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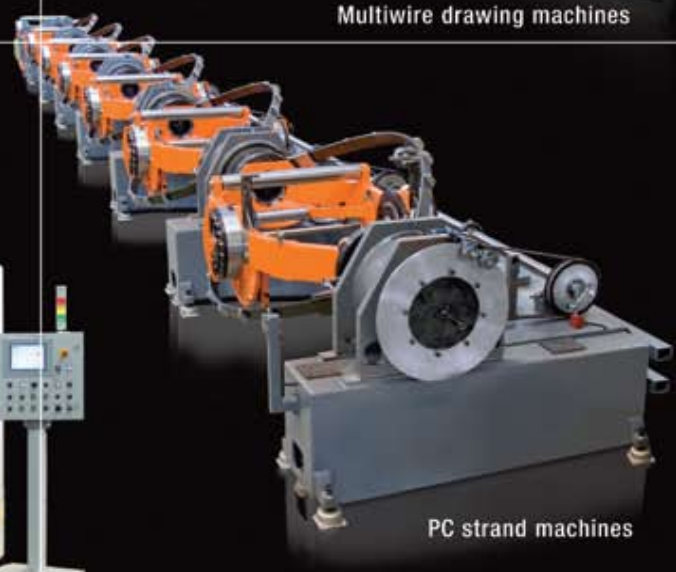
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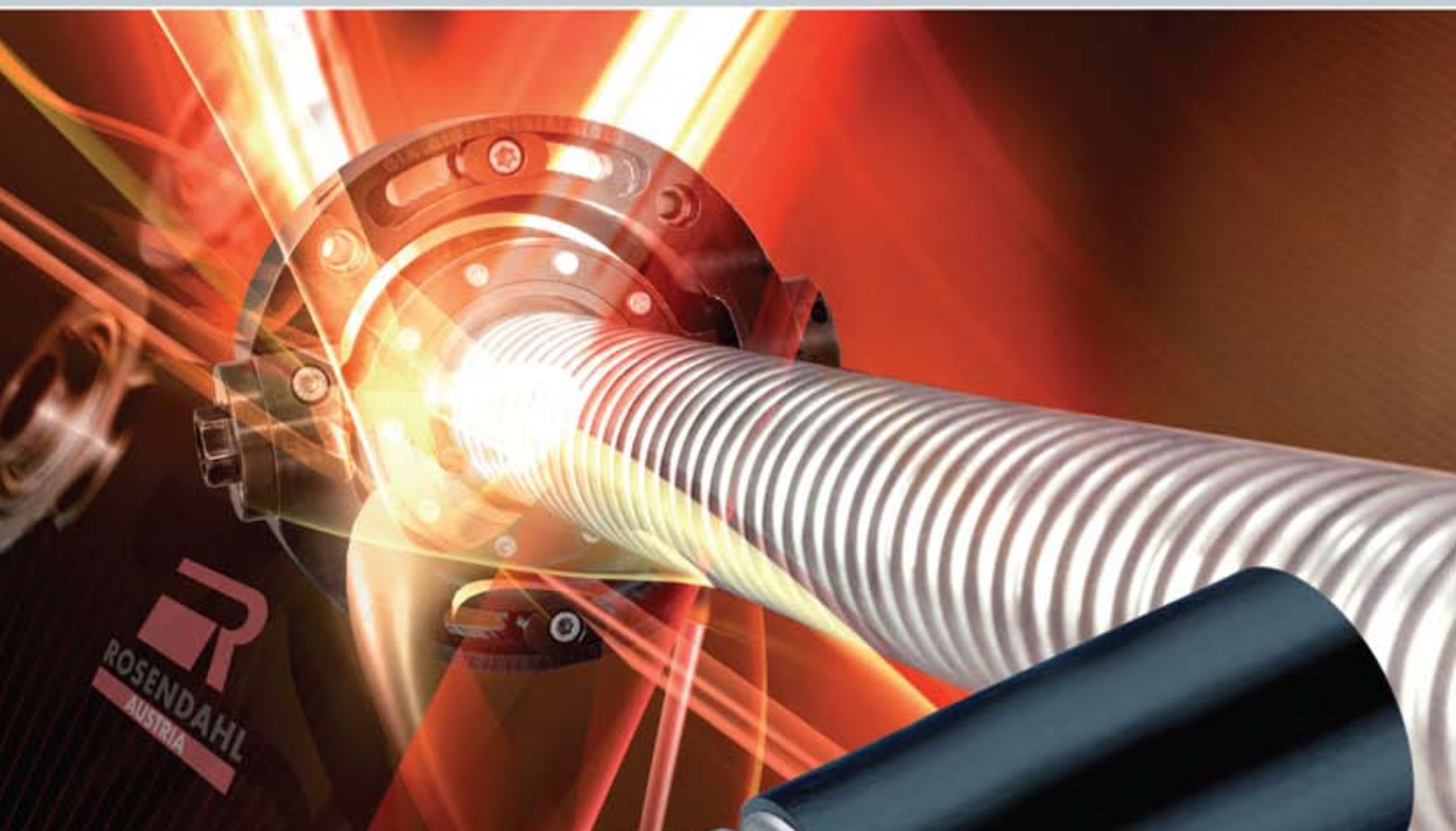
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Still a shining solution – fifty years on

We don't have to look very hard to find a fiftieth anniversary these days. In 2010 we've already celebrated fifty years since NASA's first meteorology satellite, the development of the copying machine, oral contraception and the launch of bubble wrap (originally intended as a decorative wall covering, but it didn't catch on).

Probably only one of those has genuinely changed the way we live (who ever thought they needed a copier?) but the latest half centenary is of an invention that touches everyone's life, and will continue to do so in ways we can't yet imagine.

When it was first invented, the now ubiquitous laser was accused of being a "solution looking for a problem" and the huge possibilities of this blend of optics and electronics weren't fully recognised. However, many different types of laser came along and, with them, the problems they could solve. Calcium fluoride and helium-neon lasers were followed in 1962 by the first semiconductor lasers, and these are now the most common type.

Semiconductor lasers can be small and inexpensive, and these are the lasers found in supermarket bar code readers, optical fibre communication networks and the humble laser pointer. However, it was a ruby laser that sent a beam to the Moon in 1969 (it was reflected back to Earth by a reflector placed by astronauts on the Moon's surface). Before long, lasers were received by telescopes to measure the distance to the Moon with a precision said to be within 3cms. Not bad over 384,403km!

More recently, lasers have become invaluable in medicine (eye surgery, just for a start), scientific instruments, in CD/DVD drives, for cutting steel or welding cars, or for accurately positioning the clusters of a robotic milking machine.

I'm told that laser (Light Amplification by Stimulated Emission of Radiation) is a misnomer, and that often a more correct title is Light Oscillation by Stimulated Emission of Radiation – LOSER.

Like the bubble wrap wall covering, that could never have caught on, could it?



Gill Watson

The International Magazine for the Wire and Cable Industries



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Front cover: **Wire & Plastic Machinery Corp**
See page 84 for further details

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contents

Technical Articles

50 **Improving the mechanical properties of non-halogenated flame retardant compounds**

By Jeremy R Austin,
Herbert S.-I Chao,
Sartomer Company

55 **Verbesserung der mechanischen Eigenschaften von halogenfreien flammenhemmenden compounds**

Von Jeremy R Austin,
Herbert S.-I Chao,
Sartomer Company

61 **Улучшение физико-механических свойств негалогенизированных огнестойких компаундов**

Джереми Р. Остин,
Герберт С.-И. Чао
(компания «Сартонер»)

67 **Amélioration des propriétés mécaniques des composés retardeurs de flamme non halogénés**

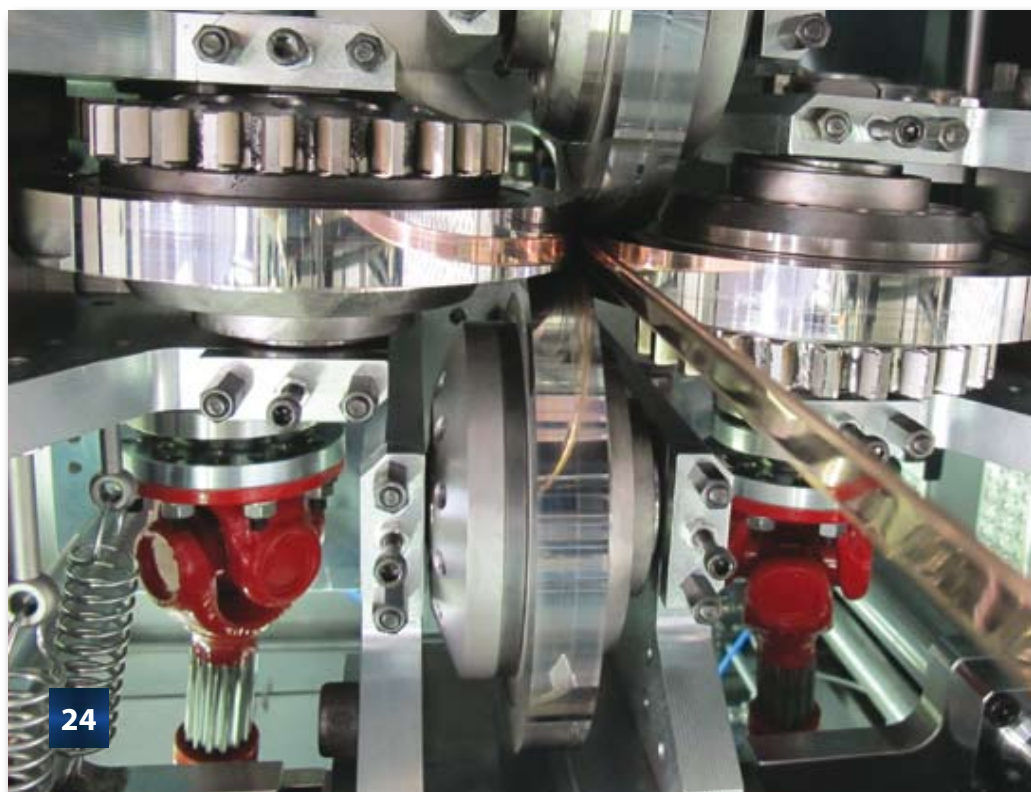
Par Jeremy R Austin,
Herbert S.-I Chao,
Sartomer Company

73 **Miglioramento delle proprietà meccaniche dei composti ritardanti di fiamma non alogenati**

A cura di Jeremy R Austin,
Herbert S.-I Chao,
Sartomer Company

79 **Mejoras de las propiedades mecánicas de los compuestos retardantes a la llama no halogenados**

Por Jeremy R Austin,
Herbert S.-I Chao,
Sartomer Company



Deutsch Inhalt

- 53** Neuigkeiten
84 Inserentenverzeichnis

Содержание на русском языке

- 59** Новости рынка
84 Перечень рекламодателей



45



- 8 Diary of events
- 9 Corporate News
- 18 Transatlantic Cable
- 24 Technology News
- 41 Feature:
Straightening,
cutting and welding
of wire and rod
- 45 Feature:
Re-conditioned and
second hand
machinery –
buyers guide
- 84 Editorial Index
- 84 Advertisers' Index



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In The Next Issue

Show issue
wire China 2010

Feature On

- Fibre Optic – machinery
and equipment

Getting Technical

Sustainability in the
development and
production of alloys
Ralf Hojda, Dr Michael
Köhler, James Schraml

Sommaire Français

- 65** Nouvelles du Marché
- 84** Index des Annonceurs

Indice Italiano

- 71** Notizie del Mercato
- 84** Indice degli Inserzionisti

Indice Español

- 77** Noticias de Mercado
- 84** Índice de Anunciadores

wire China 2010

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

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.com.sg

Website:

www.wire-southeastasia.com

2012

March 2012

26–30: **wire/Tube Düsseldorf** –
trade exhibition – Düsseldorf,
Germany

Organisers: Messe Düsseldorf

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Email: wire@messe-duesseldorf.de

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Association (ACIMAF)

- Austrian Wire and Cable Machinery Manufacturers Association (VÖDKM-AWCMA)
- International Wire and Cable Exhibitors Association - France (IWCEA-France)
- German Wire and Cable Machine Manufacturers Association (VDKM)

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▲ Visitor numbers may have been down, but exhibitors reported lively activity and keen interest

Exhibitors happy with wire Düsseldorf activity

Reports from Tube/wire Düsseldorf confirm a busy and optimistic show attracting international interest. At wire, 1,219 enterprises from 52 countries filled 52,000m² of exhibition space, corresponding to a 7.3% rise in exhibitor numbers.

