for granted, will become accessible for the first time. Hence, money will stay in the banks for longer, and be available for banks to lend to further aid development.

The Rwandan project attracted my attention because, unlike the usual network announcements, it suggests so much about optimism, cooperation and reconciliation amid circumstances and difficulties that most of us cannot even begin to comprehend.

It demonstrates a real faith in the future, and reminds me that, wherever we are, our children are inevitably one step ahead of us where technology is concerned.

Gill Watson

The International Magazine for the Wire and Cable Industries

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See page 100 for further details

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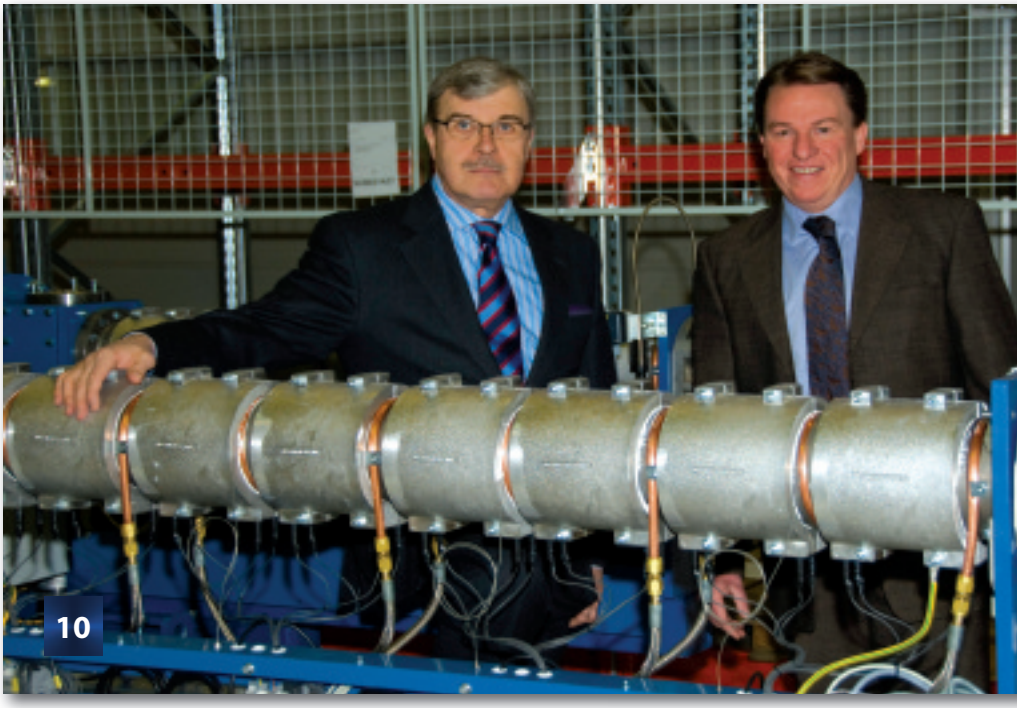

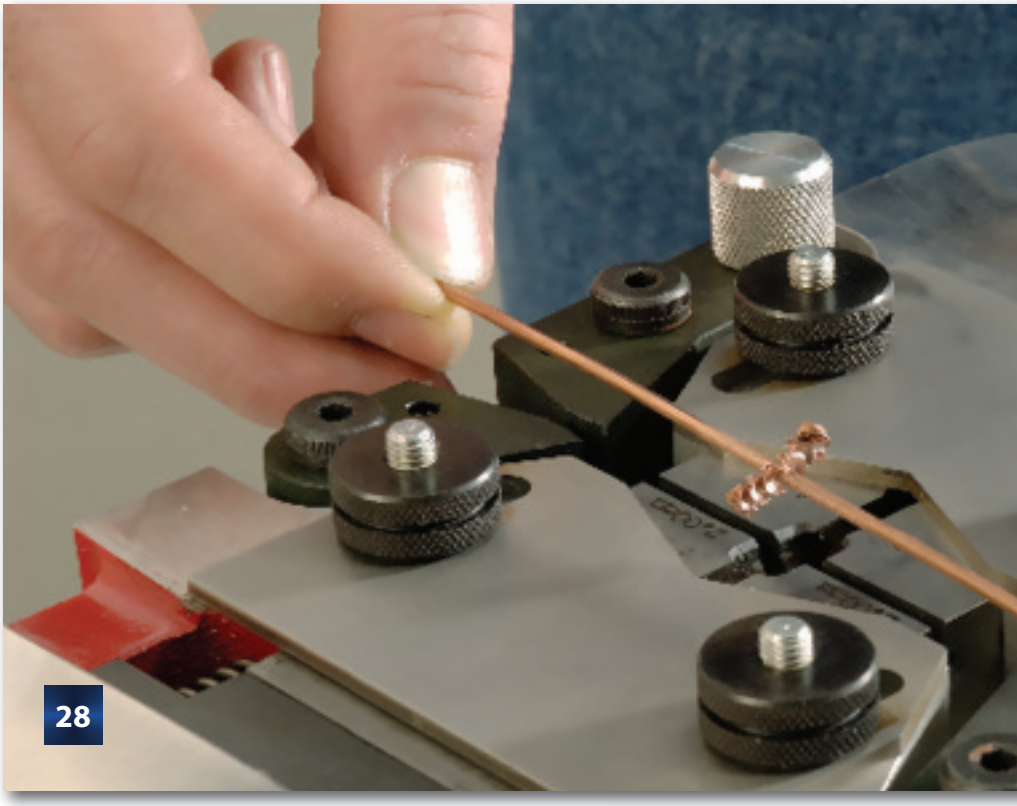

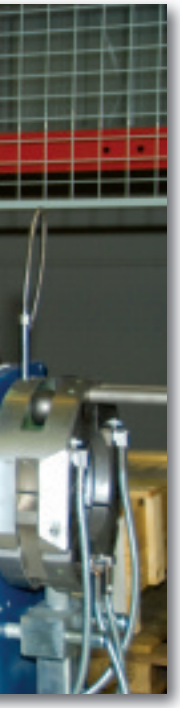

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In The Next Issue

Features On

- Straightening, cutting & welding of wire and rod
- Re-conditioned & second hand machinery - buyer's guide

Getting Technical

Improving the mechanical properties of non-halogenated flame retardant compounds
Jeremy R Austin, Herbert S.-I Chao, Sartomer Company

dates for your diary . . .

Wire Expo

May 2010

12–13: **Wire Expo** – technical conference and trade exhibition – Milwaukee, Wisconsin, USA
Organisers: Wire Association International (WAI)
Fax: +1 203 453 8384
Website: www.wirenet.org

September 2010

21–24: **wire China 2010** – trade exhibition – Shanghai, China
Organisers:
Messe Düsseldorf China
Fax: +86 21 5027 8138
Email: wire@mdc.com.cn
Website: www.wirechina.net

November 2010

7–10: **59th IWCS** – technical conference – Providence, Rhode Island, USA
Organisers: IWCS Inc
Fax: +1 732 389 0991
Email: admin@iwcs.org
Website: www.iwcs.org

18–20: **Wire & Cable India** – trade exhibition – Mumbai, India
Organisers: CII
Fax: +91 22 2493 9463
Email: info@ciionline.org
Website: http://cii.in

2011

May 2011

3–5: **Interwire** – trade exhibition – Atlanta, Georgia, USA
Organisers: Wire Association International (WAI)
Fax: +1 203 453 8384
Email: info@wirenet.org
Website: www.wirenet.org

May 2011

23–26: **wire Russia 2011** – trade exhibition – Moscow, Russia
Organisers:
Messe Düsseldorf GmbH
Fax: +49 211 4560 7740
Email: info@wire-russia.com
Website: www.wire-russia.com

June 2011

19–23: **JICABLE** – conference and trade exhibition – Versailles, France
Organisers: SEE
Email: jicable@see.assoc.fr
Website:
www.jicable.org

September 2011

13–15: **wire Southeast Asia** – trade exhibition – BITEC, Bangkok, Thailand
Organisers:
Messe Düsseldorf Asia Pte Ltd
Email: wire@mda.comsg
Website:
www.wire-southeastasia.com

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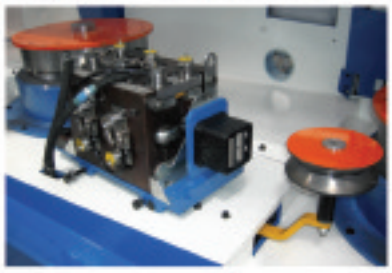

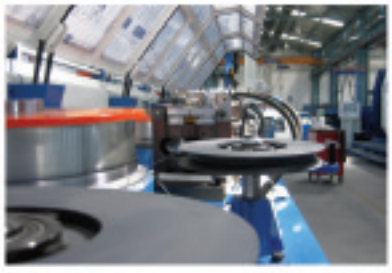

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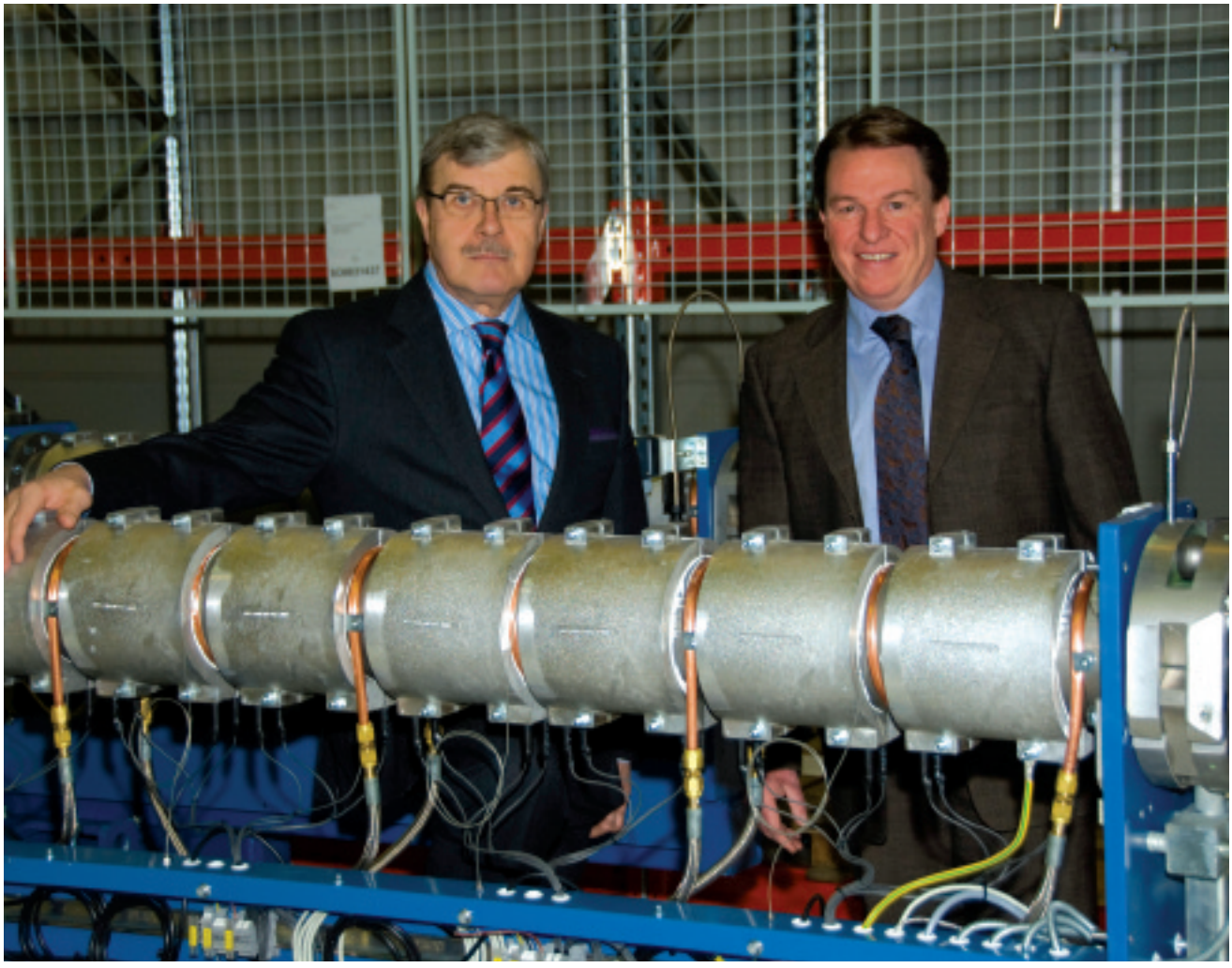


▲ *New chairman Mr Pentti Hätälä (left) with Mr Peter Roos*

Time for change

With the company's chief executive officer, Mr Pentti Hätälä, having reached the age of 65, the Maillefer board of directors has announced key changes within its board and management team.

On 17th December 2009, the directors chose to elect Mr Hätälä to the active position of chairman of the board of the Maillefer Group. Consequently on the same date, Mr Peter Roos was promoted to CEO. The changes took effect on 1st January 2010.

Mr Hätälä leaves his executive position after more than 30 years of serving the plastics and wire and cable industries. He joined Nokia Machinery in Finland over 20 years ago, and moved up the company's ranks before becoming Maillefer's CEO in 2001.

In his new role as chairman of the board, Mr Hätälä will continue to offer his valuable input in steering the company forward.

As Maillefer's current CEO, Mr Roos benefits from over 20 years of experience in the European automotive industry, including several years in key management positions. He joined Maillefer over a year ago as operations officer and has worked closely with Mr Hätälä during that same period.

Maillefer SA – Switzerland
Fax: +41 21 691 2143
Email: info@maillefer.net
Website: www.mailleferextrusion.com

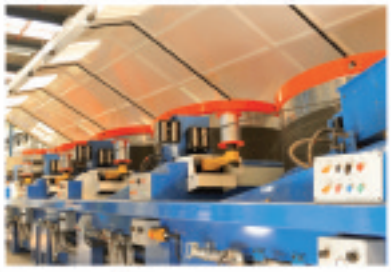
New name for Tyco Telecommunications

Tyco Telecommunications, a business unit of Tyco Electronics Ltd concerned in undersea communications technology, has changed its name to Tyco Electronics Subsea Communications (TE SubCom).

"Our new name enables us to more closely align ourselves with our parent company, Tyco Electronics," said David Coughlan, CEO of TE SubCom.

The company's management team remains unchanged and TE SubCom maintains the existing company headquarters, research and development laboratories, manufacturing facilities, ships and depots located worldwide.

Tyco Electronics Subsea Communications (TE SubCom) – USA
Website: www.subcom.com



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CEO for high-voltage cable firm

Dubai Cable Company (Ducab), one of Middle East's top power cable makers, has appointed Jon Vail as CEO of its newly launched subsidiary, Ducab HV Cable Systems.

The announcement came exactly a year after the company announced the formation of the joint venture company in which Ducab has a 50 per cent holding with Dubai Electricity and Water Authority (DEWA) and Abu Dhabi Water and Electricity Authority (ADWEA) holding 25 per cent each. Ducab is jointly owned by the governments of Dubai and Abu Dhabi.

The new company will sell cable systems in the voltage range of 66kV to 400kV, covering the highest voltage currently used in the GCC and operating as the first dedicated high-voltage facility in the region. Once fully operational, the company plans on selling over Dh1 billion of cable and associated services annually, approximately 60 per cent of which will be consumed in the UAE.

The company has also confirmed the construction of a new dedicated factory at the Jebel Ali site. Machinery installations will begin later in 2010.

Dubai Cable Company – Dubai and Abu Dhabi
Email: ducab@ducab.com
Website: www.ducab.ae

FTTH take-up gathers pace

At the FTTH Conference 2010 in February, the FTTH Council Europe unveiled the latest figures showing which European countries were leading the way in the penetration of fibre-to-the-home at year-end 2009.

Although Sweden, Norway and Slovenia maintained their places in the top five, they were overtaken by Lithuania, which made a dynamic jump to the number one position with 18 per cent FTTH penetration. All four countries now have penetration rates greater than 10 per cent.

France and Portugal broke into the ranking for the first time, helped by strong deployment of fibre infrastructure as well as marketing efforts to engage subscribers. FTTH uptake in both countries is expected to continue to increase rapidly as both countries also rank in the top ten economies in terms of the availability of FTTH.

In absolute figures Europe has reached 2.5 million subscribers – 3.5 million if Russia is also included. The majority of subscribers (77 per cent) are concentrated in seven countries, in the following order: Sweden, Italy, France, Lithuania, Norway, The Netherlands and Denmark. Amongst these seven, five countries now have more than 200,000 connected subscribers.

FTTH Council Europe – Belgium
Fax: +32 2503 2277
Email: info@ftthcouncil.eu
Website: www.ftthcouncil.eu

Correction of contact details

In the March issue of EuroWire, within the armouring and reinforcing of cables feature, the website address of Flymca was incorrect.

Please note that Flymca's correct website address and contact details are as given below.

Flymca – Spain
Fax: +34 942 55 9865
Email: flymca@flymca.com
Website: www.flymca.com

Wire manufacturer to create new jobs

Tokusen USA Inc plans to establish a wire manufacturing plant in Scottsburg and create up to 134 jobs by 2012.

The company says it will invest $24.5 million to purchase and equip a 300,000 square-foot vacant facility in Scott County to manufacture sawing wire. The wire will be used to slice silicon ingots for the solar energy industry.

Tokusen USA already operates a plant in Arkansas with over 300 employees.

"The Tokusen group, which operates wire manufacturing plants in Japan, China and the United States has been experiencing growing demand for sawing wire to support the growth in demand for solar panel manufacturing," said Hiromi Kanai, chairman of Tokusen USA Inc.

"Plans to expand the group's production capacity have been under way for some time. With the help of the state, we were able to purchase and upgrade this existing facility to meet our production needs more economically than by expansion of our other facilities."

The Tokusen group, based in Ono City, Japan, is a global supplier of steel wire. Annual sales of steel cord and saw wire from its plant in Arkansas are in excess of $80 million. The company counts among its customers global automobile tyre manufacturers including Michelin, Continental, Yokohama, Toyo, Bridgestone and Cooper in addition to many sawing wire customers.

Tokusen USA Inc – USA
Website: www.tokusenusa.com

Cable maker to shed 100 jobs

About 100 jobs will go at loss-making Christchurch cable maker, General Cable New Zealand, with plans to shut four of its five plants and shift some production to Southeast Asia. The redundancies come after other big job cuts at Christchurch manufacturers late last year, including 275 at the Bridgestone-Firestone tyre factory.

General Cable managing director Chris Birkett said jobs would not be cut until 2011, after a $5m investment in the Christchurch plant, which would be reduced in scale and productivity improved.

Demand for the cables the firm produces has slackened during the slump in residential building.

Production in Christchurch will be consolidated, with low-value-added cable production moved to facilities in the Philippines or Thailand.

Mr Birkett would not comment on how many jobs would be lost but Engineering, Printing and Manufacturing Union assistant national secretary Ged O'Connell said workers were told that around 100 manufacturing jobs, or almost a third of the workforce, would be cut.

He said that the site has five factories and the plan is to consolidate to one.

General Cable New Zealand Ltd – New Zealand
Website: www.generalcable.co.nz

New sales appointment

Kühne + Vogel Prozessautomatisierung Antriebstechnik GmbH has appointed Mr Norbert Bergmann to take charge of sales of the company's range of cable machinery. Mr Bergmann has many years of experience within the industry.

Kühne + Vogel, supplier of the Extrumatic product family, is planning to extend its activities in the cable machinery sector.

Kühne + Vogel Prozessautomatisierung Antriebstechnik GmbH – Germany
Fax: +49 9171 62767
Email: pa@kuehneundvogel.de
Website: www.kuehneundvogel-pa.de

Refined copper imports in China increase 12 per cent in February

China's February refined copper imports increased by 12 per cent over January as demand improved and scrap supply fell.

According to the Beijing-based customs office inbound shipments were 220,530 metric tons, up from 196,926 tons in January and down 19 per cent from the same month last year.

Chinese after-tax copper prices have traded at a premium to those in London for most of this year, according to calculations released by Bloomberg. The premium was around 500 yuan ($73) a ton on 19th March, down from this year's high of 3,000 yuan in February.

China imported 276,634 tons of scrap copper in February, customs confirmed, down from 337,443 tons the month before. A shortage of scrap will generally lead to a higher demand for the refined metal.

China's imports of aluminium, lead, zinc and nickel all decreased from a month earlier, customs data show. Shipments of primary aluminium and refined zinc dropped by 52 per cent, lead by 73 per cent and nickel by 25 per cent.

Kamatics acquisition confirmed

Keir Manufacturing Inc has completed the acquisition of the wire products business unit of Kamatics Corporation, a Kaman company. All wire products production will be relocated from Bloomfield, CT to the Keir Manufacturing facility and headquarters in Brevard, NC. The purchase includes all assets and intellectual property of Kamatics wire products business only.

Kamatics has designed and produced composite flyer bows for twenty years, introducing composite flyer bows in 1990 and later combining aerospace proven materials with triaxial braiding, to produce superior strength and durability in a lightweight structure. In 2005 Kamatics introduced the BackBone® flyer bow design to the industry.

Keir is an American-based manufacturer of engineered technical ceramic products. Keir's products for the worldwide wire and cable industry include high purity ceramic guides, and the Frontiersman line of air wipes.

David Watkins, president of Keir Manufacturing, is very optimistic about the acquisition and business outlook in general. "The Kamatics composite flyer bow acquisition combines two highly regarded manufacturers with brand name recognition into one company… and greatly broadens our state-of-the-art technical product offering."

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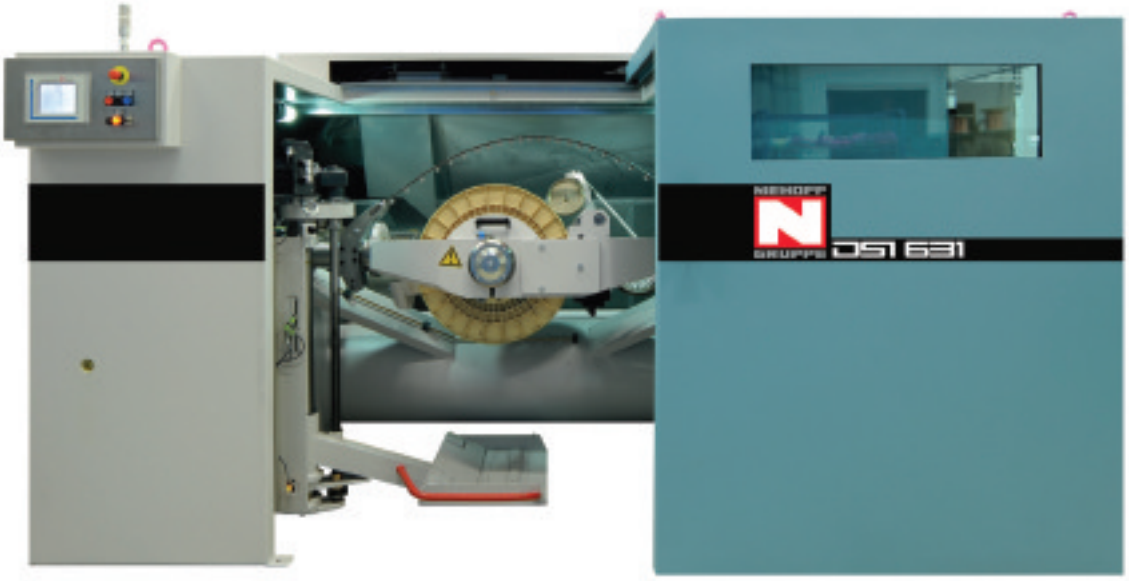

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Distribution deal for abrasion tester

Inhol BV in The Netherlands recently signed an exclusive sales and service agreement with its Swedish counterpart, TVAB International, for the sales and distribution of the TVAB 5420 N scrape abrasion tester.

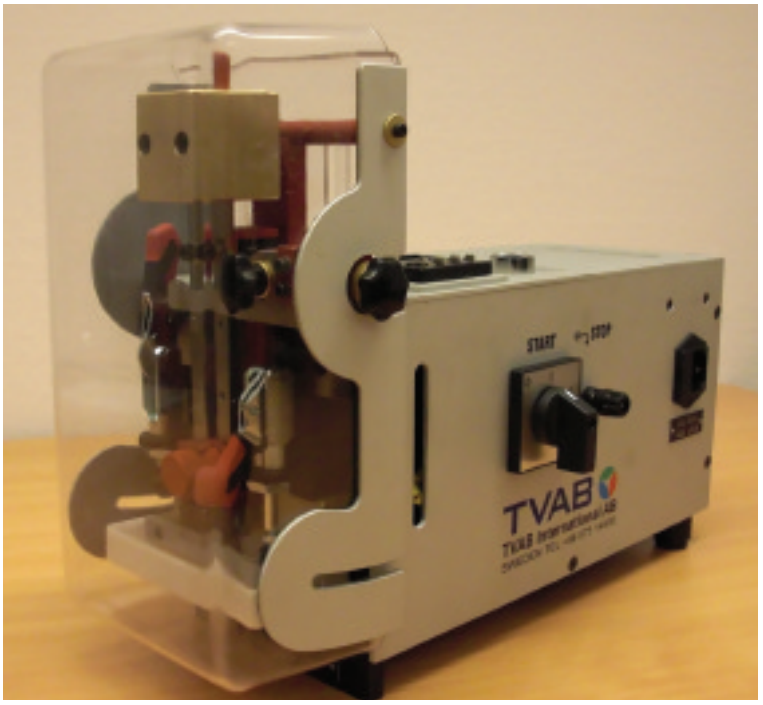
Inhol BV will be responsible for all sales and service contracts from the field, and also for those units already earlier sold by TVAB.

The purpose of the cooperation is to increase support to customers and to raise awareness of the test device in the international wire and cable market.

Jacob Steendam of Inhol BV, explained: "Hundreds of units have already been sold by TVAB over the past years. The TVAB abrasion test apparatus is so precise that it has set the abrasion standards for ISO 6722-1.

"It has been designed to test the durability of 60V and 600V single-core cables under extreme conditions, and it measures very specific abrasion durability variables."

Inhol BV/PTL – The Netherlands
Fax: +31 3560 33235
Email: office@inhol.com
Website: www.inhol.com



▲ *TVAB 5420 N scrape abrasion tester*

Wire producer diversifies into the medical sector

A century after it began producing custom cables and wires, New England Wire Technologies is branching out into the medical device field and has officially opened New England Catheter.

Company president, Rich Johns, said that while New England Catheter has been a part of the company for a few years, New England Wire decided to make "a serious effort" in this particular field of medical device manufacturing.

The climate for stepping up catheter production comes at a time when people have shorter hospital stays and medical procedures are "minimally invasive," he said. "Many of our customers are either in the innovation stages or have full production," he said. Rick Jesseman added that the company works "closely with customers to help them through their product design, prototype development and manufacturing of their final components."

In its long history of producing custom cables and wires, New England Wire Technologies has changed and adapted with the times. Like other companies in the past few years, New England Wire suffered layoffs last year but happily, Johns said, seven people have been recalled to work at New England Catheter, which employs 15 people in total.

New England Catheter – USA
Fax: +1 603 838 2805
Email: sales@necatheter.com
Website: www.necatheter.com

Sales and service partners

Sjogren Industries Inc has formed a partnership with P/A GmbH to expand its sales territory through Western Europe.

P/A GmbH was founded in January 2000 as an extension of P/A Industries Inc, a provider of payoff, feeding, straightening and cutting equipment for strip and wire since 1953.

P/A GmbH will provide sales, installation and servicing for all of Sjogren Industries' product lines, including roll straighteners, wedge grip wirepullers, assemblies and replacement parts. It also will be the stocking location for commonly used standard items for all product lines.

Sjogren Industries Inc – USA
Fax: +1 508 987 1965
Email: sales@sjogren.com
Website: www.sjogren.com

P/A GmbH – Germany
Fax: +49 7141 974 4781
Email: info@pa.com
Website: www.pa.com

Al Mashaar Makkah metro project

Bahra Cables Company, the latest cable factory in Kingdom of Saudi Arabia, has won a contract worth 50 million Saudi Riyals to supply British specification low voltage cables for the Al Mashaar Makkah Metro project between Arafat and Muzdalifa.

When fully operational in Hajj season 2011, the train will accommodate 72,000 people per hour per direction.

Bahra Cables Company – Saudi Arabia
Website: www.bahra-cables.com

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Internet

'Accident or not, Google was tweaked'

So declared Gady Epstein, Beijing bureau chief for *Forbes,* and in the matter of Google vs China the incontrovertible fact stood out from the surrounding murk. But not for long. Mr Epstein was reporting on Google's assertion that China's Great Firewall had blocked the Google search service. The California-based Internet search and technologies developer thereby reversed an earlier statement that a change in Google's own search parameter had been responsible for a nearly 10-hour blackout for users in China. Whether the block was the unintended result of a tweaking of China's firewall "remains unclear," wrote Mr Epstein. ("Google: China's Firewall Caused the Block," 30th March)

Even if clarity has improved since the end of March, the prudent person will wait until the geeks sort out the question of why, on the afternoon of 30th March in China, searches of bland terms returned error messages on Google.com.hk, in Hong Kong; Google.com, in the USA; and other international Google sites. Users in Beijing and many other major Chinese cities – including Shanghai, Chongqing, Chengdu, Shenzhen, and Guangzhou – reported the same problem. The episode, though serious enough to Google users and libertarians, had its humorous aspects. During the phase of blaming its own tinkering for the block, Google implicated a search parameter that included the letters "rfa." Thus might America's Google have beaten the Chinese gate-keepers to the punch by inadvertently triggering the Great Firewall's block of Radio Free Asia.

Energy

Developers are discovering that putting new power lines under water can forestall the objections of environmentalists

"The fish don't vote," said Edward M Stern, president of PowerBridge, a company that built the 65-mile offshore Neptune Cable from New Jersey to Long Island and is working on two more. One cable would bring wind power south from Maine along the Atlantic coast to Boston, and the other would connect wind farms under consideration for the Hawaiian islands of Molokai and Lanai to the urban centre of the most populous island, Oahu. Even if fish did vote, they might accept underwater power lines that draw virtually no resistance from the larger public – a bloc with a very jaundiced view of new high-voltage electrical lines of any kind. Matthew L Wald of the *New York Times* reported that environmentalists are mounting only token opposition to a string of projects that would bury power lines in the river- and lakebeds of the Northeast, thereby preserving trees and avoiding the necessity for huge towers. ("A Power Line Runs Through It," 16th March). What Mr Wald terms "a remarkably simple answer" to a famously thorny political problem has even elicited the cautious enthusiasm of some environmental groups, on grounds that the underwater power lines will advance the goal of getting the USA to use more renewable energy. Generating 20% of America's electricity from wind, as recommended by recent studies, calls for up to 22,000 miles of new high-voltage transmission lines.

A Toronto-based company, Transmission Developers, is seeking permits to lay one of the longest submarine power cables in the world. The 370-mile line would run from Canada, along the bottom of Lake Champlain, and down the bed of the Hudson River to New York City. It would continue under Long Island Sound to Connecticut.

Mr Wald wrote, "If Transmission Developers succeeds with such an ambitious project, others are likely to study the underwater strategy to figure out just how far they can take it. Would power lines crossing the Great Lakes make sense? Could underwater cables be used to move renewable power from the windy Great Plains to cities like Chicago?"

- Addressing the cost of submarine power lines, Mr Wald noted that it can be lower than for land burial because the cables can be laid from giant reels, allowing stretches of more than a mile with no splices. Of course, he wrote, "The strategy is limited by the availability of rivers and lakes [that] do not go everywhere power developers would like to run new lines. Many of the country's rivers run north or south, whereas much of the country's power must move east or west." But underwater lines are more expensive than lines strung on transmission towers. Mr Wald said that the PowerBridge cable cost about $600 million. Much of that – as with a $505 million, 53-mile cable under San Francisco Bay – went toward transforming the electricity from alternating to direct current. By comparison, standard lines hung on towers run from $1 million to $4 million a mile, depending on the terrain.

- The *Times* observed that nearly all submarine cables use direct current, the form of transmission widely rejected in the late 1800s in favour of alternating current. But AC lines are hard to bury because interaction between the current and the cable casing drives up the voltage.

"Direct-current transmission is also undergoing a modest revival on land," Mr Wald wrote. "Over long distances its line losses are smaller and flows are easier to control. Two recent proposals for a centrally planned overhaul of the North American electric grid called for heavy use of direct current." In this connection he also reported that new technology offered by two European engineering firms (Siemens, of Germany, and ABB Ltd, of Switzerland) has lowered the cost for some direct-current projects, and shrunk the size of the terminals in which AC is converted to DC and back – "a crucial consideration in urban projects."

Telecom

Reviewing its earthquake-ravaged communications system, does Haiti see its future as copper-free?

Except for cellphones, the population of Haiti was largely cut off from communication after the devastating 12th January earthquake that destroyed the country's already inadequate network for phone and Internet service. But, *Washington Post* staff writer Cecilia Kang has written, "Out of the rubble, one USA wireless industry pioneer sees opportunity." The pioneer is John W Stanton, CEO of Trilogy International Partners (Bellevue, Washington), who recommends that Haitians not rebuild their copper wire communications network but instead go exclusively mobile. In a keynote speech delivered 24th March in Las Vegas at a CTIA-The Wireless Association trade show, Mr Stanton called for the Haitian government to create an all-wireless nation with stronger networks for a population of nearly 10 million. ("Telecom Companies Seek to Make Haiti a Mobile Nation," 24th March)

But Mr Stanton's ambitions for Haiti go further. He said, "We see Haiti as a model for information and communications services in the twenty-first century. Our vision for the rebuilding of Haiti is to leapfrog older technologies and create a wireless platform that will become a foundation for a new economic ecosystem. Haiti can be the first 'copper-free' country in the world. Haiti can have a first-class telecom infrastructure without landline service." Ms Kang reported that the Stanton vision for a Haitian economy built on mobile technology would require getting Port-au-Prince to release more spectrum to commercial carriers for promoting business and banking as well as general-purpose phone use. Mr Stanton pledged that his company – which also owns wireless communications systems in Bolivia, New Zealand, and in Haiti's neighbour the Dominican Republic – would commit from $80 million to $100 million to expand its network in Haiti. "Trilogy owns Haiti's second-largest cellphone company, Voilà," Ms Kang wrote. "The three cellphone providers there – Voilà, Digicel and Haitel – compete vigorously for customers who have come to rely on cellphones even more after the earthquake. But only about 30 per cent of the population has [a cellphone]." Experts consulted by the *Post* pointed out the risk for the Haitian government in accepting the Stanton proposal, because "fat" fibre networks would still be needed to serve hospitals, schools and government buildings. Robert Atkinson, president of the Information Technology & Innovation Foundation (ITIF), a Washington-based independent think tank, said, "This could be a good strategy even for as long as 20 years. I just don't see it as an ultimate strategy because at a certain point you need fixed wire for services that require more bandwidth."

❉ But Ms Kang noted that, as Haiti begins to reconstruct houses, government buildings and key infrastructure, some experts see a blank canvas of opportunity – and a more robust cellphone network as the fastest way to a linked-up populace.

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Growth

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Transatlantic Cable

"Haiti is very mountainous and the people are very fond of their cellphones," Raymond Joseph, Haiti's ambassador to the United States, told the *Post*. "A wireless system would just be leaping over all sorts of impediments to connect the whole country."

Elsewhere in telecom . . .

❊ Last year, Internet Protocol television (IPTV) had its strongest growth year ever, adding over 10.8 million subscribers worldwide (compared to 9.4 million in 2008) to exceed 33 million by the end of the year, according to a report prepared by Point Topic, the London-based source for broadband statistics, for the Broadband Forum. The Americas posted the strongest IPTV growth in terms of region, with 58% more IPTV subscribers in 2009 than in 2008.

Both North and South American countries are described as having started to show significant signs of IPTV adoption; and, according to the report, "the prospects for 2010 look good." The USA ended the year with over 5.6 million IPTV customers, up more than 60% from 2008. By way of comparison with Europe, *ipTV News* for 29th March noted that the Point Topic report sees IPTV take-up there as driven by keen competition and the success of product bundles, especially in France. The estimated 8 million-plus French IPTV subscribers by the end of last year (up from 6.1 million at the end of 2008) accounted for 42% of the country's 19 million broadband lines. Point Topic places France, Germany, Russia, Italy and Spain all in the top ten IPTV countries by the end of 2009.

Automotive

❊ The 2010 Vehicle Dependability Study published by JD Power and Associates (Westlake Village, California) based its rankings on the responses of more than 52,000 owners of three-year-old cars who reported on problems presenting over the previous 12 months. The study, published 18th March, shows USA manufacturers of 2007 model-year vehicles dominating the top five spots, reflecting their growing competitiveness in both actual and perceived vehicle quality and dependability. The head of the list, however, was claimed by Germany's Porsche AG, whose namesake sports car brand was up from a tenth-place finish in last year's JD Power survey. Lincoln, the luxury brand of Detroit's Ford Motor Co, came in second this year. Buick, from General Motors Co, and Toyota Motor Corp's Lexus brand tied for third place. Ford and Toyota rounded out the top five. Chrysler LLC, which makes Dodge, Chrysler and Jeep vehicles, is the only major USA brand that came in below average in quality. In 2007 the company was going through its sale from DaimlerChrysler AG to Cerberus Capital Management. Overall, JD Power found that vehicle dependability has improved by 7% since the 2009 survey.

❊ The European Investment Bank approved a loan of $543 million to Saab Automobile, clearing the way for Spyker Cars of the Netherlands to buy the brand from Detroit-based General Motors. The European Commission endorsed an offer by the government of Sweden to guarantee the loan on condition that

Transatlantic Cable

Saab uses the funds to develop environment-friendly cars. In January, GM agreed to sell Saab to Spyker for $74 million while retaining preferred Saab shares worth $326 million. The deal ensured the survival of the 72-year-old Swedish brand.

Congress

The USA ban on travel to Cuba may be lifted this year, raising hopes of a tourist bonanza for 'the forbidden city' of Havana

"This is a 50 year-old failed policy," Senator Byron Dorgan told a meeting of American and Cuban tourist industry representatives in Cancún, Mexico, in a 25th March phone call from Washington. "Punishing Americans by restricting their right to travel just makes no sense at all." The policy assailed by the senator from North Dakota is, of course, the USA ban on travel to Cuba that has kept Americans – for 47 years, to be precise – from visiting the Communist island nation off the coast of Florida. Now it seems possible that freedom of movement over those 90 miles of water will be restored before the end of the year.

As reported by Jonathan J Levin of *Bloomberg News*, Mr Dorgan, one of 38 co-sponsors of a Senate bill that would lift the travel embargo, said he has 60 votes lined up: enough to win passage of the measure this summer. Similar legislation introduced in the House has 178 co-sponsors and needs 218 votes to pass. ("Cuba Readies for USA Tourists with Luxury Hotels," 26th March). According to Cuba's tourism minister Manuel Marrero, his country is ready, able and eager to welcome as many as a million visitors from the USA, on no advance notice. In an interview with *Bloomberg* in Cancún, Mr Marrero said, "I'm convinced that today, with [our] available capacity, we could be receiving the American tourists without any problem."

Additionally, the tourism chief said, Cuba has scheduled ground-breaking on at least nine hotels in 2010; and some 200,000 rooms may be added in the "medium to long term." Another tourism ministry official said that Cuba is also seeking investment partners for ten luxury hotels and golf courses geared to American preferences.

❉ Until the Americans return to Cuba, Canadians have been taking up much of the slack. In Havana, Jose Manuel Bisbe, commercial director for the Tourism Ministry, told *Bloomberg* that – despite the global financial crisis – tourism to Cuba increased 3.5% to 2.4 million visitors last year, with 900,000 visitors from Canada leading the way. Mr Bisbe, who expects foreign arrivals to grow by a like amount this year, said, "Havana has been the forbidden city for so long that it will be a boom destination even in the low season." Expectations of the Americans' return to Cuba are also running high among such entrepreneurs as Daniel Garcia, who sells used books in front of the neo-classical building that housed the USA Embassy before Fidel Castro's 1959 revolution.