"Wire is going well and customer interest is high. Almost everyone feels that business is picking up," was the view of Benedikt Niemeyer, CEO of Schmolz + Bickenbach, a global player in the steel sector.

Howard Fancher, of Huestis Machine Corporation, sensed interest and excitement for the future. "The wire Düsseldorf show was fresh and exciting with people focused on new technology and getting the best bang for their capital spending dollars.

"I am told that the [visitor] numbers were lower than previous shows, but you could not prove it by me. Our booth was swamped each day with eager customers looking to find equipment that is new and innovating, as well as giving them what they need to be successful in their business. I saw many

new, young faces trying to soak it all in and take away the best ideas to further their respective companies. I rate the show a huge success."

Visitors gave "very good" to "good" ratings for the events. Five trade fair days saw a total of 69,200 trade visitors come to the exhibition halls. The proportion of international trade fair visitors is traditionally high. wire was attended by 35,000 trade visitors from 70 countries, 63% of which were from abroad.

The majority of wire visitors came from the United Kingdom, France, USA, Italy, India, the Netherlands, Spain, Brazil, Turkey, Austria, Switzerland, Belgium and Poland.

wire 2012 will be held from 26th to 30th March 2012.

Messe Düsseldorf GmbH – Germany

Fax: +49 211 45 60668

Email: wire@messe-duesseldorf.de

Website: www.wire.de

3rd Wire Industry Day

The MV-Marketing Vertrieb Unternehmensberatung, member of the "netzwerkdraht e.V." (wire network) association of German wire manufacturers and their suppliers, held its third "Wire Industry Day" (Branchentag Draht) on 6th May.

Stefan Szkudlapski, netzwerkdraht secretary and manager of the MV-Marketing Vertrieb Unternehmensberatung, welcomed nearly 60 participants from the wire and wire-related industries.

The main topic was how wire manufacturers could increase their competitiveness, reduce costs and synergise their strengths. In his opening conference, Markus Mohaupt, industry analyst of the financial institute Industriekundenbank (IKB), emphasised that worldwide economic development is forced by Asia, particularly China, while the economic recovery from the current global financial crisis is far more moderate in Europe and North America. In order to remain competitive in view of new competition from upcoming nations and increasing raw material and energy costs, wire manufacturers must try to reduce or avoid superfluous costs.

Three workshops were held in which options and possibilities were discussed, including the modernisation of existing production equipment with new energy-saving drives. It was suggested that up to 70% of the energy consumption in a factory is used by electrical drives.

netzwerkdraht association – Germany

Website: www.netzwerk-draht.de

Website: www.branchentag-draht.de

IBA enters exclusive agreement with Dasheng

IBA has extended its offering by adding the Dasheng Electron beam accelerators to its portfolio of high current IBA Dynamitron® (formerly called RDI Dynamitron®). As of 1st April 2010, IBA will be the exclusive distributor of the Dasheng E-beam accelerators outside of China. IBA will also be responsible for providing installation and support services to Dasheng E-beam accelerator customers outside of China.

"Not only will this collaboration extend our IBA Dynamitron portfolio but Dasheng will also bring in the collaboration its expertise in cable and heat-shrink products, reel-to-reel under beam systems, irradiation process and related compounds," said Serge Lamisse, president of IBA Industrial. "Our customers will have access to both product lines. Dasheng E-beam accelerators are mainly targeted for R&D facilities or lower current applications, while the original IBA Dynamitron will focus on high current, high throughput applications," he explained.

Dasheng E-beam accelerators and IBA Dynamitrons are designed for both industrial processing and research applications. Wire and cable insulation crosslinking with electron beam improves cables insulation strength, durability and resistance. Every year, a greater percentage of automotive and aeronautics cables are treated with electron beam processing.

IBA Industrial – Belgium

Fax: +32 1047 5992

Email: industrial.eu@iba-group.com

Website: www.iba-industrial.com

New president for FTTH Council Europe

Chris Holden has been elected as the next president of the board at the Fibre to the Home Council Europe, becoming the fifth person to hold this position since the Council was founded in 2004. He replaces the outgoing president, Karel Helsen.

Since joining the FTTH Council Europe in 2005, Chris has been an extremely active member of several committees. In April 2008 he was elected as chairman of the development and operations committee, and in April 2009 as board member of the FTTH Council Europe.

In his farewell message Mr Helsen said: "The FTTH Council Europe can be proud of its achievements to date, with the yearly conference as its flagship event. This conference is now the biggest FTTH conference worldwide and stands in the spotlight of the international media.

"I strongly believe that fibre access will boost a whole suite of new services and applications. The strategy of the FTTH Council Europe 2015 reflects this development and I am sure that the council will be very successful in attracting new members from these industries."

FTTH Council Europe – Belgium

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Large-scale production of copper-clad steel wire in Asia

Fushi Copperweld Inc has announced the completed expansion of its Dalian facility to produce an additional 8,200 metric tons of production capacity per year for its patented Copperweld® copper-clad steel (CCS) wire.

"The completion of this major expansion of our production capabilities marks an important step forward in optimising our Dalian plant to meet our customers' demands for quality and response time," commented Joe Longever, co-CEO of Fushi Copperweld.

"The new Copperweld production lines, which utilise our industry-leading proprietary cladding technologies, signify the first large-scale production of copper-clad steel not only within China, but in all of Asia.

"The broadening of our product offering at our Dalian location to include CCS is a milestone for Fushi Copperweld because it will better enable us to serve additional worldwide growth sectors, such as transportation, electric utility, and telecom industries. We can now offer our customers in the Asia/Pacific region a locally manufactured CCS alternative to solid copper wire that is a higher quality and more cost effective product."

The additional CCS production capacity increases Fushi Copperweld's total annual wire and cable production at its

Dalian factory to 48,200 metric tons, nearly double the plant's previous capacity. Although the company expects to generate measurable sales in the fiscal year 2010 from its Dalian-produced CCS product, it anticipates that it will begin to experience the full benefits of the capacity addition in the fiscal year 2011, as it utilises 2010 to ramp up production quantities to facilitate the qualification process of its products with customers and further adoption of CCS within Asian markets.

Longever concluded, "We are very excited about broadening the market for CCS in Asia, and we are confident that the growth of Asia's utility, transportation and telecom infrastructure will fuel the emerging adoption of Copperweld for the transmission, distribution and earthing of electrical current by many major industry concerns. Our confidence stems from the fact that our CCS product has become a standard conductor for many applications in the West that will translate into Asia. The greatest impediment to CCS adoption in China has been the absence of a domestic producer.

"Now, for China and all of Asia, Dalian will be a convenient source of this technologically sophisticated material that serves as a stronger, more durable, and less costly replacement for expensive solid copper wire."


Fushi Copperweld – China
Website: www.fushicopperweld.com

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Niehoff opens new factory

On 7th April 2010, Maschinenfabrik Niehoff officially opened its new factory building in Schwabach, near Nuremberg, Germany, close to the company's headquarters.

The new facility has spacious shop floors with optimally designed workstations. The building enables efficient organisation of process flow, and includes the assembly department, paint shop, test rig and testing area, the packing and shipping department, offices, recreation rooms, building services and training workshops where Niehoff apprentices receive their technical training.

Production now has 170,000ft² more space than before, enough to sustain a throughput of 100 drawing lines a year. Another 15,000ft² on three floors is dedicated to offices and auxiliary rooms.

The 40ft high production areas, and the office and other rooms, have radiant heat ceilings and air-conditioning systems that ensure pleasant working temperatures, as well as a sensor-controlled natural lighting system.

The building meets low-energy standards, and features the latest in plant design, building management technology, and energy efficiency. The architecture, interior furnishings, geothermal heat systems, heat pumps, pneumatic system compressors, drives of production machines and other devices are designed so that energy consumption is kept to a minimum and the heat dissipated by the equipment can be recovered.

Dependent upon future business conditions, the company is planning a second phase of construction of another 80,000ft² of production area.



▲ The assembly area of Niehoff's new facility near Schwabach

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Contact: Mr. River Qi, Sales Manager

A success at any level

At this year's wire Düsseldorf Sikora AG displayed numerous newly developed measuring and control technologies for the wire and cable sector. On its two-level stand, Sikora experts explained the wide product portfolio of the company.

On the first level, Sikora introduced the latest technological developments such as the length measuring device Length 6000 and the new diameter gauge heads of the Laser Series 6000. The second level, in modern lounge style, offered a comfortable atmosphere for customer conversations.

Harry Prunk, CEO of Sikora AG commented: "Business activity is clearly increasing. Many companies are starting to invest again, in order to be optimally positioned on the market."

Sikora AG – Germany
Fax: +49 421 48900 90
Email: sales@sikora.net
Website: www.sikora.net



▲ Sikora's two-level stand at Düsseldorf this year

Solid leads from wire 2010

Pave Automation, which designs and manufactures high performance wire forming machines, found that wire 2010 exceeded expectations.

"The stand was busy throughout the show, and the fair proved an excellent opportunity to meet clients and make new contacts," said Pave's managing director, Tony Perna.

"We had a lot of visitors from Europe and the Baltic states, as well as from India, who were looking to acquire reliable, high output, low cost wire forming units for a variety of applications. The event provided an ideal platform to showcase our innovative, user-friendly touch screen technology, which reduces downtime and operator training costs, and we obtained some solid leads and requests for trial runs of our competitively-priced machines."



▲ Pave's stand at wire Düsseldorf 2010

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Website: www.ajexturner.com

Pave Automation Ltd – UK
Email: pave@enterprise.net

Fax: +44 1733 563500
Website: www.pave-wire.com

Chinese language website

UK-based continuous casting technology specialist, Rautomead Ltd, has announced the launch of a Chinese language version of its website in order to make its range of equipment for the casting of non-ferrous metals more accessible to the fast growing Chinese market.

The new website can be viewed at www.rautomead.net.cn

Guy Henderson, Rautomead's sales and marketing manager, commented: "The Chinese language website is hosted on a server in China and will facilitate access to product information to those using Chinese characters in their search engines. A Russian language site, hosted in Russia, has been active since July last year. Despite the economic situation there we have recorded an increased level of enquiries since that website went live."



▲ Rautomead goes live in Chinese

Rautomead Ltd – UK
Fax: +44 1382 622941
Email: sales@rautomead.com

Website: www.rautomead.com

Stand attracted visitors and sales

British company Pressure Welding Machines (PWM), designers and manufacturers of high performance cold pressure welding equipment and dies for the world market, reported excellent visitor traffic and sales at wire 2010.



▲ PWM's stand was kept busy, with high visitor traffic

Steve Mepsted, managing director of PWM, said: "Visitor traffic was much better and more consistent than we had anticipated and the quality was excellent. We noted a marked increase in the number of visitors from India, Iran and Turkey.

"Our large EP500 and P1500 rod welders attracted a high level of enquiries from manufacturers looking for a reliable, energy efficient method of welding large copper and aluminium rod sections. We sold the EP500 rod welder at the exhibition to a Brazilian wire and cable company, and have received orders for two more machines from Turkey. The P1500 machine was purchased by Solidal, a leading Portuguese producer of aluminium cables and conductors. The versatile portable models, especially the M101 and HP100, also proved popular with buyers.

"The show also generated a substantial number of positive sales leads which we are now following up."

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WCMA Distinguished Career award

Stanley Trykowski, a senior R&D chemist at plastic compounder S&E Specialty Polymers, received the Wire & Cable Manufacturers Alliance (WCMA) Distinguished Career Award during a ceremony at the Connecticut Convention Center in Hartford on 24th April.

In 1968, Mr Trykowski and two partners formed Lynn Plastics Corporation, a specialised PVC compounder, successful in penetrating the footwear and automotive industries. Several innovative products for these industries were developed by Mr Trykowski, including

heel and sole compounds for shoes and boots, and body side mouldings and windshield encapsulations for cars. After selling Lynn Plastics, instead of retiring Mr Trykowski joined S&E as a senior R&D chemist, and continues to lend his expertise and help the company test and develop new compounds. At 86 years young, Mr Trykowski still works three days a week at S&E as a senior research chemist.

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▲ Mr Trykowski receiving his award from Ed Fention, chairman of the WCMA

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CII and Messe Düsseldorf to jointly organise Wire & Cable India

The Confederation of Indian Industry (CII) and Messe Düsseldorf are to be joint organisers of Wire & Cable India, an important trade fair on the Indian sub-continent for this sector.

The agreement was signed by Mr Chandrajit Banerjee, director general of CII, and Mr Hans-Werner Reinhard, vice president of Messe Düsseldorf, Germany.

The organisers believe this move will provide a boost to wire and cable companies in India and worldwide. "Two leading trade fair organisers, pooling their strengths and expertise, make the platform even more attractive to international export-oriented companies to enter the Indian growth market," said Mr Banerjee.

Mr Reinhard welcomed the union as an excellent addition to Messe Düsseldorf's international trade fair portfolio. "The Indian market is becoming increasingly important for the wire and cable industry, primarily due to growth in the sectors of building and construction, automobile, aviation, energy, engineering and telecommunications," he said.

Wire & Cable India will be held for the third time from 18th to 20th November 2010. The previous show, held two years ago, attracted 223 exhibiting companies including 56 suppliers from Europe. The net exhibition space measured 3,600m² and drew 8,000 trade visitors from within India, South-East Asia and the Middle East.

The 2010 fair, to be held at the Bombay Exhibition Center in Mumbai, has already received bookings for large area options.

Messe Düsseldorf, with its subsidiary, Messe Düsseldorf India, will be responsible for bringing in exhibitors from all over the world. The founder of Wire & Cable India, CII, will remain the coordinating partner for Messe Düsseldorf and Messe Düsseldorf India, with a strong commitment to supporting visitor promotion in organising the international conference.

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Metals

Newly bold and sophisticated scrap metal thieves move well beyond stripping vacant buildings of copper plumbing

Writing from Pierce, Colorado, in the *New York Times*, Kirk Johnson devoted a paragraph to the skills set of the thieves who struck a local dairy farm. ("Metal Thievery Evolves, in Scale and in Technique," 14th May)

Start with the possession of a cherry-picker utility truck, which they apparently deployed to reach the tops of the 18-foot-tall poles bringing electricity to the farm. The thieves knew how to take down fully-charged electricity lines without getting killed; and then, the police said, had a big enough team to roll up hundreds of pounds of wire from the half-mile-long crime scene and make their getaway.

The case, still open, supports the view of law enforcement officials and insurance experts in the US that recent hard times, high commodity prices, and technology, in combination, are promoting improved methods of metals theft. Its greater profitability is a given. This spring, copper prices hit highs not seen since the summer of 2008.

What Mr Johnson calls the metabolism of the market for stolen metal has also accelerated. A senior investigator for the Harvey County Sheriff's Office in south-central Kansas, Jim Sauerwein, offered the *Times* his rule of thumb in tracing a metals theft these days: whatever is stolen will probably change hands as many as four times within 48 hours of its disappearance.

"Before, it was go check the pawnshops and scrap yards," said Mr Sauerwein. "Now it's picture phones, the Internet, and eBay."

New police tools for tracking stolen metal – hundreds of millions of dollars' worth per year, according to insurance industry estimates – are revealing the nimbleness of the new criminals, who display something of the derring-do of pirates. Last year, in Kansas, a huge trailer-mounted portable generator, with a Global Positioning System installed, was stolen from a construction site. The police were able to establish only that it was taken sometime over the weekend. By the Monday, according to data from the GPS unit, the rig was in Mexico.

"Heavy equipment, construction equipment, it all goes south," a deputy sheriff in Wichita told Mr Johnson. "That's the pattern we're seeing."

The scale of metals theft is also up. In May, when Mr Johnson filed his story, a man pleaded guilty in Federal District Court in Wichita to transferring and transporting up to \$1.1 million in stolen farm equipment from five states, including Wyoming (a 30-foot trailer), Nebraska (a John Deere tractor), and Oklahoma (a combine).

In Washington and California this past winter, thieves using metal-cutting saws raided fruit orchards, hacking out and carting away half-ton engines used to power wind machines that blow warm air through the trees to prevent damage from frost.

✱ According to a 2009 report by the National Insurance Crime Bureau, cited by the *Times's* Kirk Johnson, thieves will apparently stop at nothing. The NICB, an association of insurance and transportation companies with headquarters in Des Plaines, Illinois, said, "[They] have removed wiring from traffic and railway signals and even posed as utility workers in order to remove large sections of thick utility cable from sewers beneath city streets."

✱ Mr Johnson observed that scrap metal dealers are among those affected by the new wave of metal theft. To protect their own property, some dealers have recently installed 24-hour guards in their yards. Another concern is legal trouble stemming from the purchase of possibly stolen material, when metal in hunks or coils, or machinery in pieces, obviously resists efforts to establish its history. But Mr Johnson also noted that the police often have no better luck with farm or industrial machinery that is not broken up. A report from the fall of 2009 by the NICB and the National Equipment Register, a company that works with insurers, said that only 21% of the heavy equipment stolen in 2008 was ever recovered.

Magnitogorsk will not be coming to Ohio, after all

According to officials in Ohio, Russia's third largest steel company appears to have quietly backed out of plans, announced with considerable fanfare in late 2007, for a joint venture with a local company to build a steel mill in the southern part of the state. Magnitogorsk Iron and Steel Works, or MMK, was to have partnered with New Steel International, of the Cincinnati area, in the \$1 billion project. But a spokeswoman for the Ohio Department of Development, Kimber Perfect, has told the Columbus (Ohio) Dispatch, "We have not heard from MMK in some time."

Dan Gearino of the Dispatch wrote (14th May) that, as long ago as 2008, industry analysts had questioned whether the plant would ever materialise. The project, heralded as a sign of Ohio's return to its roots in steel making, was announced just as the decline in demand for steel was about to set in. If there is a bright side to MMK's withdrawal from the project, Mr Gearino said it lies in the interception of "a new rival" in a still-struggling sector.

Elsewhere in steel . . .

✱ Beckmann Volmer, the German manufacturer of steel components for wind turbines, already has operations in Poland and China and now has plans for a facility in the depressed Appalachian region of the US. The \$10 million plant to be built in Osceola, Arkansas, will produce turbine main frames – the "structural backbone" of the turbines. As reported in the Memphis (Tennessee) Business Journal for 21st May, the state of Arkansas is offering about \$4 million in incentives to Beckmann Volmer and will provide training for potential employees at local community and junior colleges. The company is a supplier to Nordex, also German, which is building a \$100 million turbine plant in Jonesboro, about 35 miles from Osceola. That facility is scheduled for completion by 2012.



✱ In a column on environmental issues – specifically, taconite mining as a major source of air, land, and water pollution – Karen Youso of the Minneapolis-St Paul (Minnesota) Star Tribune discussed the recyclability of stainless steel. According to the Washington-based trade association Specialty Steel Industry of North America (SSINA), all stainless steel products are 100% recyclable, with a recovery rate of between 60% and 85% typical. Many recycling companies will want the grade types of the scrap segregated (all 300 series together, etc), SSINA said. The International Stainless Steel Forum, based in Brussels, says that new stainless steel products are made from about 60% recycled stainless. While the dozens of steps involved in making stainless steel – from mining the ore to producing the steel – all consume energy, stainless recycling does not itself stress the environment significantly more than processes for recycling other steels.

Telecom

▶ Discuss: Those first in line to pay top price for a new electronic device perform a valuable service for the industry and the public

According to Apple Inc (Cupertino, California), first-month sales figures for its iPad tablet computer indicate that it sold more than twice as fast as the company's iPhone did when it was new. Apple said that it sold a million iPads in the US in the 28 days to 30th April, when the newer 3G model was delivered to its first buyers. That model can access AT&T's cellular broadband network. The units sold to that point had only Wi-Fi access.

Apple CEO Steve Jobs said on 3rd May that US demand for the iPad was still exceeding supply, but that the international launch of the device was set for 10th May. One person who could not wait is Sayuri Watanabe, who flew from Japan to be among the first to get an iPad when it became available in the United States. Her photograph in the *New York Times* shows a jubilant young woman flanked by beaming personnel of the Apple store in downtown San Francisco.

Why did Ms Watanabe do this, when the iPad was certain to reach Japan before long? Even more puzzling is why she paid top price when the iPad would be cheaper – and probably better – in a matter of months. The *Times's* Damon Darlin framed the quandary in stark money terms.

"A tough lesson about buying early could have been learned by the iPhone's first buyers back in 2007," he wrote. "Those early adopters paid \$600 for a phone. Two months later, Apple dropped the price to \$400. Then, in June 2009, it introduced a better version, with twice the storage, for \$200, one-third the original's price." ("Applause, Please, for Early Adopters," 7th May)

Mr Darlin collected the views of a number of experts, which need not detain us. Most were variations on the theme of enhancement of personal prestige through the early acquisition of a novelty in short supply. The most engaging explanation for this seemingly irrational behaviour was offered by a professor of behavioural economics, who told the *Times*, "I realized years ago that I derive great pleasure from buying a new gadget."