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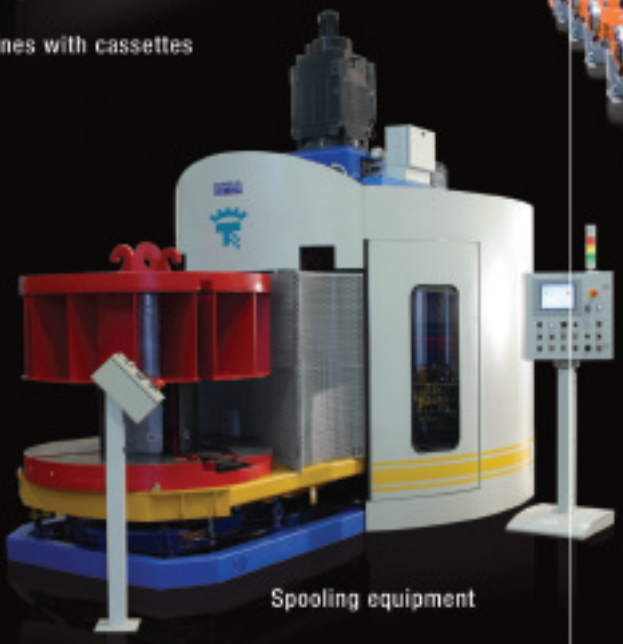

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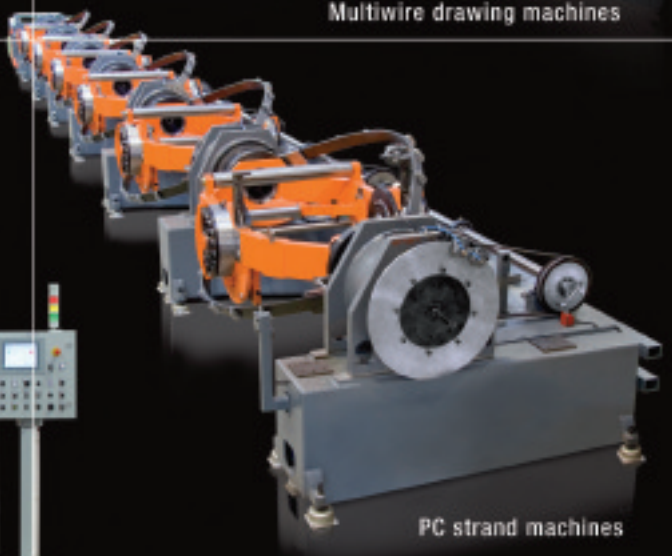

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Drawing perhaps on his experience of Canadian visitors to Old Havana, Mr Garcia told *Bloomberg News,* "The gringos can't help but spend their money. They are the easiest tourists to sell to. They never ask for discounts."

❉ While President Barack Obama is on record as seeking "a new era" in USA relations with Cuba, even as he has denounced "deeply disturbing" human rights violations by its government, he has not taken a position on the travel ban. Last year Mr Obama ended restrictions on Cuban-Americans travelling to Cuba and transferring money to relatives back home. The USA State Department has also held talks in Havana with Cuban officials about restoring mail service and cooperation on migration issues.

Aviation

Brussels and Washington build on the 'Open Skies' accord, but critics complain that not much new ground was broken

By the terms of a preliminary agreement, announced 25th March, the European Union and the United States will expand on the Open Skies pact of 2007 by narrowing some differences and making some mutual concessions. But industry executives and others have expressed disappointment that no real progress was made on the key issue of removal of the remaining barriers to ownership faced by airline companies that serve the Atlantic routes.

At present, the USA restricts foreign ownership of domestic carriers to 25 per cent of voting stock; the European Union, to 49.9 per cent. Ownership liberalisation was to be taken up in phase two of Open Skies, which three years ago opened up the Atlantic air lanes by permitting flights between any city in the EU and any USA city. But the International Air Transport Association (IATA) promptly asserted that the agreement hailed by the European Commission, the executive body of the EU, as an important step forward, in fact made no advance toward relaxation of the ownership rules.

"The agreement was not a step backwards, but it did not move us forward," said IATA's chief executive Giovanni Bisignani in a statement. "The long-term financial sustainability of the industry is dependent on normal commercial freedoms. I urge both governments to keep this on the radar screen for urgent follow-up." If the draft deal hailed by Siim Kallas, the European transport commissioner, as "a significant breakthrough" did not resolve questions of ownership and investment in airline companies, what exactly did it do?

According to Mr Kallas, the two sets of regulators agreed "to increase regulatory cooperation, and remove the barriers to market access that have been holding back the development of the world's most important aviation markets."

❊ The regulators' pride in their accomplishment may seem overblown to carriers striving, during a downturn in air travel, to pare operating costs and identify new sources of revenue – an effort that has intensified their interest in airline alliances. Existing partnerships for transatlantic operations include four members of the Star Alliance – Germany's Lufthansa, Continental Airlines and United Air Lines (both of the USA), and Air Canada – and the SkyTeam members Air France-KLM and Delta Air Lines, which absorbed Northwest Airlines (also of the USA) last year.

For some time, the European Union has been under pressure to approve what might be termed the alliance-within-an-alliance of British Airways and American Airlines – already members of Oneworld, the smallest of the three main international airline alliances – for an even closer partnership.

The arrangement proposed by BA and AA envisions shared revenues and coordination of flight marketing and scheduling on routes among the USA, Mexico, Canada, and the countries of the European Union, as well as Switzerland and Norway. It would create a unified network of some 500 destinations in over 100 countries.

The hopes of the two big carriers for the outright removal of ownership limits – and a go-ahead to dovetail, even merge, their operations as they see fit – were dashed, at least for now, by the preliminary agreement announced in March. With some justification, British Airways promptly expressed dismay that the limits would remain in place for the foreseeable future. When the first phase of Open Skies was implemented, BA was among the European carriers that stipulated, as a condition of cooperation, that ownership rules be addressed in the second set of negotiations.

A BA statement concluded, "We call on both sides to honor the firm commitments they have made in this agreement to further liberalization, and to redouble their efforts going forward, in order to make a fully liberal 'open aviation area' a reality." If the BA appeal is heeded, the British carrier would gain the potentially lucrative right to fly USA officials, currently restricted to using American carriers. The draft deal is to be presented for approval to EU transport ministers in June. It also requires approval by the USA Congress, which has rejected previous efforts to ease the ownership restrictions.

❊ The British Airways-American Airlines venture is the two carriers' third attempt over the last decade to forge a closer partnership. Their exasperation with Brussels and Washington is further exacerbated by the new uncertainty of another project, this one involving a third party: Spain's Iberia.

That plan, which stops just short of full merger, would allow the three airline companies to share costs and revenues on transatlantic flights. But it awaits relaxation of the rules on ownership.

Dorothy Fabian
USA Editor

▲ *Welding head of the M101 manual cold welder from PWM*

Next stop, Wire Expo

British company PWM will showcase its manually operated cold pressure welders at May's Wire Expo. The range includes hand-held, bench and trolley-mounted machines, with capacities from 0.1mm to 3.6mm (0.0039" to 0.141") diameter copper and 0.1mm to 5mm (0.0039" to 0.197") aluminium. The PWM range will be displayed at the show by Amaral Automation Associates, exclusive distributor of PWM cold welding equipment, spares and dies in the US and Canada.

PWM's hand-held portable welders, the M10, M25 and M30 models, designed for welding fine wire breaks quickly in confined spaces, are said to be exceptionally comfortable to hold and easy to use.

The larger bench-mounted BM10 and BM30 models are durable, low maintenance machines with capacities ranging from 0.1mm to 1.8mm (0.0039" to 0.071") copper or aluminium. The versatile M101, one of PWM's best-selling models, can either be bench-mounted or supplied with a trolley as an extra, enabling the machine to be wheeled directly to the weld area. The M101 has a capacity of 1mm to 3.6mm copper (0.04" to 0.141") and 1mm to 5mm (0.197") aluminium. PWM cold welders are precision engineered to provide strong, reliable permanent bonds, helping manufacturers save materials, cut costs and increase productivity.

Amaral Automation is also the northeast US representative for Zumbach, B & H Tool Co Inc, W Gillies Technologies, Powertec, Bardac, Engineered Control Systems (ECS), New England Temperature Solutions (NETS), Subec, Yield Management Corp, Tulsa Power and Maag Pumps.

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Flamex® cables for China railway

Nexans has been awarded a contract worth €9.5 million to supply China's state-owned vehicle producer, CNR Corporation Limited (CNR), with cables to develop the China Railway High-speed (CRH) trains that will enter service between Beijing and Shanghai in 2011.

The cables are being manufactured at Nexans China's production facilities in Waigaoqiao and Baoshan, both located in Shanghai. The first batch of cables was delivered in March 2010 and the last is due in March 2011.

The new CRH trains will be composed of 16 cars, with a design speed of 350kph, and will carry up to 1,026 passengers.

The cables supplied to this CRH project come from Nexans' Flamex® range, specially designed to adhere to the various international standards and safety needs of the rolling stock industry.

The selected cables are halogen free. The cable resists the propagation of fire and produces low smoke emissions in the event that a fire occurs.

Nexans – France
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Heat treatment of steel spring wire

Mario Frigerio and ATE have worked together to develop a continuous line for the production of tempered wire for springs. The line features a specifically designed product handling system and in-line induction heating with water quenching.

The new line can handle a wide range of wire diameters. Wire size changes and welding are performed robotically. The process is fully automated and all checking, diagnostic, recording and working functions are controlled by an industrial PC.

For cold manufacturing of high performance coil springs it is necessary to use alloyed steel wire with high tensile strength and reduction area properties. These characteristics are imparted to raw alloyed steel wire through the heat treatments of hardening and tempering. Using induction heating for the hardening and tempering process allows different mechanical properties to be obtained using a variety of time and temperature cycles.

The Mario Frigerio/ATE designed system offers reliable time-temperature cycles that provide fast and uniform heating, maintaining the wire at the required temperature for the time necessary to give the specified metallurgical characteristics.

A recipe is stored for each wire size. During production, the same or different types of wire can be queued without stopping the line. When appropriate, the control system sends specific data to the various units to apply the appropriate wire heat treatment. When a working coil is approaching its end the coil change procedure is automatically selected, and the coil ends are welded in-line.

Wire-size change is also carried out automatically within the range of wire diameters allowed by the post-Curie heating inductors.

A laser device detects the new wire diameter and this value is sent to the control system of the heat treatment section. Recipe change is made at the appropriate time, without stopping the line and without the intervention of the operator.

Medium frequency/high frequency converters or high frequency/high frequency converters supply the pre-Curie and post-Curie hardening multistage inductors according to the range of treated wire diameters and the production rate.

The advantages of induction heating over conventional furnace heat treatment are said to include high line speed with consequent high production rate; repeatable and controlled characteristics in the wire cross-section and length; a more energy efficient system and a cleaner working environment for the operator.

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Upgrade to submarine network linking Americas

Alcatel-Lucent and GlobeNet have completed the upgrade of the 22,000 kilometre submarine cable system linking the United States with Latin America. This project, the second upgrade in approximately 18 months, enables GlobeNet to deliver more than 110 Gbit/s of capacity, meaning it could carry as many as 13.75 million voice calls at one time.

GlobeNet's customers are expected to benefit from enhanced connectivity and reliability as well as faster access to applications and services. Leveraging Alcatel-Lucent's state-of-the-art submarine technology, GlobeNet can expand its wholesale service offering to include broadband, carrier Ethernet, fixed and mobile IP-based and traditional voice services as well as applications such as hosting, video conferencing and international private line services.

In addition to the submarine sections, Alcatel-Lucent upgraded the landing points in Rio de Janeiro and Fortaleza (Brazil), Maiquetia (Venezuela), St David's (Bermuda), Boca Raton and Tuckerton, Florida.

In Rio de Janeiro, the submarine network integrates with the terrestrial optical infrastructure of GlobeNet's parent company, Oi. Alcatel-Lucent also managed the installation, deployment and commissioning of the system.

"GlobeNet's commitment is to enhance the capacity and capabilities of the network to serve our customers even better with new reliable services, while leveraging the investment made in our existing infrastructure," said Eric Contag, chief operating officer, GlobeNet.

"Alcatel-Lucent continues to be a valued partner, helping us further innovate and expand our global capabilities while respecting our tight schedule requirements."

"This network upgrade provides GlobeNet with the extra capacity needed to support advanced services, while keeping its network easy to manage," stated Philippe Dumont, general manager of Alcatel-Lucent's submarine network activity.

"This project further confirms our close and successful relationship with GlobeNet to assist them in offering end-users the best possible service experience."

GlobeNet – USA
Website: www.globenet.net

Alcatel-Lucent – France
Website: www.alcatel-lucent.com

PV wire with direct burial designation

USA Wire & Cable Inc has introduced what is believed to be the first PV wire that carries the Direct Burial designation under the UL 4703 revision of 17th November 2009.

The cable offers protection from sun, ozone, heat and abrasion, and utilises ethylene propylene rubber insulation (EPR) and a separate protective jacket, said to be the preferred solution for transformerless inverter systems.

The cable is rated to 2kV, with EPR insulation combined with chlorinated polyethylene jacket. The company recommends the seven-strand bare copper conductor for better contact at the combiner box where built-in bulkhead connectors are not used. Additional ratings include UL VW-1, RHH or RHW-2, UL 44 and UL4703.

USA Wire & Cable Inc – USA
Fax: +1 512 326 3584
Website: www.usawire-cable.com

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Precision measurement[3]

▲ *The new Laser Series 6000 diameter gauges*

New laser devices will expand Sikora's current range of diameter gauges by three powerful models, said to offer even higher precision and reliability and so improving the efficiency of the production line.

The 2,500 measurements per second provide extremely high single-value precision, ensure an optimum line control and provide reliable statistical data. With the new devices the cable diameter is measured with an accuracy of up to 0.2 micrometres.

Sikora engineers are said to have integrated a number of practical improvements. The opening of the gauges is twice as large as the measuring range, to ensure an easy cable feed through.

Directly integrated into the gauge head is a new, pluggable universal interface module for all connections. In this position it is protected against water, dirt or mechanical influences during production.

A special feature, carried over from the larger Laser Series 2000 gauges, is the swivel gauge head design. It allows for the gauge head to be easily moved up, out of the extrusion line. The measuring axes are arranged in such a way that the gauge is open at the bottom to prevent dirt and water from falling into the measuring area.

Sikora offers the Laser 6020 XY for product diameters from 0.25mm to 20mm, Laser 6040 XY for a measuring range from 0.5mm to 40mm and the Laser 6080 XY for products from 1mm to 80mm.

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New bar mill for Handan Iron

Handan Iron & Steel Co plans to increase its production capacity and widen its range of products with a new long-product rolling mill in Handan. The bar mill will produce 800,000 tonnes of special bar quality (SBQ) steels per year. Siemens is supplying mechanical equipment including a six-stand roughing mill, an eight-stand intermediate mill and a six-stand pre-finishing mill.

A three-stand sizing mill completes the bar mill. The scope of supply also includes parts of the cooling system, pinch rolls, a convertible dividing shear, a fixed cold shear with a cutting force of 1,200 tonnes, guides, equipment for the oil-air lubrication system as well as spare parts, including 15 rolling stands.

The wire rod mill will have a roughing and an intermediate mill and a four-stand pre-finishing mill, including guides and oil-air lubrication systems. These plant components will complement the rod outlet that Handan Iron & Steel had previously ordered from Siemens. When complete, the wire rod mill will process about 700,000 tonnes a year of standard carbon and alloy steels as well as bearing and spring steels.

Handan Iron & Steel Co, part of the Hebei Iron & Steel Group Co Ltd, is among China's leading steelmakers and produced over 33 million tonnes of steel in 2008.

Siemens Industry Solutions Division – Germany
Website: www.siemens.com/industry

Faster forming with touch screen

Pave's Axis V1 compact single head wire forming unit has been upgraded to provide manufacturers with higher output and reduced production costs.

Designed to be reliable, accurate and easy to operate, the Mark 2 version of the machine incorporates the very latest engineering, operating and forming systems technology for the production of high quality wire formed parts.

To minimise operator training, the machine is equipped with user-friendly touch screen graphics. On-screen video clips, running continuously, show the range of specific operations that the machine can perform.

To program the machine, the operator simply touches the relevant video clip and the program line is entered automatically.

The machine's versatile new bending head offers up to eight different radii. Set up and change over time is minimal, for reduced downtime, and the Axis V1 Mark 2 will process short and long length wire products up to 6.35mm ($^1/_4$") in diameter quickly and cost-effectively.

Pave Automation Ltd – UK
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Email: pave@enterprise.net
Website: www.pave-wire.com

▲ *The upgraded Axis V1 has touch-screen control*

New software options for measurement

LaserLinc has introduced two new software options: Fast Fourier Transform (FFT) and Structural Return Loss (SRL).

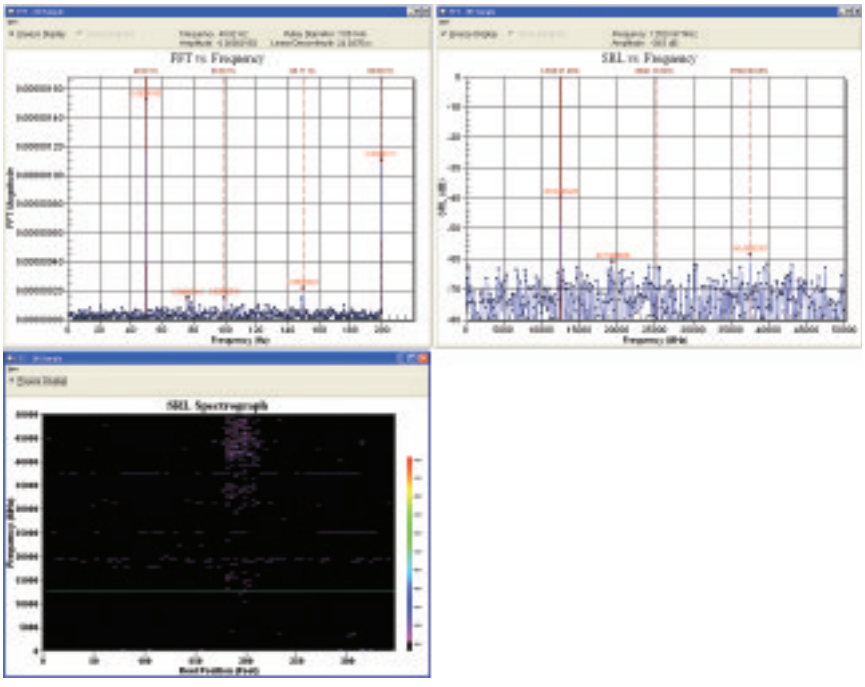
FFT allows users to analyse periodic deviations in a measurement, such as the diameter of a wire or cable. By combining the FFT information with specifications for line speed, the software can identify likely causes of the measurement deviation, such as a faulty pulley.

SRL is an option of the FFT package of particular interest to the wire and cable industry.

Periodic fluctuations in wire and cable dimensions can cause significant signal loss, especially in high-frequency products such as network patch cables. By analysing periodic deviation, the software can compute the signal loss that will occur at various frequencies throughout a length of cable. Computing signal loss during a production run gives producers the opportunity to correct the problem before needing to scrap material.

The SRL spectrograph shows a graphical representation of the signal loss that occurs at various transmission frequencies over the length of a product. An operator can quickly assess whether any portion of the cable is expected to show significant signal loss at one or more frequencies.

The spectrograph display is cumulative, so it provides an excellent historical record of SRL information acquired over the entire run of a product.



▲ *From top left, clockwise: FFT chart showing periodic deviations at 49.92 Hz and harmonic frequencies; SRL chart showing peak signal loss at 12.5 GHz and harmonic frequencies; Spectrograph showing consistent signal loss of about –40dB at 12.5 GHz*

LaserLinc manufactures non-contact, laser and ultrasonic measurement systems, which operate via a standard Windows PC running Total Vu™ software, a proprietary system that provides in-process tolerance checking, trending, SPC, feedback control, data logging, and other features. FFT and SRL are options of the Total Vu package.

LaserLinc Inc – USA
Email: info@laserlinc.com
Fax: +1 937 318 2445
Website: www.laserlinc.com

High-voltage plant to run tests before the end of the year

Ducab's Dh500 million high-voltage plant will be completed in January 2011 and the company is looking into expansion opportunities outside the GCC (Gulf Cooperation Council).

Although the project will be completed next year, the plant will begin producing cables for testing by the end of 2010, an official has said. Equipment will be installed in the third quarter of this year and testing will begin in the fourth quarter.

After the start-up, the plant will ramp up production to 30,000 tonnes over the next three years. "It is a relatively small start-up in the first few months," Jon Vail, CEO of Ducab high voltage cable systems (Ducab HV), told Emirates Business.

The company, which is 50 per cent owned by Ducab and 25 per cent each by Dubai Electricity and Water Authority (Dewa) and the Abu Dhabi Electricity and Water Authority (Adwea), aims to meet the entire high-voltage requirements of the UAE.

Currently, most HV needs of the country are imported. Dewa, for example, has recently awarded contracts to install, test and commission 132/11 substations to Switzerland's ABB, France's Areva and Saudi's Riyadh Cables, while the 400/132 substation deal went to Germany's Siemens.

"The products that Ducab has now are in low and medium-voltage. In this product range, we supply 50 per cent of the UAE requirements. Our target is to supply all the high-voltage needs of the UAE," Vail confirmed.

The UAE cable demand is about 180,000 copper tonnes per year. Cable demand across the GCC is about 770,000 tonnes per year. Meanwhile, Ducab HV will concentrate on getting commercial orders in the second half of this year for delivery next year.

The company has also laid the foundations of a Dh250m cable manufacturing plant with a production capacity of 25,000 tonnes of cables per year, said a spokesperson. Ducab is currently reviewing two expansion opportunities, and is also looking at regions outside the GCC. The company is already the largest supplier of imported cables to India.

Dubai Cable Company – Dubai and Abu Dhabi
Email: ducab@ducab.com
Website: www.ducab.ae

Non-contact measurement

Sikora presents its new Length 6000, a system for reliable non-contact online length measurement of wires and cables. For this method, the product image and its movement are defined and thus the speed and the produced length are calculated.

The technology of the Length 6000 is based on an optical measuring principle. In combination with two laser diodes, two image sensors are positioned next to each other and the cable passes both image sensors. The time taken by the product to move from the first to the second sensor is measured.

Even with reflective surfaces the high-resolution image sensors determine the unique structure by means of the patented diffraction analysis.

Conventional length measuring devices using the principle of frequency shift (Doppler effect) are suitable for the measurement of flat materials such as paper, steel sheet or textile. The technology of the Length 6000, which defines the length through comparison of image patterns, is suitable for round products and for products with reflective surfaces. In addition, the system identifies whether the product is going forwards or backwards and precisely calculates the length from zero line speed.

Sikora AG – Germany
Email: sales@sikora.net
Fax: +49 421 489009 0
Website: www.sikora.net

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Cable alliance between AMSC and Korea's LS Cable is expanded

American Superconductor Corporation (AMSC) and LS Cable Ltd (LS Cable) have expanded their superconductor power cable strategic business alliance. Under the new agreement, LS Cable and AMSC will work collaboratively to deploy more than 50km (31 miles) of superconductor power cables in commercial power grids over the next five years.

The original alliance, established in September 2009, called for the deployment of a minimum of 10km (6.2 miles) of superconductor power cables during that same period.

The strategic alliance focuses on the full spectrum of superconductor cable projects, including distribution and transmission voltages as well as alternating current (AC) and direct current (DC) systems.

Superconductor power cable systems manufactured by LS Cable will utilise AMSC's proprietary second generation (2G) high temperature superconductor (HTS) wire, branded as 344 superconductors.

LS Cable's Jongho Son said, "Superconductor cables offer unique power density, efficiency and security advantages compared to conventional power cables and will play a key role in providing the necessary backbone to support the Smart Grid in Korea and locations around the world. We are pleased to expand this important strategic alliance with AMSC."

Power cables made with AMSC's HTS wire can conduct up to 10 times the amount of power of conventional cables, which are made with copper wire.

They can be placed strategically in the power grid to draw flow from overtaxed conventional cables or overhead lines to mitigate grid congestion experienced in urban centres.

The cables also automatically suppress dangerous power surges to create resilient, self-healing Smart Grids that can survive attacks and natural disasters, making them an ideal modernisation tool for metropolitan power grids.

In 2009, South Korea's government announced plans to be the first country to convert its entire electricity network to Smart Grid technologies, a project estimated to cost around US$25 billion.

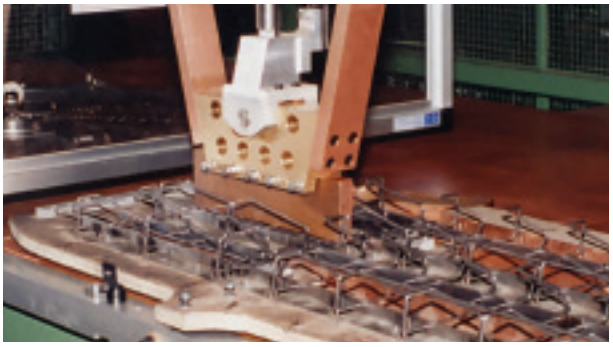
AMSC – USA
Website: www.amsc.com

LS Cable – Korea
Website: www.lscable.com

Wire welding machine

Cemsa SpA has recently introduced the Roboside PJ, a new development of the company's automatic bench-type Roboroof welding machine. The new series is designed to demonstrate improvements in productivity, power efficiency, flexibility and precision and can be integrated into any type of automatic line.

The machine can be used for welding a wide range of grids, mesh components and wire panels. It is also proving effective for welding car seat frames, often involving joining and welding pre-bent wires of complex designs. The tooling, designed by Cemsa, is made available to customers with dedicated applications to produce a wide range of seat car models in accordance with the strict tolerances required by car manufacturers.



▲ *Roboside PJ welding machine*

Cemsa SpA – Italy
Fax: +39 02 253 3307
Email: info@cemsa.it
Website: www.cemsa.it

Verifying alloys

Thermo Fisher Scientific Inc has launched the newest member of its family of Thermo Scientific Niton handheld XRF analysers, the Niton® XL2 series.

"With the introduction of the Niton XL2, we now offer a range of products to the aerospace, metal fabrication, foundry and related industries, which are engineered from the ground up to help eliminate any guesswork in verifying metal alloys for manufacturing quality assurance," said Bob Wopperer, director of marketing and business development for Thermo Scientific Niton analysers.

Wopperer continued, "We know that the potential for material mix-ups is very real and that the need for traceability is a priority. Our non-destructive analysers can provide a worry-free solution that takes control of material verification, recovery of lost traceability, analysis of finished welds to validate filler material and dilution, and confirmation of finished products all without damaging samples in any way, which can save both time and additional testing expense."

The Niton XL2 and Niton XL3 Series XRF analysers are purpose-built for alloy analysis anywhere and anytime with accurate results available in seconds. They are said to offer significant advantage over previous instruments. These instruments also provide integral storage of all test results, in a completely tamperproof data format. Multiple communication options include Bluetooth wireless, USB and RS-232 serial communication ports.

Thermo Fisher Scientific Inc – USA
Email: niton@thermofisher.com
Website: www.thermoscientific.com

Cleaning system provides wire glossy finish

Advertorial on behalf of Decalub

The GP/PDH-CL system revolutionises the wire cleaning process, benefiting from unique PDH multi-function technology, enabling an automatic control of the crucial process parameters of pressure/temperature/viscosity, compound injection speed and thermal stability. In operation, all these parameters communicate in an extremely sensitive and automatic multi-way interaction, providing drawn wire with a bright glossy finish for plating at high-speed, cleaned and polished in-line to a reflective appearance using semi-solid high-viscosity products containing anti-corrosion additives.

▲ *Wire cleaning by GP/PDH-CL system*

The GP/PDH-CL system is installed in the last draft of a drawing machine to clean drawn wire of lubricant contaminants. It simultaneously performs surface cleaning and polishing, providing a high level of cleanliness of dry drawn wire without the need for aggressive chemicals, and it operates at all practical speeds without limitation. The main reasons for this development have been cost, wire quality and environment factors.

The GP/PDH-CL wire cleaning system operates with a wide range of semi-solid lubricating solutions in a continuous "in and out" motion, evacuating lubricant contaminants from the cleaning chamber in an open or closed circuit, completely eliminating wire tunnelling effect and pressure fluctuation, and enabling the highest cleaning speed up to 15 m/s (3,000ft per minute). A light draft of 10% to 15% performs cleaning and polishing in a single run, with completely dry, clean wire leaving the unit.

The system is particularly recommended for cleaning wire drawn in severe conditions, with increased heat and burned lubricant tightly bound to the wire surface. The system is compact, easy to install and to use, and it operates at zero energy consumption.

Decalub – France
Fax: +33 1 6020 2021
Email: info@decalub.com
Website: www.decalub.com

New bio-polyamide

Evonik Industries has expanded its range of compounds for high-performance cables with a bio-based Vestamid® Terra DS. A polyamide 1010, Vestamid Terra DS is produced entirely from monomers obtained from castor oil. Castor oil is obtained from the bean of the castor oil plant, which is used neither as food nor animal feed and whose cultivation does not compete with that of food crops.

Vestamid Terra DS moulding compounds are semi-crystalline and distinguished by high mechanical strength as well as resistance to chemicals and stress cracking. They also have high to very high heat deflection temperatures and a low water-absorption capacity, retaining their good mechanical properties such as elongation at break and impact strength, even in high humidity.

Areas of application for Vestamid Terra DS cable jacketing include special cables for the automotive industry and underground cables, in which case the bio-polyamide protects against damage caused by gnawing rodents.

Evonik Industries – Germany
Website: www.evonik.com

www.kiswire.com

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Web-based service protects critical power lines

Infoterra has launched AssetMonitor, a new submarine asset protection service aimed at protecting valuable underwater assets – such as electricity and telecoms cables and oil and gas pipelines – from accidental damage by anchors and fishing activity. The company has also announced that the Channel Islands Electricity Grid (CIEG), a joint venture between Guernsey Electricity and Jersey Electricity, is the first organisation to deploy AssetMonitor, and will use it to protect the two 90,000 volt submarine cables that supply power and fibre optic communications from France to Jersey and onwards to Guernsey.

Damage to undersea assets due to shipping is a significant global problem, resulting in interrupted services and expensive repairs. Current trends show that incidences of submarine asset damage are likely to increase with the deployment of offshore wind farms and marine turbines. Infoterra's AssetMonitor solution uses live shipping vessel positions and data from the shipboard Automatic Identification System (AIS) broadcast system – in conjunction with Route Position Lists for undersea assets – to generate automatic warnings when an asset may be at risk due to shipping activity.

AssetMonitor enables the customer to define protection zones around its cables or pipelines and to configure rules based upon AIS data to identify vessels that may be a hazard, for example, vessels that are trying to anchor or dragging anchor close to the cables. If a vessel breaks one of the rules in the protection zone, then a warning will automatically be raised in the organisation's control room. Email and SMS messages can then be triggered, depending upon the severity of the event.

"The Jersey and Guernsey submarine cables are a key part of the Channel Islands infrastructure, supplying some 97 per cent of Jersey's and up to 80 per cent of Guernsey's annual electricity requirements. The cables also carry high capacity fibre optic communication cables that allow the Channel Islands' financial services sector to operate globally on a 24/7 basis. Clearly, any interruption to either service would have significant implications for the economy of both Guernsey and Jersey," commented Sally-Ann David, director of Channel Islands Electricity Grid.

Infoterra Ltd – UK
Website: www.infoterra.co.uk

Improved cutting performance

Hydropulsor AB has recently launched an enhanced version of its cutter HYP30-15.

The machine cuts wire and rod with a diameter up to 15mm; a new improved feeder system gives a length accuracy of ±0.02mm.

▲ *Hydropulsor's HYP30-15 cutter*

Three of the enhanced HYP30-15 machines have recently been delivered to the United States: one delivered to a wire company and two machines have been delivered to HVIT LLC in Elgin, Illinois.

HVIT LLC cuts and cold forms materials for customers and is also a distributor of Hydropulsor products in North America.

Hydropulsor AB – Sweden
Email: info@hydropulsor.com
Website: www.hydropulsor.com

Subsea capacity expansion

Global Crossing has announced that a significant expansion of capacity on its Mid-Atlantic crossing (MAC®), South American crossing (SAC®) and Pan American crossing (PAC®) undersea fibre optic cable systems is to be rolled out over the next six months.

John Legere, Global Crossing's CEO, explained: "The investments we're making are in response to the continued demand Global Crossing is experiencing across our global network for broadband services such as video over IP, social media and content delivery networks."

Global Crossing's MAC undersea system includes approximately 4,600 route miles (7,500km) of fibre optic cable. MAC connects Global Crossing's PAC, SAC and Atlantic Crossing-1 (AC-1®) subsea systems to provide full connectivity between North America, Latin America and Europe.

The MAC system provides IP and synchronous digital hierarchy (SDH) services at rates up to 10Gbps or STM-64.

The PAC submarine cable network spans over 6,000 route miles (10,000km), connecting the United States to Mexico, Central and South America. It comprises a self-healing ring and wavelength division multiplexing technology.

Global Crossing's SAC system includes approximately 12,000 route miles (20,000km) of fibre optic cable. It is a four-fibre-pair repeatered system providing 10Gbps transport.

Global Crossing – USA
Website: www.globalcrossing.com

▲ *Nexans' Skagerrak before the conversion*

Upgrade for cable vessel

Nexans has extended the subsea cable laying capabilities of the C/S Nexans Skagerrak, one of the world's most advanced cable ships, following the successful completion of a major conversion and upgrading project at the Cammell Laird Shiprepairers and Shipbuilders Limited dockyard in Birkenhead, England. The €8,000,000 two-month contract has increased the C/S Nexans Skagerrak's capability to carry out even larger scale power cable and umbilical installation projects, extended her service life and given her greater autonomy while at sea.

The major element in the project has been the insertion of a new 12.5m prefabricated hull section that has increased the ship's overall length to 112.25m. An additional accommodation module has also been installed, taking the total number of single cabins on board to 60, together with a new work deck, complete with cable-handling equipment, that has increased the on-deck storage capacity to around 2,000m^2 (from 900m^2). The upgrade has increased the ship's deadweight from 7,886 tonnes to 9,373 tonnes.

The C/S Nexans Skagerrak was the first purpose-built ship specifically for the transport and installation of submarine high-voltage power cables and umbilicals. To date, there are only two vessels of this kind in the world. It features a 29m diameter turntable with 7,000 tonne capacity, a computer-based laying control system and a state-of-the-art dynamic positioning system, and can also deploy Nexans' specialist Capjet ROV trenching systems for cable burial operations.

Nexans – France
Fax: +33 15669 8484
Email: nexans.web@nexans.com
Website: www.nexans.com

www.wire-southeastasia.com

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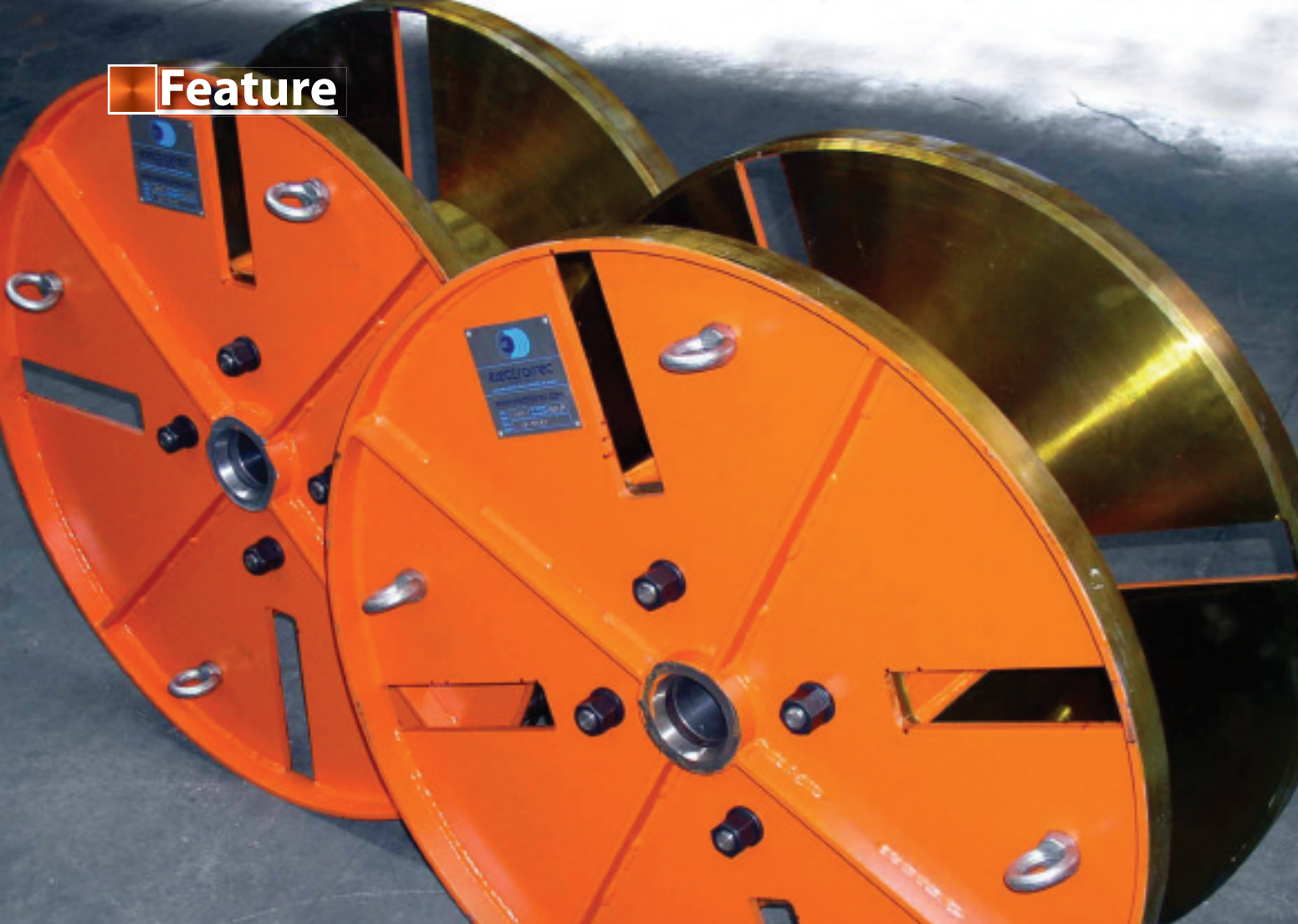


Spools, reels & pre-packaging systems

No one with responsibility for handling wire and cable will underestimate the importance of the equipment under review here. An expertly executed spooling, reeling or other packaging operation does not merely complement a flawless production run, it is an essential element of the delivery system that ultimately results in a satisfied customer.

What might be underestimated is the number and variety of designs necessary if the right spool or reel is to be selected and employed, every time. Should it be of wood, metal, plastic or composite? Which is best for accurate winding from high-speed machinery? For use with a coil handler? A strander? For tyre cord; hose wire; annealed product? For fine wire; welding wire; bare wire; ground wire? Should it be rigid or collapsible? Reusable or returnable? Is a corrugated spool design worth the money?

A casual or uninformed choice can be damaging – not only to the wire and cable being readied for transport, but also to a company's bottom line. The products and services appearing in this section are intended to aid wise decision-making.

Photo courtesy of Electrorrec SA

Steel and ABS process reels

Pentre Group, incorporating Hearl Heaton, designs, manufactures and supplies a comprehensive range of high speed steel and plastic ABS process reels for the wire, cable, telecommunication and fibre optic industries, plywood and cardboard reels, wholly-moulded plastic spools, steel and wooden shipping reels and drums for the offshore industry.

Hearl Heaton's ABS range uses a special grade of virgin ABS for the flanges, specially selected to give maximum strength without brittleness. The reels range from 250mm to 1,000mm diameter and conform to both DIN 46395 and imperial standards for optical fibre tubing.

Pentre's whole operation is focused on developing technically advanced processing solutions for today's high-speed wire and cable manufacturing plants, including those incorporating the latest robotic handling systems.

Pentre's reels and drums can be manufactured to either international recognised standards or to customers' own specific requirements.

▲ *ABS reels from Pentre Group*

Pentre Group - Hearl Heaton – UK **Fax**: +44 1924 400 803 **Email**: info@hearlheaton.co.uk **Website**: www.pentregroup.com

Offering a "Reel" alternative

▲ *The range of Reelex reel-less packaging*

Reel-less technology offers installer-friendly payout in environmentally friendly packaging. As the sole provider of Reelex® tangle and twist-free reel-less packaging technology, Reelex Packaging Solutions licenses the technology as well as manufactures the specialised coiling machinery necessary to package products in Reelex.

Sometimes known as a "pull box" package, Reelex is a patented method of winding cable in such a way as to result in a reel-less, self-supporting coil. This unique coil dispenses through a payout tube from the inside out, without twists, tangles, snags or overruns. Sold under various brand names by the world's leading wire and cable manufacturers, Reelex has become the standard packaging system for last-mile lengths of structured cabling such as category 5e, category 6, and coaxial cables.

Reelex is said to benefit every component in the supply chain, as the packages are easy to handle, stack and palletise, are lighter than reels and spools, produce less waste, and can be manufactured using environmentally friendly materials. The most popular packaging option – the cardboard Reelex box – is an especially eco-friendly package as paperboard is compostable, recyclable and can be manufactured from post-consumer materials. To further reduce environmental impact, Reelex is eliminating all plastic from its packaging by introducing payout tube replacements manufactured from the same material as the rest of the box – post-consumer paper fibre.

Reelex – USA
Email: sales@reelex.com
Website: www.reelex.com

Automatic Range

Windak has a wide range of spool and reel packaging machine solutions, such as SW6, SW6-DL, AR18, AR18-DL and the newest model AR24. SW6 and AR18 are fully automatic packaging machines, for in-line or off-line packaging and palletising of wire, cable and other flexible products onto spools or reels.

Spools are automatically loaded and unloaded from the spooling head. The outer end is secured with stretch wrap.

All operational parameters and mechanical settings are recipe controlled in order to reduce time between product and spool changeovers.

▲ *Windak's AR18*

These machines can be single lift (SW6, AR18) or dual lift (SW6-DL, AR18-DL) and have labelling, boxing and palletising as options. SW6 spool outside diameter is 165mm and AR18 reel outside diameter is 165mm to 300mm or 200mm to 460mm.

The Auto Reeler AR24 is a dual-head fully automatic spooler developed for automatic packaging of cable and wire products on spools or reels between 298 and 609mm in overall diameter.

It can be used for in-line applications (direct connection with extruder) and off-line applications (AR24 is fed from payoff/flyer) and loads and unloads the reels automatically.

It includes stretch wrapping of the spool to contain the cut end. AR24 options include labelling, metre marking, testing and palletising.

Windak AB – Sweden
Fax: +46 858 03 8955
Email: info@windak.se
Website: www.windak.se

Wooden reels offer green solution

Hamelin has manufactured wooden reels for 70 years, and repaired returnable wood reels for the Canadian market for 25 years, and now repairs over 50,000 units every year.

▲ *Wooden reels from Hamelin, 118" diameter designed to carry 18 tons each*

Hamelin produces many large diameter reels, with weight capacities up to 35 tons and diameters up to 168". The advantage of wood over steel is the speed of design, build and delivery to site.

J Hamelin Industries – Canada
Fax: +1 450 435 1211
Email: info@jhamelin.com
Website: www.jhamelin.com

One machine, four functions

Quadromatik 400 is the new multi-purpose, wide production range coil and spool packing line from Domeks. The double-head machine has automatic palletising and is capable of high speed coiling or spooling of rigid, flexible or multi-stranded single wire insulated cables with cross sections from 1mm² to 16mm² and rigid or flexible multi-core cables with cross sections from 2 x 0.75mm² up to 4 x 2.5mm². Speeds of 300m to 400m per minute are achieved, depending on the product.

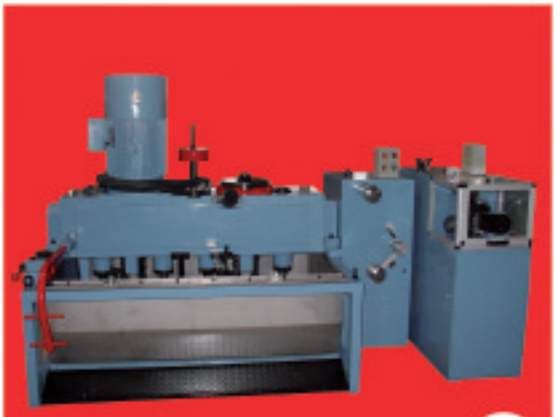
▲ *The new Quadromatik 400*

Quadromatik 400 can also spool flat twin and earth-type cables with cross sections from 2 x 1+1mm² up to 2 x 4+2.5mm² at a line speed of 350m per minute. Available coil types: coil outer diameter: minimum 210mm and maximum 400mm; coil inner diameter: 150mm; coil height: min. 30mm to a maximum 190mm. Available spools: Spool outer diameter: minimum 140mm, maximum 350mm; spool inner diameter: 80mm; spool height: minimum 40mm, maximum 250mm.

Domeks Makine – Turkey
Fax: +90 216 364 3913
Website: www.domeksmakine.com

JIANGSU JINTAILONG

JIANGSU JINTAILONG is the largest equipment manufacturer in China for the steel cord making industry. Over the years we have made high-quality, cost-effective machinery for some of the best-known steel cord producers in the global tyre market. Long-term relationships with our customers have been built upon our proven innovation and our ability to take designs through development and into real-time production. Come to JIANGSU JINTAILONG for high-quality, cost-effective steel cord equipment.



1. plating line
2. dry drawing machine
3. 23 Wet drawing machine
4. double twisting strander
5. wet drawing machine
6. wrapping machine

JIANGSU JINTAILONG MECHANICAL AND ELECTRICAL EQUIPMENT MANUFACTURER

Address: NO.288 DAQING.E.RD.TAIXING CITY, JIANGSU PROVINCE P.R.CHINA

Area cood: 225400

Tel: 0086-523-87668197

Fax: 0086-523-87760660

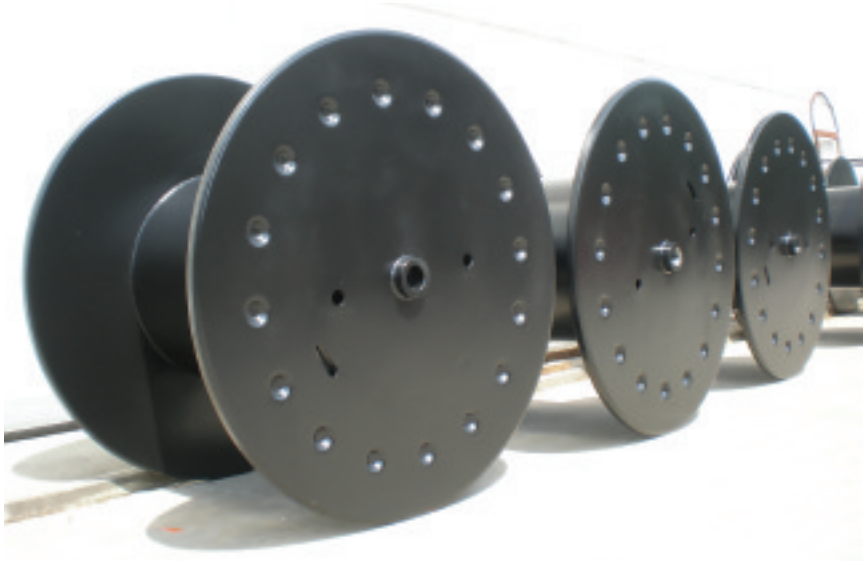
Email: jstl@vip.163.com

cellphone: 0086-13905264693

website: www.jsjintai.cn

Reels for extrusion

The ISO 9001:2000 accredited company, A Appiani Srl, has been established since 1962 as a supplier of spools and reels. The range includes TA100 spools and B-type for steel cord, hose wire and sawing wire, now produced with a new CN welding machine. These spools have class-A welding spots, as required in many fields including automotive.



▲ *Spools from Appiani*

This new welding line has speeded up the manufacturing cycle, thus reducing the costs of the spools. Quality of the spools has also improved, showing less deformation during the winding cycle and longer operational life. These spools are used by Bekaert, Michelin, ArcelorMittal and Bridgestone.

An alternative to fabricated steel reels for cables and strands, Appiani's BAP double-flanged pressed steel reel, partially machined and dynamically balanced, is designed for use in the extruding process. Traditionally, BCG or composite ABS steel spools are widely used in the extrusion of telephone and communication cable and fibre optic cables. The space-saving BSC type collapsible, take-apart reels, and reel handling and storage equipment (lifters and tilters, coilers and pallets) are also available.

A Appiani Srl – Italy
Email: info@appiani.reels.it
Fax: +39 030 938 2425
Website: www.appiani.reels.it

Reels and handling

GMP Slovakia's range of products includes metal reels and drums suitable for drawing, bunching and stranding applications of either standard designs or customised as per customer requirements. GMP Slovakia also supplies drums up to 8m for cable and rope, in reinforced versions or in lightweight versions for transportation, either assembled or knocked down.

▲ *A selection of GMP reels*

In addition to metal reels and drums, GMP Slovakia manufactures reel and drum handling equipment and the patented Easykoil take-apart reel.

GMP Slovakia has obtained the ISO 9001 DNV quality certification for its reels and handling equipment.

GMP Slovakia – Slovakia
Email: sales@gmp-slovakia.com
Website: www.gmp-slovakia.com

Layer winding coreless coiler

DEM Wire Rolling Technology, a company specialised in the design and manufacture of flat and profile wire rolling lines and cold rolling lines for construction wire, presents its new five-ton perfect layer winding coreless coiler.

The newest DEM coreless coiler is provided with a precision layer winding system for flat, square, plain, construction and profile wires in a coil weight range from 200kg up to 5 tons. The coiler is operator-friendly, using a new collapsible mandrel design and an automatic side-opening flange.

The coil height can be automatically set within the full range from 100mm to 600mm directly from the operator panel. The coiler is also provided with an automatic coil extraction and tilting unit.

DEM Wire Rolling Technology – Italy
Email: info@demills.com
Fax: +39 0432 655484
Website: www.demgroup.com

Reel integration brings savings

The integration of Carris Reels with J Hamelin Industries combines the facilities and expertise of what are believed to be the second and third largest reel manufacturers in North America. Expanded recycling capabilities in the Carris plants now complement a full line of reel types.

Working with utilities and electrical distributors, the Carris truck fleet can coordinate used reel pick-ups with the delivery of new products. Combining recycled reels with new reel shipments offers savings to the customer.

Exports from both companies are coordinated from many ports with preferable freight lanes to specific destinations. Products from Carris' US plants have been expanded to Hamelin manufacturing sites in Bowmanville, Ontario and Montreal.

▲ *Carris' truck fleet coordinates used reel pick-ups with the delivery of new products*

On-site inventories allow Hamelin customers an expanded line of reel types including nailed wood, nailed plywood, plywood, plastic, hardboard spools, stamped metal and wood/metal process reels.

Wood sourcing and aggregated volumes have delivered new opportunities in material markets.

Carris Reels Inc – USA
Email: sales@carris.net
Fax: +1 802 770 3551
Website: www.carris.com

Packaging for short lengths

Ya Sih Technology Co Ltd specialises in coiling, spooling, wrapping and packaging systems for the wire and cable industry. The company has introduced a series of new coiling and packaging equipment to enable customers to reduce labour cost, increase cable packaging efficiency and maximise return on investment.

These developments include the FastCoil coiling machine, designed to produce 100m coils at a consistent speed of 3.5 coils per minute. It can be installed into an existing extrusion line or a payoff rewinding line.

The new short length coiler and small head coiler meet the demand for short length or small size packaging.

The short length single head coiler can produce 10m to 30m coils at a speed of up to 6 coils per minute. The small head coiler allows a small size of coil ID to 50mm.

An upgraded, fully automatic version of a computerised spooler and cross winder for LAN cable is now also available. Further packing with PVC film or cardboard is available if required.

▲ *Ya Sih Technology's short length coiler*

Ya Sih Technology Co Ltd – Taiwan
Email: sales@yasih.com.tw
Fax: +886 22680 4926
Website: www.yasih.com.tw

Packaging for enamelled copper wire

Plastic spool and reel manufacturer, Going Well Precision Industry Company Ltd (GWPI) has provided spools and reels compliant to CNS, JIS, IEC and NEMA standards for more than 30 years. GWPI designs, produces and sells plastic spools and reels for enamelled copper wire, stainless wire, PV ribbon, EDM wire and welding wire. For high-speed ultra fine enamelled copper wire spooling, GWPI provides spool models 76/45, 79/45 and 99/45 with a true running deviation of 0.02mm and maintained within 0.1mm. GWPI's new spool P-10S is designed to be more precise, with a true running deviation of ≤ 0.1mm, and stronger (tensile strength ≥ 3000 kgf).

▲ *GWPI's product range*

Other GWPI products include:

- Biconical spools suitable for fine enamelled copper wire of 0.01mm to 0.5mm diameter
- Cylindrical spools suitable for general wire of 0.03mm to 4mm diameter
- Tapered spools suitable for enamelled copper wire of 0.03mm to 3.2mm diameter

Going Well Precision Industry Co Ltd – Taiwan
Email: info@gwpi.com.tw
Fax: +886 7697 5702
Website: www.gwpi.com.tw

Steel and ABS reels

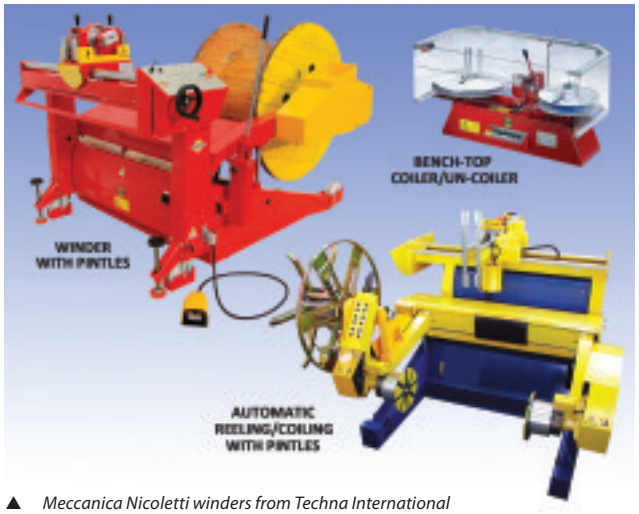
Inosym supplies a range of steel and ABS plastic reels to over 45 countries worldwide. All reels are manufactured to DIN international standards, or as per customer specific requirements, and are suitable for all cable and wire making processes from high-speed wire drawing reels to large take-up reels.

The range includes:

- ABS plastic reels of 300mm to 1,000mm diameter
- Metal flange press metal process reels
- Semi-machined double-wall high-speed reels
- Fully machined high-speed steel reels
- Steel process and shipping drums

Inosym's largest ever reels were recently supplied to producers in Egypt and Malaysia. Steel drums of 4,000mm and 3,600mm diameter were designed to carry a maximum cable weight of 25,000kg at drum twisting speeds of 28rpm.

Inosym Reels – New Zealand
Email: inosym@inosym.com
Fax: +64 3341 6668
Website: www.inosym.com



▲ *Meccanica Nicoletti winders from Techna International*

Winding up, and down

Techna International is the UK agent for Meccanica Nicoletti equipment. The range includes a selection of winding machines to suit almost every cable winding application, from the smallest manual bench-top models, through motorised and semi-automated units, up to fully automated cable handling systems for large-scale operations.

Working on drums, coils, coils to drums, coils to coils, drums to coils and drums to drums, these units are designed to provide consistent and reliable winding and unwinding operations, from the most basic to the most sophisticated requirements.

The range includes:

- Stand or bench-mounted coil winders and unwinders
- Twin function stand-mounted take-ups and payoffs (Bob-Mat and CD series)
- Avomat 16 series PC-controlled take-up and coiler
- Linap series of semi-automated, high speed drum winding and unwinding systems

For large cable facilities a further Nicoletti development is the Automat 300, providing fully automated cable handling including payoff, electronic cable stretching control, drums supplied on pallets, fork-lift or conveyor, guide rollers for correct cable feeding, cable diameter measurement, winding and coiling (only one winder required), keyboard drum positioning and drum marking. The system can be integrated with customer order and service software and hardware for a remote system inspection.

Techna International Ltd – UK **Fax**: +44 1923 219700 **Email**: sales@techna.co.uk **Website**: www.techna.eu

Reels for shipping and storage

IWE Germany is a worldwide supplier of steel reels and drums for cables, wires and strands. These reels can be designed for internal processes or for shipping purposes with dimensions from 800mm to 3,500mm flange diameter and according to DIN standards or customer specifications.

▲ *A steel reel for wire rope from IWE*

IWE's durable shipping reels are manufactured with solid flanges and reinforcements. They are offered with smooth internal flanges and a smooth drum surface for protection of the winding material.

Special surface treatments are available, including hot galvanizing to UNI EN ISO 1461, painting with a two-component lacquer and heat resistant lacquer. Reels are also available in stainless steel.

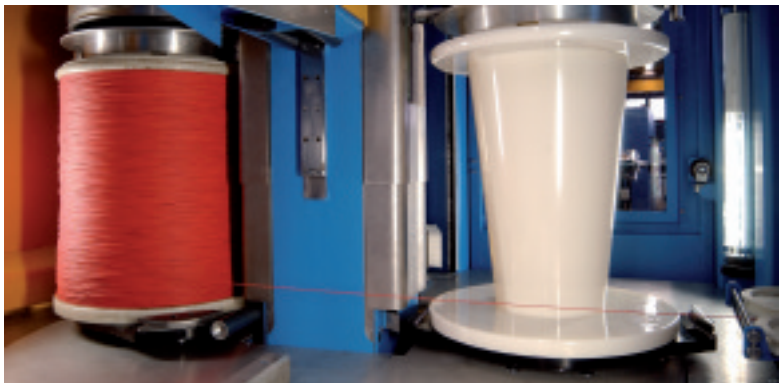
Several accessories are available: fixing holes for safe loading, rim profiles for nail-less lagging, large steel nameplates for a company logo, data plate, cable entry bow, tying bow and more. Reel design and loading capacity are always checked to comply with each customer's specific application.

iwe-Spulen und Handling GmbH – Germany
Fax: +49 9568 85444
Email: info@iwe-reels.com
Website: www.iwe-reels.com

Wire, strand and cable handling

For over a decade the Niehoff Package System (NPS) has provided an efficient, safe, reliable and economic handling system for wires, bunches, strands, conductors and cables.

The NPS consists of specially developed spoolers and spools. NPS high-speed double spoolers, SV 400 D and SV 410 D, use a patented conical wire-laying technology to spool the insulated wire inline with an extrusion line onto NPS spools. The collapsible multi-way NPS spools made of ABS plastic offer a secure, stable and tangle-free package when full or partially empty and enable high cable payoff speeds into downstream processes.



▲ *SV 410 D type spooler with a filled and an empty NPS spool*

The system works efficiently for all automotive wire and cable including small cross section wire, 0.22mm² and 0.13mm².

The empty NPS spools can be separated into a flange and a cone/flange that can be nested into each other for reduced storage space. An NPS spool takes up only a third of the space of a comparable conventional spool and requires less return shipping space than traditional spools and packages of the same capacity, resulting in considerable savings in shipping and handling costs. On return to the cable manufacturer NPS spools can be easily and quickly reassembled and reused for dozens of cycles.

A recent development from Niehoff and its partners is a radio frequency identification (RFID) based braiding bobbin management system that simplifies spool tracking logistics. The system can be connected to a production data acquisition (PDA) system with a manufacturing execution system (MES). The RFID transponders, inserted into the NPS spools by manufacturer Astroplast, carry production data. They have a higher data storage capacity, thus more information, than traditional barcode systems and cannot be erased or rendered illegible. The stored data is secure as the RFID transponder is insensitive to conventional pollutants.

▲ *NPS double spooler type SV 410 D*

The new RFID system enables decentralised data storage beyond factory boundaries, tracking of individual spools and data documentation.

When further processing the spools, a machine operator can compare the spool data with the order data and identify whether or not a spool is suitable for the production process.

Maschinenfabrik Niehoff GmbH & Co KG – Germany
Fax: +49 9122 977 155
Email: info@niehoff.de
Website: www.niehoff.de

Spools, reels & pre-packaging systems

Heavy duty spools

Electrorrec SA specialises in detachable spools of special sizes, manually or pneumatically operated, for the wire and cable industry.

All Electrorrec spools have a strong frame and heavy steel construction. The retractable drum consists of four hinged sections to ease the extraction of the strapped material. In the case of pneumatically operated spools, the disassembly and re-assembly is very fast using the central pneumatic cylinder. Compressed air is supplied by means of easy-access fastenings located under the upper flange. In addition, a mechanical safety system is provided to prevent disassembly in case of air failure while running.

Electrorrec SA specialises in detachable spools

The flanges are designed with four guides for the passage of the straps using a portable strapping machine. The capacity of the spools ranges from 500kg to 2,000kg.

Electrorrec SA – Spain
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Email: sales@electrorrec.com
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Advances in TPE styrenic block copolymer compounding for UL flame retardant cable applications

By Biing-Lin Lee, Darnell Worley, Phil Scadding, Ben Jones, Sachin Sakhalkar, Wilfred Giroux, Teknor Apex Company

Abstract

Teknor Apex Company has undertaken research and development efforts in the TPE styrenic block copolymer compounding technologies to develop new RoHS-compliant enhanced flame retardant (FR) compounds. This paper will detail the performance of new compounds using different UL vertical burn test methods. EL-1392B (Shore A 86), EL-1934E (Shore A 82), and EL-1934F (Shore A 73) pass UL 94 V-0 rating at a thickness of 0.06". These compounds also pass UL 1581 VW-1 and method 1061 for cable flammability tests for insulation and jacketing. They are ideal for flexible cords, coil cords, robotics cables, power tools, high-flex cables, low temperature applications, and connector parts and components requiring a V-0 flame rating.

1 Introduction

The primary applications of TPE compounds requiring fire retardancy are in wire and cable insulation, jacketing, and electronic devices. Styrenic thermoplastic elastomers (TPE-S) are also used in a wide variety of fire retardant applications including automotive, audio, battery, electrical junction boxes, submersible pump and other flexible cord applications that require a balance of electrical, thermal, flame-resistance, and physical properties. In the past, many industrial product designers and manufacturers sacrificed TPE mechanical performance in order to incorporate flame-retardants into products[1].

Key requirements of these applications include requisite UL ratings, mechanical property retention after heat ageing, ease of processing and low temperature flexibility. Styrenic TPE-S compounds are particularly suitable for such applications. Formulations of flame retardant TPE-S to achieve UL 1581 VW-1 and method 1061 flame resistance require high levels of additives. However, high levels of additives tend to negatively impact the mechanical, physical and rheological properties of the FR compounds.

This paper discusses Teknor Apex's recent development of a series of high performance RoHS-compliant flame retardant TPE-S. The effort covers the manipulation of styrenic block copolymer (SBC) technology[2], combined FR additives technology[3] and fire science on the UL vertical burns. The use of these technologies enables the achievement of UL 1581 VW-1 and method 1061 in a compound with good properties.

2 Results and discussion

2.1 UL 94 Vertical burn

The UL 94 test is designed to assess the flammability of plastic materials for parts in devices and appliances.

The test method is a measure of ignitability and flame spread for polymeric materials exposed to a small flame. To assess the test, a bar shape specimen of plastic, 120mm x 13mm with different thicknesses, is positioned vertically and held from the top. The thicknesses of the test specimens are 3.2mm, 1.6mm and 0.8mm. Surgical cotton is placed 300mm below the specimen to detect combustible drips that will ignite the cotton.

A Bunsen burner flame is applied to the specimen twice for 10 seconds. After each flame application the time of self-sustained combustion is recorded. The second application of the flame follows immediately after self-extinguishment of the specimen from the first flame application.

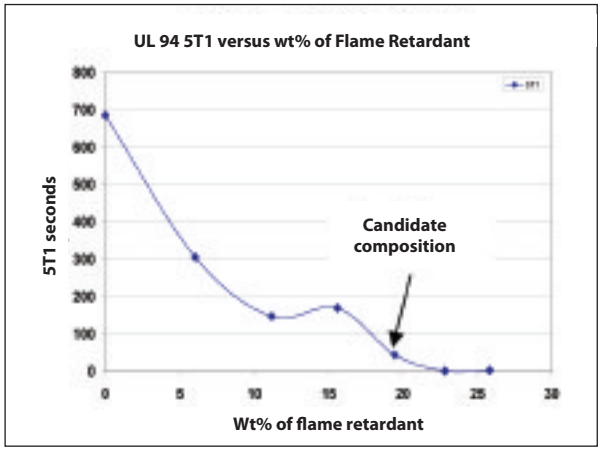
Table 1 summarises the criteria for V-0, V-1 and V-2 ratings. For example, a V-0 classification is given to a material that meets all of the following criteria: (i) it is extinguished in less than 10 seconds after any flame application; (ii) the total combustion time for the five specimens tested should not exceed 50 seconds, (iii) no combustible drips occur[4].

The UL 94 rating is a discrete classification such as V-0, V-1 or V-2. There is an attempt to correlate the UL 94 ratings to the heat release capacity[5]. However, the numerical values of T1 and T1+T2 are useful in the screening evaluation.

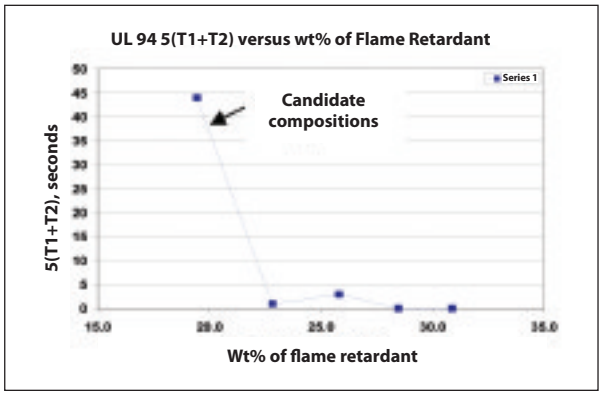
▼ **Table 1**: *Rating/classification of UL 94 vertical burn*[4]

Criteria conditions	V-0	V-1	V-2
After flame time for each individual specimen T1 & T2	<10s	<30	<30
Total after flame time for 5 specimens for any conditions set (T1 + T2)	<50s	<250	<250
After flame time, T2, plus afterglow time, T3, for each individual specimen after the 2nd flame applications	<30s	<60	<60
After flame or afterglow of any specimen up to the holding clamp	No	No	No
Cotton indicator ignited by flaming particles or drops	No	No	Yes

T1: flame out time for first flame application; T2: flame out time right for the second flame application; T3: glow time after the second flame out.



▲ **Figure 1**: *UL 94 5T1 versus wt% of flame retardant*



▲ **Figure 2**: *UL 94 5(T1+T2) versus wt% of flame retardant*

Figure 1 plots 5T1, the sum of T1 for five tested samples according to the UL94 procedure, versus the weight % of a flame retardant.

The sample thickness is 0.125". Based on the criteria shown in *Table 1*, the compositions that achieve 5T1 less than 50 seconds are candidates for further study. In this example, it requires more than 20 wt% of flame retardant.

Figure 2 plots 5(T1+T2), the sum of T1 and T2 for five tested samples according to the UL 94 procedure, versus the wt% of a flame retardant. The sum of 5(T1+T2) must be less than 50 seconds. In this particular example, it requires approximately 20 wt% of flame retardant to meet the V-0 rating at 0.125".

2.2 UL 1581 wire and cable flammability tests

VW-1 vertical-wire flame test

This is a small-scale test conducted on a completed wire construction of 24" in length.

The UL 1581 test method states that a vertical wire, cable or cord shall not convey flame along its length, and it shall not convey flame to combustible materials in its vicinity during, between, or after five 15-second applications of a standard test flame. The flame source is a Tirrill burner (similar to a Bunsen burner) with a heat output of approximately 500W or 1,700 Btu/h.

The flame is applied for 15 seconds and reapplied four times, each time after the wire ceases to burn. If the sample burns longer than 60 seconds after any application, or if the indicator flag or cotton batting is ignited during the test, the tested cable or wire fails the test[6].

1061 Cable flame test

This is also a small-scale test conducted on a single 24" length of cable.

A vertical specimen of the finished cable shall not convey flame along its length, and it shall not convey flame to combustible materials in its vicinity during, between, or after a one-minute application of a standard test flame.

The standard test flame is nominally 125mm high and produces heat at the nominal rate of 500W or 1,700 Btu/h. The flame is applied three times, for one minute each time. The period between flame applications is to be 30 seconds; regardless of whether flaming of the specimen ceases within 30 seconds of the previous application. If the indicator flag is burned over 25% or the cotton batting is ignited during the test, the cable fails the test[6].

The VW1 and 1061 cable flame tests are affected by the wire and cable design, for instance, the insulation wall thickness, the jacket wall thickness, and the number of insulated wires.

Cone calorimetry testing

Cone calorimetry is a bench-scale test developed at the National Institute of Standards and Technology (NIST)[7]. It is used to burn small samples for the evaluation of heat release rates, time to ignition, smoke generation and char formation.

The basic principle, albeit empirical, exploits the observation that the net heat of combustion is proportional to the amount of oxygen required for combustion. Therefore, the investigation of the new FR TPE-S formulations required the use of cone calorimetry testing.

2.3 Polymer/resin technology

Styrenic block copolymers (SBCs) are used for wire and cable applications. With the significant advances in hydrogenation technology a broad range of hydrogenated SBCs, compatible with polyolefins and mineral oils, is available. Furthermore, due to the recent advances in polyolefin process and catalyst technology, a broad range of polyolefins can extend the service temperature range[8, 9]. The domain microstructure of SBC also affects the melt strength and processability[10].

The combination of hydrogenated SBC rheology and polyolefin technology is a building block for high performance flame retardant compounds with a unique balance of properties including excellent tensile properties and rheological characteristics. These properties are achieved while improving the flame retardancy to UL 94 V-0 rating, and also imparting good low temperature properties, good thermally aged properties, and good dielectric properties.

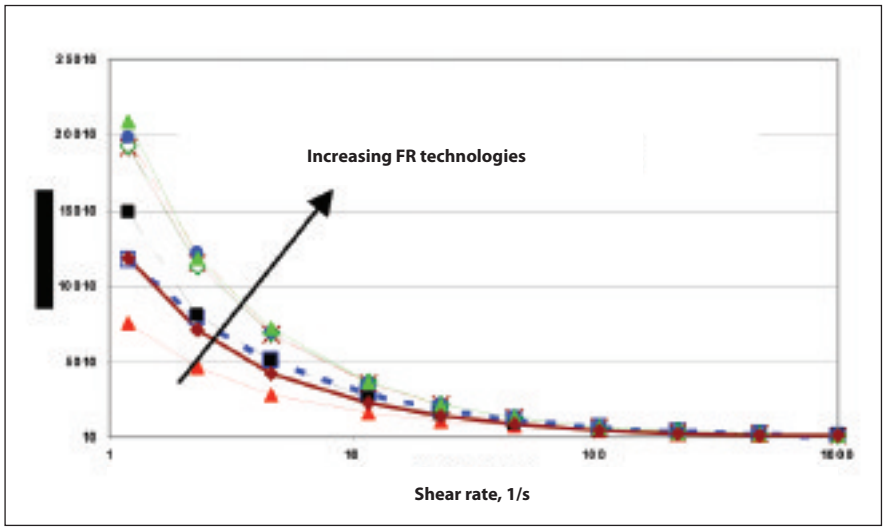
Furthermore, blends of SBC and polyolefin can be developed for use where UV resistance, high service temperature (eg 105˚C temperature rating), low service temperature (eg brittle point < –50˚C), and processing stability are essential. Hydrogenated SBC-based flame retardant TPEs can be formulated to cover a wide range of hardness from Shore A 50s to Shore D 60s.

2.4 Flame retardants

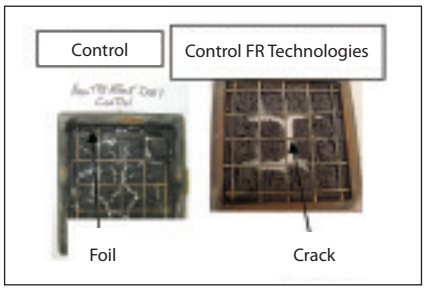
There are several different categories of flame-retardants, the most diversified class being of those containing halogen. A broad range of brominated and chlorinated flame-retardants are commercially available. Fully brominated aromatics are generally used in resins with a relatively high processing temperature[11, 12].

Recent efforts in the development of new flame-retardants have shifted toward phosphorous and other inorganic hydroxide halogen-free systems. In this paper the choice of polymers and a combination of flame retardant technologies results in an RoHS-compliant flame retardant TPE.

The effect on performance when combining FR technologies is a modification in rheology and burn characteristics with minimal effect on physical properties. The observed changes are demonstrated in *Figures 3*, *4* and *5*. *Figure 3* shows an increase in low shear viscosity with increases in FR ingredients. *Figure 4* shows good stable char formation with a combination of FR ingredients. Finally, *Figure 5* shows a decrease in peak heat release rate with increasing FR ingredients.



▲ **Figure 3**: *Viscosity of FR TPE-S (200˚C)*



▲ **Figure 4**: *Char formation for conventional and combined FR technologies*

- ***Eliminating dripping:***
  As demonstrated in *Figure 3*, the incorporation of combined FR technologies in TPEs increases the viscosity at low shear rates. This is translated to reduced drip under UL 94 vertical burning.

- ***Enhancing char formation and char integrity:***
  Char formation and integrity is desirable for improved flame retardancy. The incorporation of combined FR technologies to flame-retardant TPE compounds can promote char formation when exposed to a flame. *Figure 4* compares the char of conventional FR TPE-S to that of the new flame-retardant TPE-S technology. The dark portion is char, and the white portion is ash or cracks in the char. The char for the combined FR technology is much thicker than that of a conventional FR TPE-S and shows less cracking.

- ***Reducing peak heat release rate:***
  Figure 5 shows the cone calorimeter peak heat release rate (PHRR) data of a conventional FR TPE-S versus the new combined FR TPE-S technology. The results show that the incorporation of combined ingredients reduces the peak heat release rate. It can also slightly increase the flame out time.

3 Enhanced flame retardant TPE-S

3.1 Properties

The material technologies and their underlying principles discussed above are used to develop enhanced flame retardant TPE-S.

These enhanced FR TPE-S compounds use an RoHS-compliant flame retardant. Specific examples are highlighted below. See *Table 2* for the typical properties of several enhanced flame retardant TPE-S.

The special features of enhanced FR TPE-S are:

- RoHS compliance
- Pass UL 94 V-0 rating at 0.06"
- Meet VW-1 and 1061 cable flame test, without dripping
- Brittle point below –50˚C
- Exhibit good retention of tensile properties upon heat ageing at 136˚C for 7 days and also at 158˚C for 7 days
- Show excellent electrical properties

3.2 VW-1 and method 1061 cable flammability tests and coil cords

Wire and cable extrusion trials verified these properties and also indicated good processability.

These compounds are ideal for flexible cords, coil cords, robotics cables, power tools, high-flex cables, low temperature applications, and connector parts and components requiring a V-0 flame rating.

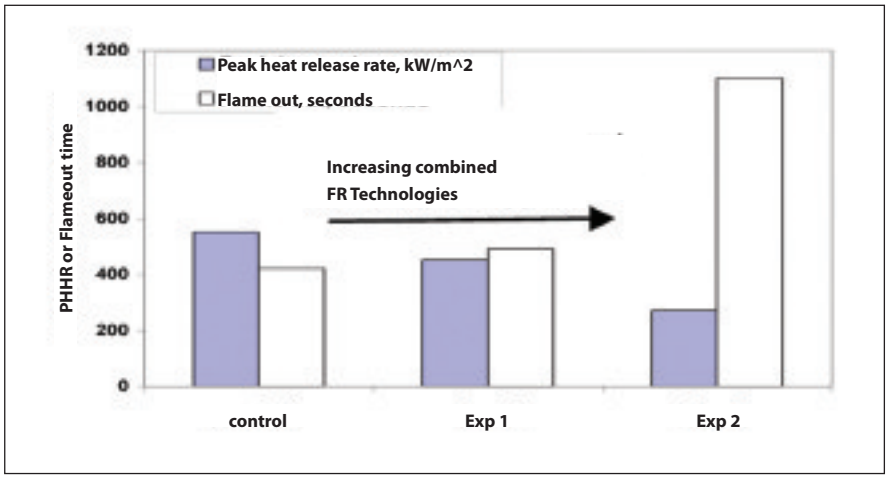
In VW-1 and 1061 cable flammability tests, the wire or cable must pass the criteria of retention of more than 75% of the indicator flag without dripping.

For illustration, *Figures 6* and *7* show a burned wire and a burned cable made of EL-1392B compound. The retention of the indicator flag upon VW-1 and 1061 cable flammability test is achieved without dripping. *Figure 8* shows a coil cord made with EL-1392B for insulation and jacketing. It has very good retract performance.

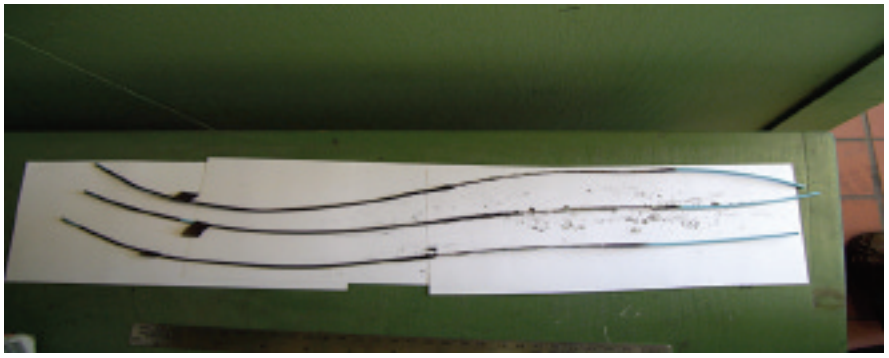
▼ **Table 2**: *Typical property values of enhanced flame retardant TPE-S*

Property	EL-1392B	EL-1934E	EL-1934F
RoHS compliance	yes	yes	yes
Sp. Gr	1.24	1.32	1.30
Hardness, Shore A	86	82	73
Tensile strength, psi	1540	1480	1220
Elongation %	540	630	680
Tensile strength retention *	99 %	98%	105%
Elongation retention *	95%	92%	95%
Tensile strength retention *	100%	97%	104%
Elongation retention **	95%	87%	92%
Brittle point °C	-51	-59	-60
Melt Index #	14	14	20
DC, 1 Mega Hz	2.42	2.41	2.40
DF 1 Mega Hz	0.003	0.0032	0.003
DC, 1 kilo Hz	2.43	2.43	2.41
DF, 1 kilo Hz	0.0029	0.0043	0.0027
Oxygen Index, % oxygen	28	30	27
UL 94 ##	V0	V0	V0

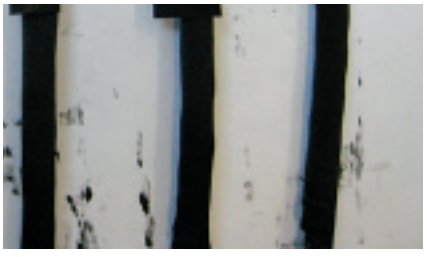
** 136ºC 7 days ageing*
*** 156ºC 7 days ageing*
 # 200ºC 5kg, g/10 min
thickness 0.060 "
DC= dielectric constant
DF= dielectric dissipation factor



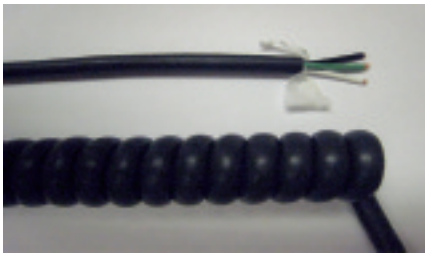
▲ **Figure 5**: *Cone calorimeter data for combined FR technologies*



▲ **Figure 6**: *The retention of an indicator flag of EL-1392B wire upon 1061 flammability test*



▲ **Figure 7**: *The retention of an indicator flag of an EL-1392B cable upon 1061 cable flammability test*



▲ **Figure 8**: *A coil cord using EL-1392B for insulation and jacketing*

4 Conclusions

A combination of the availability of new polymer materials and flame retardant technologies offers the ideal timing for the development of RoHS-compliant enhanced flame retardant TPEs.