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✱ Another respondent, Jay Pil Choi, a professor of economics at Michigan State University, supports Mr Darlin's view that the telecom industry, and the buying public, should be grateful for the Ms Watanabes of this world. Mr Choi, author of a much-quoted treatise on herd behaviour and "the penguin effect," noted the value of the early adopters' service as guinea pigs for the rest of us. He contrasted them with consumers who strive for value and take the wait-and-see approach. In a marketplace dominated by persons of such little civic-mindedness, new products will either never take off or take much longer to succeed. Of the pioneers, Mr Choi said, "Their early purchase allows the firms to go down the learning curve and enables a lower price for other consumers."

▶ Juniper signals its intention of standing up to ever-stiffer data centre competition

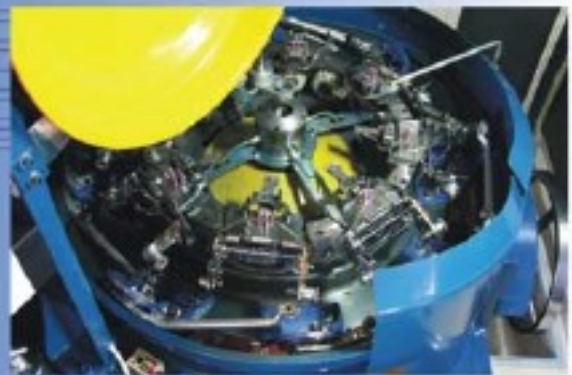
Jim Duffy, who covers service providers for networkworld.com, saw a very direct challenge to Cisco Systems and HP, among others, in the mid-May announcement by Juniper Networks (Sunnyvale, California) of switches and routers designed to flatten and simplify legacy networks.

In this view, the Juniper rollout takes aim at Cisco's Nexus switches and other data centre network wares, even as it sets the stage for Juniper's Project Stratus. This "converged data centre fabric" was unveiled in early 2009 but is still short of delivery by as much as a year. ("Juniper Seeks to Out-Virtualize Cisco in Data Centers," 20th May). Juniper apparently is set on distinguishing itself from other designers and sellers of high-performance Internet Protocol network products and services. Accordingly, the company's IP product line is organised around the virtualisation technologies in increasing use within the most computing- and networking-intensive sites. "Virtualization levels the network playing field," the Yankee Group analyst Zeus Kerravala told networkworld.com. "The vendor that solves that problem first has a huge upside."

The challenge for Juniper, according to Mr Duffy, is that Cisco (San Jose, California) has been targeting virtualisation from the networking side for several years. Server titans such as HP and IBM (a Juniper partner in Stratus) have been tackling it "from the computer side" even longer. "Meanwhile," Mr Duffy wrote, "Brocade [also in San Jose] points out that it has been building data center fabrics with partners for years and that Juniper remains vague about how it will support legacy storage networks." So the time has come for Juniper to deliver on the bold pronouncements whose timing was

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noted by networkworld.com: this spring, last fall at the New York Stock Exchange (NYSE), and over a year ago at the Stratus launch. But if Mr Duffy is holding Juniper's feet to the fire, he sees some promising signs. For one example, "Juniper beat Cisco in landing the NYSE account, a demanding environment in which latency cannot be tolerated when billions of stock market trades are executed daily."

Automotive

▶ On a former Toyota-GM site, Toyota-Tesla will explore the 'infinite possibility' of Tesla's electric-car technology

Toyota Motor Corp is acquiring a \$50 million stake in Tesla Motors, Inc, the Palo Alto, California-based designer and manufacturer of electric vehicles and power trains, and will develop EVs with Tesla. Governor Arnold Schwarzenegger said on 21st May that Tesla is buying a shuttered factory in the Silicon Valley city of Fremont, in the San Francisco Bay area, to build its Model S and other cars. The companies are to cooperate on EV development, parts and production systems, and engineering support.

Tesla will revive the New United Motor Manufacturing Inc plant, known as NUMMI, a 25-year joint venture between Toyota and General Motors that came to an end in April. The deal will create 1,000 jobs immediately, Mr Schwarzenegger said, and more jobs later on. As reported by *Bloomberg News*, the announcement of Toyota's investment came as Tesla, which notably sells the \$109,000 Roadster electric sports car, prepares to launch an initial share sale to raise some \$100 million. "I've felt an infinite possibility about Tesla's technology," said a surprisingly rhapsodic Akio Toyoda, chief executive of the Japanese auto maker founded by his grandfather. "By partnering with Tesla, my hope is that all Toyota employees will recall that spirit [of the Toyota-GM venture]."

Patrick May, of the *San Jose Mercury News*, collected other lyrical passages on the Tesla-Toyota initiative. "This is like Christmas in May," said one respondent. Another said, "In a great big hurry, our fortunes have changed." Mr May contained himself: "Fremont's back on its feet," he wrote. "Or at least up on one knee." ("Resurrection of NUMMI Auto Plant by Tesla and Toyota Lifts Spirits All Over Fremont," 22nd May)

* If the wish of its mayor that Fremont become the electric car capital of the US is to be fulfilled, Tesla must overcome competition from General Motors, Nissan, Ford, and even Toyota. Bloomberg noted that Tesla, which lost more than \$230 million while it was selling some 1,000 Roadsters, is using the share sale and a \$465-million government loan to help produce its lower-price electric sedan. The company has said that a federal tax credit will enable it to offer the Model S for less than \$50,000. Tesla founder-CEO Elon Musk – who also founded the online payment company PayPal – had spent more than \$70 million on Tesla up to May 2009, when German automotive giant Daimler acquired nearly 10% of the company. Mr Musk said at the time that Tesla would supply Daimler with battery packs for use in its own electric Smart car.

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The economy

▶ More freely spending consumers and businesses help push up the US growth rate, bolstering hopes of a sustainable recovery

Because consumer spending makes up more than 70% of the US economy and is the customary driver of growth during economic recoveries, the spending habits of the average American are of more than sociological interest. Would the hard lessons of the burst real estate bubble and the ensuing recession create a new class of prudent, even pinchpenny, citizens? Fortunately for the health of the national economy, the most recent report from the Commerce Department suggests that the answer is no. The broadest measure of the overall economy shows growth at an inflation-adjusted annual rate of 3.2% in the first quarter of 2010, Commerce reported on 30th April. Growth expanded 5.6% and 2.2% in the fourth and third quarters of 2009, respectively.

Americans stepped up their purchases of cars and other products in this year's first quarter, and companies invested more in capital goods. Business purchases of equipment and software grew at an annual rate of 13.4%, building on a 19% increase in the last quarter of 2009. For the first time in two years, businesses started increasing their stockpiles of goods, and this inventory growth accounted for about half of first-quarter expansion. In the previous quarter, about two-thirds of economic growth resulted from the decision by companies to draw down their inventories more slowly. Unfortunately, employment is proving stubbornly resistant to the improving trend. Speaking at the White House on the day the Commerce Dept report was released, President Barack Obama acknowledged that many Americans would not be buoyed by the good news. The president said, "You're hired" is the only economic news they're waiting to hear."

▶ With fewer Americans falling behind on debt service, the recovery approaches the last redoubt of the recession

Daniel Gross, who writes the Moneybox blog for the online current-affairs magazine Slate, began a recent analysis of the most damaged segment of the American economy – consumer credit – by citing the accounting maxim "First in, last out." In his view, this applies to the economic recovery under way in the US and explains why credit, "the sector that led us into the mess," has remained in recession longest. But now, nearly a year into the overall economic expansion, Mr Gross sees tentative signs of improvement coming to the world of consumer credit. ("Giving Credit Where Credit Is Due," 19th May). That would be good news indeed, since another axiom has it that an increase in the buying power of the average consumer exerts a beneficial ripple effect upward and outward. But Americans have been constrained in their spending by personal debt, especially in its biggest component – residential mortgages. Data on the first quarter of 2010 from the Mortgage Bankers Association found a rise in the mortgage delinquency rate to 10.06%, up substantially from both the last and first quarters of 2009.

However, other data noted by Mr Gross suggest that the foreclosure wave is beginning to ebb. According to Shaun Donovan, secretary of the Department of Housing and Urban Development, new foreclosure filings were down 27% in April 2010 from April 2009. "We're not out of the woods," Mr Donovan told reporters in early May, "But where we are today is remarkably different from where we were 15 months ago."

RealtyTrac reported an April drop in foreclosure filings of all types of 9% from March 2010 and 2% from April 2009. In confirmation of Mr Donovan's claim that the pace of foreclosure initiation is declining, the online marketplace for foreclosed-property listings said, "[In April] a total of 103,762 properties received default notices, a decrease . . . of 27% from April 2009 when default activity peaked at more than 142,000."

Moneybox also spotted improvement in another problem area. TransUnion reported that the delinquency rate on credit cards (the percentage of borrowers who are more than 90 days late in their payments) fell to 1.11% in the first quarter of 2010, down from both the first and last quarters of 2009. Average balances fell, as well. Mr Gross observed that at least some of the improvement could be ascribed to the banking practice of writing off debt as uncollectible when borrowers are 180 days late. But here again he saw hopeful signs. Capital One Financial said that in April these charge-offs fell to \$451.7 million, or 9.68% of balances, from \$510.9 million, or 10.87%, in March. Capital One also reported that the delinquency and charge-off rates for auto loans fell in April from March.

✱ Mr Gross, who is also the business columnist for *Newsweek*, cautioned against making too much of a single month's data which, even if they mark a trend, may be modified by other forces. Even so, more borrowers are staying current with their repayment obligations. Sooner or later this will mean more discretionary money in the pockets of people whose spending habits signify importantly to the US economy. While a return to profligate spending is hardly to be recommended, a judicious loosening of the purse strings is a welcome turn of events.

In brief . . .

✱ Whether for economic reasons or from personal preference, workers at the extreme of an aging US labour force are staying on the job longer. While the number of employed Americans age 75 and over is still small (less than 1%), according to the US Bureau of Labor Statistics these ranks grew 188% between 1977 and 2009, the most dramatic increase among any age group. Deborah Russell, who directs workforce issues at the American Association of Retired Persons (AARP), said the assumption that employees will step down at the traditional retirement age of 65 is changing as people have to work longer or want to work longer. Ms Russell told the *Boston Globe*, "It's a trend that's continuing to grow." ("They're Just Not The Retiring Type," 22nd May)

✱ The back-to-back G8 and G20 meetings in Canada in late June will have taken place over three very expensive days. As reported in the *Toronto Star*, taken together the two summits represent the largest security event ever on Canadian soil. While organisers would not disclose costs beforehand, eight years ago the two-day G8 in Kananaskis, in the Canadian



province of Alberta, cost the government at Ottawa \$300 million, with \$1.1 million spent on armoured vehicles alone. Assuming identical costs in Huntsville, a picturesque town in the District of Muskoka, hosting the leaders of France, Italy, Germany, Russia, Japan, the United States, and the United Kingdom for the day and night of 25th June 2010, works out to about \$12.5 million per hour. Originally, the G20 summit also was set to take place in tiny Huntsville (population 18,000), but the larger June 26th to 27th meeting – attended by finance ministers and central bank governors – was moved to Toronto’s Metro Convention Centre.