New FR compounds extend the performance range beyond that of conventional FR TPEs. They pass UL 94 V-0 rating at 0.06" and meet VW-1 and method 1061 wire and cable flame tests without dripping.

These are achieved with good low temperature flexibility, a good retention of tensile properties upon heat ageing, and also showing excellent electrical properties.

New FR compounds are ideal for flexible cords, coil cords, robotics cables, power tools, high-flex cables, low temperature applications, and connector parts and components requiring a V-0 flame rating.

The improved flame retardant capability of these SBC compounds is due to formulation techniques that modify melt viscosity, and char formation. ■

5 Acknowledgments

The authors would like to thank Teknor Apex for permission to discuss this work.

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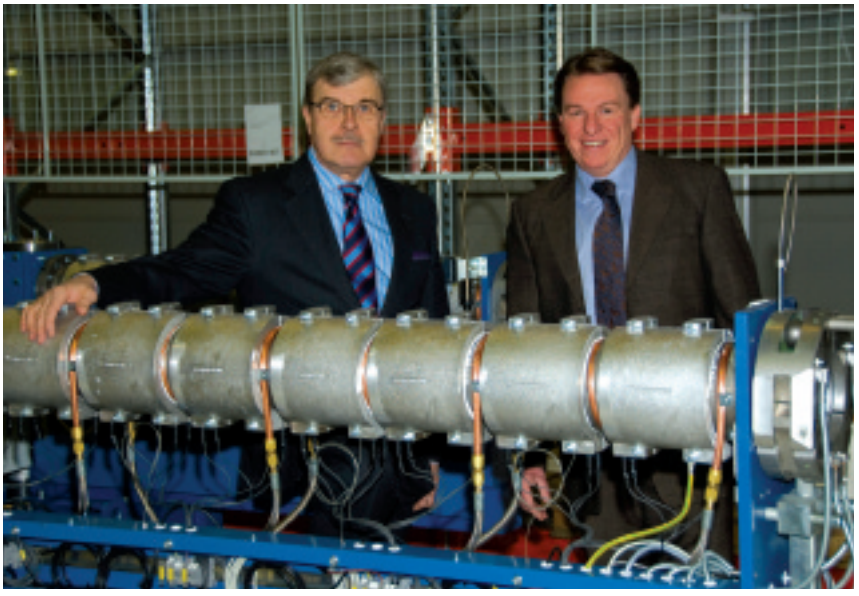

▲ *Neuer Vorsitzende Herr Pentti Hätälä (links) mit Herrn Peter Roos*

Jetzt wo der Vorsitzende der Geschäftsführung des Unternehmens Herr Pentti Hätälä das Alter von 65 Jahre erreicht hat, kündigt der Verwaltungsrat von Maillefer große Änderungen im Vorstand und im Managementteam an.

Am 17. Dezember 2009 wurde Herr Hätälä von den Verwaltungsmitgliedern in die aktive Position des Vorstandsvorsitzenden der Maillefer Gruppe ernannt. Danach wurde am gleichen Tage Herr Peter Roos zum Vorstandsvorsitzenden befördert.

Herr Hätälä verläßt seine leitende Position nach über 30 Jahren Tätigkeit in der Kunststoff- sowie Draht- und Kabelindustrie. Er schloß sich Nokia Machinery in Finnland vor über 20 Jahren an und machte Karriere in den einzelnen Unternehmensbereichen.

2001 wurde er Vorstandsvorsitzende bei Maillefer. In dieser neuen Stelle wird er weiterhin dem Unternehmen seinen wertvollen unterstützenden Beitrag anbieten.

Der jetzige Vorsitzende von Maillefer Herr Roos profitiert von über 20 Jahren Erfahrung in der europäischen Automobilindustrie, einschließlich mehrerer Jahre in Management-Schlüsselpositionen. Er ist vor über einem Jahr bei Maillefer als Betriebsleiter eingetreten und hat eng mit Herrn Hätälä in diesem Zeitraum zusammengearbeitet.

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Vertrieb von Prüfgeräten

Inhol BV in den Niederlanden hat kürzlich ein exklusives Vertriebs- und Serviceabkommen mit seinem schwedischen Vertragspartner TVAB International für den Verkauf und Vertrieb des TVAB 5420 N Kratzabrieb-Prüfgerät unterzeichnet. Inhol BV wird für alle Verkaufs- und Servicekontakte in diesem Bereich verantwortlich sein, selbst für jene Einheiten die zuvor von TVAB vertrieben wurden. Ziel der Zusammenarbeit ist es, die Kundenunterstützung zu erhöhen und im internationalen Draht- und Kabelmarkt Bewußtsein für die Prüfvorrichtung zu schaffen.

Jacob Steendam von Inhol BV, erklärte: "Hunderte von Einheiten wurden bereits von TVAB im Laufe der letzten Jahren verkauft. Das TVAB-Abriebprüfgerät ist so genau, das es die Abriebstandards für ISO 6722-1 festlegte. Es wurde entworfen um die Beständigkeit von einadrigen 60V-und 600V-Kabeln unter extremen Bedingungen zu prüfen, und es mißt sehr spezifische Abreibhaltbarkeitsvariabeln."

Inhol BV/PTL – Niederlande
Fax: +31 3560 33235
Email: office@inhol.com
Website: www.inhol.com

FTTH nimmt weiter zu

Bei der im Februar stattgefundenen FTTH-Konferenz 2010 präsentierte FTTH Council Europe die neuesten Angaben der europäischen Länder, die Ende 2009 im Marktbereich von Fibre-to-the-home führend waren.

Obwohl Schweden, Norwegen und Slowenien Plätze unter den ersten fünf Positionen belegten, wurden sie von Litauen überholt, das einen dynamischen Sprung nach vorne in die erste Position mit 18 Prozent FTTH-Durchdringung machte. Alle vier Länder weisen nun Durchdringungsraten auf, die 10 Prozent überschreiten.

Frankreich und Portugal faßten zum ersten Mal in der Klassifizierung Fuß, dank der starken Weiterentwicklung von Faserinfrastrukturen sowie Marketingstrategien um Benutzer zu gewinnen. Man erwartet daß FTTH in diesen beiden Ländern weiterhin hohe Zuwachsraten erreichen wird, da auch diese Länder zu den Top 10 der Wirtschaft in Bezug auf die FTTH-Einsatzfähigkeit zählen.

In absoluten Zahlen hat Europa 2,5 Millionen Benutzer erreicht – 3,5 Millionen wenn man auch Rußland hinzuzählt. Der Großteil der Benutzer (77 Prozent) konzentriert sich auf sieben Länder, entsprechend nachfolgender Reihenfolge: Schweden, Italien, Frankreich, Litauen, Norwegen, Niederlande und Dänemark. Unter diesen sieben verfügen nun fünf Länder über 200.000 angeschlossene Benutzer.

FTTH Council Europe – Belgien
Fax: +32 2503 2277
Email: info@ftthcouncil.eu
Website: www.ftthcouncil.eu

PV-Kabel für die direkte Erdverlegung

USA Wire & Cable Inc hat das PV-Kabel auf den Markt gebracht, das als erstes PV-Kabel gilt, das die Bezeichnung der direkten Erdverlegung unter der UL 4703 Revision vom 17. November 2009 besitzt.

Dieses Kabel bietet Sonnen-, Ozon-, Wärme- und Abriebbeständigkeit, und setzt eine Isolierung aus Ethylenpropylen-Gummi (EPR) ein sowie eine getrennte Schutzummantelung, die als bevorzugte Lösung für transformatorlose Wechselrichtersysteme gilt.

USA Wire & Cable Inc – USA
Fax: +1 512 326 3584
Website: www.usawire-cable.com

Drahtschweißer

Cemsa SpA hat kürzlich Roboside PJ auf den Markt gebracht, eine neue Entwicklung der automatischen Tisch-Schweißmaschine Roboroof des Unternehmens. Diese neue Baureihe ist dazu bestimmt Verbesserungen der Produktivität, Leistungsaufnahme, Flexibilität und Genauigkeit aufzuzeigen und kann in jeglicher automatischen Linie integriert werden.

Diese Maschine kann zum Schweißen einer großen Auswahl an Netzen, Maschenbestandteilen und Metallplatten eingesetzt werden. Außerdem hat sie sich für das Schweißen von Fahrzeugsitzrahmen bewährt, bei denen oft das Verbinden und Schweißen vorgebogener Drähte mit komplexen Entwürfen beteiligt ist.

Die von Cemsa entworfene Werkzeugbestückung wird den Kunden mit dedizierten Anwendungen zur Verfügung gestellt, um eine umfangreiche Auswahl an Fahrzeugsitzmodellen gemäß den strengen Toleranzen herzustellen, die von den Automobilherstellern gefordert werden.

▲ *Roboside PJ Schweißmaschine*

Cemsa SpA – Italien
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Fax: +39 02 253 3307
Website: www.cemsa.it

Aufrüstung des Unterwasserkabelsystems

Alcatel-Lucent und GlobeNet haben die Aufrüstung des 22.000 Kilometer langen Unterwasserkabelsystems fertig gestellt, das die Vereinigten Staaten mit Lateinamerika verbindet. Dank dieses Projekts, bzw. der zweiten Aufrüstung in zirka 18 Monaten, kann GlobeNet über 110 Gbit/s Kapazität liefern, das bedeutet, daß gleichzeitig bis zu 13,75 Millionen Telefongespräche übertragen werden können.

Die Kunden von GlobeNet profitieren nun von einer erhöhten Konnektivität und Zuverlässigkeit sowie schnellerem Zugang zu den Applikationen und Diensten. Durch Einsatz der Unterwassertechnologie nach dem neusten Stand der Technik von Alcatel-Lucent, kann GlobeNet sein Angebot an Großhandelsdienstleistungen erweitern, indem Breitband, Carrier Ethernet, feste und mobile traditionelle sowie IP-basierte Sprachdienste angeboten werden sowie Anwendungen wie z. B. Hosting, Videokonferenzführungen und internationale private Leitungsdienste.

Neben der Unterwasserkabel-Abschnitten, rüstete Alcatel-Lucent die Anschlußpunkte in Rio de Janeiro und Fortaleza (Brasilien) um, sowie jene in Maiquetia (Venezuela), St.David's (Bermuda), Boca Raton und Tuckerton in Florida (Vereinigte Staaten). In Rio de Janeiro integriert sich das Unterwassernetz in die terrestrische optische Infrastruktur der Muttergesellschaft von GlobeNet, Oi. Alcatel-Lucent sorgt außerdem für die Leitung der Installation, Verlegung und Inbetriebnahme des Systems.

"GlobeNet verpflichtet sich die Kapazität und Fähigkeiten des Netzwerks zu erhöhen um seine Kunden noch besser mit neuen zuverlässigen Dienstleistungen zu bedienen, während die in unseren bestehenden Infrastrukturen durchgeführten Investitionen eingesetzt werden" sagte dazu Eric Contag, leitender Geschäftsführer von GlobeNet.

"Alcatel-Lucent bleibt weiterhin ein geschätzter Partner, der uns dabei unterstützt, unsere weltweiten Fähigkeiten weiter zu innovieren und zu erweitern, während unsere strengen Anforderungen berücksichtigt werden."

"Dank dieser Netzwerkaufrüstung erhält GlobeNet die zusätzliche Kapazität, die erforderlich ist um fortgeschrittene Dienstleistungen zu unterstützen, während sein Netz weiterhin leicht geleitet werden kann" erklärte Philippe Dumont, Generaldirektor der Unterwassernetzwerktätigkeiten von Alcatel-Lucent.

"Dieses Projekt bestätigt außerdem unsere enge und erfolgreiche Beziehung zu GlobeNet, die wir darin unterstützen, den Endnutzern die bestmöglichste Dienstleistungserfahrung anzubieten."

GlobeNet – USA
Website: www.globenet.net
Alcatel-Lucent – Frankreich
Website: www.alcatel-lucent.com

Bahnwagenauftrag in China

Nexans wurde ein Auftrag in Höhe von 9,5 Millionen Euro erteilt, um den chinesischen staatlichen Hersteller von Bahneinrichtungen, CNR Corporation Limited (CNR), mit den Kabeln zu beliefern, die gefordert werden um die chinesischen Hochgeschwindigkeitszüge "China Railway High-speed (CRH)" zu entwickeln, die zwischen Peking und Shanghai 2011 in Betrieb gehen werden.

Die gelieferten Kabel werden in den chinesischen Herstellungsanlagen von Nexans in Waigaoqiao und Baoshan gefertigt. Die erste Kabelgruppe wurde März 2010 geliefert und die letzte wird für März 2011 vorgesehen.

Die neuen CRH-Züge werden aus 16 Wagen bestehen, für eine Nenndrehzahl von 350km/h, und bis zu 1.026 Reisende werden dort Platz finden.

Die für dieses CRH-Projekt gelieferten Kabel gehören zur Produktpalette Flamex® von Nexans, die speziell entworfen wurden, um sich an den verschiedenen internationalen Standards und Sicherheitsanforderungen der Bahneinrichtungsindustrie zu halten. Die ausgewählten Kabel sind umweltfreundlich und halogenfrei – dies hilft zu sichern, daß das Kabel der Brandausbreitung widersteht und raucharme Emissionen im Brandfall erzeugt.

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Fortschritte bei TPE Styrol-Block-Copolymer Compounds für UL-flammwidrige Kabelanwendungen

Von Biing-Lin Lee, Darnell Worley, Phil Scadding, Ben Jones, Sachin Sakhalkar, Wilfred Giroux, Teknor Apex Company

Übersicht

Teknor Apex Company hat Forschungs- und Entwicklungsaufwände im Bereich der Technologien der TPE Styrol-Block-Copolymer Compounds betrieben, um neue, den RoHS-Richtlinien entsprechende, erhöhte flammwidrige (FR) Compounds zu entwickeln.

In diesem Artikel wird die Leistung neuer Compounds bei verschiedenen Methoden der Vertikalbrennprüfung (Vertical-Burn-Test) entsprechend UL näher beschrieben. EL-1392B (Shore A 86), EL-1934E (Shore A 82) und EL-1934F (Shore A 73) bestehen die UL 94 V-0-Klassifizierung bei einer Dicke von 0,06 Zoll. Diese Compounds bestehen auch UL 1581 VW-1 und die Methode 1061 für die Entflammbarkeitsprüfungen für Kabelisolierung und -umhüllung. Sie eignen sich ideal für flexible Leitungen, Spiralkabel, Kabel für die Robotertechnik, Elektrowerkzeuge, hochflexible Kabel, Anwendungen bei Niedertemperatur und Steckerverbinderteile und Komponenten, bei denen eine Klassifizierung der Flammbeständigkeit nach V-0 erforderlich ist.

1 Einleitung

Die wichtigsten Anwendungen der TPE-Compounds die eine Flammwidrigkeit erfordern sind: Draht- und Kabelisolierung, -umhüllung sowie elektronische Vorrichtungen.

Thermoplastische Styrol-Elastomere (TPE-S) werden ebenfalls in einer weiten Auswahl an feuerhemmenden Anwendungen eingesetzt, einschließlich Automobile, Audio, Batterie, elektrische Anschlußkästen, Tauchpumpen und anderen Anwendungen mit flexiblen Leitungen, die ein Gleichgewicht der elektrischen, thermischen, flammwidrigen und physikalischen Eigenschaften fordern. In der Vergangenheit opferten viele Industrieproduktdesigner und -hersteller die mechanische TPE-Leistung, um Flammschutzmittel in die Produkte aufzunehmen[1].

Zu den Schlüsselanforderungen dieser Anwendungen gehören erforderliche UL-Klassifizierungen, mechanische Eigenschaftsbeibehaltung nach Wärmealterung, einfache Verarbeitung und Niedertemperatur-Flexibilität.

TPE-S Styrol-Compounds eignen sich ideal für solche Anwendungen. Bei den Mischungen flammwidriger TPE-S, um die Flammbeständigkeit nach UL 1581 VW-1 und der Methode 1061 zu erreichen, sind hohe Additivniveaus erforderlich. Jedoch neigen hohe Additivniveaus dazu, eine negative Wirkung auf die mechanischen, physikalischen und rheologischen Eigenschaften der FR-Compounds zu haben.

Dieser Artikel befaßt sich mit den neuesten Entwicklungen einer Reihe von flammwidrigen Hochleistungs-TPE-S von Teknor Apex, die den RoHS-Richtlinien entsprechen. Der Aufwand deckt die Beeinflussung der Styrol-Block-Copolymer-Technologie (SBC)[2], kombiniert mit FR-Additivtechnologie [3] und Feuerwissenschaft bei den UL-Vertikalbrennprüfungen. Der Einsatz dieser Technologien ermöglicht es UL 1581 VW-1 und die Methode 1061 in einem Compound mit guten Eigenschaften zu erzielen.

2 Ergebnisse und Diskussion

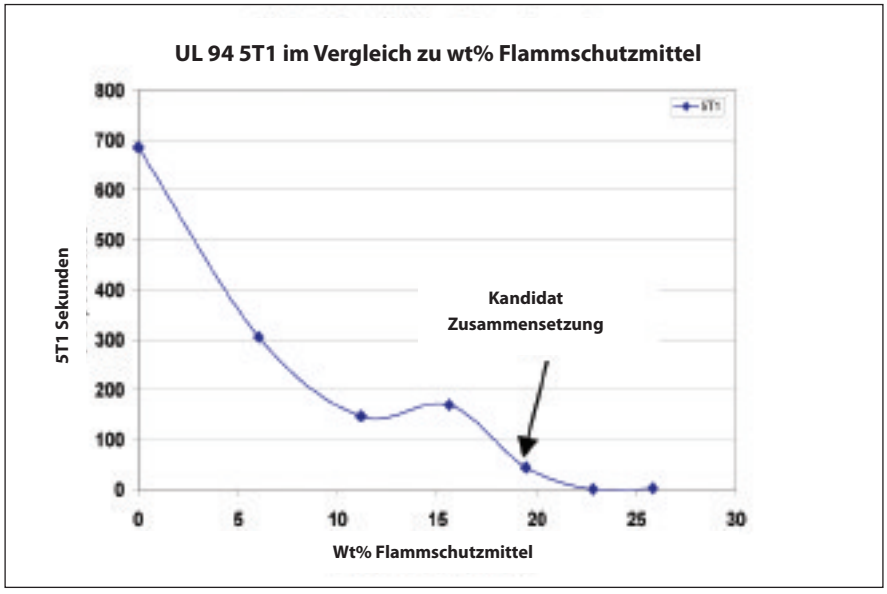
2.1 UL 94 Vertikalbrennprüfung

Die UL 94-Prüfung ist dazu bestimmt, die Entflammbarkeit von Kunststoffmaterialien

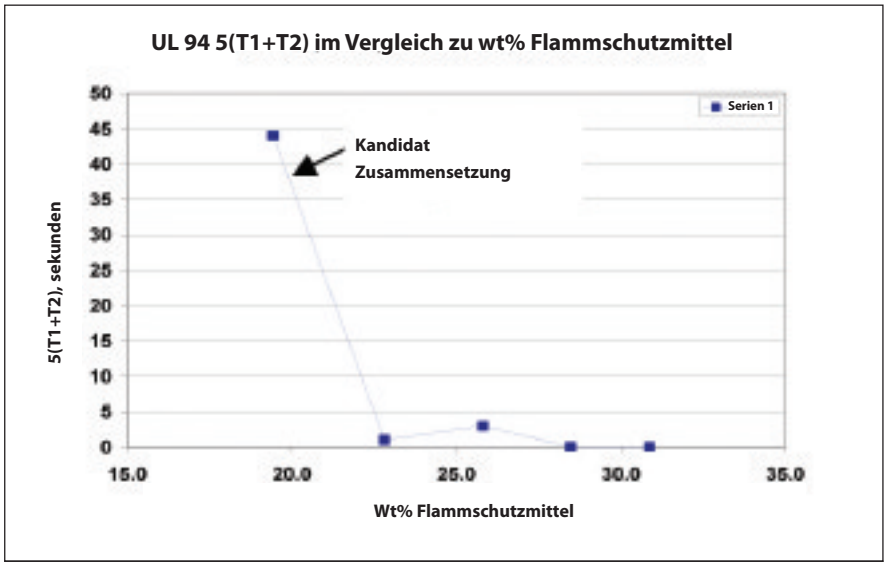
▼ **Tabelle 1**: *Bewertung/Klassifizierung der Vertikalbrennprüfung UL 94*[4]

Kriterienbedingungen	V-0	V-1	V-2
Nachbrennzeit je einzelne Probe T1 und T2	<10s	<30	<30
Gesamte Nachbrennzeit für 5 Proben für jegliche eingestellte Bedingung (T1 + T2)	<50s	<250	<250
Nachbrennzeit, T2, plus Nachglühzeit, T3, je einzelne Probe nach der 2. Beflammung	<30s	<60	<60
Nachbrennen oder Nachglühen jeder Probe bis zur Halteklemme	Nein	Nein	Nein
Anzeiger der durch Flammenteilchen oder -tropfen entzündeten Watte	Nein	Nein	Ja

T1: Flammen-Löschzeit nach der ersten Beflammung; T2: Flammen-Löschzeit nach der zweiten Beflammung; T3: Glühzeit nach dem zweiten Flammenlöschen



▲ **Bild 1**: *UL 94 5T1 im Vergleich zu wt% Flammschutzmittel*



▲ **Bild 2**: *UL 94 5(T1+T2) im Vergleich zu wt% Flammschutzmittel*

für Bestandteile in Vorrichtungen und Geräten einzuschätzen. Die Prüfmethode besteht in der Messung der Entzündbarkeit und Flammenausbreitungen für Polymermaterialien, die einer kleinen Flamme ausgesetzt werden. Um die Prüfung einzuschätzen wird eine stabförmige Probe aus Kunststoff, mit einer Abmessung von 120mm x 13mm und unterschiedlichen Dicken vertikal angeordnet und von oben gehalten. Die Dicke der Prüfkörper beträgt 3,2mm; 1,6mm und 0,8mm. Watte wird 300mm unter der Probe angeordnet, um entflammbare Tropfen zu erkennen, die die Watte entzünden werden. Eine Bunsenbrennerflamme wird zwei Mal 10 Sekunden lang an die Probe gehalten.

Nach jeder Beflammung wird die Zeit der selbstunterhaltenden Verbrennung aufgenommen. Die zweite Beflammung erfolgt sofort nach der Selbstlöschung der Probe aus der ersten Beflammung.

Tabelle 1 faßt die Kriterien für die V-0-, V-1- und V-2-Klassifizierungen zusammen. Eine V-0 Klassifizierung wird z. B. einem Material zuerkannt, das alle nachfolgenden Kriterien erfüllt: (i) es löscht sich in weniger als 10 Sekunden nach jeglicher Beflammung (ii) die gesamte Verbrennungszeit für alle fünf geprüften Proben sollte 50 Sekunden nicht überschreiten, (iii) es entstehen keine Verbrennungstropfen[4]. Die UL 94-Bewertung ist eine getrennte Klassifizier- ung, wie V-0, V-1 oder V-2. Es wird versucht die UL 94-Klassifizierung mit der Wärmefreisetz- ungsfähigkeit zu korre- lieren[5]. Trotzdem sind die Zahlenwerte von T1 und T1+T2 in der Untersuchungsbewertung nützlich.

Bild 1 stellt 5T1 dar, die Summe von T1 für fünf geprüfte Proben, gemäß dem UL94-Verfahren, im Vergleich zum %-Gewicht eines Flammschutzmittels.

Die Probendicke entspricht 0,125 Zoll. Basierend auf das in der *Tabelle 1* dargestellte Kriterium, sind die Zusammensetzungen, die 5T1 in weniger als 50 Sekunden erreichen, Kandidaten für eine weitere Studie. Im vorliegenden Beispiel ist dafür über 20 wt% (Gewichtprozentsatz) Flammschutzmittel erforderlich.

Bild 2 stellt den Wert 5(T1+T2) dar, bzw. die Summe von T1 und T2 für fünf geprüfte Proben, gemäß dem UL94-Verfahren, im Vergleich zum wt% eines Flammschutzmittels. Die Summe von 5(T1+T2) muß unter 50 Sekunden liegen. In diesem besonderen Beispiel ist dafür zirka 20 wt% Flammschutzmittel erforderlich, um die V-0-Klassifizierung bei 0,125 Zoll zu erfüllen.

2.2 UL 1581 Prüfung auf Entflammbarkeit für Draht und Kabel

VW-1 Vertikaldraht-Flammenprüfung

Es handelt sich um einen Modellversuch, der an einer 24 Zoll langen kompletten Drahtkonstruktion durchgeführt wurde.

Die UL 1581-Prüfmethode zeigt, daß ein Vertikaldraht, -kabel oder –kord, während, zwischen oder nach fünf 15-Sekunden langen Beflammungen durch eine Standardprüfflamme, keine Flammen entlang deren Länge übertragen sollte sowie keine Flammen zu brennbaren Materialien in deren Nähe leiten sollte.

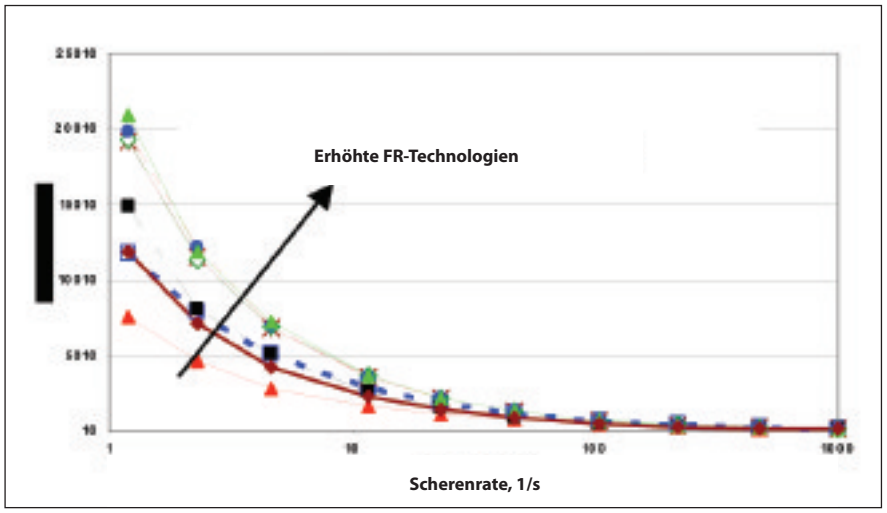
Die Flammenquelle ist ein Tirrill-Brenner (ähnlich dem Bunsenbrenner) mit einer Wärmeabgabe von zirka 500W oder 1700 Btu/Std. Es wird 15 Sekunden lang beflammt und vier weitere Male beflammt, jedes Mal nachdem der Draht aufhört zu brennen. Wenn die Probe länger als 60 Sekunden nach einer jeglichen Beflammung brennt, oder wenn sich die Anzeigefahne oder die Watte während der Prüfung entzündet, gilt die Prüfung vom geprüften Kabel oder Draht als nicht bestanden[6].

1061 Kabel-Flammenprüfung

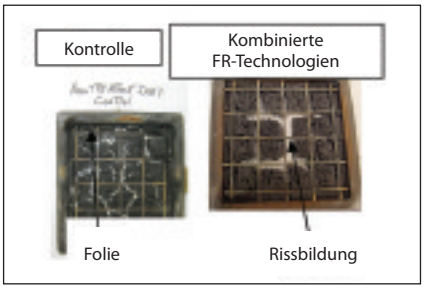
Es handelt sich auch in diesem Fall um einen Modellversuch, der an einer einzigen 24 Zoll langen Kabellänge durchgeführt wurde.

Eine vertikale Probe des Fertigkabels sollte, während, zwischen oder nach einer 1-Minuten langen Beflammung durch eine Standardprüfflamme, keine Flammen entlang dessen Länge übertragen sowie keine Flammen zu brennbaren Materialien in dessen Nähe leiten.

Die Standardprüfflamme ist nominell 125mm hoch und stellt Wärme bei einer Nennrate von 500W oder 1700 Btu/Std. her. Die Beflammung erfolgt drei Mal, jeweils eine Minute lang. Die Zeitspanne zwischen den Beflammungen muß 30 Sekunden



▲ **Bild 3**: *Viskosität von FR TPE-S (200°C)*



▲ **Bild 4**: *Bildung der künstlichen Kohle für konventionelle und kombinierte FR-Technologien*

entsprechen; unabhängig davon, ob das Flammen der Probe sich innerhalb 30 Sekunden von der vorherigen Beflammung löscht. Wenn über 25% der Anzeigefahne verbrannt ist oder die Watte sich während der Prüfung entzündet, besteht das Kabel die Prüfung nicht[6].

Die VW1- und 1061-Kabelflammenprüfungen werden vom Draht- und Kabelaufbau beeinflußt, z. B. durch die Isolierungswanddicke, die Wanddicke der Umhüllung und die Anzahl an isolierten Drähten.

Prüfung der Cone-Kalorimetrie

Die Cone-Kalorimetrie ist ein Labor-Pilotversuch, der vom National Institute of Standards and Technology (NIST) entwickelt wurde[7]. Er wird eingesetzt um kleine Proben zu brennen um Wärmefreisetzungsraten, Zündzeit, Raucherzeugung und die Bildung der künstlichen Kohle zu bewerten. Das Grundprinzip, obwohl empirisch, nutzt die Beobachtung, daß der Heizwert proportional zur Sauerstoffmenge ist, die für die Verbrennung erforderlich ist. Demzufolge wird bei der Untersuchung der neuen FR TPE-S-Rezepturen der Einsatz der Cone-Kalorimetrieprüfung gefordert.

2.3 Polymer-/Harztechnologie

Styrol-Block-Copolymer (SBCs) werden bei Draht- und Kabelanwendungen eingesetzt. Dank der bedeutenden Fortschritte im Bereich der Hydrogenierungstechnologie steht eine große Auswahl an hydrogenierten SBCs zur Verfügung, die mit Polyolefinen und Mineralölen kompatibel sind. Anhand der neusten Fortschritte im Polyolefinverfahren und in der Katalysatortechnologie, können außerdem eine große Auswahl an Polyolefinen den Betriebstemperaturbereich erweitern[8, 9].

Die Domain-Mikrostruktur des SBC beeinflußt auch die Schmelzstärke und -bearbeitbarkeit[10].

Die Kombination von hydrierter SBC-Rheologie und Polyolefintechnologie ist ein Baustein für flammwidrige Hochleistungs-Compounds mit außerordentlich ausgewogenen Eigenschaften, einschließlich hervorragenden Zugeigenschaften und rheologischen Merkmalen. Diese Eigenschaften werden erzielt wobei die Flammwidrigkeit bis zur UL 94 V-0-Klassifizierung verbessert wird sowie gute Niedertemperatur-Eigenschaften, gute thermische Alterungseigenschaften und gute dielektrische Eigenschaften verschafft werden.

Darüber hinaus können Mischungen von SBC und Polyolefin entwickelt werden, die dort Einsatz finden wo eine UV-Beständigkeit, hohe Betriebstemperatur (z. B. 105°C Temperaturnennwert), niedrige Betriebstemperatur (z. B. Sprödigkeitspunkt < –50°C), und Verarbeitungsstabilität von grundlegender Bedeutung sind.

Hydrogenierte SBC-basierte flammwidrige TPEs können entworfen werden, um eine große Auswahl an Härten von Shore A 50s bis zu Shore D 60s abzudecken.

2.4 Flammschutzmittel

Es gibt viele verschiedene Kategorien von Flammschutzmitteln. Die verschiedenartigsten Klassen davon sind jene die Halogen enthalten. Eine große Auswahl an bromierten und chlorierten Flammschutzmitteln ist handelsüblich. Vollbromierte Aromastoffe werden in der Regel in Harzen mit einer relativ hohen Verarbeitungstemperatur eingesetzt[11, 12].

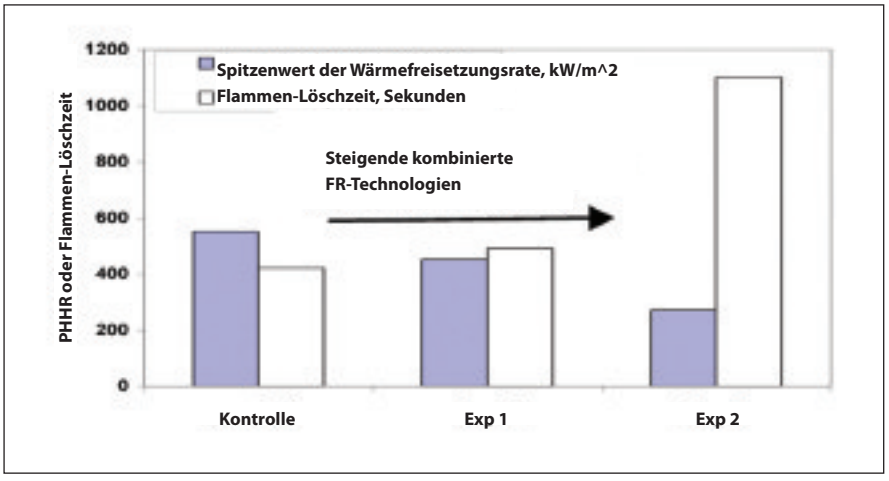
Die aktuellen Anstrengungen in der Entwicklung neuer Flammschutzmittel haben sich in Richtung phosphorischer und anderer anorganischer halogenfreier Hydroxidsysteme bewegt.

In diesem Artikel resultiert die Wahl der Polymere mit einer Kombination von Technologien von Flammschutzmitteln in ein den RoHS-Richtlinien entsprechendes flammwidriges TPE.

Die Wirkung auf die Leistung bei der Kombination der FR-Technologien besteht in einer Änderung der Rheologie- und Brennmerkmale mit minimaler Wirkung auf die physikalischen Eigenschaften. Die beobachteten Änderungen sind in *Bild 3*, *4* und *5* dargestellt. *Bild 3* zeigt eine Erhöhung der niedrigen Scherenviskosität mit Zunahme der FR-Inhaltsstoffen.

Bild 4 zeigt eine gute stabile Bildung der künstlichen Kohle mit einer Kombination von FR-Inhaltsstoffen.

▼ **Bild 5**: *Daten zum Cone-Kalorimeter für kombinierte FR-Technologien*



Eigenschaft	EL-1392B	EL-1934E	EL-1934F
Übereinstimmung mit den RoHS-Richtlinien	Ja	Ja	Ja
Relative Dichte	1.24	1.32	1.30
Härte, Shore A	86	82	73
Zugfestigkeit, psi	1540	1480	1220
Dehnung %	540	630	680
Beibehaltung der Zugfestigkeit*	99 %	98%	105%
Beibehaltung der Dehnung *	95%	92%	95%
Beibehaltung der Zugfestigkeit *	100%	97%	104%
Beibehaltung der Dehnung **	95%	87%	92%
Sprödigkeitspunkt °C	-51	-59	-60
Schmelzindex #	14	14	20
DK, 1 Mega Hz	2.42	2.41	2.40
DV 1 Mega Hz	0.003	0.0032	0.003
DK, 1 kilo Hz	2.43	2.43	2.41
DV, 1 kilo Hz	0.0029	0.0043	0.0027
Sauerstoffindex, % Sauerstoff	28	30	27
UL 94 ##	V0	V0	V0

** 136°C 7 Tage Alterung* *** 156°C 7 Tage Alterung* *# 200°C 5kg, g/10 min*
Dicke 0,06 Zoll *DK= dielektrische Konstante* *DV= dielektrischer Verlustfaktor*

▲ **Tabelle 2**: *Typische Eigenschaftswerte des erhöhten flammwidrigen TPE-S*

▲ **Bild 6**: *Die Beibehaltung der Anzeigefahne von EL-1392B-Draht bei 1061 Entflammbarkeitsprüfung*

Schließlich wird in *Bild 5* eine Senkung der Spitzenwerte der Wärmefreisetzungsrate mit erhöhten FR-Inhaltsstoffen dargestellt.

- ***Beseitigung des Tropfens:***
  Wie in *Bild 3* dargestellt, steigert die Einbeziehung von kombinierten FR-Technologien in TPEs die Viskosität bei niedrigen Scherenraten. Dies bewirkt eine verringerte Tropfenbildung bei der UL 94-Vertikalbrennprüfung.

- ***Verbesserung der Bildung und der Unversehrtheit künstlicher Kohle:***
  Die Bildung und die Unversehrtheit künstlicher Kohle ist wünschenswert um die Flammwidrigkeit zu erhöhen. Die Einbeziehung von kombinierten FR-Technologien in flammwidrigen TPE-Compounds kann die Bildung der künstlichen Kohle fördern, falls sie einer Flamme ausgesetzt werden.

Bild 4 vergleicht die künstliche Kohle konventioneller FR TPE-S mit jener der neuen flammwidrigen TPE-S-Technologie. Der dunkle Teil ist die künstliche Kohle, und der helle Teil ist Asche oder stellt Rissbildungen in der künstlichen Kohle dar.

Die künstliche Kohle für die kombinierte FR-Technologie ist viel dicker als jene eines konventionellen FR TPE-S und zeigt weniger Rissbildungen.

- ***Reduzierung des Spitzenwerts der Wärmefreisetzungsrate***
  Bild 5 zeigt die Angabe des Cone-Kalorimeter-Spitzenwerts der Wärmefreisetzungsrate (PHRR) eines konventionellen FR TPE-S im Vergleich zu einer neuen kombinierten FR TPE-S-Technologie.

Die Ergebnisse zeigen, daß die Einbeziehung kombinierter Inhaltsstoffe den Spitzenwert der Wärmefreisetzungsrate reduziert. Außerdem kann es auch die Flammen-Löschzeit leicht erhöhen.

3 Erhöhtes flammwidriges TPE-S

3.1 Eigenschaften

Die oben erwähnten Materialtechnologien und deren Rahmengrundsätze werden eingesetzt, um erhöhte flammwidrige TPE-S zu entwickeln. Bei diesen erhöhten FR TPE-S-Compounds wird ein den RoHS-Richtlinien entsprechendes Flammschutzmittel eingesetzt.

Spezifische Beispiele werden nachfolgend hervorgehoben. Siehe *Tabelle 2* für die typischen Eigenschaften verschiedener erhöhter flammwidriger TPE-S.