Finance

An ill wind for Goldman Sachs blows balmy in Asia

Asian banks are likely to benefit from the fraud charges brought against Goldman Sachs Group Inc in the United States. Reporting from Singapore for Business Week, Jonathan Burgos observed that bank shares in China and India – which have outperformed global rivals by about 30 percentage points since the New York-based brokerage house Lehman Brothers filed for

bankruptcy in September 2008 – seem well positioned to extend their advantage. The US Securities and Exchange Commission (SEC) sued Goldman, a huge global investment banking and securities firm, on 16th April. (“Goldman Probes Enhance Allure of Asian Banks,” 21st April). “Asian emerging-market financial stocks will continue to outperform,” Mr Burgos was told by Khiem Do, the Hong Kong-based head of multi-asset strategy at Baring Asset Management (Asia) Ltd, which oversees \$11 billion. “There’s a lot less volcanic eruption in Asian financials compared with Western financials, which face increasing regulation and sovereign-debt issues.”

“Asian banks in general have more healthy balance sheets, and their loan growth so far has been recovering quite well versus still-negative loan growth in US and European banks,” said Grace Tam, vice president of investment services at JPMorgan Asset Management Ltd, also in Hong Kong. Ms Tam’s unit manages about \$102 billion in Asia-Pacific assets. Ironically, much of the strength of the Asian banks derives from the financial crisis triggered in 1997 by plunging currencies that forced Indonesia, Thailand and South Korea to seek International Monetary Fund aid. The crisis also reinforced the importance of fiscal prudence in banking. As a result, Asia’s emerging-market countries have about \$3.7 trillion in reserves, almost half the global total.

Dorothy Fabian – USA Editor



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▲ Fuhr copper wire line in action at Düsseldorf

Copper wire line launched at Düsseldorf

Fuhr GmbH & Co KG chose wire Düsseldorf to introduce its latest development for the production of high-precision rectangular copper wire. Its largest-ever booth (over 1,000ft²) allowed Fuhr the opportunity to display an entire rolling mill, capable of processing copper wire in real-time from round to rectangular with tolerances of ± 0.005 mm with excellent surface quality and material properties.

The company reports that a large number of visitors came to watch the operational capability of the machines and observe the quality of the final product.

Featuring a combination of a horizontal spooler (payoff), a two-high rolling machine (WSR-type), two edge-rolling devices (WSE), two Universal Turks Head (WST) rolling machines, as well as two combined dancers, three Vollmer measurement systems and an oscillating spooler, this very compact rolling mill is thought ideally geared towards the production of high-precision rectangular copper wires (such as CTC) or copper flat wire, such as PV ribbon (interconnect wire and bus bar).

In general, applications for CTC cables are windings for transformers, motors and generators. Furthermore, high-precision rectangular copper wires with small cross-sections are being used for high-efficiency hybrid motors and wind generators. With the emergence of CTC cable and its related applications, required tolerances for these rectangular wires have been reduced to ± 0.005 – 0.01 mm, which cannot be achieved with traditional cold rolling technology.

Fuhr's concept and layout of its wire rolling machines offers a rolling mill capable of processing copper round wires into a wide range of rectangular and flat shapes, achieving width to thickness ratios of up to 40:1.

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Powering up the extrusion process

The Sampingranaggi division of SAMP SpA has introduced a series of four new, water-cooled extruder drives. The compact Powerpack™ drives are designed for easy 'plug and play' integration with single- or double-screw extruders on MHV extrusion lines.

The torque servo motors of the new drives run at low speeds with the highest torque rates. The drive is short and compact, while the axial construction allows a better force distribution in the work direction. Power input is directly transferred into torque performance, so the units use less energy to produce maximum performance.

The torque motor axis is located directly on the shaft of the speed reducer, minimising the number of joints within the drive and eliminating belts and other wear parts. The direct power transmission has no couplings and no vibrations; the drive operates at less than 70 dBA.

Particular attention is given to the quality of the bearings and gears. The thrust bearing life is said to be 50,000 working hours at 700 bar – double the lifetime expected of an off-the-shelf solution and incurring less downtime for maintenance or bearing changes.

Gears are made in-house to tight tolerances, manufactured for reduced friction.

SAMP SpA – Italy


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▲ SAMP's Powerpack extruder drive (photo courtesy Rene Tillman, Messe Düsseldorf)

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Optical length and speed measurement

In highly automated production processes, length and velocity data are required for many purposes. For instance, measurement of operational throughput delivers essential data to control process parameters. In the manufacturing of piece goods an automatic start and end recognition mechanism enables an autonomous length measurement.

For a variety of materials, especially those that are hot, elastic, highly sensitive or dough-like, it is impossible to use tactile sensors such as odometers or tachometers.

The accuracy of a mechanical sensor system is also reduced by slippage, which in practice can lead to measuring errors of 10% or more.

In both cases, non-contact optical metrology provides significant benefits. With the Speel 3000, Zumbach offers a high-tech gauge that can be used for a wide range of applications requiring accuracy at very high velocities.

The Speel 3000 is available for a measuring distance of 300mm and achieves an accuracy of 0.05% or better. The measured length is transmitted to subsequent electronics using an industry standard incremental interface. As an alternative, a synchronous serial interface (SSI) is also available.

In addition, an electrical output signal compatible with common incremental encoders is available and can be directly connected to control systems, electrical counters, or frequency inverters.

The main features of Speel 3000 include:

- Speed range up to 3,000m/min
- Detection of standstill
- Detection of direction
- Start and end recognition
- Allows deviation of the measuring distance
- Suits smooth and rough surfaces
- Long life LED illumination
- Maintenance free



▲ Non-contact length measurement from Zumbach

Zumbach Electronic AG – Switzerland
Fax: +41 32 356 0430
Email: sales@zumbach.ch
Website: www.zumbach.com

Web guiding system

The FMS-webMASTER 040 series of steering frames and the new BKS309 web guide controller form a sophisticated web guiding system for even the most demanding applications including unwind and rewind stations on extrusion, coating and laminating lines, and intermediate splicing, packing or printing stations.

The FMS tradition of providing low cost-of-ownership solutions is continued with the FMS-webMASTER 040 series web guides. The steering frames of this large web guide family are available with roller-spans of 600mm to 2,000mm. Standard features such as a stepper motor drive (no brushes), a robust ball screw and spindle assembly (preloaded to eliminate backlash) with lifetime lubrication, and oversize ultra-low-friction sliding guides form the basis for years of operation. Signal processing and controlling tasks are fully digitalised, resulting in a fast 1 millisecond cycle time and thus the ability to succeed in applications where higher web speeds prevail.

The BKS309 controller is available in wall, DIN rail, and panel mount versions, and a single cable provides both power and control interfaces between the steering frame actuator and the controller. The controller is equipped with an Ethernet interface.

All products from FMS are designed as plug and play units, and all functions can be configured using the user-friendly control panel or a PC.

FMS Force Measuring Systems AG – Switzerland

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Email: info@fms-technology.com

Website: www.fms-ag.ch

Breakthrough in breakdown technology

Headlined as "Rod breakdown with breakthrough technology," Sampsystemi launched the RBL 1 at this year's wire Düsseldorf. The RBL 1 design includes continuous, high precision process control that saves energy and materials.

Working with copper or aluminium alloys, the RBL 1 rod breakdown line will handle between 9 and 17 drafts of 1, 2 or 4 wires at speeds up to 40m per second. Wire elongation per draft is fully variable and selectable.

The inlet diameter for copper wire is 8mm–10mm, or 9.5mm–12.7mm for aluminium alloy; the outlet diameter is between 0.88mm and 5.5mm for copper, and 1.25mm–5.5mm for alloy.

Advantages of the RBL 1 over existing technology are said to include:

- CNC process control
- Diameter or conductivity operation modes
- 30% less energy consumption
- Quieter running, less than 80 dBA
- Oil-free, direct drive technology
- Operator-friendly supervision and diagnostics systems
- Remote control via Internet connection
- Requires no preventative maintenance

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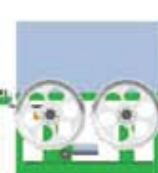
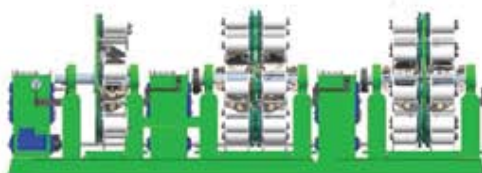
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Wire Stranding Machine



World's largest reeling cable order for cranes



Cable manufacturer and supplier Tratos Ltd has won what is believed to be the largest order in the world for reeling cable for high-speed cranes. The Tratosflex-ESDB cable is to be used in 38 ZPMC cranes at the latest Busan Port terminal in Korea.

Busan Port is the world's fifth busiest container port and largest trans-shipment port in North East Asia. Equipment in use at the port includes the latest generation high-speed container cranes, which operate at speeds up to 300m per minute.

Tratosflex-ESDB has been designed to combat the common problem of twisting that affects cables reeling at high speeds. Twisting makes cable cores elongate unevenly so conductors on the outer layer of a strand are at greater risk of damage. A broken cable reeling at high speed is dangerous, and can cause extensive and costly damage to equipment.

Tratosflex-ESDB is different from other reeling cables available in that Tratos engineers have modified the internal cable design, tightening the structure against the internal relative movement to accommodate high-speed applications.

A medium-voltage rubber insulated and sheathed drum reeling cable, Tratosflex-ESDB operates in temperatures from -20°C to $+60^{\circ}\text{C}$.

Tratos Ltd – UK

Fax: +44 1246 858001

Website: www.tratos.co.uk

Dry cable offers advantages

Totally dry cable designs are said to offer benefits in terms of cable preparation time and fibre-splicing costs. In conventional cable designs a gel is used to achieve water tightness. In dry tube cable designs, the gel is replaced by swelling materials such as super absorbent powders (SAP).

An important process parameter in the buffering process is to control the excess fibre length (EFL). Replacing filling gels with super absorbent powder results in EFL increase. The invention of the so-called clenching process within the newest generation of high-speed loose tube secondary coating line RL-R/OFC40 buffering lines support a precise EFL control, even on small dimension products.

The clenching concept compensates the EFL increase, since low EFL is required for the production of compact, dry loose tube fibre optic cable (FOC) designs. A clenching caterpillar, installed in front of the mid-span capstan inside the tube cooling section, ensures a very low tube tension during the tube crystallisation process. This also results in less post shrinkage (REL) of the produced buffered tube.

The clenching caterpillar NCA 210 has to meet specific demands of long-term stability within a challenging environment. Recent design improvements ensure a long-term reliability of the production process. The clenching caterpillar NCA 210 is also suitable for the upgrade of existing Nextrom OFC40 and Rosendahl RL-R buffering lines.

The production of loose tubes without jelly filling can cause tube diameter variations and collapsing of the tube after the extrusion head. In order to obtain a uniform tube dimension the diameter of the tube is controlled by the injection of pressurised gas into the tube. To avoid friction between optical fibres and



▲ Rosendahl's patented clenching concept for dry cable production

the plastic tube, a tube lubricant can be added. Water tightness of the tube is achieved by using super absorbent powders as swellable powder or in yarn form.