Die besonderen Merkmale der erhöhten FR TPE-S sind:

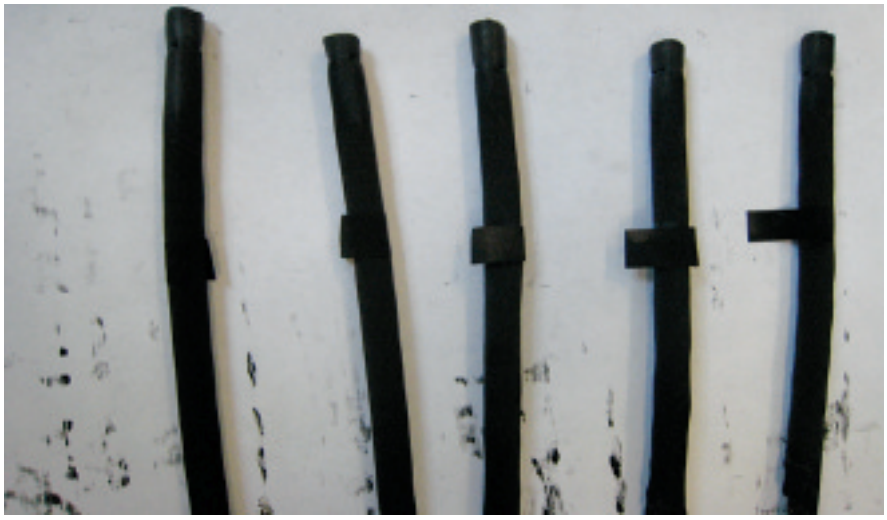
- Übereinstimmung mit den RoHS-Richtlinien
- UL 94 V-0-Klassifizierung bei 0,06 Zoll wurde bestanden
- VW-1 und 1061-Kabelflammenprüfung wurde ohne Tropfen erfüllt
- Sprödigkeitspunkt unter –50°C
- Zeigt gute Beibehaltung der Zugeigenschaften nach Wärmealterung bei 136°C, 7 Tage lang und auch bei 158°C, 7 Tage lang
- Zeigt hervorragende elektrische Eigenschaften

3.2 VW-1 und 1061-Methode der Entflammbarkeitsprüfungen für Kabel und für Spiralkabel

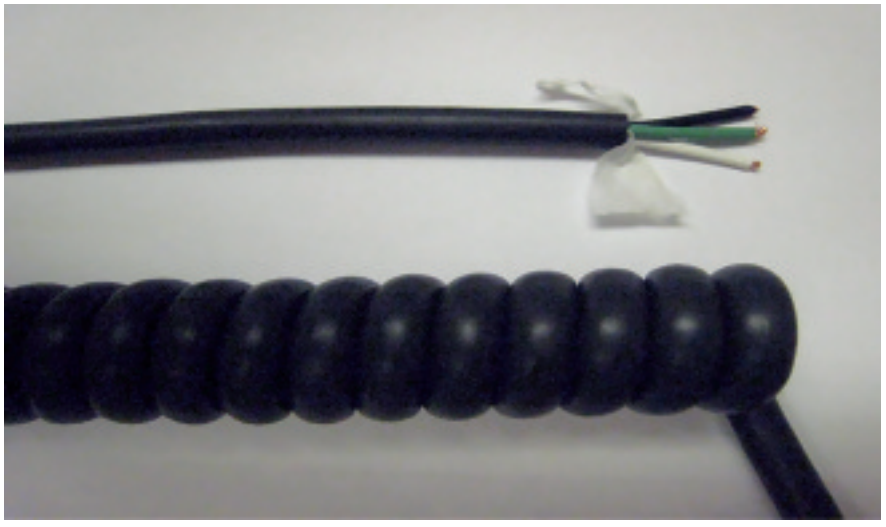
Draht- und Kabelextrusionsversuche belegten diese Eigenschaften und zeigten auch eine gute Verarbeitbarkeit.

Diese Compounds eignen sich ideal für flexible Leitungen, Spiralkabel, Kabel für die Robotertechnik, Elektrowerkzeuge, hochflexible Kabel, Anwendungen bei Niedertemperatur und Steckerverbinderteile und Komponenten, bei denen eine Klassifizierung der Flammbeständigkeit nach V-0 erforderlich ist.

Bei der Prüfung der Entflammbarkeit für Kabel nach VW-1 und 1061 müssen Draht und Kabel die Kriterien der Beibehaltung von über 75% der Anzeigefahne ohne Tropfen bestehen. Zur Darstellung zeigen *Bild 6* und *7* einen verbrannten Draht und ein verbranntes Kabel, bestehend aus EL-1392B-Compound. Die Beibehaltung der Anzeigefahne bei VW-1 und 1061 Entflammbarkeitsprüfungen für Kabel wird ohne Tropfen erreicht.



▲ **Bild 7**: *Die Beibehaltung der Anzeigefahne von EL-1392B-Kabel bei 1061 Entflammbarkeitsprüfung für Kabel*



▲ **Bild 8**: *Ein Spiralkabel bestehend aus EL-1392B für die Isolierung und Umhüllung*

Bild 8 zeigt ein Spiralkabel bestehend aus EL-1392B für die Isolierung und Umhüllung. Dieses Spiralkabel zeigt sehr gute Rückzieheigenschaften.

4 Schlußfolgerungen

Die Kombination neuer Polymermaterialien und Flammschutzmitteltechnologien bieten ideales Timing für die Entwicklung der RoHS-Richlinien verbesserter flammwidrigen TPEs die den RoHS-Richlinien enstprechen. Neue FR-Compounds erweitern den Leistungsbereich jenseits konven- tioneller FR TPEs.

Sie bestehen UL 94 V-0-Klassifizierung bei 0,060 Zoll und erfüllen VW-1 und die 1061-Methode der Draht- und Kabelflammenprüfungen ohne Tropfen. Dies wird mit einer guten Niedertemperaturflexibilität und einer guten Beibehaltung der Zugeigenschaften bei Wärmealterung erzielt, und zeigt darüber hinaus hervorragende elektrische Eigenschaften.

Neue FR-Compounds sind ideal für flexible Leitungen, Spiralkabel, Kabel für die Robotertechnik, Elektrowerkzeuge, hochflexible Kabel, Anwendungen bei Niedertemperatur und Steckerverbinderteile und Komponenten, bei denen eine Klassifizierung der Flammbeständigkeit nach V-0 erforderlich ist.

Die erhöhte flammwidrige Fähigkeit dieser SBC-Compounds wird durch die Erarbeitung von Techniken erreicht, die die Schmelzviskosität und die Bildung der künstlichen Kohle ändern. ■

5 Danksagungen

Die Autoren möchten Teknor Apex für die Erlaubnis danken, diese Arbeit zu besprechen.

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Diese Unterlage wurde zum ersten Mal während der 57. IWCS vorgestellt und ist mit der Genehmigung der Veranstalter vervielfältigt worden.

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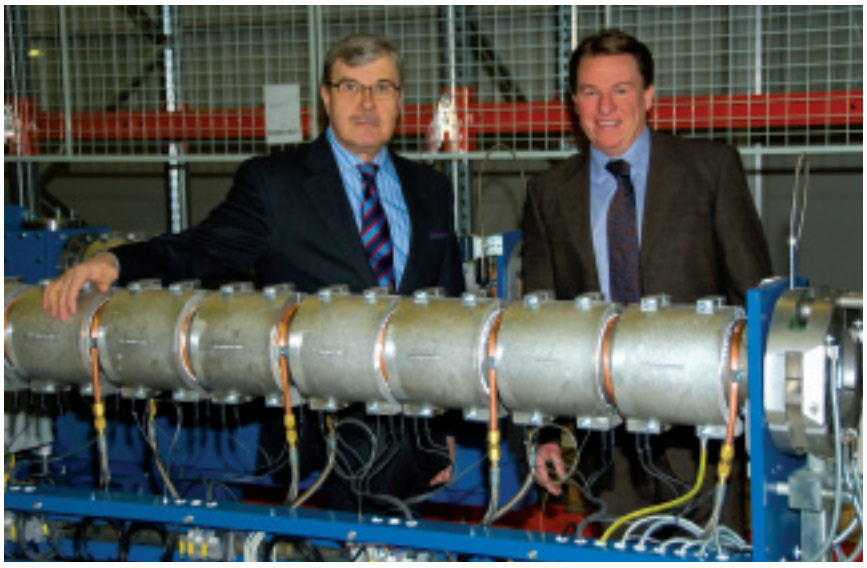

▲ *Новый председатель правления г-н Пентти Хааталаа (слева) вместе с г-ном Питером Роосом*

Принимая во внимание, что главному исполнительному директору компании г-ну Пентти Хааталаа (Pentti Hätälä) исполнилось 65 лет, совет директоров «Мэйллефер» (Maillefer) объявил о ключевых изменениях в своем составе, а также в составе руководства. 17 декабря 2009 года директора приняли решение об избрании г-на Хааталаа действующим председателем правления группы компаний «Мэйллефер груп». Соответственно, в тот же день г-н Питер Роос (Peter Roos) получил повышение и был назначен на пост главного исполнительного директора. Изменения вступили в силу с 1 января 2010 года.

Г-н Хааталаа оставляет руководящий пост, проработав свыше 30 лет на предприятиях, занятых в производстве пластмасс и проволочно-кабельной продукции. Более 20 лет тому назад он начал работу в финской компании «Нокия мэшинери» (Nokia Machinery), где продвинулся вверх по служебной лестнице. В 2001 году он стал главным исполнительным директором компании «Мэйллефер». На новом посту председателя правления он продолжит делиться своим неоценимым опытом для продвижения компании к новым рубежам. На помощь г-ну Роосу на посту действующего главного исполнительного директора «Мэйллефер» придет 20-летний опыт работы в европейской автомобильной отрасли, включая несколько лет работы на ключевых руководящих должностях. Он начал свою карьеру в компании «Мэйллефер» больше года тому назад в качестве руководителя производства и на протяжении всего времени тесно сотрудничал с г-ном Хааталаа.

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Развитие сетей FTTH набирает темп

На состоявшейся в феврале 2010 года Конференции по вопросам развития технологий «волокно до дома» (FTTH) Европейский Совет по развитию волоконных сетей в жилых зонах (FTTH Council Europe) обнародовал последние данные о том, какие из европейских стран занимали лидирующее положение в области продвижения технологий FTTH по состоянию на конец 2009 года. Несмотря на то что Швеция, Норвегия и Словения сохранили свое положение в пятерке лидеров, их обогнала Литва, которая с 18-процентной долей рынка FTTH резко вышла на первое место. Теперь темпы продвижения технологий FTTH во всех четырех странах превышают 10 %.

В расстановку сил впервые вмешались Франция и Португалия, успеху которых способствовали активные действия по развертыванию волоконной инфраструктуры, а также маркетинговые мероприятия по привлечению новых абонентов. Доля подключений к сетям FTTH в этих странах, как ожидается, будет продолжать стремительно расти, поскольку, с точки зрения доступности технологий FTTH, обе они также входят в десятку ведущих экономик. В абсолютных цифрах Европа достигла отметки в 2,5 миллиона абонентов, а с учетом России – 3,5 миллиона. Большинство абонентов (77 %) приходится на следующие семь стран (в порядке очередности): Швецию, Италию, Францию, Литву, Норвегию, Нидерланды и Данию. В настоящее время в пяти из указанной семерки стран число подключенных абонентов превышает 200 000 человек.

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Контракт для китайских железных дорог

Компания «Нексанс» (Nexans) получила контракт стоимостью 9,5 млн. евро на поставку в Китай для государственного производителя транспортных средств «Си-эн-ар корпорэйшн лимитед» (CNR Corporation Limited) кабелей, необходимых для реализации проекта разработки высокоскоростных поездов для китайской железнодорожной сети, которые начнут курсировать между Пекином и Шанхаем в 2011 году.

Предназначенный к поставке кабель изготавливается на китайских предприятиях компании «Нексанс» в расположенных в Шанхае районах Вайгаокьяо и Баошан. Первая партия кабеля была поставлена в марте 2010 года, а последняя должна быть поставлена в марте 2011 года. Новые высокоскоростные поезда будут состоять из 16 вагонов, иметь расчетную скорость 350 км/ч и перевозить до 1026 пассажиров. Кабели для проекта высокоскоростного железнодорожного сообщения поставляются из выпускаемой компанией «Нексанс» серии Flamex®, специально разработанной в соответствии с различными международными стандартами и требованиями техники безопасности, предусмотренными для железнодорожного подвижного состава. Отобранные кабели экологически безвредны и не содержат галогенов, благодаря чему они устойчивы к распространению огня и выделяют малое количество дыма в случае пожара.

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Модернизация подводной кабельной системы

Компании «Алкатель-Лусент» (Alcatel-Lucent) и «Глоубнет» (GlobeNet) завершили работы по модернизации подводной кабельной системы протяженностью 22 000 километров, которая соединяет США с Латинской Америкой. Данный проект, предусматривающий уже вторую почти за 18 месяцев модернизацию, обеспечивает для «Глоубнет» пропускную способность более 110 Гбит/с, что означает, что линия может одновременно пропускать до 13,75 млн. голосовых вызовов.

Теперь абоненты «Глоубнет» могут воспользоваться улучшенными возможностями и надежностью связи, а также более быстрым доступом к прикладным программам и услугам. Благодаря современным технологиям подводных сетей «Алкатель-Лусент» компания «Глоубнет» может расширить ассортимент предлагаемых ею оптовых услуг, в том числе за счет предоставления широкополосного доступа, услуг Ethernet операторского класса, услуг стационарной и мобильной голосовой связи по IP-протоколу и услуг традиционной телефонной связи, а также прикладных сервисов, таких как хостинг, видеоконференцсвязь и международные частные линии связи. Помимо работ на подводных участках компания «Алкатель-Лусент» провела модернизацию точек выхода линии на поверхность в Рио-де-Жанейро и Форталезе (Бразилия), Майкетии (Венесуэла), Сент-Дэвиде (Бермуды), Бока-Ратоне и Такертоне (шт. Флорида). В Рио-де-Жанейро подводная сеть сопрягается с наземным оптическим сетевым оборудованием «Оу-ай» (Oi) – головного предприятия компании «Глоубнет». Кроме того, «Алкатель-Лусент» осуществляла руководство монтажом, размещением системы и пуско-наладочными работами.

«Компания «Глоубнет» намерена увеличить пропускную способность и функциональные возможности сети, чтобы улучшить обслуживание наших абонентов за счет предоставления новых качественных услуг, используя при этом средства, инвестированные в нашу существующую инфраструктуру», – сказал Эрик Контаг (Eric Contag), главный операционный директор компании «Глоубнет».

«Компания «Алкатель-Лусент» остается нашим ценным партнером, который помогает нам в дальнейшем обновлении и расширении функциональных возможностей по всему миру, одновременно соблюдая жесткие требования установленного нами графика».

«Модернизация сети обеспечивает компанию «Глоубнет» дополнительной пропускной способностью, необходимой для реализации передовых видов сервиса, при сохранении простоты сетевого управления», – заявил Филипп Дюмон (Philippe Dumont), генеральный менеджер по вопросам организации подводных сетей.

«Этот проект служит еще одним подтверждением наших тесных и успешных взаимоотношений с компанией «Глоубнет», направленных на оказание ей содействия в предоставлении конечным пользователям лучших сервисных наработок».

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Alcatel-Lucent (Франция)
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Сварной аппарат для металлической проволоки

Компания «Кемса спа» (Cemsa SpA) недавно представила Roboside PJ – новую модификацию в выпускаемой ею линейке настольных сварочных автоматов Roboroof. Новая серия имеет целью продемонстрировать улучшенную производительность, коэффициент полезного действия, эксплуатационную гибкость и точность обработки и может агрегатироваться с автоматическими линиями любого типа.

▼ *Сварочный аппарат Roboside PJ*

Агрегат может использоваться для сварки различных видов сетки, сетчатых элементов и проволочных панелей. Кроме того, он хорошо зарекомендовал себя при сварке каркасов автомобильных сидений, в процессе которой зачастую требуется собрать и приварить гнутые проволочные секции сложной конструкции.

Разработанная компанией «Кемса» инструментальная оснастка поставляется заказчикам под узкоспециализированные цели, позволяя изготавливать широкий ассортимент автомобильных сидений в соответствии с жесткими допусками, требуемыми автопроизводителями.

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Кабель с ПВ изоляцией для непосредственной укладки в грунт

Компания «Ю-Эс-Эй уайр энд кейбл инк» (USA Wire & Cable Inc) представила, как считается, первый кабель с поливиниловой (ПВ) изоляцией, который носит обозначение «Для непосредственной укладки в грунт» согласно стандарту UL 4703 в редакции от 17 ноября 2009 года. В кабеле обеспечена защита от воздействия солнечных лучей, озонового излучения, повышенных температур и абразивного износа и используются изоляция из этиленпропиленовой резины (ЭПР) и отдельная защитная оболочка, которая, как утверждается, является предпочтительным решением для бестрансформаторных инверторных систем.

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Новые успехи в технологии приготовления термопластичных эластомерных компаундов на основе блок-сополимеров стирола для огнестойких кабелей, соответствующих требованиям Лаборатории по технике безопасности США

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Аннотация

Компанией «Текнор эйпекс» (Teknor Apex) выполнен комплекс научно-исследовательских и опытно-конструкторских работ в области приготовления термопластичных эластомерных компаундов на основе блок-сополимеров стирола с целью создания новых, не поддерживающих горения (FR) композиционных материалов с улучшенными характеристикам, которые соответствуют требованиям директивы ЕС, ограничивающей содержание вредных веществ (RoHS) . В настоящей работе будут подробно рассмотрены эксплуатационные характеристики новых компаундов, полученные с использованием различных методов испытания на горение в вертикальной плоскости согласно стандартам Лаборатории по технике безопасности США (UL).

Эластомерные компаунды марок EL-1392B (твердость по Шору «А» 86 ед.), EL-1934E (твердость по Шору «А» 82 ед.) и EL-1934F (твердость по Шору «А» 73 ед.) соответствуют рейтингу горючести V-0 согласно стандарту UL 94 при толщине материала 0,06 дюйма. Эти компаунды также отвечают требованиям испытаний кабельных изделий на распространение пламени, предусмотренным стандартом UL 1581 VW-1 и методикой 1061 для изоляции и оболочки. Они идеально подходят для гибких и спиральных шнуров, робототехнических кабелей, электроинструмента, высокогибких кабелей, для использования в условиях низких температур, а также для соединительных деталей и компонентов, которые должны обладать расчетной стойкостью к воздействию пламени V-0.

1 Введение

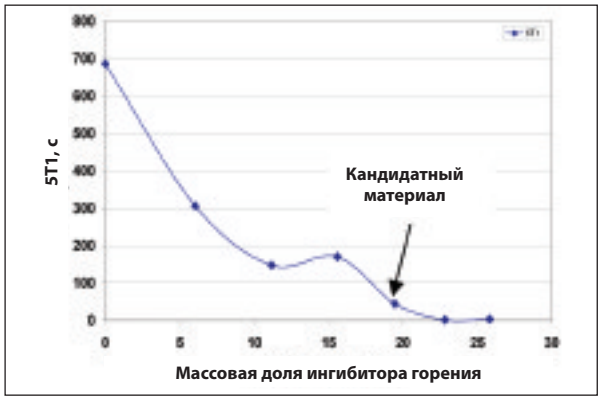
Термопластичные эластомерные компаунды с высокой степенью огнестойкости преимущественно используются при производстве кабельной изоляции, оболочек и электронных устройств. Стирольные термопластичные эластомеры (TPE-S) также используются в производстве широкого ассортимента изделий, не поддерживающих горения, таких как автомобильные и акустические кабели, аккумуляторы, электрораспределительные коробки, погружные насосы и прочие изделия, в которых используются гибкие шнуры и которые должны обладать сбалансированными электрическими, теплотехническими, антипиреновыми и физико-механическими свойствами. В прошлом многие разработчики и производители изделий промышленного назначения жертвовали физико-механическими свойствами ТПЭ, включая в свою продукцию ингибиторы горения [1].

Основными требованиями для указанных сфер применения являются: обеспечение необходимых номинальных параметров согласно стандартам UL, сохранение прочностных свойств после термического старения, легкость обработки и гибкость при низких температурах. Композиционные материалы на основе стирольных ТПЭ в особенности подходят для этих целей. Для обеспечения стойкости к воздействию пламени, предусмотренной стандартом UL 1581 VW-1 и методикой 1061, рецептура не поддерживающих горения стирольных ТПЭ требует высокого содержания добавок. Однако высокое содержание добавок обычно отрицательно сказывается на

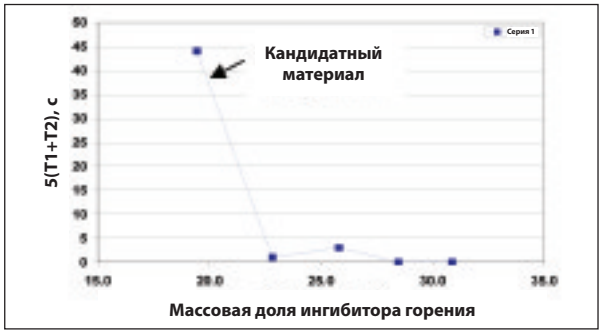
▼ **Таблица 1**: *Рейтинг горючести/классификация для испытаний на горение вертикально ориентированных образцов согласно стандарту UL 94* [4]

Условия оценки	V-0	V-1	V-2
Время остаточного пламени для каждого отдельно взятого образца (T1 и T2)	< 10 с	< 30	< 30
Общее время остаточного пламени для 5 образцов при любом наборе условий (T1 + T2)	< 50 с	< 250	< 250
Время остаточного пламени, T2, плюс время остаточного тления, T3, для каждого отдельно взятого образца после повторного воздействия пламени	< 30 с	< 60	< 60
Остаточное пламя или остаточное тление для любого образца, сгоревшего до крепежного зажима	Нет	Нет	Нет
Воспламенение ватного индикатора под действием горящих частиц или потеков	Нет	Нет	Да

T1 – время самогашения при первом воздействии пламени
T2 – время самогашения непосредственно при повторном воздействии пламени
T3 – время тления после второго удаления пламени



▲ **Рис. 1.** *График зависимости параметра 5T1 согласно методике стандарта UL 94 от массовой доли ингибитора горения*



▲ **Рис. 2.** *График зависимости параметра 5(T1+T2) согласно методике стандарта UL 94 от массовой доли ингибитора горения*

прочностных, физико-механических и реологических свойствах не поддерживающих горения компаундов.

В настоящей работе обсуждается разработанная компанией «Текнор эйпекс» новейшая серия высококачественных, не поддерживающих горения стирольных ТПЭ, которые соответствуют требованиям директивы RoHS. Рассматриваются вопросы, касающиеся применения технологий приготовления стирольных блок-сополимеров (SBC)[2], комбинированного использования огнестойких добавок [3] и соблюдения требований пожарной безопасности при проведении испытаний на горение вертикально ориентированных образцов согласно стандартам UL. Использование этих технических решений позволяет обеспечить параметры, предусмотренные стандартом UL 1581 VW-1 и методикой 1061, для компаунда, обладающего хорошими характеристиками.

2 Результаты и их обсуждение

2.1 Испытание на горение вертикально ориентированных образцов согласно стандарту UL 94

Испытания согласно стандарту UL 94 имеют целью проведение оценки воспламеняемости пластмасс, используемых в устройствах и бытовых приборах. Методика испытаний позволяет определить степень горючести и распространения пламени у полимерных материалов в результате воздействия слабого пламени. Для проведения оценки образцы пластмассы в форме брусков размером 120 мм x 13 мм и разной толщины размещаются в вертикальной плоскости с креплением в верхней части. Толщина испытуемых образцов составляет 3,2 мм, 1,6 мм и 0,8 мм. Под образцами, на расстоянии 300 мм размещается слой хирургической ваты для обнаружения потеков, которые должны привести к возгоранию ваты. Образцы дважды, в течение 10 секунд испытываются пламенем горелки Бунзена. После каждого воздействия пламени регистрируется время самогорения. Повторная подача пламени производится непосредственно вслед за самозатуханием образца после первого воздействия пламени.

В таблице 1 представлены обобщенные данные по условиям оценки рейтинга горючести V-0, V-1 и V-2. Например, классификация по V-0 присваивается материалу, который удовлетворяет всем нижеперечисленным условиям: (i) горение материала прекращается менее чем через 10 секунд после каждой подачи пламени; (ii) общее время горения для пяти испытанных образцов не должно превышать 50 секунд; (iii) горение не должно сопровождаться образованием потеков. [4]

Рейтинг горючести согласно стандарту UL 94 представляет собой дискретную классификацию по категории V-0, V-1 или V-2. Делается попытка провести корреляцию между рейтингом горючести согласно стандарту UL 94 и мощностью тепловыделения [5]. Однако при отборочной оценке практический характер имеют численные значения T1 и T1+T2.

На рис. 1 представлен график зависимости параметра 5T1, представляющего собой сумму значений T1 для пяти испытанных образцов согласно методике стандарта UL 94, от массовой доли ингибитора горения. Толщина образца составляет 0,125 дюйма. Исходя из условий оценки, представленных в таблице 1, следует, что смеси, у которых величина 5T1 составляет менее 50 секунд, являются кандидатными материалами, на которых будут проводиться дальнейшие исследования. В нашем примере для этого требуется, чтобы содержание ингибитора горения составляло более 20 массовых долей.

На рис. 2 представлен график зависимости параметра 5(T1+T2), представляющего собой сумму значений T1 и T2 для пяти испытанных образцов согласно методике стандарта UL 94, от массовой доли ингибитора горения. Сумма 5(T1+T2) должна быть менее 50 секунд. В данном примере для достижения номинальных параметров V-0 при толщине 0,125 дюйма материал должен содержать приблизительно 20 массовых долей ингибитора горения.

2.2 Испытания проводов и кабелей на распространение пламени согласно требованиям стандарта UL 1581

Испытание на распространение пламени по вертикально ориентированному проводу согласно стандарту VW-1

Представляет собой лабораторное испытание, которое проводится на одиночном изолированном проводе длиной 24 дюйма.

В соответствии с требованиями методики испытаний UL 1581 вертикально расположенный провод, кабель или шнур не должен распространять горение по всей длине, а также не должен распространять горение на горючие материалы, находящиеся рядом с ним, во время или после пятикратного 15-секундного приложения стандартного тестового очага пламени, либо в интервале между такими приложениями. Источником пламени служит горелка Тиррилла (аналогичная горелке Бунзена) тепловой мощностью около 500 Вт, или 1700 БТЕ/ч. Пламя прикладывается в течение 15 секунд с четырехкратным повтором, каждый раз после прекращения горения провода. В случае если горение образца после каждого приложения пламени продолжается более 60 секунд, или если во время испытания происходит возгорание флажкового индикатора или хлопковой подкладки, испытуемый кабель или провод выбраковывается [6].

Испытание на распространение пламени по кабелю согласно методике 1061

Также представляет собой лабораторное испытание, которое проводится на

отрезке одиночного кабеля длиной 24-дюйма. Вертикально расположенный образец готового кабеля не должен распространять горение по всей длине, а также не должен распространять горение на горючие материалы, находящиеся рядом с ним, во время или после приложения стандартного тестового очага пламени в течение одной минуты, либо в интервале между такими приложениями. Стандартное тестовое пламя имеет номинальную высоту 125 мм, при этом номинальная мощность тепловыделения составляет 500 Вт, или 1700 БТЕ/ч. Пламя прикладывается три раза, каждый раз в течение одной минуты. Интервал между приложениями пламени должен составлять 30 секунд, вне зависимости от того, прекращается горение образца через 30 секунд после предыдущего приложения пламени или нет. В случае сгорания флажкового индикатора более чем на 25 % или воспламенения хлопковой подкладки при проведении испытания кабель выбраковывается [6].

Результаты испытаний на распространение пламени по кабелю согласно стандарту VW1 и методике 1061 зависят от конструкции кабельно-проводниковых изделий, например, от толщины слоя изоляции, толщины слоя оболочки и количества изолированных проводов.

Испытание с помощью конического калориметра

Испытание с помощью конического калориметра представляет собой стендовое испытание, разработанное Национальным институтом по стандартам и технологиям (NIST) [7]. Испытание проводится с целью сжигания небольших образцов для определения скорости тепловыделения, времени воспламенения и количественной оценки дымообразования и обугливания. Основной принцип, хотя и эмпирический, основывается на наблюдении, согласно которому полезный объем теплоты горения пропорционален количеству кислорода, которое требуется для процесса горения. Таким образом, для исследования новых, не поддерживающих горения смесей на основе стирольных ТПЭ требовалось провести испытания с помощью конического калориметра.

2.3 Технология производства полимеров и смол

Стирольные блок-сополимеры (SBC) используются в производстве кабельно-проводниковых изделий. Значительные успехи в развитии технологии гидрогенизации позволили предложить рынку широкий ассортимент гидрогенизированных стирольных блок-сополимеров, совместимых с полиолефинами и минеральными маслами. Кроме того, благодаря последним достижениям в процессе производства и каталитических технологиях использование различных полиолефинов может расширить диапазон рабочих температур [8, 9]. На прочность расплава и пригодность для обработки также влияет микроструктура доменов стирольного блок-сополимера [10].

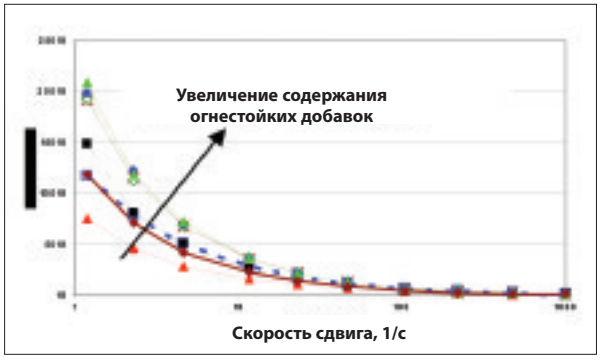
Сочетание реологии гидрогенизированных стирольных блок-сополимеров и технологии полиолефинов является структурным элементом для создания высококачественных, не поддерживающих горения компаундов с уникальным балансом свойств, включая прекрасные механические свойства при растяжении и реологические характеристики. Обеспечение этих параметров сопровождается повышением огнеупорных характеристик до уровня категории V-0 согласно стандарту UL 94, а также приданием высокой морозостойкости, хорошей устойчивости к термическому старению и оптимальных диэлектрических свойств.

Кроме того, смеси из стирольного блок-сополимера и полиолефина могут разрабатываться для использования в тех случаях, когда существенное значение имеют такие параметры, как стойкость к ультрафиолетовому излучению, высокие рабочие температуры (например, температурный номинал в 105 °C), низкие рабочие температуры (например, температура хрупкости < –50 °C) и стабильность условий обработки. Рецептура не поддерживающих горения ТПЭ на основе гидрогенизированных стирольных блок-сополимеров может составляться таким образом, чтобы охватить широкий спектр значений твердости – от 50 ед. твердости по Шору «A» до 60 и более единиц твердости по Шору «D».

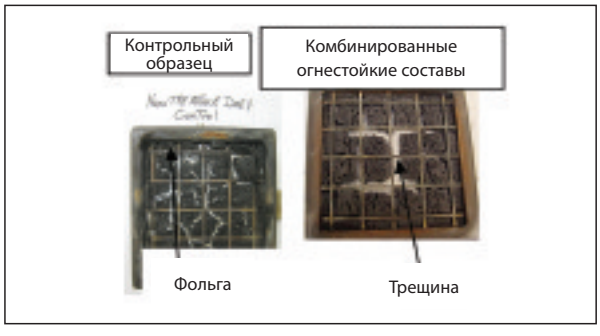
2.4 Ингибиторы горения

Существует несколько различных классов ингибиторов горения, из которых наиболее диверсифицированным является класс галогенсодержащих ингибиторов. На рынке предлагается широкий ассортимент бромированных и хлорированных ингибиторов горения. В общем случае бромированные ароматические соединения используются в составе смол с относительно высокой температурой технологической обработки [11, 12]. В последних исследованиях в области разработок новых ингибиторов горения упор сместился в сторону фосфорных и других неорганических гидроксидных систем, не содержащих галогенов. В настоящей работе благодаря выбранным полимерам и комбинированному использованию огнестойких ингредиентов получен не поддерживающий горения термопластичный эластомер, который соответствует требованиям директивы ЕС, ограничивающей содержание вредных веществ.

С точки зрения эксплуатационных характеристик, результатом комбинированного сочетания огнестойких ингредиентов стало изменение реологических свойств и характеристик горения при минимальном воздействии на физико-механические свойства материала. Наблюдаемые изменения представлены на рис. 3, 4 и 5. На рис. 3 показано увеличение малой сдвиговой вязкости с ростом содержания огнестойких ингредиентов. На рис. 4 показан слой кокса с весьма ровной и стабильной структурой, образовавшийся при комбинированном использовании огнестойких ингредиентов. Наконец,



▲ **Рис. 3.** *Вязкость не поддерживающих горения стирольных ТПЭ (200°C)*



▲ **Рис. 4.** *Коксообразование для обычных и комбинированных огнестойких составов*

▲ **Рис. 5.** *Данные, полученные методом конического калориметра для комбинированных огнестойких составов*

на рис. 5 представлены данные, свидетельствующие о снижении максимальной скорости тепловыделения с увеличением содержания огнестойких ингредиентов.

- ***Устранение потеков при горении***
  Как показано на рис. 3, включение в ТПЭ комбинированных огнестойких составов повышает вязкость при малых скоростях сдвига. Это ведет к уменьшению потеков при испытаниях на горение вертикально ориентированных образцов согласно стандарту UL 94.

- ***Усиление коксообразования и целостность коксового слоя***
  Коксообразование и целостность коксового слоя являются желательными факторами, повышающими огнестойкость. Включение комбинированных огнестойких составов в не поддерживающие горения термопластичные эластомерные компаунды может способствовать усилению коксообразования при воздействии пламени. На рис. 4 показан коксовый слой на образце обычного не поддерживающего горения стирольного ТПЭ в сравнении с коксовым слоем на образце нового не поддерживающего горения материала на основе стирольных ТПЭ. Темным цветом показан кокс, светлым – зола или трещины в слое кокса. Коксовый слой у комбинированного огнестойкого состава имеет значительно большую толщину, чем у обычного не поддерживающего горения стирольного ТПЭ, и демонстрирует меньшее трещинообразование.

- ***Снижение максимальной скорости тепловыделения***
  На рис. 5 представлены полученные с помощью конического калориметра сравнительные данные по максимальной скорости тепловыделения (PHRR) для обычного, не поддерживающего горения стирольного ТПЭ и для новых комбинированных материалов на основе не поддерживающих горения стирольных ТПЭ. Результаты свидетельствуют о том, что включение в состав комбинированных ингредиентов снижает максимальную скорость тепловыделения. Кроме того, это может незначительно увеличить время самогашения.

▼ **Таблица 2**: *Типичные значения характеристик не поддерживающих горения стирольных ТПЭ с улучшенными свойствами*

Характеристика	EL-1392B	EL-1934E	EL-1934F
Соответствие требованиям директивы RoHS	Да	Да	Да
Уд. вес	1.24	1.32	1.30
Твердость по Шору (шкала «А»)	86	82	73
Предел прочности на растяжение, фунт/кв. дюйм	1540	1480	1220
Относительное удлинение, %	540	630	680
Остаточная прочность на растяжение *	99%	98%	105%
Остаточное удлинение *	95%	92%	95%
Остаточная прочность на растяжение	100%	97%	104%
Остаточное удлинение **	95%	87%	92%
Температура хрупкости, °C	-51	-59	-60
Индекс расплава, #	14	14	20
DC, 1 МГц	2.42	2.41	2.40
DF, 1 МГц	0.003	0.0032	0.003
DC, 1 кГц	2.43	2.43	2.41
DF, 1 кГц	0.0029	0.0043	0.0027
Кислородный индекс, % содержания кислорода	28	30	27
Рейтинг горючести по UL 94 ##	V0	V0	V0

* 7-дневное старение при 136 °C
** 7-дневное старение при 156 °C
# 200 ˚C, 5 кг, г/10 мин
толщина 0,06 дюйма
DC= диэлектрическая постоянная
DF= коэффициент диэлектрических потерь

3 Не поддерживающие горения стирольные ТПЭ с улучшенными свойствами

3.1 Свойства

Технологии материалов и лежащие в их основе принципы, которые обсуждались выше, используются для разработки не поддерживающих горения стирольных ТПЭ, обладающих улучшенными свойствами. В этих улучшенных, не поддерживающих горения компаундах на основе стирольных ТПЭ применяется ингибитор горения, который соответствует требованиям директивы ЕС, ограничивающей содержание вредных веществ. Ниже представлены некоторые примеры. Типичные параметры отдельных не поддерживающих горения стирольных ТПЭ с улучшенными свойствами приводятся в таблице 2. Не поддерживающие горения стирольные ТПЭ с улучшенными свойствами обладают следующими особенностями:

- соответствуют требованиям директивы RoHS;
- отвечают требованиям рейтинга горючести V-0 согласно стандарту UL 94 при толщине 0,06 дюйма;
- отвечают требованиям испытаний на распространение пламени по кабелю согласно стандарту VW-1 и методике 1061, без потеков при горении;

- имеют температуру хрупкости ниже –50 ˚С;
- в достаточной мере сохраняют механические свойства при растяжении после термического старения при 136 ˚С в течение 7 дней, а также при 158 ˚С в течение 7 дней;
- демонстрируют прекрасные электрические свойства.

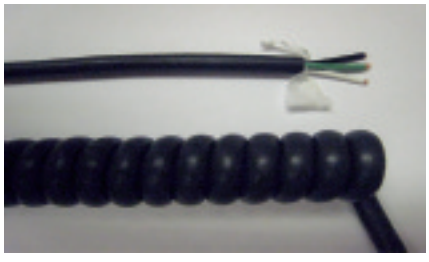
3.2 Испытания кабеля на распространение пламени согласно стандарту VW-1 и методике 1061. Спиральные шнуры

Пробное изготовление проводов и кабелей методом экструдирования подтвердило указанные свойства, а также продемонстрировало высокую технологичность материалов. Эти компаунды идеально подходят для гибких и спиральных шнуров, робототехнических кабелей, электроинструмента, высокогибких кабелей, для использования в условиях низких температур, а также для соединительных деталей и компонентов, которые должны обладать расчетной стойкостью к воздействию пламени V-0.

При испытаниях кабельного изделия на распространение пламени согласно стандарту VW-1 и методике 1061 провод или кабель должен удовлетворять условию сохранения флажкового индикатора более чем на 75 % без потеков при горении. В качестве примера на рис. 6 и 7 показаны обгоревшие провод и кабель, изготовленные из компаунда EL-1392B. Сохранение флажкового индикатора после испытаний кабеля на распространение пламени согласно стандарту VW-1 и методике 1061 обеспечивается в отсутствие потеков при горении. На рис. 8 показан спиральный шнур, изоляция и оболочка которого изготовлены из компаунда EL-1392B. Он обладает высокой способностью к сокращению.

▼ **Рис. 7.** *Сохранение флажкового индикатора на кабеле из компаунда EL-1392B после испытания на распространение пламени по кабелю согласно методике 1061*

▼ **Рис. 8.** *Спиральный шнур с изоляцией и оболочкой, изготовленными из компаунда EL-1392B*



▲ **Рис. 6.** *Сохранение флажкового индикатора на проводе из компаунда EL-1392B после испытания на распространение пламени согласно методике 1061*

4 Выводы

Сегодняшний день, когда на рынке одновременно доступны новые полимерные материалы и огнестойкие ингредиенты, является идеальным моментом для разработки соответствующих требованиям директивы RoHS, не поддерживающих горения ТПЭ с улучшенными свойствами. Новые огнестойкие компаунды расширяют диапазон эксплуатационных характеристик за пределы, доступные для обычных не поддерживающих горения ТПЭ. Они соответствуют рейтингу горючести V-0 согласно стандарту UL 94 при толщине материала 0,06 дюйма, а также отвечают требованиям испытаний кабельно-проводниковых изделий на распространение пламени, предусмотренным стандартом VW-1 и методикой 1061, в отсутствие потеков при горении. Это обеспечивается при высоких показателях гибкости в условиях низких температур, сохранении хороших механических свойств при растяжении после термического старения, а также при наличии отличных электрических свойств.

Новые не поддерживающие горения компаунды идеально подходят для гибких и спиральных шнуров, робототехнических кабелей, электроинструмента, высокогибких кабелей, для использования в условиях низких температур, а также для соединительных деталей и компонентов, которые должны обладать расчетной стойкостью к воздействию пламени V-0.