The key characteristics of the patented clenching concept are:

- Integrated EFL process control system for both jelly-filled and dry buffered tubes
- Tube diameter control system
- Specific clenching caterpillar design to cover demanding surrounding conditions
- Modular concept also suitable for the upgrade of existing buffering lines

Rosendahl Maschinen GmbH – Austria

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Email: office@rosendahlaustria.com

Website: www.rosendahlaustria.com



▲ Combined drawing lines from SAS

Combining advanced technology with service

SAS Engineering & Planning was established in 1973, primarily to carry out maintenance and refurbishment projects, but by the end of the 1970s had widened its area of activity to include modification and improvement of wire drawing lines.

During the 1980s SAS established a technical department to design technically advanced solutions, and now over a hundred of SAS's flexible combined drawing lines have been supplied worldwide.

The SAS combined line can include the most advanced accessories to obtain a totally automated process: payoff group, pre-straightening device, draw bench, chamfering machine, bundle strapping, weighing and handling.

SAS will be exhibiting its newly developed peeling machine at Messe Düsseldorf China's wire China 2010, to be held in Shanghai in September.

SAS Engineering & Planning Srl – Italy
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Sheathed cables without the lead

Nexans has developed its new Hypron® range to provide an environment friendly alternative to lead-sheathed cables for onshore power, control and instrumentation applications in the oil and gas industry. The Hypron design offers exactly the same protection against aggressive petrochemicals as traditional lead-sheathed cables, with the added advantage of improved ease of handling and installation thanks to its lower weight and smaller cross-section.

All types of cables used in the onshore oil and gas industry require protection against chemicals – acids, bases, aliphatic and aromatic hydrocarbons – that can penetrate towards the conductors. Traditionally, a lead sheath has provided this protection. However, in response to the growing market demand for more environmentally friendly cables, Nexans undertook a five-year programme to develop a new lead-free chemical barrier in the form of Hypron.

In general, Hypron complies with IEC 60228 and also meets other international standards such as IEC 60502-1 for low voltage and BS EN 50288-7 for instrumentation cables. Hypron comprises three co-extruded construction elements: AluPE, an HDPE

(high density polyethylene) sheath and a PA (polyamide) sheath. The AluPE layer is an aluminium-coated tape, applied longitudinally, that provides a watertight seal. The HDPE sheath provides the resistance to inorganic chemicals such as chlorine, and the PA sheath provides resistance to organic materials such as benzene.

Hypron has been fully tested to prove its suitability for a wide variety of applications – including MV (medium voltage) and LV (low voltage) power as well as control and instrumentation – when exposed to aggressive chemicals as well as temperatures ranging from -20°C to +60°C.

Hypron cable is significantly lighter than lead-sheathed cables – over 40% lighter in the case of an LV cable with 12 copper cores – so is easier to transport, handle and pull into cable ducts.

A further advantage is the cost savings of up to 25% due to the continually rising costs of lead.

Nexans – France
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Uninterrupted cable production lines



▲ Strandshield 2000

Short interruptions of the inner semiconductor (strand shield) during production of medium voltage cables are abnormal occurrences that can occur periodically in very thin insulation layers. In the best-case scenario they are detected at a discharge test.

However, if such faults are detected by the end-user the costs can be tremendous.

With the Strandshield 2000 Sikora has developed a system to detect and report any short interruptions of

the semiconductor during the cable production process. With this method, the measuring system is installed in a separate short cooling trough after the CV-line. It detects the shortest interruptions with a length of 100mm.

The Strandshield 2000 is a useful tool for active quality control of the production line.

Sikora AG – Germany
Fax: +49 421 48900 90
Email: sales@sikora.net
Website: www.sikora.net



Wire lubrication system for frictionless drawing

Advertorial on behalf of Decalub

The system revolutionises the wire drawing process, benefiting from unique PDH multi-function technology, enabling an automatic control of lubrication crucial parameters (pressure/temperature/viscosity), including lubricant injection speed and lubricant thermal stability. In operation, all these parameters communicate together in a sensitive and automatic multi-way interaction, performing: (a) a high-density strongly adherent anti-wear multi-layer coat for high carbon wire (0.88–0.90%C), deposited in 5–10 microseconds, and (b) a nano-layer coat for plating wire.



▲ Wire rod lubrication by PDH system

The critical aspects of lubrication are presently greatly simplified and some virtually eliminated, such as friction and wear. Instantaneous wire rod dry coating, operating with no speed limit, at zero energy consumption (self-generated by the PDH unit), enables automatic control of liquefied lubricant thermal stability, a vital parameter that prevents metal-to-metal contact at the wire-die interface and permits the highest frictionless drawing speed with a unique wear performance of about 0.1–0.3 micron per ton of wire drawn in the last draft, and 200 tons per die in the first draft.

Spring wire is drawn from mechanically descaled bare rod, without pre-coating chemicals, at 18m/s (3,600ft/min); 5.5mm 0.72%C rod drawn to 2.35mm at 16m/s (3,200ft/min); 10.5mm 0.88%C rod drawn to 4.22mm at 9m/s (1,800ft/min).

In the LVC version, used in the first draft, the PDH system eliminates conventional wire rod wet preparation, including phosphate and borax pre-coating chemicals. The result is lower cost, improved wire quality and environmental benefits. The PDH unit is compact, and easy to install and use.

Decalub – France
Email: info@decalub.com

Fax: +33 1 6020 2021
Website: www.decalub.com

Touch & Form

The new FRX04 wire forming and spring manufacturing machine by Numalliance is faster and sleeker than its forerunner, released in 2008.

“This servo-driven 7-axis machine takes advantage of its tooling, gives endless bending capability and almost deletes tooling costs for prototyping and machine series,” explains Jean-François Counilh, CTO of Numalliance.

“The complexity of the movements allowed by the human machine interface Touch & Form generates a virtual 8th axis for the cut.”

The FRX04 covers a wide range from 0.03" to 0.16" (0.8mm to 4mm). With the option of a laser probe and external cutter, the machine is capable of producing parts with loops on both ends. “The new FRX04 received a warm welcome during the wire and tube show in Düsseldorf,” adds Joël Etienne, CEO of Numalliance. “We are excited about its future applications on the market.”

Numalliance – France
Fax: +33 329 584647
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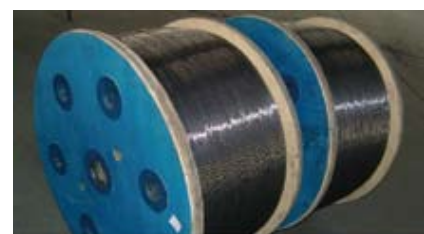


▲ Touch & Form from Numalliance

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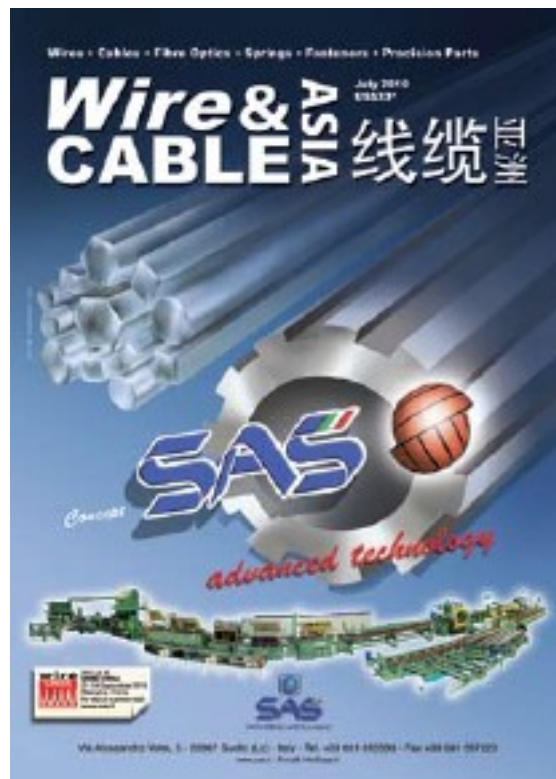
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A choice of payoff and take-up stands

PS Costruzioni Meccaniche is a worldwide company, designing and manufacturing cable packaging, rewinding lines, payoff and take-up stands.

The company produces two types of PS payoff and take-up stand.

The portal type is available in various models, to suit the dimensions of the reels used.

It is normally used for heavy reels, with diameters from 1,600mm to 3,000mm.



▲ Cantilever type with hydraulic pistons

The reels are lifted using motor gearboxes, while the lifting and closure of the pintles uses a motor gearbox with an electrical and mechanical torque limiter.

Portal payoffs are housed on tracks and have a lateral movement, which facilitates the lifting operations. The payoff can also work as a wire guide. It is suitable for smaller reels (diameters from 400mm to 1,250mm).

The cantilever type features hydraulic pistons for easy reel lifting while the closure of the pintles can be either pneumatic or hydraulic. Both the portal and the cantilever type are equipped with AC winding/unwinding motors.

PS Costruzioni Meccaniche Srl – Italy

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▲ Portal payoff for use with reels

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Twist-free wire from coil, with Micro-Mac

Designed to produce twist- and mark-free finished form products quickly and accurately from coil, Pave's Micro-Mac machine can process wire up to 6mm diameter and 2,600mm long (or longer, on request).

Micro-Mac incorporates Pave's Trueline front end wire stabiliser and patented straightening system for production of evenly stressed, twist-free wire. The competitively priced Micro-Mac offers exceptional wire straightness (within 0.1mm over 1,000mm).

Programmed via touchscreens with animated icons, the Micro-Mac is quick and easy to operate, reducing operator training and supervision costs. The machine has ten programmable bending speeds, up to 0.5 seconds for 180 degrees, and can be programmed to produce three-dimensional shapes. Set-up and tool changeover times are very fast, and the Micro-Mac's fully automatic CNC operation ensures economical production. Repeatability on bend angles is ± 0.05 degrees, and the machine offers variable carriage speeds up to 80m per minute, with positional tolerance 0.01mm from datum.

All Pave's wire forming machines are designed and manufactured in-house at the company's production facility in England, which incorporates a specialist machine shop and fabrication unit. The current range includes single- and twin-head wire forming centres for a broad range of applications.

Pave Automation Ltd – UK
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▲ Micro-Mac for twist- and mark-free finished form products

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Comprehensive range of wire equipment

Sheng Chyeon has established many cold processing lines in the domestic and international market, including Germany, USA, China, Russia, India, Turkey and the Middle East.

Following a policy of continuous development, Sheng Chyeon is involved with ferrous and non-ferrous metal fabrication, and can meet the individual needs of national and international customers. The company uses high quality parts and materials, and machines are designed with higher tolerances for improved machine durability. Faster processor units and software are employed to ensure the machine's ease of use.

Sheng Chyeon products include:

- Drawing line
- Combined drawing machine
- Chain type draw bench
- Flat rolling mill machine
- Peeling machine
- Chamfering machine
- Straightening machine
- Shot blasting machine
- Swaging machine
- Pointing machine
- Auto straightening machine
- Polishing and grinding machine
- Portable hydraulic electric steel bar cutter and bender

Sheng Chyeon's combined drawing machines offer all related devices in processing line, for example coil opener, section straightening machine, straightening and polishing or shot blasting unit.