Повышенную стойкость к воздействию пламени указанных компаундов на основе стирольных блок-сополимеров обеспечивают технологии составления рецептуры, которые модифицируют вязкость расплава, и коксообразование.

5 Выражение признательности

Авторы хотели бы выразить благодарность компании «Теknор эйпекс» за разрешение представить настоящую работу на обсуждение. ■

6 Справочная литература

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Настоящая работа была впервые представлена на 57-ой Конференции Международного симпозиума по кабелям и проводам (IWCS) и перепечатывается с разрешения организаторов.

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Temps de changements

▲ *Le nouveau Président Pentti Hätälä (à gauche) avec Peter Roos*

Lorsque le Président Directeur Général de Maillefer Pentti Hätälä a fêté son 65ème anniversaire, le Conseil d'Administration de la société a annoncé des changements essentiels au sein du conseil et du groupe directeur. Le 17 décembre 2009, les directeurs ont élu Hätälä pour occuper le poste actif de président du conseil d'administration du Groupe Maillefer. Par conséquent, le même jour, Peter Roos a été promu Président et Directeur Général. Les changements sont entrés en vigueur le 1er janvier 2010.

Hätälä quitte son poste de dirigeant après plus de 30 ans de service dans le secteur de la plastique et dans le secteur du fil et du câble. Hätälä s'était uni à Nokia Machinery en Finlande il y a plus de 20 ans et il a gravi les échelons au sein de la société.

Dans son nouveau rôle de président du conseil d'administration, il continuera à offrir sa contribution précieuse dans le guide de la société.

En qualité d'actuel Président et Directeur Général de Maillefer, Roos compte sur plus de 20 ans d'expérience dans l'industrie de l'automobile européenne, y compris plusieurs années en occupant des postes de direction stratégiques. Il s'est uni au Groupe Maillefer il y a plus d'un an en tant que directeur opérationnel en travaillant en collaboration étroite avec Hätälä durant la même période.

Maillefer SA – Suisse
Fax: +41 21 691 2143
Email: info@maillefer.net
Website: www.mailleferextrusion.com

Distribution d'un dispositif d'essai

La société hollandaise Inhol BV a récemment signé un contrat de vente et d'assistance technique exclusif avec son homologue suédois TVAB International pour la vente et la distribution du dispositif TVAB 5420 N conçu pour déterminer la résistance à l'abrasion causé par le raclage. Inhol BV sera responsable des contacts de vente et d'assistance technique du secteur, y compris les instruments vendus précédemment par TVAB.

Le but de cette collaboration est d'intensifier le support aux clients et de faire mieux connaître le dispositif d'essai sur le marché international du fil et du câble.

Jacob Steendam de Inhol BV a ainsi commenté: "TVAB a déjà vendu des centaines d'instruments au cours des années passées. Le mesureur de résistance à l'abrasion de TVAB est tellement précis qu'il a déterminé les normes de résistance à l'abrasion ISO 6722-1. Il a été projeté pour essayer la résistance des câbles avec un seul conducteur de 60V et 600V dans des conditions extrêmes, et mesure des variables de résistance à l'abrasion très spécifiques."

Inhol BV/PTL – Pays Bas
Email: office@inhol.com
Fax: +31 3560 33235
Website: www.inhol.com

Les systèmes FTTH prennent pied

À l'occasion de la conférence concernant les systèmes FTTH (fibres jusqu'à domicile) qui s'est tenue le dernier février, le FTTH Council Europe a dévoilé les dernières données indiquant quels sont les pays leader dans la pénétration de la fibre jusqu'à domicile à la fin 2009.

Bien que la Suisse, la Norvège et la Slovénie aient maintenu leur position parmi les cinq premiers pays classés, elles ont été dépassées par la Lituanie qui a accompli un saut énergique en se plaçant au premier rang avec 18% de systèmes FTTH installés. Actuellement, les quatre pays présentent des taux d'installation supérieurs à 10 pour cent.

La France et le Portugal sont entrés dans la classification pour la première fois grâce à un emploi considérable d'infrastructures de fibres optiques ainsi qu'à une campagne publicitaire intense pour recruter de nouveaux abonnés. On prévoit que l'utilisation des systèmes FTTH dans ces deux pays va augmenter rapidement puisque ces derniers figurent parmi les 10 systèmes économiques les plus importants en termes de disponibilité de fibres jusqu'à domicile.

En chiffres absolus, l'Europe a atteint 2,5 millions d'abonnés (3,5 millions y compris la Russie). La majorité des abonnés (77%) est concentrée dans sept pays dans l'ordre suivant: Suisse, Italie, France, Lituanie, Norvège, Pays-Bas et Danemark. Parmi ces sept pays, cinq ont désormais plus de 200 000 abonnés connectés.

FTTH Council Europe – Belgique
Fax: +32 2503 2277
Email: info@ftthcouncil.eu
Website: www.ftthcouncil.eu

Câble PV pour enterrement direct

USA Wire & Cable Inc a présenté ce qu'on estime va être le premier câble PV d'isolement à enterrement direct conformément à la révision de la norme UL 4703 du 17 novembre 2009. Le câble est caractérisé par une protection contre le soleil, l'ozone, la chaleur et l'abrasion et utilise un isolement en caoutchouc d'éthylène propylène (EPR) et un revêtement de protection séparé, qui est considéré la solution idéale pour les systèmes d'invertisseurs sans transformateur.

USA Wire & Cable Inc – États-Unis
Fax: +1 512 326 3584
Website: www.usawire-cable.com

Mise à niveau d'un réseau sous-marin

Alcatel-Lucent et GlobeNet ont achevé la mise à niveau du réseau de câble sous-marin de 22 000 kilomètres qui relie les États-Unis avec l'Amérique latine. Ce projet, deuxième mise à niveau du réseau en près de 18 mois, permet à GlobeNet de disposer d'une capacité de plus de 110 Gbit/s, ce qui correspond à environ 13,75 millions d'appels vocaux en même temps.

Les clients de GlobeNet bénéficient maintenant d'une meilleure connectivité, d'une fiabilité accrue et d'un accès plus rapide aux applications et aux services. Fort de la technologie sous-marine de pointe d'Alcatel-Lucent, GlobeNet peut élargir son offre de services de gros pour proposer le haut débit, le carrier Ethernet, la téléphonie fixe et mobile traditionnelle et IP, ainsi que des applications telles que l'hébergement, les visioconférences et les lignes privées internationales.

Outre les segments sous-marins, Alcatel-Lucent a également modernisé les points d'atterrage de Rio de Janeiro et Fortaleza (Brésil), Maiquetía (Venezuela), St.David's (Bermudes), Boca Raton et Tuckerton (Floride). À Rio de Janeiro, le réseau sous-marin rejoint l'infrastructure optique terrestre d'Oi, la maison mère de GlobeNet. Alcatel-Lucent a par ailleurs géré l'installation, le déploiement et la mise en service du système.

"GlobeNet s'est engagé à améliorer la capacité et les fonctionnalités de son réseau afin de mieux servir ses clients avec de nouveaux services fiables, tout en continuant d'utiliser son infrastructure existante", a déclaré Eric Contag, directeur des opérations de GlobeNet.

"Alcatel-Lucent est toujours un partenaire précieux qui nous aide à innover et à accroître nos capacités globales, en respectant les délais très courts que nous lui imposons.

"Cette mise à niveau apporte à GlobeNet le supplément de capacité nécessaire pour distribuer des services avancés, en gardant un réseau facile à gérer", a ajouté Philippe Dumont, directeur général de l'activité de réseaux sous-marins d'Alcatel-Lucent.

"Ce projet confirme la réussite de notre étroite collaboration avec GlobeNet pour l'aider à offrir à ses utilisateurs la meilleure expérience possible."

GlobeNet – États-Unis
Website: www.globenet.net
Alcatel-Lucent – France
Website: www.alcatel-lucent.com

Nexans remporte un contrat de fourniture pour trains

Nexans a remporté un contrat de 9,5 millions d'euros portant sur la fourniture, au constructeur public chinois d'équipement ferroviaire CNR Corporation Limited (CNR), des câbles nécessaires au développement des trains à grande vitesse CRH (China Railway High-speed - CRH) qui entreront en service en 2011 entre Pékin et Shanghai. Les câbles fournis sont fabriqués sur les sites de production chinois de Nexans de Waigaoqiao et Baoshan à Shanghai.

Le premier lot de câbles a été livré en mars 2010 et la dernière livraison est prévue en mars 2011.

Les nouvelles rames CRH comprendront 16 voitures et seront conçues pour transporter jusqu'à 1 026 voyageurs à une vitesse de conception pouvant atteindre 350 km/h.

Les câbles destinés à ce projet CRH appartiennent à la gamme FLAMEX®, spécialement conçue par Nexans pour répondre aux diverses normes internationales et aux exigences de sécurité du secteur des équipements ferroviaires. Les câbles retenus sont respectueux de l'environnement et sans halogène.

Nexans – France
Email: nexans.web@nexans.com
Fax: +33 15669 8484
Website: www.nexans.com

Soudeuse pour fils

Cemsa SpA a récemment présenté la soudeuse Roboside PJ, nouvelle version de sa soudeuse d'établi automatique Roboroof.

La nouvelle série est conçue pour améliorer la productivité, le rendement, la flexibilité et la précision, et peut être intégrée dans tout type de ligne automatique.

La machine peut être utilisée pour souder une ample gamme de grilles, de composants en treillis et de panneaux métalliques. Elle est également efficace pour souder les châssis des sièges des voitures exigeant souvent la connexion et le soudage de fils prépliés de structures élaborées.

L'équipement, conçu par Cemsa, est disponible pour les clients avec des applications spécialisées pour produire une vaste gamme de modèles de sièges pour voitures conformément aux strictes tolérances imposées par les fabricants de voitures.

Cemsa SpA – Italie
Fax: +39 02 253 3307
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Website: www.cemsa.it

Progrès dans les composés à base de copolymère styrénique séquence TPE pour applications de câbles ignifuges UL

Par Biing-Lin Lee, Darnell Worley, Phil Scadding, Ben Jones, Sachin Sakhalkar, Wilfred Giroux, Teknor Apex Company

Résumé

Teknor Apex Company a entrepris la recherche et le développement de technologies pour les composés de TPE à base de copolymère styrénique séquence pour développer de nouveaux retardeurs de flamme (FR) perfectionnés conformes à la directive RoHS.

Le présent article décrit en détail les performances des nouveaux composés en utilisant différentes méthodes d'essai de combustion verticale conformément à la norme UL. Les composés EL-1392B (Shore A 86), EL-1934E (Shore A 82), et EL-1934F (Shore A 73) ont passé le classement UL 94 V-0 en utilisant des éprouvettes d'une épaisseur de 0,06 pouce. Ces composés ont également passé l'essai UL 1581 VW-1 et la méthode 1061 pour les essais de résistance au feu de l'isolement et du revêtement vdes câbles.

Ils sont particulièrement indiqués pour: câbles flexibles, câbles enroulés, câbles pour les robots industriels, câbles pour outils électriques, câbles super-flexibles, applications à basses températures, parties de connecteurs et composants exigeant un classement V-0 de résistance au feu.

1 Introduction

Les applications principales des composés TPE exigeant des caractéristiques ignifuges sont réalisées dans les isolements et dans les revêtements de fils et câbles et dans les dispositifs électroniques. Les élastomères thermoplastiques à base de styrène (TPE-S) sont également utilisés dans une vaste gamme d'applications ignifuges telles que le secteur automobile, les systèmes audio, les batteries, les boîtes de jonction électrique, les pompes submersibles et d'autres applications de conducteurs flexibles exigeant un équilibre entre les propriétés électriques, thermiques, ignifuges et physiques.

Dans le passé, de nombreux concepteurs et fabricants industriels ont sacrifié les performances mécaniques des élastomères thermoplastiques (TPE) afin d'inclure les retardeurs de flamme dans les produits[1].

Les spécifications clé de ces applications comprennent les classements UL, le maintien des propriétés mécaniques à la suite de vieillissement thermique, ouvrabilité aisée et flexibilité aux basses températures. Les composés TPE-S styréniques sont parfaits pour ces applications. Les formulations des composés TPE-S ignifuges pour obtenir la résistance au feu conformément au classement UL 1581 VW-1 et à la méthode 1061, exigent des niveaux d'additifs élevés. Toutefois, des niveaux d'additifs élevés ont tendance à influencer négativement les propriétés mécaniques, physiques et rhéologiques des composés FR.

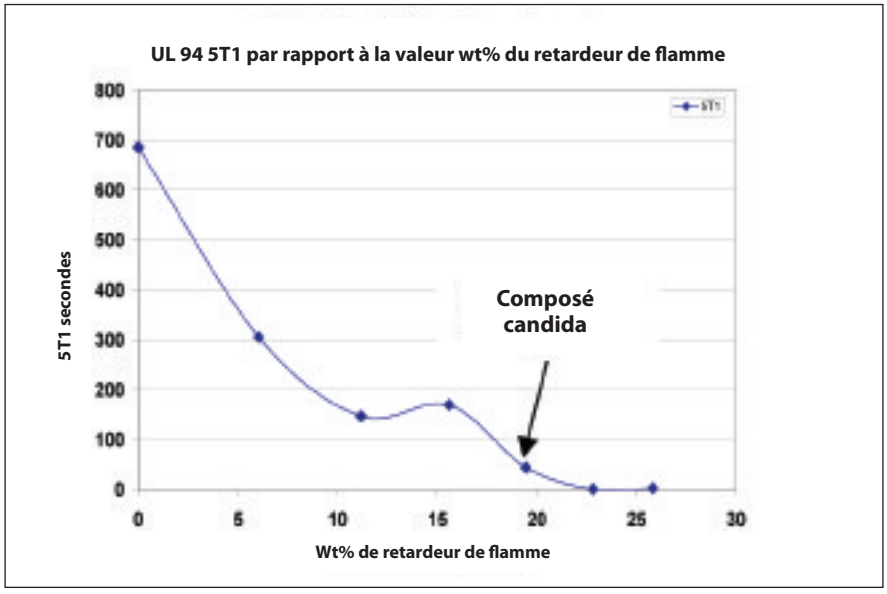
Le présent article décrit une série de composés ignifuges TPE-S à performances élevées et conformes à la directive RoHS, récemment développés par Teknor Apex. Les nouveaux produits sont le résultat de la combinaison de la technologie des copolymères styréniques séquence (SBC[2], avec la technologie des additifs FR[3] combinée et la science de la combustion appliquées aux essais de combustion verticaux UL.

L'utilisation de ces technologies permet d'obtenir le classement UL 1581 VW-1 et la méthode 1061 dans un composé avec de bonnes propriétés.

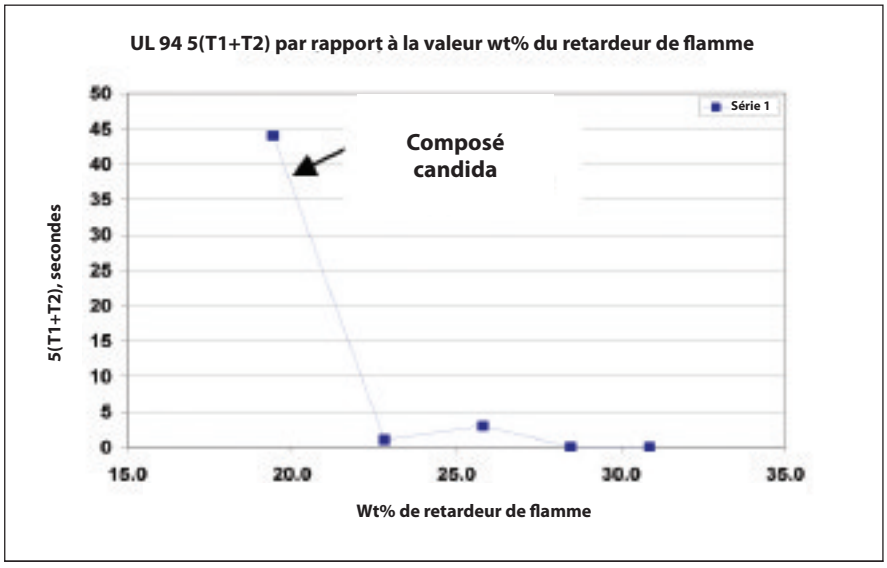
▼ **Tableau 1**: *Caractéristiques nominales/classification de l'essai de combustion verticale UL 94*[4]

Conditions des critères d'applicabilité	V-0	V-1	V-2
Durée de persistance de flamme pour chaque éprouvette T1 et T2	<10s	<30	<30
Durée de persistance de flamme totale pour 5 éprouvettes pour toute condition préétablie (T1 + T2)	<50s	<250	<250
Durée de persistance de flamme, T2, plus temps d'incandescence résiduelle, T3, pour chaque éprouvette après les applications de flamme successives	<30s	<60	<60
Persistance de flamme ou incandescence résiduelle de chaque éprouvette jusqu'à la bride de fixation	Non	Non	Non
Indicateur du coton enflammé au moyen de particules ou gouttes incendiées	Non	Non	Oui

T1: durée d'extinction de flamme après la première application de la flamme; T2: durée d'extinction de flamme après la deuxième application de la flamme; T3: durée d'incandescence résiduelle après la deuxième extinction de flamme



▲ **Figure 1**: *UL 94 5T1 par rapport à la valeur wt% du retardeur de flamme*



▲ **Figure 2**: *UL 94 5(T1+T2) par rapport à la valeur wt% du retardeur de flamme*

2 Résultats et discussion

2.1 Essai de combustion vertical UL 94

L'essai UL 94 a pour but d'évaluer la résistance au feu dans les matières plastiques de composants de dispositifs et d'appareils.

La méthode d'essai consiste à mesurer la sensibilité à l'allumage et la propagation des flammes des matériaux polymériques exposés à une petite flamme. Pour évaluer l'essai, une éprouvette de plastique en forme de barreau, de 120mm x 13mm et d'épaisseurs différentes est positionnée verticalement et saisie d'en haut. L'épaisseur des éprouvettes est de 3,2mm, 1,6mm et 0,8mm. Du coton hydrophile à 300mm est placé au-dessous de l'éprouvette pour localiser d'éventuelles gouttes de combustible pouvant incendier le coton. Ensuite, une flamme du brûleur de Bunsen est appliquée à l'éprouvette deux fois pour une durée de dix secondes. Après chaque application de flamme, le temps de combustion auto-entretenue est enregistré. Une deuxième application de la flamme suit immédiatement l'auto-extinction des éprouvettes après la première application de la flamme.

Le *Tableau 1* résume les critères pour les classifications V-0, V-1 et V-2. Par exemple, la classification V-0 correspond à un matériau satisfaisant tous les critères suivants:

(i) il s'éteint en moins de 10 secondes après chaque application de flamme
(ii) le temps de combustion total pour cinq éprouvettes essayées ne devrait pas dépasser 50 secondes
(iii) il n'y a aucune goutte de combustible[4]

Le classement UL 94 est une classification distincte telle que les classements V-0, V-1 ou V-2. Il a été essayé de mettre en corrélation les classements UL 94 avec le taux de dégagement de chaleur[5]. Toutefois, les valeurs numériques de T1 et T1+T2 sont utiles dans l'évaluation de l'analyse.

La *Figure 1* représente graphiquement la valeur 5T1, ou bien la somme de T1 pour cinq éprouvettes essayées selon le procédé UL94, par rapport au pourcentage de poids (wt%) d'un retardeur de flamme. L'épaisseur de l'éprouvette est égale à 0,125 pouce. Sur la base des critères illustrés au *Tableau 1*, les compositions atteignant la valeur 5T1 en moins de 50 secondes ont été posées comme candidats pour des études complémentaires. Cet exemple exige plus de 20wt% (pourcentage de poids) de retardeur de flamme.

La *Figure 2* représente graphiquement la valeur 5(T1+T2), c'est-à-dire la somme de T1 et T2 pour cinq éprouvettes essayées selon le procédé UL94, par rapport au pourcentage de poids (wt%) d'un retardeur de flamme.

La somme de 5(T1+T2) doit être inférieure à 50 secondes. Dans ce cas spécifique, il faut un pourcentage de poids d'environ 20wt% de retardeur de flamme pour satisfaire le classement V-0 à 0,125 pouce.

2.2 Tests d'inflammabilité UL 1581 pour fils et câbles

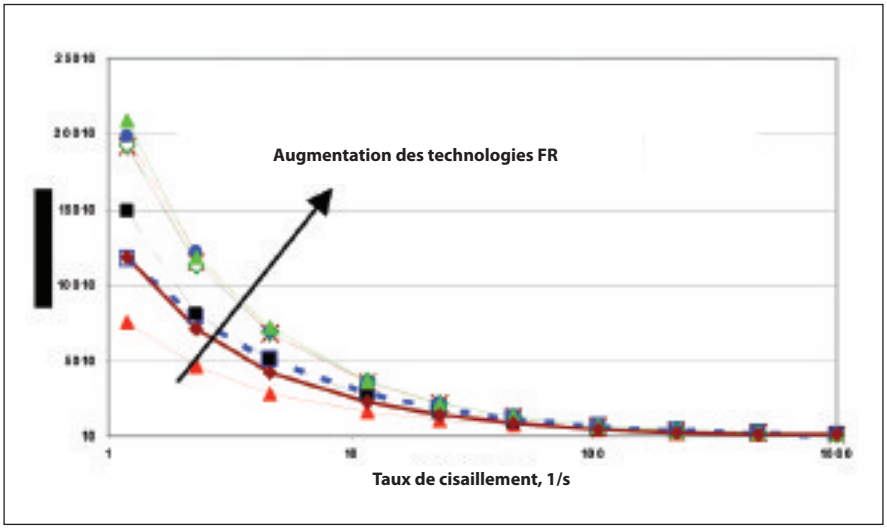
Test d'inflammabilité VW1 pour fils verticaux

Il s'agit d'un test à petite échelle effectué sur une structure de fil complète d'une longueur de 24 pouces. D'après la méthode d'essai UL 1581 un fil, un câble ou un cordon vertical ne doit pas propager la flamme sur sa longueur ni à des matériaux combustibles contigus durant, dans, ou après cinq applications de 15 secondes d'une flamme d'essai standard. La source de la flamme est un brûleur Tirrill (similaire au brûleur Bunsen) avec un rendement thermique d'environ 500W ou 1700 Btu/h.

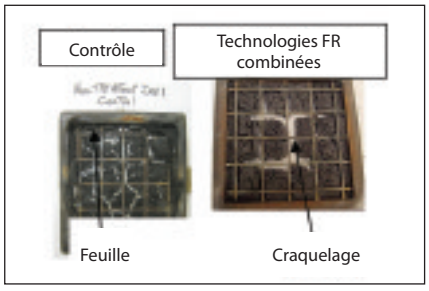
La flamme est appliquée pendant 15 secondes et appliquée de nouveau quatre fois, chaque fois après l'extinction du feu sur le fil. Si l'éprouvette brûle pendant plus de 60 secondes après chaque application, ou si la languette d'indication ou le coton hydrophile s'enflamme durant l'essai, cela signifie que le câble ou le fil soumis à l'essai a échoué à ce test[6].

Test d'inflammabilité du câble 1061

Même dans ce cas, il s'agit d'un essai à petite échelle, réalisé sur une longueur de câble de 24 pouces. Une éprouvette verticale de câble fini ne doit pas propager la flamme sur sa longueur ni à des matériaux combustibles contigus



▲ **Figure 3**: *Viscosité du FR TPE-S (200°C)*



▲ **Figure 4**: *Formation de résidu charbonneux dans le cas de technologies FR traditionnelles et combinées*

durant, dans, ou après une application d'une minute d'une flamme d'essai standard. La flamme d'un essai standard a une hauteur nominale de 125mm et produit de la chaleur avec un rendement thermique nominal de 500W ou 1700 Btu/h. La flamme est appliquée trois fois pour une minute à la fois. Le temps entre les applications de flamme est de 30 secondes, indépendamment de l'extinction de la combustion de l'éprouvette dans v30 secondes de l'application précédente. Si plus de 25% de la languette d'indication est brûlée ou si le coton hydrophile s'enflamme durant l'essai, cela signifie que le câble a échoué à ce test[6].

Les tests d'inflammabilité pour câblevs VW1 et 1061 sont influencés par la structure du fil et du câble, comme par exemple l'épaisseur de la paroi d'isolement, l'épaisseur de la paroi de la gaine et le nombre de fils isolés.

Essai avec le calorimètre conique

L'essai effectué avec le calorimètre conique est un essai à petite échelle mis au point par le NIST (National Institute of Standards and Technology[7]. Il est utilisé pour la combustion d'éprouvettes de petites dimensions afin d'évaluer le taux de dégagement de chaleur, le temps d'allumage, la production de fumée et la formation de résidu charbonneux. Le principe fondamental, bien qu'empirique, exploite l'observation selon laquelle la chaleur de combustion nette est proportionnelle à la quantité d'oxygène requise pour la combustion. Par conséquent, l'étude de nouvelles formulations de composés FR TPE-S exige l'utilisation de l'essai avec le calorimètre conique.

2.3 Technologie des polymères/résines

Les copolymères styréniques séquence (SBCs) sont utilisés pour des applications de fils et câbles. Grâce aux développements importants réalisés avec la technologie de l'hydrogénation, une vaste gamme de composés hydrogénés SBCs, compatibles avec les polyoléfines et les huiles minérales est actuellement disponible.

En outre, grâce aux récents développements dans les processus des polyoléfines et de la technologie des catalyseurs, une ample gamme de polyoléfines permet d'étendre la gamme des températures d'exploitation[8, 9]. La microstructure du domaine du composé SBC influence également la résistance et l'ouvrabilité de la masse fondue[10].

La combinaison des caractéristiques rhéologiques du composé SBC hydrogéné et de la technologie des polyoléfines est fondamentale pour obtenir des retardeurs de flamme hautes performances avec un équilibre de propriétés extraordinaire, et des propriétés de résistance à la traction excellentes.

Ces propriétés sont obtenues en améliorant la résistance aux flammes conformément à la norme UL 94 V-0, et en réalisant de bonnes propriétés aux basses températures, de bonnes propriétés de vieillissement thermique et de bonnes propriétés diélectriques.

En outre, il est possible de développer des mélanges de SBC et polyoléfines à utiliser lorsque la résistance aux rayons UV, une température d'exploitation élevée (ex. valeur nominale de 105°C), de basses températures d'exploitation (ex. point de fragilité < –50°C) et la stabilité durant le processus sont requises.

Les retardeurs de flamme TPE à base de SBC hydrogéné peuvent être formulés pour couvrir une ample gamme de valeurs de dureté de Shore A 50s à Shore D 60s.

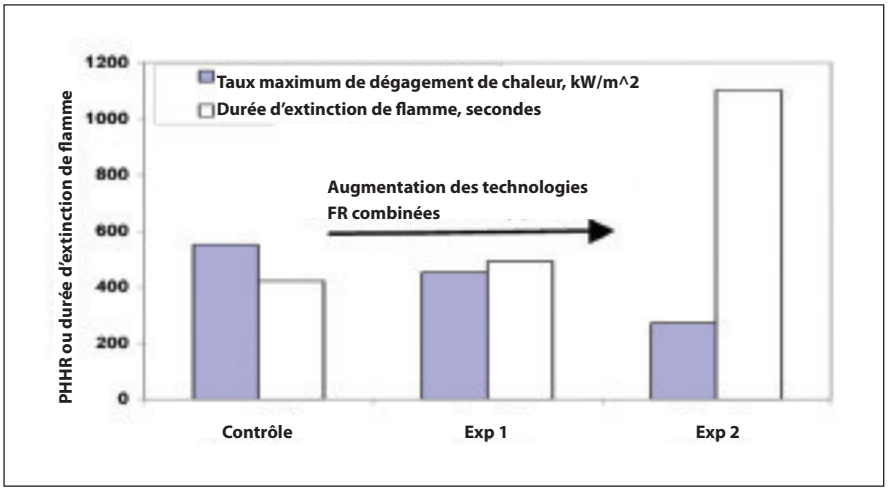
2.4 Retardeurs de flamme

Il existe plusieurs catégories de retardeurs de flamme, parmi lesquels les classes les plus diversifiées sont celles contenant des substances halogènes. Une vaste gamme de retardeurs de flamme bromés et chlorifiés est disponible sur le marché.

Les composés aromatiques bromés sont généralement utilisés dans les résines avec une température de processus relativement élevée[11, 12].

Récemment on a essayé de développer de nouveaux retardeurs de flamme en utilisant le phosphore et d'autres systèmes à base d'hydroxyde inorganique sans substances halogènes.

▼ **Figure 5**: *Données relatives au calorimètre conique pour les technologies combinées FR*



Propriété	EL-1392B	EL-1934E	EL-1934F
Conformité à la directive RoHS	Oui	Oui	Oui
Gravité spécifique	1.24	1.32	1.30
Dureté Shore A	86	82	73
Résistance à la traction, psi	1540	1480	1220
Allongement %	540	630	680
Maintien de la résistance à la traction *	99 %	98%	105%
Maintien de l'allongement *	95%	92%	95%
Maintien de la résistance à la traction *	100%	97%	104%
Maintien de l'allongement *	95%	87%	92%
Point de fragilité °C	-51	-59	-60
Indice de fusion #	14	14	20
CD, 1 Mega Hz	2.42	2.41	2.40
FD, 1 Mega Hz	0.003	0.0032	0.003
CD, 1 kilo Hz	2.43	2.43	2.41
FD, 1 kilo Hz	0.0029	0.0043	0.0027
Indice d'oxygène, % oxygène	28	30	27
UL 94 ##	V0	V0	V0

** 136°C 7 jours de vieillissement*
 # 200°C 5kg, g/10 min
CD= constante diélectrique
** 156°C 7 jours de vieillissement*
épaisseur 0,06 pouce
FD= facteur de dissipation diélectrique

▲ **Tableau 2**: *Valeurs des propriétés typiques des retardeurs de flamme perfectionnés TPE-S*

▲ **Figure 6**: *Maintien de la languette d'indication d'un fil EL-1392B dans le test d'inflammabilité 1061*

Le présent article surligne que le choix des polymères et une combinaison de technologies de retardeurs de flamme permettent d'obtenir un retardeur de flamme TPE conforme à la directive RoHS. L'effet sur les performances dans la combinaison de technologie FR est la modification des caractéristiques rhéologiques et des caractéristiques de combustion avec un effet négligeable sur les propriétés physiques. Les modifications remarquées sont illustrées aux *Figures 3*, *4* et *5*.

La *Figure 3* illustre une augmentation de la viscosité de cisaillement réduite avec une augmentation des additifs FR. La *Figure 4* illustre une formation du résidu charbonneux stable satisfaisante avec une combinaison des additifs FR. Enfin, la *Figure 5* représente une réduction du taux maximum de dégagement de chaleur avec une augmentation des additifs FR.

Elimination de l'égouttement
Comme représenté à la *Figure 3*, l'intégration des technologies FR combinées dans les composés TPE, entraîne une augmentation de la viscosité à des taux de cisaillement réduits. Cela entraîne une réduction de l'égouttement dans le test d'inflammabilité vertical UL 92.

Amélioration de la formation et de l'intégrité du résidu charbonneux
La formation et l'intégrité du résidu charbonneux sont souhaitables aux fins d'une meilleure résistance aux flammes. L'intégration de technologies combinées FR dans les retardeurs de flamme TPE peut favoriser la formation de résidu charbonneux lorsque exposés à la flamme. La *Figure 4* présente une comparaison entre le résidu charbonneux de composés FR TPE-S traditionnels et le résidu charbonneux de la nouvelle technologie de retardeurs de flamme TPE-S.

La partie foncée représente le résidu charbonneux et la partie claire représente la cendre ou les craquelages du résidu charbonneux. Le résidu charbonneux pour la technologie combinée FR présente une épaisseur considérablement supérieure à celle d'un composé FR TPE-S traditionnel et moins de craquelages.

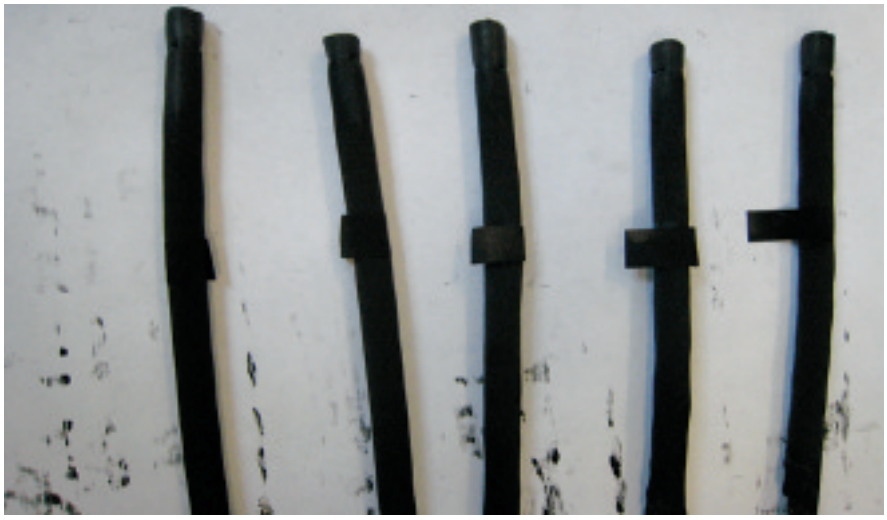
Réduction du taux maximum de dégagement de chaleur
La *Figure 5* illustre les données relatives au taux maximum de dégagement de chaleur (PHRR) obtenu avec le calorimètre conique d'un FR TPE-S conventionnel par rapport à la nouvelle technologie FR TPE-S combinée. Les résultats montrent que l'intégration d'additifs combinés réduit le taux maximum de dégagement de chaleur, et peut également augmenter légèrement la durée d'extinction de flamme.

3 Retardeur de flamme TPE-S perfectionné

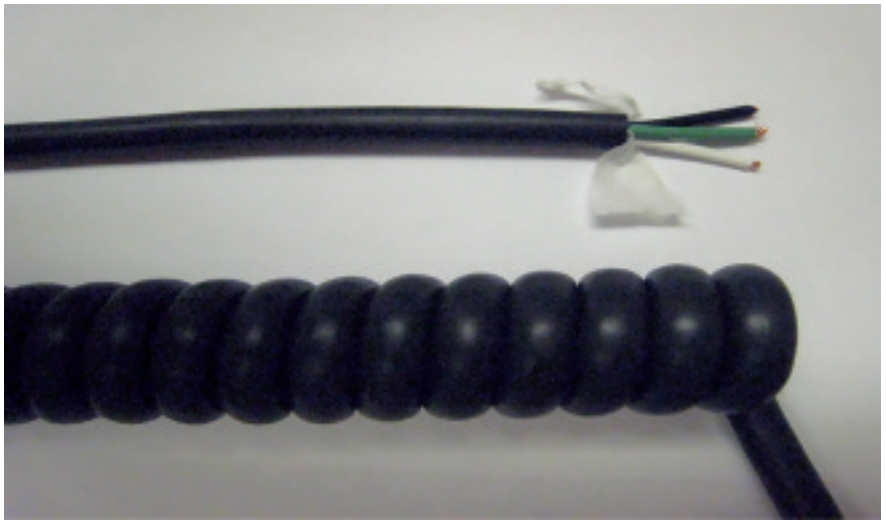
3.1 Propriétés
Les technologies des matériaux et les principes de base correspondants discutés plus haut, sont utilisés pour développer des composés TPE-S perfectionnés. Ces composés FR TPE-S améliorés utilisent un retardeur de flamme conforme à la directive RoHS. Quelques exemples spécifiques sont fournis ci- après. Voir le *Tableau 2* en ce qui concerne les propriétés typiques de nombreux retardeurs de flamme TPE-S perfectionnés.

Les caractéristiques spécifiques du retardeur de flamme FR TPE perfectionné sont:
- Conformité avec la directive RoHS
- Approbation du classement UL 94 V-0 à 0,06 pouces
- Conformité avec les spécifications du test d'inflammabilité du câble VW-1 et 1061 sans égouttement
- Point de fragilité inférieur à –50°C
- Bonne conservation des propriétés de résistance à la traction face à un vieillissement thermique à 136°C pendant 7 jours ainsi qu'à 158°C pendant 7 jours
- Propriétés électriques excellentes

3.2 Tests d'inflammabilité des câbles VW-1, méthode 1061 et câbles enroulés
Les essais d'extrusion des fils et câbles ont vérifié ces propriétés et indiqué également une ouvrabilité satisfaisante. Ces composés sont particulièrement indiqués pour: câbles flexibles, câbles enroulés, câbles pour les robots industriels, outils électriques, câbles super-flexibles, applications aux basses températures, parties de connecteurs et composants exigeant un classement V-0 de résistance au feu.



▲ **Figure 7**: *Maintien de la languette d'indication d'un câble EL-1392B pendant le test d'inflammabilité du câble 1061*



▲ **Figure 8**: *Câble enroulé avec isolement et revêtement de EL-1392B*

Dans les tests d'inflammabilité des câbles VW-1 et 1061, le fil ou le câble doit dépasser les critères de maintien de plus de 75% de la languette d'indication sans égouttement.

Les *Figures 6* et *7* illustrent un fil brûlé et un câble brûlé réalisés avec le composé EL-1392B. Le maintien de la languette d'indication dans les tests d'inflammabilité pour câbles VW-1 et 1061 est obtenue sans égouttement.

La *Figure 8* représente un câble enroulé réalisé avec un isolement et un revêtement de EL-1392B, qui présente des performances de rétraction excellentes.

4 Conclusion

La disponibilité de nouveaux matériaux polymériques associée aux technologies des retardeurs de flamme offre la combinaison idéale pour le développement des retardeurs de flamme TPEs perfectionnés conformes à la directive RoHS.

Les nouveaux composés FR étendent la gamme des performances offertes par les composés FR TPEs traditionnels. Ils dépassent les spécifications du classement UL 94 V-0 pour une épaisseur de 0,060 pouce et sont conformes aux tests d'inflammabilité VW-1 et 1061 pour fils et câbles sans égouttement.

Ces résultats ont été obtenus avec une bonne flexibilité aux basses températures, une bonne conservation des propriétés de résistance à la traction en présence de vieillissement thermique ainsi que d'excellentes propriétés électriques.

Les nouveaux composés FR sont particulièrement indiqués pour: câbles flexibles, câbles enroulés, câbles pour les robots industriels, outils électriques, câbles super-flexibles, applications aux basses températures, parties de connecteurs et composants exigeant un classement V-0 de résistance au feu. La meilleure résistance aux flammes de ces composés SBC est due aux techniques de formulation qui modifient la viscosité de la masse fondue et la formation de résidu charbonneux. ■

5 Remerciements

Les auteurs souhaitent remercier Teknor Apex pour avoir donné l'autorisation pour mener cette étude.

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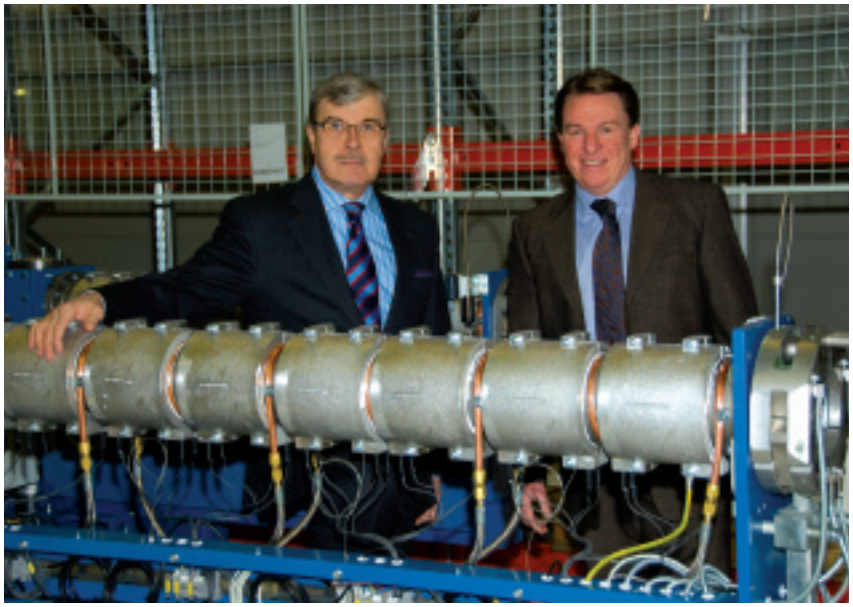

▲ *Il nuovo Presidente Pentti Hätälä (a sinistra) con Peter Roos*

Al compimento del 65° anno d'età del Presidente e Direttore Generale di Maillefer Pentti Hätälä, il Consiglio di Amministrazione della società ha annunciato dei cambiamenti essenziali all'interno del consiglio e del gruppo direttivo. Il 17 dicembre 2009, il gruppo direttivo ha eletto Hätälä per ricoprire la posizione attiva di presidente del consiglio di amministrazione del Gruppo Maillefer. Successivamente, nello stesso giorno Peter Roos è stato promosso Presidente e Direttore Generale. I cambiamenti sono entrati in vigore il 1° gennaio 2010.