▲ Sheng Chyeon combined drawing line

Sheng Chyeon Enterprise Co Ltd – Taiwan

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Medium voltage cable conducts record current

Nexans' superconductor specialists have concluded the Endesa Supercable project while setting a new world record. In December 2009, the single-phase, medium voltage cable (24kV) carried 3,200A in laboratory conditions, almost 10% more than any installed medium voltage cable worldwide. During ten load cycles of 24 hours the rated current was applied for 8 hours per cycle while the cable was subjected to twice the nominal voltage.

The project partners, Nexans, Endesa SA, the Spanish energy provider, and the ICMAB-CSIC Institute for Materials Sciences (Institut de Ciència de Materials de Barcelona – Consejo Superior de Investigaciones Científicas) – plan an installation in a power grid as the next step.

Nexans – France

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SALES@WINSUN.COM WWW.WINSUN.COM

Systems and equipment for wire and cable

Founded in 1983, Cometo is among leading firms in the engineering sector of the town of Lecco, Italy. The firm combines the manufacture of machinery and equipment with the supply of wire and cable drawing machines.

In addition to the manufacture of rotating die-holders, which marked its first success, the firm offers wide and varied solutions including wire straighteners and wire guides, which can be equipped with either pneumatic or electronic drives.



▲ Wire straightener manufactured by Cometo

Besides these consolidated devices, addressed to both producers of wire and cable processing machines and users, the company has recently launched a new range of traverse unit, equipped with electronic drive and used for thin wire and plated winding for layering without any overlapping or lack of adherence to spool flanges.

Believed to be Cometo's most important innovation is the use of a laser control system, a technological choice expected to boost Cometo's production worldwide. The firm already exports 40% of its production to North and South America and to all European countries.

Cometo Snc - Italy
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Website: www.cometo.eu

Power link to offshore platform

ABB has won an order worth \$110 million from Eni Norway AS, to build a power link between a new oil and gas platform in the Barents Sea and the Norwegian power grid. The Goliat platform will be partly electrified by a 106km subsea power cable, which can lower Goliat's carbon dioxide emissions up to 50 per cent by reducing the need for electricity produced by the platform's gas turbines.

"The cable link will deliver reliable power supplies from the mainland and help reduce the platform's environmental impact," said Peter Leupp, head of ABB's Power Systems division.

The 123kV (kilovolt) 75MW (megawatt) XLPE insulated cable is believed to be the longest, most powerful cable ever delivered for an offshore application. It will supply AC (alternating current) power from the mainland grid in Norway to Goliat, a floating oil and gas production, storage and offloading unit.

The cable integrates fibre optics to monitor temperature and provide general communication services, and includes a 1.5km dynamic section to accommodate the movement of the floating platform.

The project is scheduled for completion by the end of 2013, when Goliat is due to begin operations.

ABB's high-voltage three-core polymeric insulated (XLPE) subsea cables have low electrical losses, are resistant to solvents, oil and abrasions and have an excellent tensile strength. They are ideal in harsh marine environments. ABB has delivered around 3,000km of polymeric (oil-free) insulated AC and DC (direct current) subsea cable to projects around the world. This includes power links to oil and gas platforms in the Persian Gulf and the North Sea.

ABB Ltd - Switzerland

Website: www.abb.com



Quality control for data cable production

The Centerview 8000 from Sikora is designed to deliver non-contact continuous measurements of 8-point eccentricity, 4-axis diameter and 8-point ovality during the production of data cables. The online repeatability and accuracy of these non-contact measurements provide optimum control and productivity on today's production lines at all line speeds.

A feature of the Centerview is the automatic positioning of the gauge head to the cable position. With this design, guide rollers are not required to achieve precise single measuring values, even at the micron level.

Centerview 8000 records the single measuring values with highest precision. These are displayed at 4-points (diameter) and 8-points (eccentricity, ovality) on the processor system Ecocontrol 600, 1000 or 2000. Instantly, the operator has clear information about eccentricity values that can be used for control or crosshead adjustments.

Centerview 8000 is available as a stand-alone gauge head with direct connection to a control system or a data collection system for SPC (statistical process control). It can be combined with the processor system, Ecocontrol, for constant accurate online measurement and control.

The cloud diagram provides an additional way to present the measuring values of the ongoing measurement at the Ecocontrol. It provides information on distribution of short-term variation of eccentricity in graphical form. Each dot corresponds




▲ Circular distribution of the single values of the eccentricity

to one single measuring value of the eccentricity in relation to the amount and angle. The extension of the cloud diagram is the indicator for the standard deviation of the eccentricity.

The display of the single eccentricity values in the cloud diagram shows the operator what eccentricity values remain and what fluctuation the product has, even after a perfect centring. This visualisation of the single values provides an option for the operator to take appropriate measures to minimise the eccentricity.

Sikora AG – Germany
Email: sales@sikora.net

Fax: +49 421 48900 90
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- Niehoff M30 Intermediate Drawing Machines
- Niehoff M15 & M5 Fine Wire Drawing Machines

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- Skaltek Portal Payoffs & Take-ups (1.2m - 3m / 25 Available)

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Visit wireandplastic.com or contact us at sales@wireandplastic.com to see our complete inventory.

Advances in greener insulation

Dow Wire & Cable has announced a step in sustainable chemistry by launching Dow Ecolibrium™ bio-based plasticisers, a new family of phthalate-free plasticisers for use in wire insulation and jacketing, made from nearly 100% renewable feedstocks.

The use of Dow Ecolibrium plasticisers in PVC compounds for wire applications can help cable-makers and original equipment manufacturers reduce greenhouse gas emissions by up to 40% if used instead of traditional PVC plasticisers. The new plasticisers were developed to meet growing demand for more sustainable options in wiring applications such as personal electronics and appliance wiring, residential and commercial building wiring, communications and data cabling, and automotive wiring.

"We are very excited about the commercial launch of Dow Ecolibrium bio-based plasticisers and our ability to help cable-makers use sustainable technology to differentiate their offerings in key industries," said Jonathan Penrice, global marketing director for Dow Wire & Cable. "Our excitement stems from the use of nearly 100% renewable feedstock in the

chemistry of these products and from the outcome of field trials conducted with a select group of customers. The field trials demonstrated that the new plasticisers exhibit the same performance and feel as incumbent PVC plasticisers while meeting all regulatory requirements for flame resistance."

Penrice added: "Dow Ecolibrium plasticisers are truly a breakthrough for the wire and cable industry but their introduction here is just the tip of the iceberg – in time they will also open up differentiation opportunities for OEMs in other industries that use PVC compounds."

Dow Wire & Cable will license select cable makers to commercialise Dow Ecolibrium plasticisers consistent with its Dow Inside programme. Cable manufacturers in the Dow Inside programme are supported by Dow Wire & Cable's forward-thinking technology, versatile products and enhanced services, backed by the strength of a supplier that can offer a competitive edge in a demanding industry.

- Wires jacketed with material that includes Dow Ecolibrium can achieve an improved balance of flame retardance, flexibility and heat performance. In wiring for personal electronics the use of Dow

Ecolibrium can deliver on global OEM requirements for heat deformation resistance, flexibility and electrical performance.

- Dow Ecolibrium plasticisers are phthalate- and lead-free, offering safe building wire options for end-users. The new products are also effective in data communications delivery applications.
- Wires jacketed with Dow Ecolibrium and used for the transmission of power and data inside passenger and commercial vehicles can provide an environment-friendly solution that exhibits requirements for heat resistance and ease of installation.

The introduction of Dow Ecolibrium bio-based plasticisers provides another example of Dow's commitment to deliver sustainable chemistry as part of its 2015 sustainability goals. Sustainable chemistry is a cradle-to-cradle concept that drives Dow to adopt a lifecycle view of its products, processes and product uses in order to provide value and solutions for its customers while enhancing the quality of life for current and future generations.

Dow Wire & Cable – Switzerland
Website: www.dowwireandcable.com

Compact wire and cable tension controller for multi-spindle payoffs

The latest in the Merobel digital controller range, the X-block, has been specifically designed for multi-spindle wire and cable payoff applications using open loop or closed loop tension control systems.

The X-block has been designed to meet the demand for easy wiring and start-up, and to answer the need for compactness for cabinet backplane installation. These criteria are essential features for integrators designing multiple wire and cable payoff equipments. Its narrow profile and its rear-panel DIN rail-mounting clip allow up to six units to be installed side-by-side in a width of 300mm.

The connectors are located on the front panel for easy access to the units installed on the cabinet backplane when cabling.

The electronic board provides comprehensive functions built around a dedicated PID controller. It meets all the specific needs of tension control systems. It also includes a digital, fully configurable sensor amplification module, enabling plug-and-play settings for all types of load cells currently available on the market.

In addition, the same amplification module allows direct calibration of

position measurement potentiometers (used for dancer roller systems) or distance measurement sensors (ultrasonic or laser). Moreover, a built-in power supply function allows direct control from many types of electromagnetic actuators without any need of external powering modules, including the entire range of EMP brakes and clutches supplied by Merobel.

Merobel X-block eliminates the need of external wirings linked up to all the usual components of tension control systems between the sensor and the actuator.

Start-up programming uses the X-block PC software, which provides intuitive access to all adjustment settings. All the adjustment settings determined on one station can be copied without limit to all the other stations by simple drag-and-drop to the internal memory of each controller.

A data acquisition embedded function allows both the real time data and the associated operating set of parameters to be archived.

Redex Andantex – France
Website: <http://merobel.redex-andantex.com>



Data acquisition, processing & display

USYS 20 is designed to be an economic solution for a single diameter or capacitance measuring point. The system features real-time, multi-tasking data processing and control. USYS 20 accepts measurements from a broad line of laser diameter gauges of the ODAC[®] series, covering a diameter or width range from 0.012mm to 310mm with a selectable resolution of up to 0.00001mm.

The processor also accepts capacitance measurements from Zumbach's CAPAC[®] systems, instead of the diameter gauges.