Hätälä lascia il proprio incarico di dirigente dopo più di 30 anni di servizio nel settore della plastica e in quello del filo e del cavo. Hätälä fece il suo ingresso in Nokia Machinery in Finlandia oltre 20 anni fa e ha scalato la società. Nel 2001 fu nominato Presidente e Direttore Generale di Maillefer. Nel suo nuovo ruolo di presidente del consiglio di amministrazione, continuerà ad offrire il proprio valido contributo nella guida della società.

In qualità di attuale Presidente e Direttore Generale di Maillefer, Roos conta su oltre 20 anni di esperienza nell'industria automobilistica europea, compresi vari anni in importanti posizioni direttive. Si unì al gruppo Maillefer oltre un anno fa come direttore operativo lavorando in stretto contatto con Hätälä durante lo stesso periodo.

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Distribuzione di dispositivo di misura

La società olandese Inhol BV ha recentemente firmato un contratto esclusivo di vendita ed assistenza tecnica con il proprio omologo svedese TVAB International per la vendita e la distribuzione del dispositivo TVAB 5420 N progettato per determinare la resistenza all'abrasione da raschiamento. Inhol BV sarà responsabile di tutti i contatti di vendita ed assistenza tecnica del settore, inclusi gli strumenti venduti in precedenza da TVAB. L'obiettivo di questa collaborazione è di potenziare il servizio di supporto ai clienti e di far conoscere meglio il dispositivo di prova sul mercato internazionale del filo e del cavo.

Jacob Steendam di Inhol BV ha così commentato: "TVAB ha già venduto centinaia di strumenti negli scorsi anni. Il misuratore di resistenza all'abrasione TVAB è talmente preciso che ha determinato le norme di resistenza all'abrasione ISO 6722-1. É stato progettato per testare la resistenza di cavi con un solo conduttore da 60V e 600V in condizioni estreme, e misura variabili di resistenza all'abrasione molto specifiche."

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I sistemi FTTH prendono piede

Alla conferenza sui sistemi FTTH tenutasi lo scorso febbraio, l'FTTH Council Europe ha divulgato gli ultimi dati che indicano quali sono i paesi leader nella penetrazione della fibra fino a domicilio alla fine del 2009.

Sebbene la Svezia, la Norvegia e la Slovenia abbiano mantenuto la propria posizione fra le prime cinque classificate, sono state sorpassate dalla Lituania che ha compiuto un salto vigoroso collocandosi in prima posizione con il 18 per cento di sistemi FTTH installati. Attualmente, tutti e quattro i paesi presentano dei tassi di installazione superiori al 10 per cento.

La Francia e il Portogallo hanno fatto irruzione in classifica per la prima volta grazie ad un impiego massiccio di infrastrutture di fibre ottiche e all'intensa campagna pubblicitaria avviata per l'ingaggio di nuovi abbonati. Si prevede che l'utilizzo dei sistemi FTTH in entrambi i paesi continui ad aumentare rapidamente poiché sia la Francia che il Portogallo figurano fra i 10 sistemi economici più importanti in termini di disponibilità di fibre fino a domicilio.

In cifre assolute, l'Europa ha raggiunto 2,5 milioni di abbonati (3,5 milioni includendo anche la Russia). La maggioranza degli abbonati (77%) è concentrata in sette paesi, nel seguente ordine: Svezia, Italia, Francia, Lituania, Norvegia, Paesi Bassi e Danimarca. Fra questi sette paesi, cinque hanno ora più di 200.000 utenti collegati.

FTTH Council Europe – Belgio
Fax: +32 2503 2277
Email: info@ftthcouncil.eu
Website: www.ftthcouncil.eu

Cavo PV direttamente interrato

USA Wire & Cable Inc ha presentato quello che si è considerato il primo cavo PV di isolamento da interrare direttamente e conforme alla revisione della norma UL 4703 del 17 novembre 2009.

Il cavo è caratterizzato da una protezione contro il sole, l'ozono, il calore e l'abrasione ed utilizza un isolamento di gomma di etilene propilene (EPR) ed un rivestimento di protezione separato, che è considerato la soluzione ideale per i sistemi di invertitori senza trasformatore.

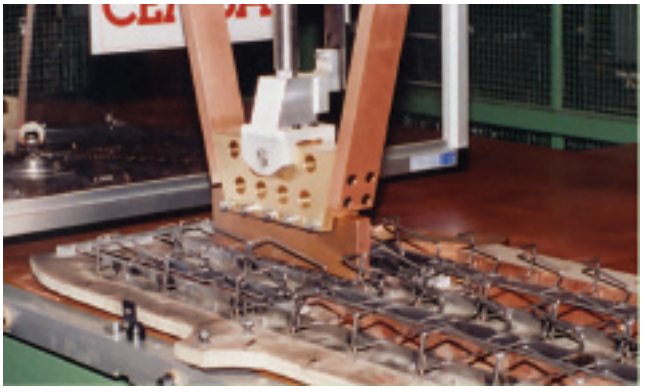
USA Wire & Cable Inc – Stati Uniti
Fax: +1 512 326 3584
Website: www.usawire-cable.com

Saldatrice di filo

Cemsa SpA ha recentemente presentato la saldatrice Roboside PJ, nuova versione della sua saldatrice da banco automatica Roboroof.

La nuova serie è progettata per migliorare la produttività, il rendimento, la flessibilità e la precisione, e può essere integrata in qualsiasi tipo di linea automatica.

La macchina può essere utilizzata per saldare un'ampia gamma di griglie, componenti di maglie e pannelli metallici. Si sta inoltre rivelando efficace per saldare i telai dei sedili delle automobili che spesso prevedono l'unione e la saldatura di fili prepiegati di strutture elaborate. L'attrezzatura, progettata da Cemsa, è disponibile per clienti con applicazioni dedicate che consentono di produrre un'ampia gamma di modelli di sedili per automobili conformemente alle strette tolleranze imposte dai costruttori di automobili.



▲ *Saldatrice Roboside PJ*

Cemsa SpA – Italia **Fax**: +39 02 253 3307 **Email**: info@cemsa.it **Website**: www.cemsa.it

Ammodernamento di rete sottomarina

Alcatel-Lucent e GlobeNet hanno completato l'ammodernamento della rete del cavo sottomarino di 22.000 chilometri che collega gli Stati Uniti con l'America Latina. Questo progetto, secondo ammodernamento della rete in quasi 18 mesi, consente a GlobeNet di disporre di una capacità di oltre 110 Gbit/s, che corrisponde a circa 13,75 milioni di chiamate vocali contemporaneamente.

I clienti di GlobeNet beneficiano ora di una migliore connettività, di una maggiore affidabilità e di un accesso più rapido alle applicazioni ed ai servizi. Grazie alla tecnologia sottomarina di punta di Alcatel-Lucent, GlobeNet può ampliare la propria offerta di servizi all'ingrosso per proporre la banda larga, il carrier Ethernet, la telefonia fissa e mobile tradizionale e l'IP, nonché applicazioni quali l'ospitalità, le videoconferenze e le linee private internazionali.

Oltre ai segmenti sotto-marini, Alcatel-Lucent ha inoltre modernizzato le stazioni terrestri di Rio de Janeiro e Fortaleza (Brasile), Maiquetia (Venezuela), St.David's (Bermuda), Boca Raton e Tuckerton (Florida).

A Rio de Janeiro, la rete sotto-marina collega l'infrastruttura ottica terrestre di Oi, casa madre di GlobeNet. Alcatel-Lucent ha inoltre gestito l'installazione, l'applicazione e la messa in servizio del sistema.

"La società GlobeNet si è impegnata a migliorare la capacità e le funzionalità della propria rete per poter offrire un servizio migliore ai propri clienti con nuovi servizi affidabili, continuando contemporaneamente ad utilizzare la propria infrastruttura esistente", ha dichiarato Eric Contag, direttore operativo di GlobeNet.

"Alcatel-Lucent è sempre un partner prezioso che ci aiuta ad innovare e ad accrescere le nostre capacità globali, rispettando i tempi stretti che gli imponiamo."

"Questo ammodernamento offre a GlobeNet una capacità aggiuntiva necessaria per distribuire servizi avanzati, mantenendo una rete di facile gestione", ha aggiunto Philippe Dumont, direttore generale dell'attività delle reti sottomarine di Alcatel-Lucent.

Questo progetto conferma la riuscita della nostra stretta collaborazione con GlobeNet per aiutare la società ad offrire ai propri utenti la migliore esperienza possibile. "

GlobeNet – Stati Uniti
Website: www.globenet.net

Alcatel-Lucent – France
Website: www.alcatel-lucent.com

Nexans firma un contratto per la fornitura di vagoni ferroviari

Nexans ha firmato un contratto di 9,5 milioni di euro per la fornitura al costruttore pubblico cinese di equipaggiamenti ferroviari CNR Corporation Limited (CNR), dei cavi necessari allo sviluppo dei treni alta velocità CRH (China Railway High-speed CRH) che entreranno in servizio nel 2011 fra Pechino e Shanghai.

I cavi forniti sono fabbricati sui siti di produzione cinese di Nexans di Waigaoqiao e Baoshan a Shanghai.

Il primo lotto di cavi è stato consegnato in marzo 2010 e l'ultima consegna è prevista in marzo 2011.

I nuovi treni CRH comprenderanno 16 vetture progettate per trasportare fino a 1.026 passeggeri ad una velocità nominale di 350km/h.

I cavi destinati a questo progetto CRH appartengono alla gamma FLAMEX®, specificamente progettata da Nexans per soddisfare le diverse norme internazionali e le esigenze di sicurezza del settore degli equipaggiamenti ferroviari. I cavi selezionati sono ecologici e senza alogeni, garantiscono la resistenza alla propagazione delle fiamme e la riduzione di emissioni di fumo in caso d'incendio.

Nexans –Francia
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Progressi nei composti di TPE a base di copolimero stirenico a blocchi per applicazioni di cavi ignifughi UL

A cura di Biing-Lin Lee, Darnell Worley, Phil Scadding, Ben Jones, Sachin Sakhalkar, Wilfred Giroux, Teknor Apex Company

Riassunto

Teknor Apex Company ha intrapreso la ricerca e lo sviluppo di tecnologie per composti di TPE a base di copolimero stirenico per sviluppare nuovi composti ignifughi (FR) perfezionati, conformi alla direttiva RoHS. Il presente articolo descrive in dettaglio le prestazioni di nuovi composti utilizzando diversi metodi di prova di combustione verticale secondo la norma UL. I composti EL-1392B (Shore A 86), EL-1934E (Shore A 82) ed EL-1934F (Shore A 73) hanno superato i requisiti specificati nella norma UL 94 V-0 con provini dello spessore di 0,06 pollici. Questi composti hanno inoltre superato il test UL 1581 VW-1 ed il metodo 1061 per i test d'infiammabilità dell'isolamento e del rivestimento di cavi. Essi sono particolarmente indicati per cavi flessibili, cavi a spirale, cavi per robotica, utensili elettrici, cavi super flessibili, applicazioni a basse temperature, componenti per connettori e componenti che richiedono una classificazione V-0 di resistenza alla fiamma.

1 Introduzione

Le principali applicazioni dei composti TPE che richiedono caratteristiche ignifughe si hanno nell'isolamento e nel rivestimento di fili e cavi e nei dispositivi elettronici. Gli elastomeri termoplastici stirenici (TPE-S) sono inoltre utilizzati in una vasta gamma di applicazioni ignifughe come il settore automobilistico, sistemi audio, batterie, cassette di derivazione elettriche, pompe sommergibili ed altre applicazioni di conduttori flessibili che richiedono un equilibrio fra le proprietà elettriche, termiche, ignifughe e fisiche. In passato, numerosi progettisti e fabbricanti di prodotti industriali hanno sacrificato le prestazioni meccaniche degli elastomeri termoplastici (TPE) al fine di includere i composti ignifughi nei prodotti[1].

I requisiti fondamentali di tali applicazioni comprendono le classificazioni UL, il mantenimento delle proprietà meccaniche in seguito ad invecchiamento termico, facilità di lavorazione e flessibilità alle basse temperature. I composti TPE-S stirenici sono particolarmente indicati per tali applicazioni. Le formulazioni di composti TPE-S ignifughi per ottenere la resistenza alla fiamma secondo la classificazione UL 1581 VW-1 ed il metodo 1061, richiedono elevati livelli di additivi. Tuttavia, livelli di additivi elevati tendono ad influenzare negativamente le proprietà meccaniche, fisiche e reologiche dei composti FR.

Il presente articolo descrive una serie di composti ignifughi TPE-S ad elevate prestazioni e conformi alla direttiva RoHS, recentemente sviluppati da Teknor Apex. I nuovi prodotti sono il risultato della combinazione della tecnologia dei copolimeri stirenici a blocchi (SBC)[2], con la tecnologia degli additivi FR[3] combinata e la scienza della combustione applicate alle prove di combustione verticale UL. L'utilizzo di queste tecnologie consente di ottenere la classificazione UL 1581 VW-1 ed il metodo 1061 in un composto con buone proprietà.

2 Risultati e discussione

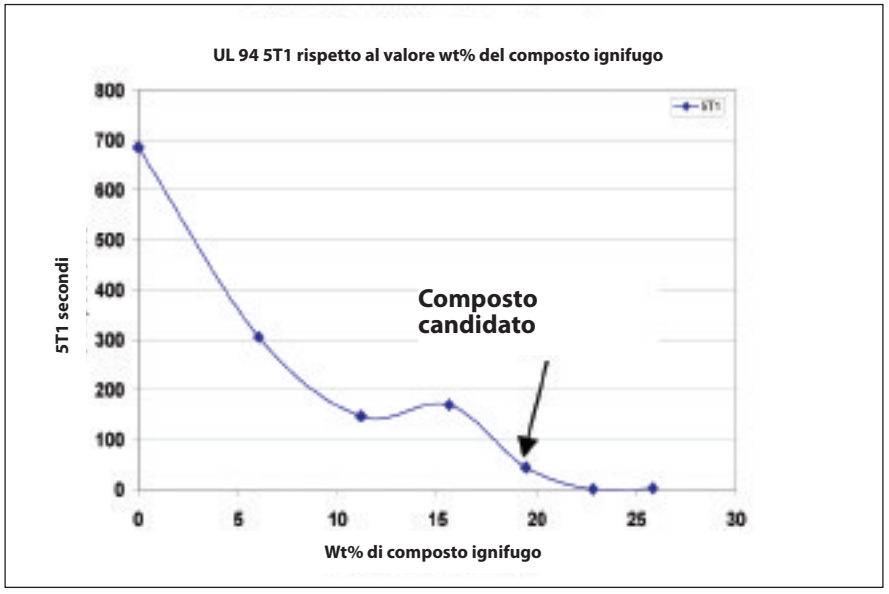
2.1 Prova di combustione verticale UL 94

Il test UL 94 ha lo scopo di valutare l'infiammabilità nei materiali plastici di componenti di dispositivi e di apparecchiature.

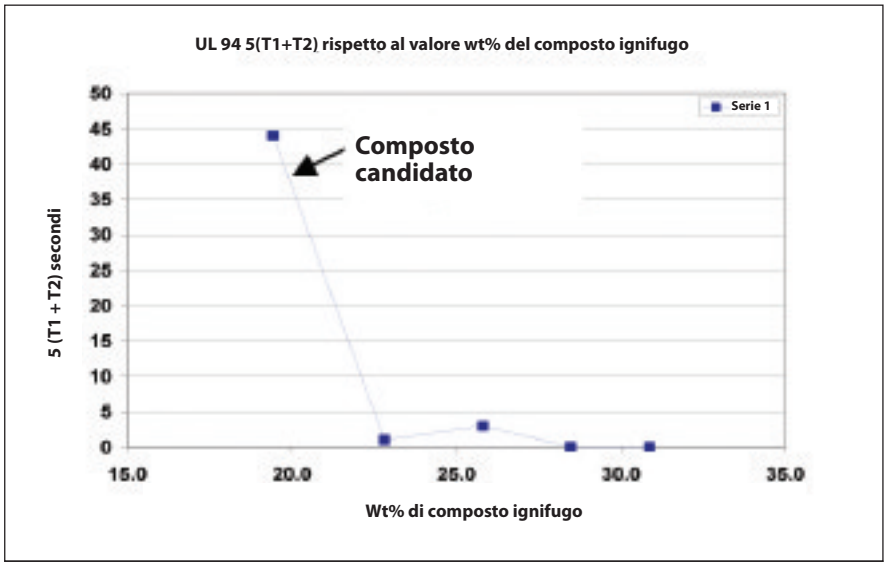
▼ **Tabella 1**: *Valori/classificazione della prova di combustione verticale UL 94*[4]

Condizioni dei criteri di applicabilità	V-0	V-1	V-2
Durata di persistenza della fiamma per ciascun provino T1 e T2	<10s	<30	<30
Durata di persistenza della fiamma totale per 5 campioni per qualsiasi condizione stabilita (T1 + T2)	<50s	<250	<250
Durata di persistenza della fiamma, T2, più tempo di incandescenza residua, T3, per ciascun provino dopo le successive applicazioni di fiamma	<30s	<60	<60
Persistenza della fiamma o incandescenza residua di ciascun provino fino al morsetto di fissaggio	No	No	No
Indicatore del cotone incendiato mediante particelle o gocce incendiate	No	No	Si

T1: tempo di estinzione della fiamma dopo la prima applicazione della fiamma; T2: tempo di estinzione della fiamma dopo la seconda applicazione della fiamma; T3: tempo di incandescenza dopo la seconda estinzione della fiamma



▲ **Figura 1**: *UL 94 5T1 rispetto al valore wt% del composto ignifugo*



▲ **Figura 2**: *UL 94 5(T1+T2) rispetto al valore wt% del composto ignifugo*

Il metodo di prova consiste nella misura dell'infiammabilità e della propagazione della fiamma di materiali polimerici esposti ad una fiamma piccola. Per valutare la prova, si posiziona verticalmente un provino di plastica a forma di barra della misura di 120mm x 13mm con diversi spessori, afferrandolo dalla sommità.

Lo spessore dei provini è di 3,2mm, 1,6mm e 0,8mm. Si pone del cotone idrofilo a 300mm sotto il provino per individuare possibili gocciolamenti di combustibile che incendieranno il cotone.

Si applica quindi la fiamma di un bruciatore Bunsen al provino due volte per 10 secondi. Dopo ciascuna applicazione di fiamma, si registra il tempo di combustione autosostenuta. Una seconda applicazione della fiamma segue immediatamente l'auto-estinzione del provino dopo la prima applicazione della fiamma.

La *Tabella 1* riassume i criteri per le classificazioni V-0, V-1 e V-2. Ad esempio, la classificazione V-0 corrisponde ad un materiale che soddisfa tutti i seguenti criteri:

(i) si estingue in meno di 10 secondi dopo ciascuna applicazione di fiamma
(ii) il tempo di combustione totale per i cinque provini testati non dovrebbe superare i 50 secondi
(iii) non si verifica alcun gocciolamento di combustibile[4]

La classificazione UL 94 è una classificazione distinta come le classificazioni V-0, V-1 o V-2. Si è tentato di correlare le classificazioni UL 94 con la capacità di emanazione del calore[5]. Tuttavia, i valori numerici di T1 e T1+T2 sono utili nella valutazione dell'analisi.

La *Figura 1* rappresenta graficamente il valore 5T1, ovvero la somma di T1 per cinque provini testati secondo la procedura UL94, rispetto alla percentuale di peso (wt%) di un composto ignifugo. Lo spessore del provino è pari a 0,125 pollici. Sulla base dei criteri illustrati nella *Tabella 1*, le composizioni che raggiungono il valore 5T1 in meno di 50 secondi sono candidati per ulteriori studi. In questo esempio, è richiesto oltre il 20wt% di composto ignifugo.

La *Figura 2* rappresenta graficamente il valore 5(T1+T2), ovvero la somma di T1 e T2 per cinque provini testati secondo la procedura UL94, rispetto alla percentuale di peso (wt%) di un composto ignifugo.

La somma di 5(T1+T2) deve essere inferiore a 50 secondi. In questo caso specifico, è richiesto approssimativamente il 20wt% di composto ignifugo per soddisfare la classificazione V-0 a 0,125 pollici.

2.2 Test d'infiammabilità UL 1581 per fili e cavi

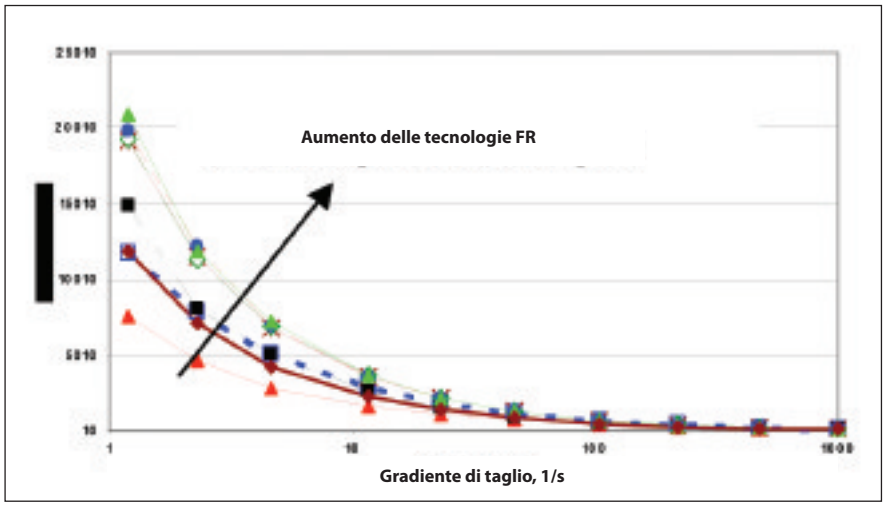
Test d'infiammabilità VW1 per fili verticali
Si tratta di una prova su scala piccola realizzata su una struttura di filo completa della lunghezza di 24 pollici. Il metodo di prova UL 1581 stabilisce che un filo, cavo o cordone verticale non deve propagare la fiamma sulla sua lunghezza né propagare la fiamma a materiali combustibili adiacenti durante, entro, o dopo cinque applicazioni da 15 secondi di una fiamma di prova standard.

La sorgente della fiamma è un bruciatore Tirrill (simile al bruciatore Bunsen) con un rendimento termico nominale di circa 500W o 1700 Btu/h. La fiamma è applicata per 15 secondi e applicata nuovamente per quattro volte, ciascuna volta dopo l'estinzione del fuoco sul filo. Se il provino brucia per più di 60 secondi dopo ciascuna applicazione, o se la linguetta d'indicazione o il cotone idrofilo si incendia durante la prova, il cavo o filo sottoposto alla prova fallisce il test[6].

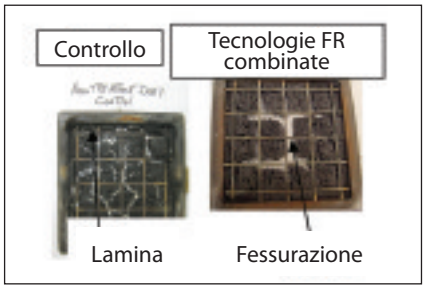
Test d'infiammabilità del cavo 1061

Anche in questo caso si tratta di una prova su scala ridotta, realizzata su un tratto di cavo singolo della lunghezza di 24 pollici. Un provino verticale di cavo finito non deve propagare la fiamma sulla sua lunghezza né a materiali combustibili adiacenti durante, entro, o dopo un'applicazione di un minuto di una fiamma di prova standard.

La fiamma di una prova standard ha un'altezza nominale di 125mm e produce calore con un rendimento termico nominale di 500W o 1700 Btu/h. La fiamma viene applicata tre volte per un minuto alla volta. Il tempo che intercorre fra le applicazioni della fiamma è di 30 secondi, indipendentemente dal fatto se la combustione del provino cessa entro 30 secondi dall'applicazione precedente.



▲ **Figura 3**: *Viscosità del FR TPE-S (200°C)*



▲ **Figura 4**: *Formazione di residuo carbonioso nel caso di tecnologie FR tradizionali e combinate*

Se la linguetta d'indicazione viene bruciata per oltre il 25% o se il cotone idrofilo si incendia durante la prova, il cavo fallisce la prova[6]. I test d'infiammabilità per cavi VW1 e 1061 sono influenzate dalla struttura del filo e del cavo, come ad esempio lo spessore della parete di isolamento, lo spessore della parete della guaina e il numero di fili isolati.

Prova con calorimetro a cono

La prova con calorimetro a cono è una prova su scala ridotta messa a punto presso il National Institute of Standards and Technology (NIST)[7]. É utilizzata per la combustione di piccoli provini per valutare il tasso di emanazione di calore, il tempo di accensione, la generazione di fumo e la formazione di residuo carbonioso.

Il principio fondamentale, sebbene empirico, sfrutta l'osservazione in base alla quale il calore di combustione netto è proporzionale alla quantità di ossigeno richiesta per la combustione. Pertanto, lo studio delle nuove formulazioni di composti FR TPE-S richiede l'utilizzo della prova con il calorimetro a cono.

2.3 Tecnologia dei polimeri/resine

I copolimeri stirenici a blocchi (SBCs) sono utilizzati per applicazioni di fili e cavi. I notevoli sviluppi realizzati con la tecnologia dell'idrogenazione hanno reso disponibile una vasta gamma di composti idrogenati SBCs, compatibili con le poliolefine e gli oli minerali. Inoltre, grazie ai recenti sviluppi nei processi delle poliolefine e della tecnologia dei catalizzatori, una vasta gamma di poliolefine consente di ampliare la gamma delle temperature di esercizio[8, 9].

La microstruttura del dominio del composto SBC influenza inoltre la resistenza e la lavorabilità della massa fusa[10].

La combinazione delle caratteristiche reologiche del composto SBC idrogenato e della tecnologia delle poliolefine è fondamentale per ottenere composti ignifughi ad alte prestazioni con uno straordinario equilibrio di proprietà, nonché proprietà di resistenza alla trazione e caratteristiche reologiche eccellenti.

Queste proprietà si ottengono sia migliorando la resistenza alla fiamma secondo la norma UL 94 V-0, sia ottenendo buone proprietà alle basse temperature, buone proprietà di invecchiamento termico e buone proprietà dielettriche.

Inoltre, è possibile sviluppare miscele di SBC e poliolefine da utilizzare quando sono essenziali: resistenza ai raggi UV, elevate temperature di esercizio (es. valore nominale di 105°C), basse temperature di esercizio (es. punto di fragilità < –50°C) e stabilità durante il processo. I composti ignifughi TPE a base di SBC idrogenato possono essere formulati per coprire un'ampia gamma di valori di durezza da Shore A 50s a Shore D 60s.

2.4 Composti ignifughi

Esistono diverse categorie di composti ignifughi, fra cui le classi più diversificate sono quelle che contengono alogeno. È disponibile sul mercato una vasta gamma di composti ignifughi bromati e clorurati. I composti aromatici bromati sono generalmente utilizzati in resine con una temperatura di processo relativamente elevata[11, 12].

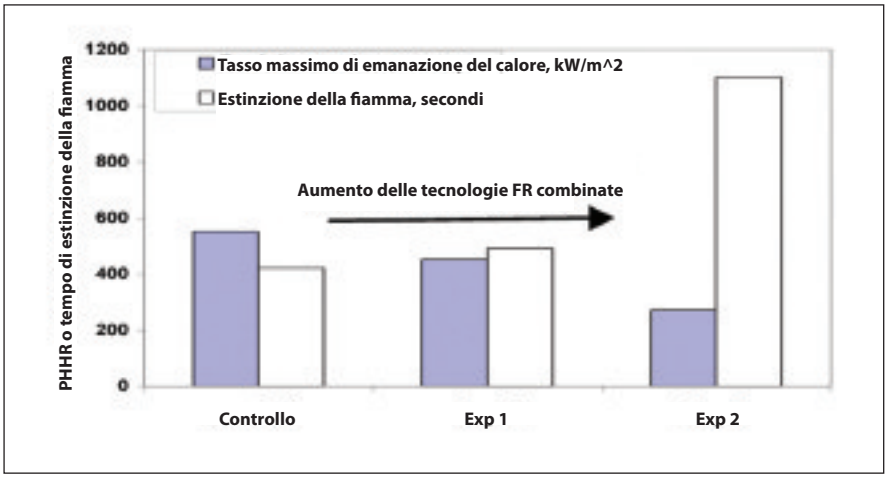
Recentemente si è tentato di sviluppare nuovi composti ignifughi utilizzando il fosforo ed altri sistemi a base di idrossido inorganico privi di alogeni. Il presente articolo sottolinea che la scelta dei polimeri ed una combinazione di tecnologie di composti ignifughi consentono di ottenere un composto TPE ignifugo conforme alla direttiva RoHS.

L'effetto sulle prestazioni nella combinazione di tecnologie FR è la modifica delle caratteristiche reologiche e delle caratteristiche di combustione con un effetto trascurabile sulle proprietà fisiche.

Le modifiche osservate sono illustrate sulle *Figure 3*, *4* e *5*. La *Figura 3* illustra un aumento della viscosità a bassi gradienti di taglio con un aumento degli additivi FR.

La *Figura 4* illustra una buona formazione del residuo carbonioso stabile con una combinazione degli additivi FR. Infine, la *Figura 5* illustra una diminuzione del tasso massimo di emanazione del calore con un aumento degli additivi FR.

▼ **Figura 5**: *Dati relativi al calorimetro a cono per le tecnologie combinate FR*



Proprietà	EL-1392B	EL-1934E	EL-1934F
Conformità con la direttiva RoHS	Si	Si	Si
Gravità specifica	1.24	1.32	1.30
Durezza Shore A	86	82	73
Resistenza alla trazione, psi	1540	1480	1220
Allungamento %	540	630	680
Mantenimento della resistenza alla trazione *	99 %	98%	105%
Mantenimento dell'allungamento *	95%	92%	95%
Mantenimento della resistenza alla trazione *	100%	97%	104%
Mantenimento dell'allungamento **	95%	87%	92%
Punto di fragilità °C	-51	-59	-60
Indice di fusione, #	14	14	20
CD, 1 Mega Hz	2.42	2.41	2.40
FD, 1 Mega Hz	0.003	0.0032	0.003
CD, 1 chilo Hz	2.43	2.43	2.41
FD, 1 chilo Hz	0.0029	0.0043	0.0027
Indice di ossigeno, % ossigeno	28	30	27
UL 94 ##	V0	V0	V0

** 136°C 7 giorni di invecchiamento*
** 156°C 7 giorni di invecchiamento*
 # 200°C 5kg, g/10 min
spessore 0,06 pollici
CD= costante dielettrica
FD= fattore di dissipazione dielettrica

▲ **Tabella 2**: *Valori di proprietà tipici dei composti ignifughi perfezionati TPE-S*

▲ **Figura 6**: *Mantenimento della linguetta d'indicazione di un filo EL-1392B nel test d'infiammabilità 1061*

Eliminazione del gocciolamento
Come illustrato sulla *Figura 3*, l'integrazione delle tecnologie FR combinate nei composti TPE, comporta un aumento della viscosità a bassi gradienti di taglio. Ciò comporta una riduzione del gocciolamento nella prova di combustione verticale UL 92.

Miglioramento della formazione e dell'integrità del residuo carbonioso
La formazione e l'integrità del residuo carbonioso sono auspicabili ai fini di una migliore resistenza alla fiamma. L'integrazione di tecnologie combinate FR nei composti ignifughi TPE può favorire la formazione di residuo carbonioso qualora esposto alla fiamma.

La *Figura 4* presenta una comparazione fra il residuo carbonioso di composti FR TPE-S tradizionali e il residuo carbonioso della nuova tecnologia di composti ignifughi TPE-S.

La parte scura rappresenta il residuo carbonioso e la parte chiara rappresenta la cenere o le fessurazioni del residuo carbonioso.

Il residuo carbonioso per la tecnologia combinata FR ha uno spessore di gran lunga superiore a quello di un composto FR TPE-S tradizionale ed evidenzia meno fessurazioni.

Riduzione del tasso massimo di emanazione del calore
La *Figura 5* illustra i dati relativi al tasso massimo di emanazione del calore ottenuto con il calorimetro a cono (PHRR) di un FR TPE-S convenzionale rispetto alla nuova tecnologia FR TPE-S combinata. I risultati evidenziano che l'integrazione di additivi combinati riduce il tasso massimo di emanazione del calore, e può altresì aumentare leggermente il tempo di estinzione della fiamma.

3 Composto ignifugo TPE-S perfezionato

3.1 Proprietà
Le tecnologie dei materiali ed i relativi principi fondamentali discussi in precedenza, sono utilizzati per sviluppare composti TPE-S perfezionati.

Questi composti FR TPE-S migliorati utilizzano un composto ignifugo conforme alla direttiva RoHS. Alcuni esempi specifici sono evidenziati qui di seguito. Si veda la *Tabella 2* per quanto riguarda le proprietà tipiche di numerosi composti ignifughi perfezionati.

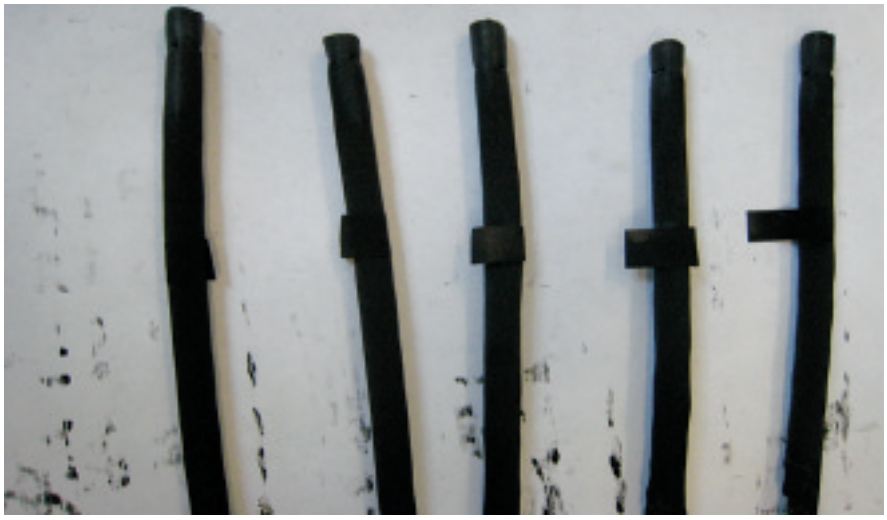
Le caratteristiche specifiche del composto FR TPE perfezionato sono:
- Conformità con la direttiva RoHS
- Superamento dei requisiti della classificazione UL 94 V-0 a 0,06 pollici
- Conformità con i requisiti del test d'infiammabilità del cavo VW-1 e 1061 senza gocciolamento
- Punto di fragilità inferiore a –50°C
- Buon mantenimento delle proprietà di resistenza alla trazione a fronte di invecchiamento termico a 136°C per 7 giorni nonché a 158°C per 7 giorni
- Eccellenti proprietà elettriche

3.2 Prove di infiammabilità del cavo VW-1 e metodo 1061 e cavi a spirale
Le prove di estrusione di fili e cavi hanno verificato queste proprietà ed evidenziato inoltre una buona lavorabilità. Questi composti sono particolarmente indicati per guaine flessibili, cavi a spirale, cavi per robotica, utensili elettrici, cavi super flessibili, applicazioni a basse temperature, componenti per connettori e componenti che richiedono una classificazione V-0 di resistenza alla fiamma. Nelle prove d'infiammabilità dei cavi VW-1 e 1061, il filo o il cavo deve superare i criteri di mantenimento di oltre il 75% della linguetta d'indicazione senza gocciolamento.

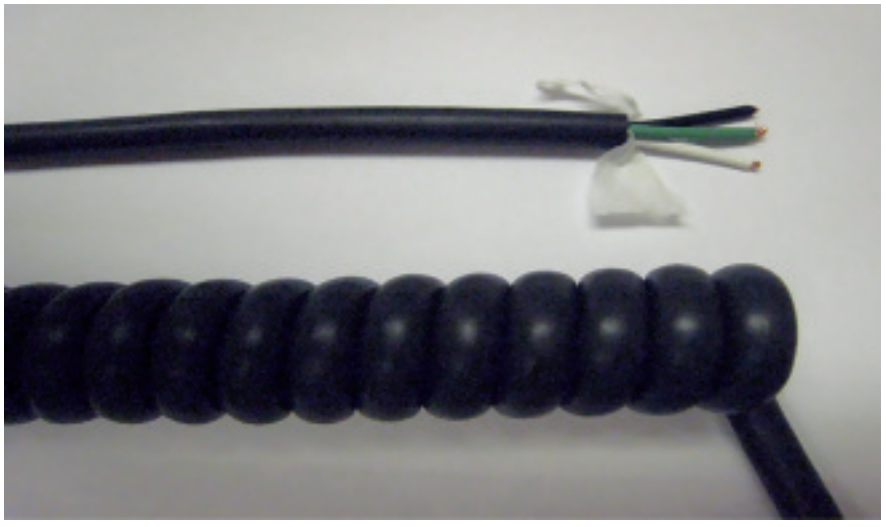
Le *Figure 6* e *7* illustrano un filo bruciato ed un cavo bruciato realizzati con il composto EL-1392B. Il mantenimento della linguetta d'indicazione nei test di infiammabilità del cavo VW-1 e 1061 si ottiene senza gocciolamento. La *Figura 8* illustra un cavo a spirale realizzato con isolamento e rivestimento di EL-1392B, che presenta ottime prestazioni di ritrazione.

4 Conclusione

La disponibilità di nuovi materiali polimerici associata a tecnologie dei composti ignifughi offre la combinazione ottimale per lo sviluppo di composti TPEs ignifughi perfezionati conformi alla direttiva RoHS.



▲ **Figura 7**: *Mantenimento della linguetta d'indicazione di un cavo EL-1392B nel test di infiammabilità del cavo 1061*



▲ **Figura 8**: *Cavo a spirale con isolamento e rivestimento di EL-1392B*

I nuovi composti FR estendono la gamma di prestazioni offerte dai FR TPEs tradizionali. Essi superano i requisiti della classificazione UL 94 V-0 per uno spessore di 0,060 pollici e sono conformi ai test d'infiammabilità VW-1 e 1061 per fili e cavi senza gocciolamento.

Questi risultati sono stati ottenuti con una buona flessibilità a basse temperature, un buon mantenimento delle proprietà di resistenza alla trazione in presenza di invecchiamento termico e inoltre con eccellenti proprietà elettriche.

I nuovi composti FR sono particolarmente indicati per guaine flessibili, cavi a spirale, cavi per robotica, utensili elettrici, cavi super flessibili, applicazioni a basse temperature, componenti per connettori e componenti che richiedono una classificazione V-0 di resistenza alla fiamma.

La migliore resistenza alla fiamma di questi composti SBC si deve alle tecniche di formulazione che modificano la viscosità della massa fusa e la formazione del residuo carbonioso. ■

5 Ringraziamenti

Gli autori desiderano ringraziare Teknor Apex per aver concesso l'autorizzazione per il presente studio.

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Il presente articolo è stato presentato per la prima volta nel corso del 57° Seminario IWCS ed è stato riprodotto con l'autorizzazione degli organizzatori.

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Tiempo de cambios

▲ *Pentti Hätälä (izq.), nuevo presidente del grupo, y Peter Roos*

Con la llegada a los 65 años del Sr. Pentti Hätälä, director ejecutivo de Maifeller, el consejo de administración de la empresa ha anunciado una serie de cambios importantes en el consejo y cuerpo directivo. El 17 de diciembre de 2009, el cuerpo directivo eligió al Sr. Hätälä como presidente del consejo administrativo del Grupo Maillefer. Y ese mismo día, Peter Roos fue ascendido a director ejecutivo.

Los cambios entraron en vigor el 1 de enero de 2010.

El Sr. Hätälä deja su cargo ejecutivo después de más de 30 años al servicio de los sectores del plástico y del hilo y cable. Empezó a trabajar para Nokia Machinery en Finlandia hace más de 20 años y fue ascendiendo gradualmente en la empresa. En 2001 fue nombrado director ejecutivo de Maillefer. En su nuevo cargo de presidente del consejo administrativo seguirá ofreciendo su inestimable colaboración en la dirección de la empresa.

Como director ejecutivo actual de Maillefer, el Sr. Roos cuenta con más de 20 años de experiencia en el sector europeo de la automoción, en el que ocupó importante cargos directivos durante varios años. Entró a formar parte del grupo Maillefer hace más de un año como director de operaciones, trabajando estrechamente con el Sr. Hätälä durante ese periodo.

Maillefer SA – Suiza
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Email: info@maillefer.net
Website: www.mailleferextrusion.com

Distribución de comprobador de resistencia a la abrasión

La sociedad holandesa Inhol BV ha firmado recientemente un contrato exclusivo de venta y asistencia técnica con su homólogo sueco TVAB International para la venta y distribución de su comprobador de resistencia a la abrasión por raspado TVAB 5420 N. Inhol BV se encargará de todos los contactos de venta y sistencia técnica del sector, incluyendo los instrumentos vendidos anteriormente por TVAB. El objetivo de esta colaboración es potenciar el servicio de soporte a los clientes y dar a conocer mejor el instrumento de prueba en el mercado internacional del hilo y cable.

Jacob Steendam de Inhol BV comentó: "TVAB ya ha vendido cientos de instrumentos los años pasados. El comprobador de resistencia a la abrasión de TVAB es de tal precisión que ha establecido las normas de resistencia a la abrasión ISO 6722-1. Ha sido diseñado para probar la durabilidad de cables de un solo conductor de 60V y 600V en condiciones extremas, y mide variables de durabilidad a la abrasión muy específicas."

Inhol BV/PTL – Países Bajos
Email: office@inhol.com
Fax: +31 3560 33235
Website: www.inhol.com

Creciente implantación de FTTH

En la Conferencia sobre FTTH celebrada en febrero de 2010, el Consejo Europeo de FTTH reveló las últimas cifras que indicaban qué países europeos estaban a la cabeza en la implantación de fibra hasta el hogar a finales del 2009.

Aunque Suecia, Noruega y Eslovenia mantenían sus posiciones entre los primeros cinco clasificados, fueron superados por Lituania, que dio un fuerte salto hasta colocarse en primera posición con un 18% de implantación de FTTH. En este momento, el porcentaje de implantación de FTTH supera el 10% en esos cuatro países.

Francia y Portugal entraron en la clasificación por primera vez, gracias al intenso despliegue de infraestructuras de fibra, además de la intensa campaña de marketing puesta en marcha para acaparar abonados. Se espera que el uso de FTTH en ambos países siga creciendo rápidamente, ya que los dos países también se clasificaron entre las 10 economías más importantes en términos de disponibilidad de FTTH.

En términos absolutos, Europa ha conseguido 2,5 millones de abonados (3,5 millones si se incluye a Rusia). La mayoría de los abonados, un 77%, se encuentra concentrada en siete países en el orden siguiente: Suecia, Italia, Francia, Lituania, Noruega, Países Bajos y Dinamarca. Entre estos siete países, cinco de ellos ahora tienen más de 200.000 abonados conectados.

FTTH Council Europe – Bélgica
Fax: +32 2503 2277
Email: info@ftthcouncil.eu
Website: www.ftthcouncil.eu

Cable fotovoltaico

USA Wire & Cable Inc ha presentado lo que se cree que será el primer cable fotovoltaico de instalación directa bajo tierra (Direct Burial) conforme a la revisión de la norma UL 4703 del 17 de noviembre de 2009. El cable dispone de protección contra el sol, ozono, calor y abrasión y lleva un aislamiento de goma de etileno propileno (EPR) y una cubierta protectora separada, considerada la solución ideal para los sistemas de invertidor sin transformador.

USA Wire & Cable Inc – Estados Unidos
Fax: +1 512 326 3584
Website: www.usawire-cable.com

Soldadora de varilla

Cemsa SpA acaba de presentar su nueva soldadora Roboside PJ, nueva versión de su soldadora automática de banco Roboroof.

La nueva serie está diseñada para mejorar la productividad, eficiencia energética, flexibilidad y precisión, y puede ser integrada en cualquier tipo de línea automática.

La máquina puede ser usada para soldar una amplia gama de rejillas, componentes de mallas y mallas metálicas. Asimismo, se está relevando útil para soldar los bastidores de los asientos de automóviles que, a menudo, consiste en unir y soldar varillas predobladas de diseño elaborado. La máquina, diseñada por Cemsa, lleva instaladas aplicaciones dedicadas que permiten producir una amplia gama de modelos de asientos para automóviles conformes a las estrictas tolerancias impuestas por los fabricantes de automóviles.

Cemsa SpA – Italia
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Fax: +39 02 253 3307
Website: www.cemsa.it

▲ *Soldadora Roboside PJ*

Modernización de la red submarina

Alcatel-Lucent y GlobeNet han completado la modernización del sistema de cable submarino de 22.000 Km de longitud que conecta Estados Unidos y Latinoamérica. Este proyecto es la segunda modernización efectuada en 18 meses aproximadamente y pemitirá a GlobeNet facilitar una capacidad de más de 110 Gbit/s, lo que significa que podría transportar 13,75 millones de llamadas de voz a la vez.

A partir de este momento, los clientes de GlobeNet disfrutarán de una conectividad y fiabilidad más avanzada así como de una mayor velocidad de acceso a aplicaciones y servicios. Al apoyarse en la más moderna tecnología de sistemas submarinos de Alcatel-Lucent, GlobeNet podrá ampliar su oferta de servicios mayoristas para incluir servicios de banda ancha, conexiones Ethernet de operador, servicios de redes fijas y móviles basados en IP, y servicios tradicionales de voz, así como servicios de alojamiento de aplicaciones, videoconferencia y servicios de líneas privadas internacionales.

Además de los tramos submarinos, Alcatel-Lucent ha modernizado los puntos de conexión con las redes terrestres en Río de Janeiro y Fortaleza (Brasil), Maiquetía (Venezuela), St. David (Bermudas), Boca Ratón y Tuckerton (Florida, EE.UU.). En Río de Janeiro, la red submarina se integra con la infraestructura óptica de la red terrestre de la casa matriz de GlobeNet, Oi. Asimismo, Alcatel-Lucent se ha encargado de la instalación, despliegue y puesta en servicio del sistema.

"El compromiso de GlobeNet es mejorar la capacidad y funcionalidades de la red para dar a nuestros clientes un servicio aún mejor, con nuevas aplicaciones de alta fiabilidad, y aprovechar al mismo tiempo las inversiones que hemos realizado en las infraestructuras existentes," comentó Eric Contag, director general de Operaciones de GlobeNet. "Alcatel-Lucent sigue siendo un socio de alto valor para nosotros, que nos ayuda a incorporar las últimas innovaciones y ampliar nuestra capacidad global, respetando al mismo tiempo nuestra ajustada programación de activiades".

"Esta modernización de la red proporciona a GlobeNet la capacidad adicional necesaria para soportar servicios avanzados, y mantener al mismo tiempo la facilidad de gestión de su red," explicó Philippe Dumont, director general de las actividades de redes submarinas de Alcatel-Lucent.

"Este proyecto estrecha nuestra relación con GlobeNet, de cara a ayudarles a ofrecer a sus usuarios finales los mejores servicios posibles".

GlobeNet – Estados Unidos
Website: www.globenet.net
Alcatel-Lucent – Francia
Website: www.alcatel-lucent.com

Nexans consigue contrato de suministro para la flota ferroviaria china

Nexans se ha adjudicado un contrato valorado en 9,5 millones de euros para suministrar, al fabricante estatal chino de equipamiento ferroviario CNR Corporation Limited (CNR), los cables necesarios para el desarrollo de los trenes de alta velocidad de la red de ferrocarriles china (CRH), que entrarán en servicio en 2011entre Pekín y Shangái.

Los cables son fabricados en las plantas chinas que Nexans tiene en Waigaoqiao y Baoshan, ambas en Shangái. El primer lote de cables fue entregado en marzo de 2010 y el último está programado para marzo de 2011.

Los nuevos trenes de CRH estarán constituidos por 16 vagones y están diseñados para alcanzar una velocidad de 350 Km/h y transportar hasta 1026 pasajeros.

Los cables suministrados para este proyecto de CRH pertenecen a la gama Flamex® de Nexans, diseñados especialmente para responder a las distintas normas internacionales y requisitos de seguridad del sector del equipamiento rodante ferroviario. Los cables seleccionados son respetuosos con el medioambiente y libres de halógenos, lo cual garantiza que el cable no propaga el fuego y produce bajas emisiones de humo en caso de incendio.

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Adelantos en los compuestos de TPE a base de copolímeros en bloque de estireno para aplicaciones de cables retardantes de llama según UL

Por Biing-Lin Lee, Darnell Worley, Phil Scadding, Ben Jones, Sachin Sakhalkar, Wilfred Giroux, Teknor Apex Company

Resumen

Teknor Apex Company se ha dedicado a la búsqueda y al desarrollo de tecnologías de compuestos de TPE a base de copolímeros en bloque de estireno para desarrollar nuevos compuestos retardantes de llama (FR) mejorados, conformes a la directiva RoHS.

Este artículo describirá con detalle las prestaciones de los nuevos compuestos utilizando varios métodos de prueba de combustión vertical según UL. Los compuestos EL-1392B (Shore A 86), EL-1934E (Shore A 82), y EL-1934F (Shore A 73) han superado los requisitos especificados en la norma UL 94 V-0 para un espesor de 0,06 pulgadas.

Estos compuestos han superado también la prueba UL 1581 VW-1 y el método 1061 para pruebas de inflamabilidad de aislamientos y cubiertas de cables.

Son ideales para cables flexibles, cables en espiral, cables para robótica, herramientas eléctrica, cables de alta flexibilidad, aplicaciones de baja temperatura y partes de conectores y componentes que requieren una clasificación V-0 de resistencia a la llama.

1 Introducción

Las aplicaciones principales de los compuestos de TPE (elastómeros termoplásticos), donde se requieren características de retardo de llama, se efectúan en los materiales para el aislamiento y el recubrimiento de alambres y cables, y en los dispositivos electrónicos. Los elastómeros termoplásticos de estireno (TPE-S) se usan también en una amplia gama de aplicaciones que requieren retardo de llama como automóviles, sistemas de audio, baterías, cajas de empalme eléctricas, bombas sumergibles y otras aplicaciones donde se utilizan cables flexibles que requieren un equilibrio entre propiedades eléctricas, térmicas, de resistencia a la llama y físicas. En pasado, muchos diseñadores y fabricantes de productos industriales han sacrificado las prestaciones mecánicas de los elastómeros termoplásticos (TPE) para incorporar retardantes de llama en los productos[1].

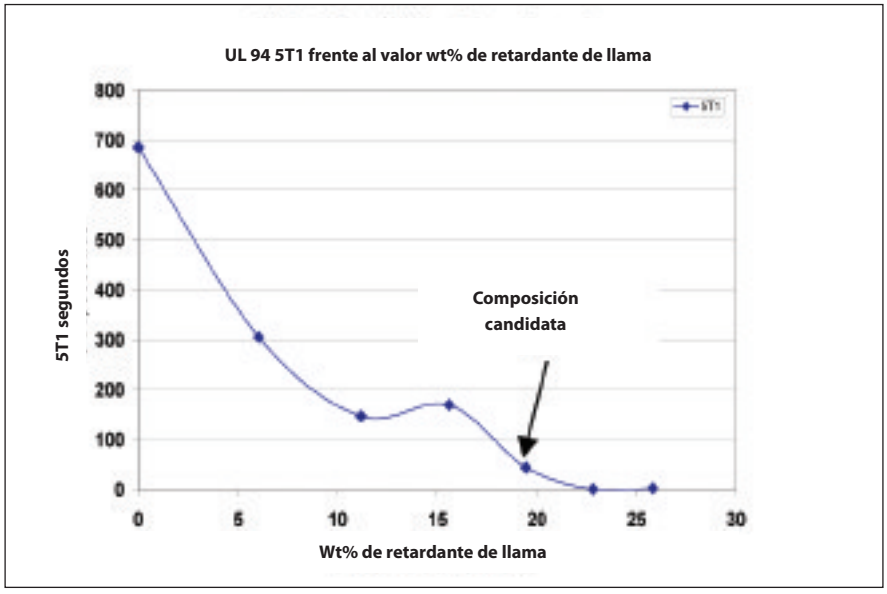
Los requisitos clave de estas aplicaciones incluyen las clasificaciones UL, la conservación de las propiedades mecánicas después del envejecimiento térmico, la facilidad de procesamiento y la flexibilidad a bajas temperaturas. Los compuestos de TPE-S de estireno son ideales para dichas aplicaciones. Las formulaciones de los compuestos de TPE-S retardante de llama, para alcanzar la resistencia a la llama de la clasificación UL 1581 VW-1 y el método 1061 requieren altos niveles de aditivos. Sin embargo, estos altos niveles de aditivos tienen un impacto negativo en las propiedades mecánicas, físicas y reológicas de los compuestos retardantes de llama (FR).

Este artículo describe una serie de compuestos de TPE-S retardantes de llama de altas prestaciones, desarrollados recientemente por Teknor Apex, que cumplen con la directiva RoHS. Los nuevos productos son el resultado de la combinación entre la tecnología de copolímeros de estireno en bloque (SBC)[2] y la tecnología de aditivos retardantes de llama (FR)[3] y la ciencia del fuego aplicada a las pruebas de combustión vertical de UL. El uso de estas tecnologías permite obtener la clasificación UL 1581 con prueba VW-1 y método 1061 en un compuesto con buenas propiedades.

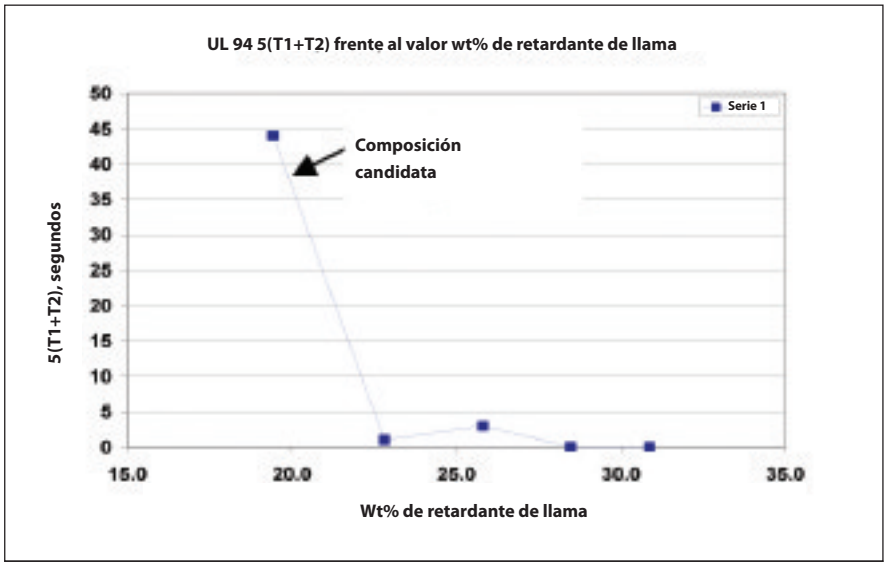
▼ **Tabla 1**: *Valores/clasificación de la prueba de combustión vertical UL 94*[4]

Condiciones de los criterios	V-0	V-1	V-2
Tiempo de persistencia de la llama para cada probeta individual T1 & T2	<10s	<30	<30
Tiempo de persistencia de la llama total para las 5 probetas para cualquier condición establecida (T1 + T2)	<50s	<250	<250
Tiempo de persistencia de la llama, T2, más el tiempo de incandescencia residual, T3, para cada probeta individual después de las aplicaciones de llama siguientes	<30s	<60	<60
Tiempo de persistencia de la llama o de incandescencia residual de cualquier probeta hasta la mordaza de agarre	No	No	No
Indicador de algodón inflamado por partículas o gotas flameantes	No	No	Si

T1: tiempo de extinción de la llama después de la primera aplicación de la llama
T2: tiempo de extinción de la llama después de la segunda aplicación de la llama
T3: tiempo de incandescencia después de la segunda extinción de la llama



▲ **Figura 1**: *UL 94 5T1 frente al valor wt% de retardante de llama*



▲ **Figura 2**: *UL 94 5(T1+T2) frente al valor wt% de retardante de llama*

2 Resultados y consideraciones

2.1 Prueba de combustión vertical UL 94

La prueba UL 94 ha sido concebida para comprobar la inflamabilidad de los materiales plásticos utilizados para construir componentes de dispositivos y electrodomésticos. El método de prueba es una medida de la inflamabilidad y de la propagación de la llama para materiales poliméricos expuestos a una llama pequeña.

Para evaluar la prueba, se posiciona verticalmente una probeta de plástico en forma de barra de 120mm x 13mm y de varios espesores, sujetándola en la parte superior. El espesor de las probetas es 3,2mm, 1,6mm y 0,8mm. Se pone algodón hidrófilo 300mm por debajo de la probeta para detectar posibles goteos de combustible que darían fuego al algodón. Se aplica a la probeta una llama de un quemador Bunsen dos veces durante 10 segundos. Después de cada aplicación de la llama, se registra el tiempo de combustión autosostenida.

La segunda aplicación de la llama se efectúa inmediatamente después de la autoextinción de la probeta, desde la primera aplicación de la llama.

La *Tabla 1* recopila los criterios para las clasificaciones V-0, V-1 y V-2. Por ejemplo, una clasificación V-0 corresponde a un material que cumple con todos los criterios siguientes:

(i) se extingue en menos de 10 segundos después de cada aplicación de la llama
(ii) el tiempo total de combustión para las cinco probetas sometidas a pruebas no debería superar 50 segundos
(iii) no hay goteo de combustible[4]

La clasificación UL 94 es una clasificación discreta como las V-0, V-1 ó V-2. Se ha hecho una tentativa para relacionar las clasificaciones UL 94 con la capacidad de liberar el calor[5]. Sin embargo, los valores numéricos de T1 y T1+T2 son útiles para la evaluación del análisis.

La *Figura 1* representa gráficamente el valor 5T1, que es la suma de T1 para cinco muestras sometidas a pruebas según el procedimiento UL94, respecto al porcentaje de peso (wt%) de un aditivo retardante de llama. El espesor de la muestra es de 0,125 pulgadas. En base a los criterios ilustrados en la *Tabla 1*, las composiciones que alcanzan un valor de 5T1 en menos de 50 segundos son candidatas para un estudio ulterior. En este ejemplo, se requiere más de 20 wt% de retardante de la llama.

La *Figura 2* representa gráficamente el valor 5(T1+T2), que es la suma de T1 y T2 para cinco muestras sometidas a pruebas según el procedimiento UL94, respecto al porcentaje de peso (wt%) de un aditivo retardante de llama. La suma de 5(T1+T2) debe ser inferior a 50 segundos. En este ejemplo específico se requiere aproximadamente una cantidad de 20 wt% de aditivo retardante de llama para cumplir con la clasificación V-0 a 0,125 pulgadas.

2.2 Pruebas de inflamabilidad UL 1581 para alambres y cables

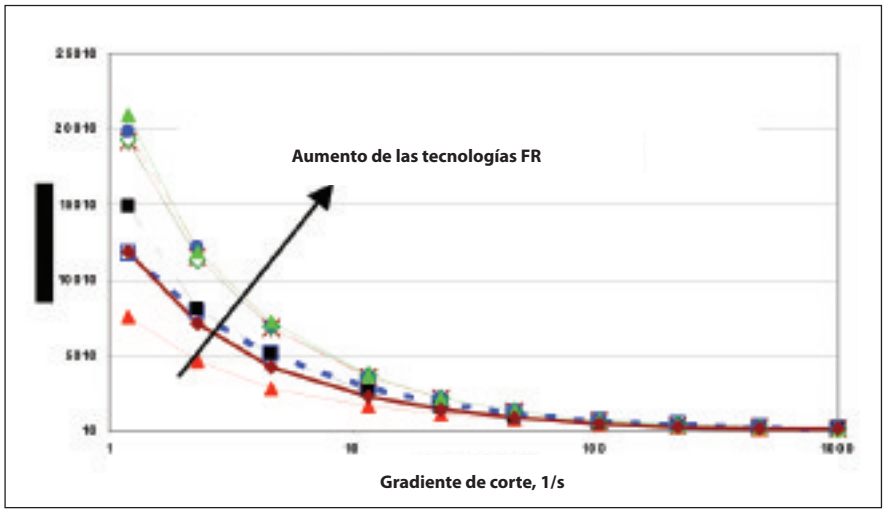
Prueba de llama VW-1 para cables verticales

Se trata de una prueba de baja escala realizada en una estructura de alambre completa de 24 pulgadas de longitud. El método de prueba UL 1581 establece que un alambre o un cable vertical no debe propagar la llama a lo largo de su longitud, y no debe propagar la llama a materiales combustibles adyacentes, durante, entre, o después de cinco aplicaciones de 15 segundos de una llama de prueba estándar.

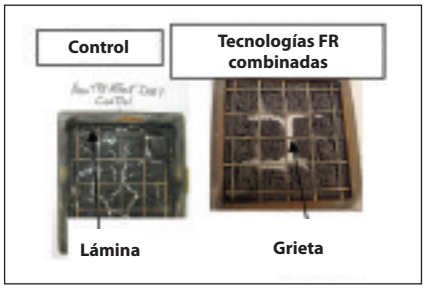
La fuente de la llama es un quemador Tirrill (similar a un quemador Bunsen) con un rendimiento térmico de aproximadamente 500W o 1700 Btu/h. La llama se aplica durante 15 segundos y se vuelve a aplicar cuatro veces, después de cada vez que el alambre se extingue. Si la muestra arde durante más de 60 segundos después de cada aplicación, o si la lengueta indicadora o el algodón hidrófilo se prenden durante la prueba, el cable o alambre no supera la prueba[6].

Prueba de llama del cable 1061

Esta prueba es también de baja escala y se realiza en un tramo de cable de 24 pulgadas de longitud. Una probeta vertical de cable acabado no debe propagar la llama a lo largo de su longitud, y no debe propagar la llama a materiales combustibles adyacentes, durante, entre,



▲ **Figura 3**: *Viscosidad del TPE-S FR (200°C)*



▲ **Figura 4**: *Formación de residuo carbonoso con tecnologías convencionales y tecnologías FR combinadas*

o después de una aplicación de 1 minuto de una llama de prueba estándar. La llama de prueba estándar tiene una altura nominal de 125mm y produce calor con un rendimiento térmico nominal de 500W ó 1700 Btu/h.

La llama se aplica tres veces, cada vez durante un minuto. El periodo entre una aplicación de la llama y la siguiente debe ser de 30 segundos, sin tener en cuenta si la probeta se apaga dentro de 30 segundos desde la aplicación anterior. Si la lengüeta indicadora se quema más de un 25%, o el algodón hidrófilo se inflama durante la prueba, el cable no supera la prueba[6].

Las pruebas de llama para cables VW1 y 1061 dependen también del diseño del alambre y del cable, por ejemplo, el espesor de la pared de aislamiento, el espesor de la cubierta, y el número de alambres aislados.

Pruebas de calorimetría de cono

La prueba con calorímetro de cono es una prueba a escala de banco desarrollada por el instituto NIST *(National Institute of Standards and Technology)*[7]. Se usa para quemar muestras pequeñas para evaluar la velocidad de liberación del calor, el tiempo hasta la ignición, la generación de humo y la formación de residuo carbonoso. El principio de base, a pesar de ser empírico, saca provecho de la observación que el calor neto de la combustión es proporcional a la cantidad de oxígeno requerida para la combustión.

Por lo tanto, la búsqueda de las nuevas formulaciones de compuestos TPE-S retardantes de llama (FR) requiere el uso de pruebas de calorimetría de cono.

2.3 Tecnología de polímeros/resinas

Los copolímeros en bloque de estireno (SBCs) se usan en aplicaciones de alambre y cable. Gracias a los importantes adelantos de la tecnología de hidrogenación, se dispone de una amplia gama de SBCs hidrogenados, compatibles con las poliolefinas y los aceites minerales.

Además, gracias a las recientes mejoras en el proceso de elaboración de las poliolefinas y en la tecnología de catalizadores, una amplia gama de poliolefinas pueden ampliar el campo de las temperaturas de servicio[8, 9].

La microestructura del dominio del SBC afecta también a la resistencia a la fusión y la procesabilidad de la masa fundida[10].

La combinación de las características reológicas del SBC hidrogenado y de la tecnología de poliolefinas es fundamental para obtener compuestos retardantes de llama de altas prestaciones con un equilibrio único de propiedades que incluyen características de resistencia a la tracción y reológicas excelentes.

Estas propiedades se obtienen mejorando la capacidad de retardar la llama según UL 94 V-0, y también tratando de alcanzar buenas prestaciones a baja temperatura, al envejecimiento térmico y a la resistencia dieléctrica.

Además, las mezclas de SBC y poliolefina pueden desarrollarse para usar donde son esenciales la resistencia a lo rayos UV, a altas temperaturas de servicio (ej. valor nominal de 105°C), bajas temperaturas de servicio (ej. punto de fragilidad < -50°C) y estabilidad durante el procesamiento. Los TPEs retardantes de llama a base de SBC hidrogenado pueden ser formulados para cubrir una amplia gama de durezas de Shore A 50s a Shore D 60s.

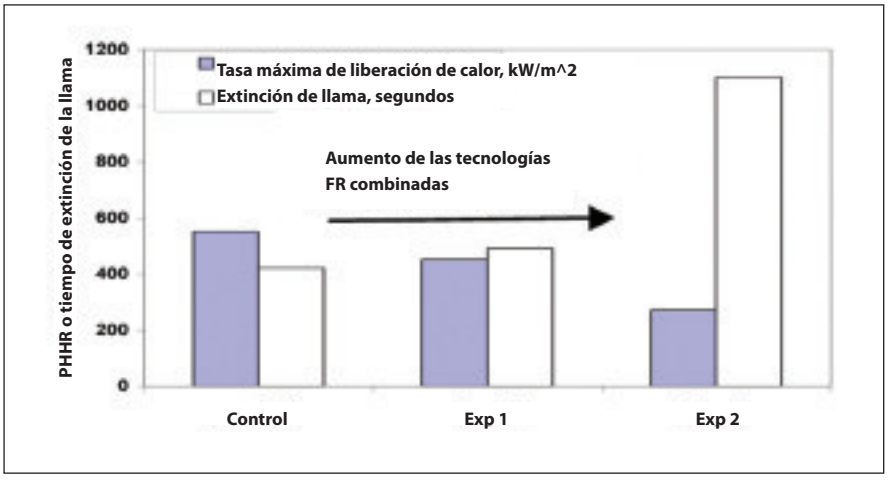
2.4 Retardantes de llama

Hay distintas categorías de retardantes de llama, las más diversificadas son las que contienen halógeno. Una amplia gama de retardantes de llama bromados y clorados están disponibles en el mercado. Los compuestos aromáticos bromados se usan generalmente en las resinas con una temperatura de procesamiento relativamente alta[11, 12].

Recientemente se ha tratado de desarrollar nuevos retardantes de llama utilizando fósforo y otros sistemas sin halógeno de hidróxido inorgánico.

En este artículo se evidencia que la cuidadosa selección de los polímeros y una combinación de tecnologías de retardo de llama permiten obtener un elastómero termoplástico (TPE) retardante de llama conforme a la directiva RoHS.

▼ **Figura 5**: *Datos del calorímetro de cono para las tecnologías FR combinadas*



Eigenschaft	EL-1392B	EL-1934E	EL-1934F
Übereinstimmung mit den RoHS-Richtlinien	Ja	Ja	Ja
Relative Dichte	1.24	1.32	1.30
Härte, Shore A	86	82	73
Zugfestigkeit, psi	1540	1480	1220
Dehnung, %	540	630	680
Beibehaltung der Zugfestigkeit*	99 %	98%	105%
Beibehaltung der Dehnung *	95%	92%	95%
Beibehaltung der Zugfestigkeit *	100%	97%	104%
Beibehaltung der Dehnung **	95%	87%	92%
Sprödigkeitspunkt °C	-51	-59	-60
Schmelzindex #	14	14	20
DK, 1 Mega Hz	2.42	2.41	2.40
DV 1 Mega Hz	0.003	0.0032	0.003
DK, 1 kilo Hz	2.43	2.43	2.41
DV, 1 kilo Hz	0.0029	0.0043	0.0027
Sauerstoffindex, % Sauerstoff	28	30	27
UL 94 ##	V0	V0	V0

**136°C 7 días de envejecimiento*
*** 156°C 7 días de envejecimiento*
 # 200°C 5 kg, g/10 min
espesor 0,06 pulgadas
CD= constante dieléctrica
FD= factor de disipación dieléctrica

▲ **Tabla 2**: *Valores típicos de las propiedades del TPE-S retardante de llama mejorado*

▲ **Figura 6**: *Conservación de la lengüeta indicadora del alambre EL-1392B después de la prueba de inflamabilidad 1061*

Cuando se combinan tecnologías de retardo de llama (FR), el efecto sobre las prestaciones se percibe en la modificación de las características reológicas y de las características de quemadura, con un efecto mínimo sobre las propiedades físicas. Los cambios observados se ilustran en las *Figuras 3*, *4* y *5*. La *Figura 3* muestra un aumento de la viscosidad a bajos gradientes de corte con el incremento de los retardantes de llama (FR).

La *Figura 4* muestra una buena formación de residuo carbonoso estable con una combinación de aditivos FR. Por último, la *Figura 5* muestra una disminución de la velocidad de liberación del calor con un aumento de aditivos FR.

- ***Eliminación del goteo***
  Como se muestra en la *Figura 3*, la incorporación de tecnologías FR combinadas en los TPEs aumenta la viscosidad a bajos gradientes de corte. Esto permite reducir el goteo durante la prueba de combustión vertical UL 94.

- ***Mejora de la formación y de la integridad del residuo carbonoso***
  La formación de residuo carbonoso y su integridad es importante para obtener características de retardo de llama mejoradas. La incorporación de tecnologías FR combinadas en compuestos de TPE retardantes de llama puede favorecer la formación de residuo carbonoso cuando están expuestos a una llama. La *Figura 4* compara el residuo carbonoso de TPE-S FR convencionales con el residuo carbonoso que se obtiene con la nueva tecnología de TPE-S retardante de llama.

  La porción oscura es residuo carbonoso y la porción clara es ceniza o grietas en el residuo carbonoso. El residuo carbonoso de la tecnología FR combinada es más espeso del residuo carbonoso de un TPE-S FR convencional y presenta menos grietas.

- ***Reducción de la tasa máxima de liberación de calor***
  La *Figura 5* muestra los datos de la tasa máxima de liberación de calor(PHRR, peak heat release rate) obtenida con un calorímetro de cono de un TPE-S FR convencional respecto a la nueva tecnología de TPE-S FR combinada. Los resultados muestran que la incorporación de aditivos combinados reduce la tasa máxima de liberación de calor. Además, puede aumentar apenas el tiempo de extinción de la llama.

3 TPE-S retardante de llama mejorado

3.1 Propiedades

Las tecnologías de materiales y sus principios subyacentes tratados arriba se usan para desarrollar un TPE-S retardante de llama mejorado. Estos compuestos mejorados TPE-S FR usan un retardante de llama que cumple con la directiva RoHS. Se detallan a continuación algunos ejemplos específicos. Ver la Tabla 2 para las propiedades típicas de varios TPE-S retardantes de llama mejorados.

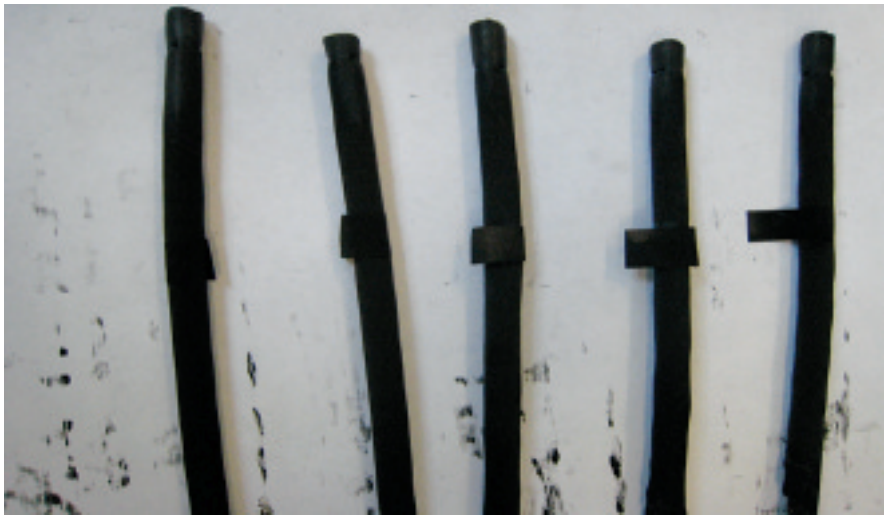
Las características peculiares del TPE-S FR mejorado son:

- Conformidad con la directiva RoHS
- Aprobación de la clasificación UL 94 V-0 para un espesor de 0,06 pulgadas
- Conformidad con los requisitos de la prueba de inflamabilidad del cable VW-1 y 1061, sin goteo
- Punto de fragilidad debajo de -50°C
- Buena conservación de las propiedades de resistencia a la tracción después del envejecimiento térmico a 136°C durante 7 días y también a 158°C durante 7 días
- Propiedades eléctricas excelentes

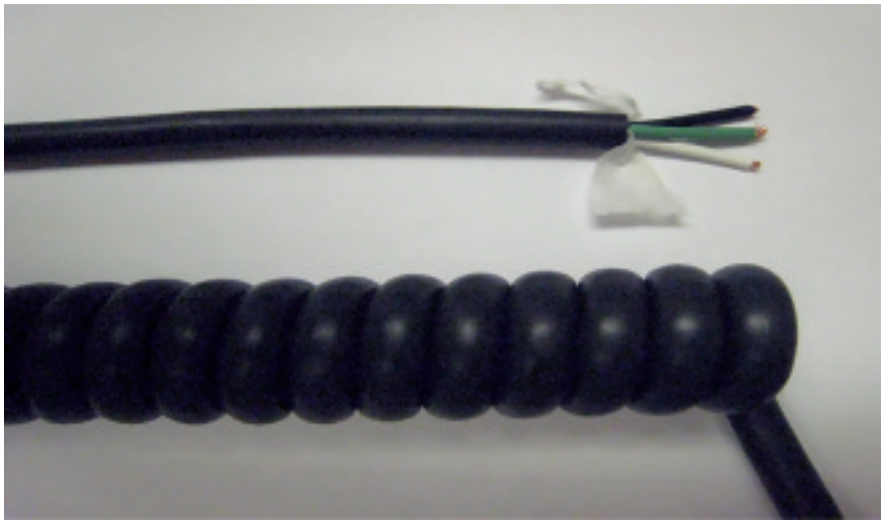
3.2 Pruebas de inflamabilidad del cable VW-1 y método1061, y cables en espiral

Las pruebas de extrusión de alambre y cable han verificado estas propiedades y han evidenciado también una buena capacidad de procesamiento. Estos compuestos son ideales para cables flexibles, cables en espiral, cables para robótica, herramientas eléctricas, cables de alta flexibilidad, aplicaciones de baja temperatura y partes de conectores y componentes que requieren una clasificación V-0 de resistencia a la llama.

En las pruebas de inflamabilidad del cable VW-1 y 1061, el alambre o el cable debe superar los criterios de conservación de



▲ **Figura 7**: *Conservación de la lengüeta indicadora del cable EL-1392B después de la prueba de inflamabilidad 1061*



▲ **Figura 8**: *Cable en espiral con aislamiento y cubierta de EL-1392B*

más de un 75% de la lengüeta indicadora sin goteo. Las *Figuras 6* y *7* muestran un alambre quemado y un cable quemado realizados con el compuesto EL-1392B. La conser- vación de la lengüeta indicadora durante la prueba de inflamabilidad del cable VW-1 y 1061 se alcanza sin goteo. La *Figura 8* muestra un cable en espiral con aislamiento y cubierta de EL-1392B. Ofrece prestaciones de retracción muy buenas.

4 Conclusiones

La disponibilidad de nuevos materiales poliméricos y de tecnologías de retardo de llama ofrece la combinación ideal para desarrollar TPEs retardantes de llama mejorados conformes con la directiva RoHS.

Los nuevos compuestos retardantes de llama (FR) extienden la gama de prestaciones ofrecidas por los TPEs FR convencionales. Estos han sido clasificados según UL 94 V-0 para un espesor de 0,060 pulgadas y han superado la prueba de llama VW-1 y el método 1061 para alambre y cable sin goteo.

Se han obtenido estos resultados manteniendo una buena flexibilidad a bajas temperaturas, conservando adecuadamente las propiedades de resistencia a la tracción después del envejecimiento térmico, y también las excelentes propiedades eléctricas.

Los nuevos compuestos FR son ideales para cables flexibles, cables en espiral, cables para robótica, herramientas eléctricas, cables de alta flexibilidad, aplicaciones de baja temperatura y partes de conectores y componentes que requieren una clasificación V-0 de resistencia a la llama. Las propiedades de retardo de llama mejoradas de estos compuestos SBC se deben a las técnicas de formulación que modifican la viscosidad de la masa fundida y la formación de residuo carbonoso. ■

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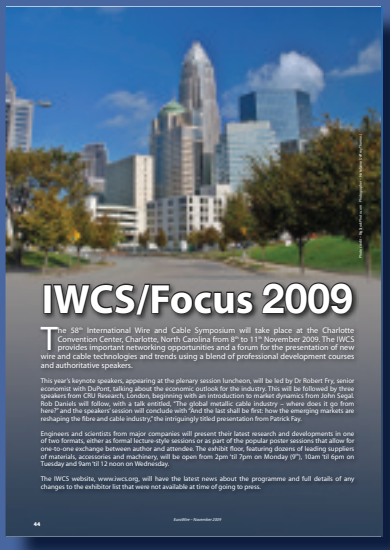

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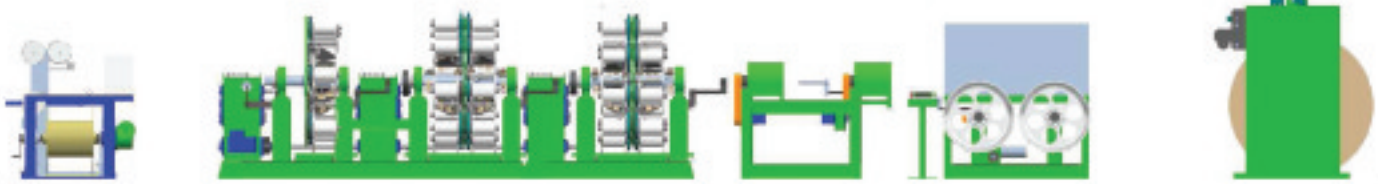

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