Key features include:

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- Direct access function keys
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- Alarm displays
- Real-time data collection
- Reel and session reports
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- SRD – Static Regulating Device



▲ Tabletop version of the USYS 20

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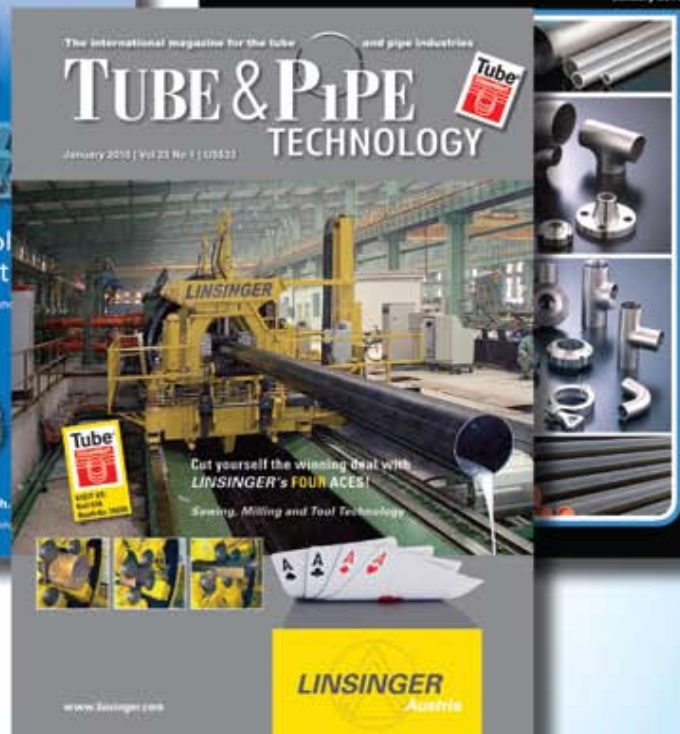
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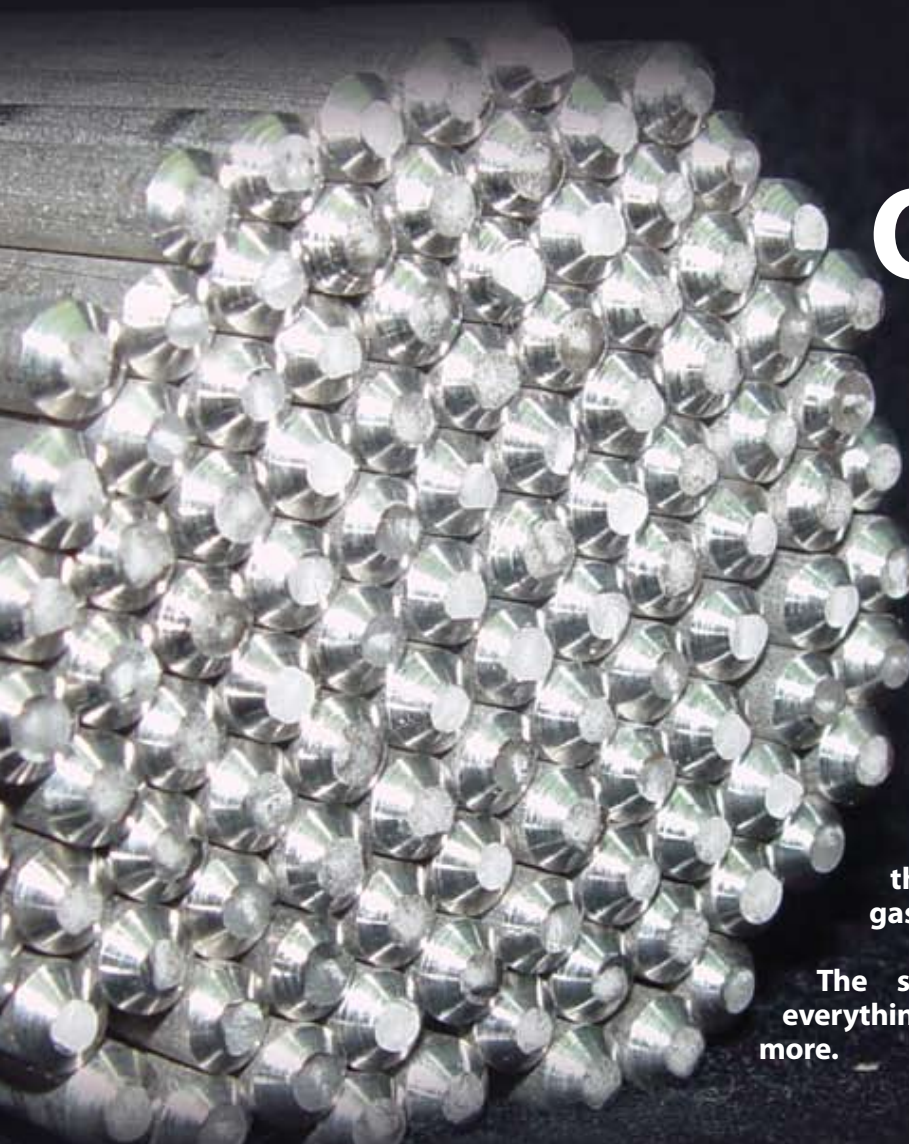
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Straightening, cutting & welding of wire & rod



On entering a straightener, wire may have bends or coiling memory in more than one plane.

It exits the straightener free not only of coils and kinks but also of the tendency to coil and kink.

Machines for cutting insulated cable frequently incorporate a slitting or stripping component for opening the insulation without damaging its shielding.

Actually a type of projection welding, cross wire welding is a reliable means of joining wire and rod.

It is also a fast, inexpensive process that eliminates the need for shielding gases or filler metals.

The specialities reviewed here deliver everything that is expected of them – and more.

Straightening expertise

For more than 35 years, Techna International has handled Witels-Albert products in the UK. With over three hundred standard straighteners for wire, strip and flat-wire, numerous straightening rolls and rollers, roller guides (for wire, strip, tube, cable and rope), a range of pre-forming heads, driven and manual cable strippers and transportation drive-rolls and belts, the range is available for material diameters from less than 0.3mm to 150mm (model dependent) ranging from small manually operated units to semi-automated and fully automated computerised equipment.



▲ Guide rolls and straighteners from Techna's range

Although the topic of straightening has long been considered as a "hands on" operation, Witels-Albert has elevated the art of straightening away from the traditional "trial and error" approach, into a more exact science. By researching and developing a scientific approach to the subject, and with many years' continuous involvement in design evolution, the company is able to provide real expertise, including computer software, to solve many of today's complex straightening tasks whilst ensuring consistently reliable straightening, thereby eliminating many of the uncertainties previously associated with these operations.

This long association results in Techna being able to offer a combination of products, spares and service, and the technical knowledge, expertise and experience to solve most guiding, straightening and feeding applications.

Where standard units are unavailable because of unusual or exceptionally complex operational demands or environments, customised processing equipment can often be designed and commissioned to customers' specific requirements.

Techna International Ltd – UK
Email: sales@techna.co.uk

Fax: +44 1923 219 700
Website: www.techna.eu

Straightening and cutting steel wire

The main features of Delisi's straightening and cutting machines for steel wire are fast set-up, easy change of diameter, high-speed production, and flexibility respond to customer requirements.

Delisi machines can be supplied with a spinner for the rapid change of diameter or with a roll straightening unit. The machine can be made ready to work a new diameter very quickly and easily. The operator chooses the necessary groove for the required wire diameter on the feeding rolls and puts the pre-regulated set of straightening jaws in the spinner. The maximum feed speed is 200m per minute and the same machine can be set up both for ribbed or smooth wires.

Customers can select mechanical cut or flying shear cut, and the size of rod collection bed needed, with an electronic positioner or programmer. The rod collection bed can be provided with the picker at one or three lines of tiltable arms. This system is advantageous when the programmed rods finish and tiltable arms rise-up to hold the new size of wire to be worked. The machine continues working while the operator empties the container underneath.

Delisi Srl – Italy
Email: delisi@delisisrl.com

Fax: +39 0882 333236
Website: www.delisisrl.com

Butt welding

Ideal-Werk manufactures wire butt-welding machines for wire drawing mills, cable factories and wire fabricators.

A wide range of machines, Ideal models DSH 010 – DSH 180, is offered for welding steel, copper, aluminium or brass wire.

The welders are said to produce constant draw resistant welds and have a high welding capacity as well as superior reproducibility of welds in all material grades within a wide welding range from 0.1mm to 18mm wire diameters.



▲ The DSH 130 butt welder with accessories

The machine is designed for ease of operation by unskilled labour with a common setting of jaw distance.

The machine design is rigid and long lasting for tough working conditions. Low maintenance cost is combined with easy access to all machine components.

Ideal-Werk also offers butt welding machines for stranded copper and aluminium conductors, Ideal models LSF 001 – LS 1200, from 0.12mm up to 1,200mm².

These machines are used by cable manufacturers in continuous extruding lines.

All Ideal butt welders are engineered to weld wire and stranded conductors as perfectly, as easily and as rapidly as possible.

Ideal-Werk – Germany
Fax: +49 2941 206 169
Email: info@ideal-werk.com
Website: www.ideal-werk.com

Precision under pressure

First identified in 1724, cold pressure welding has many advantages over electrical welding. The cold weld process is faster, cleaner and more energy efficient, and creates a reliable, permanent weld stronger than the parent material without loss of electrical integrity. Cold welding is a form of solid phase welding, unique because it is carried out at ambient temperatures. Other types of solid phase welding, such as the hammer welding of wrought iron carried out by blacksmiths for centuries, are conducted at elevated temperatures. However, although this involves high temperatures, the material is not molten, merely more ductile.

How a weld is formed



▲ **Close-up weld:** Close up of a cold weld on copper rod after deflashing and rubbing down ready for the drawing machine

There have been several explanations as to the actual mechanism by which a cold pressure weld is obtained.

For example, it has been suggested that it happens via recrystallisation or by an energy hypothesis, but most explanations have been either experimentally disproved or refuted on theoretical grounds.

The metallic bond

The currently accepted hypothesis relates to the fact that the atoms of metals are held together by a metallic 'bond', so called because it is peculiar to metallic substances. This bond can be described as a 'cloud' of free negatively-charged electrons, which envelop ionised positively charged atoms into a unit as a result of attractive forces. So, if two metallic surfaces are brought together with a space of only a few angstroms separation (there are 300 million angstroms to one centimetre), interaction between the free electrons and ionised atoms can occur. This will eliminate the potential barrier, allowing the electron cloud to become common. This, in turn, effects a bond and therefore a weld. A simpler way of explaining this process is to say that if two surfaces (both atomically clean and atomically flat when considered on an atomic scale) are put together, a bond is effected equal to the parent metal. In practice, however, bonding is virtually impossible under most conditions due to surface irregularities, organic surface contamination and chemical films such as oxide films. In order to obtain maximum weld efficiency, any form of contamination must be reduced to a minimum, while the area of contact has to be made as large as possible.

Early attempts

In early applications of cold pressure butt welding, the upset and radial displacement of the interfaces was undertaken in a single step. This was not very satisfactory, since the ends to be joined had first to be squared off and both surfaces had to be free of contamination.

In addition, the amount of material projecting from the gripping dies could result in bending and lack of coaxiality, so spoiling the correct flow of metal.

Multiple upset principle

A butt welding system employing what is known as the 'multiple upset principle' proved more effective. When the material is inserted in the dies, each time the machine is activated the material is gripped by the dies and fed forward.

As the two opposing faces are forced against each other, they are stretched and enlarged over their entire surface area.

This forces the oxides and other surface impurities outward from the core of the material and a metallurgical bond stronger than the parent material is effected. To ensure all impurities are forced out of the interfaces, four to six 'upsets' are recommended.



▲ **Flash photo:** Close up of an aluminium weld showing the resulting flash where the excess material, and any impurities, has been squeezed out from the interfaces

Most non-ferrous metals can be cold welded as well as various alloys. The cold weld process can also be used to join dissimilar materials, for example, aluminium to copper, and materials of different sizes.

High performance equipment

PWM Ltd designs and manufactures high performance cold pressure welding machines and dies to suit a broad range of applications, from hand-held, manually operated welders up to electro-pneumatic and electro-hydraulic powered rod welders. Precision engineered to provide consistent, reliable welds and minimise materials wastage, PWM machines are very simple to operate and easy to maintain.

Pressure Welding Machines – UK Fax: +44 1233 820591
Email: pwm@btinternet.com **Website:** www.pwmltd.co.uk

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Please contact: Mr Michel Landman
E-mail: michel.landman@wiresteel.be
Website: www.wiresteel.be

Flying shear straighten and cut machinery

In 2002 Videx launched its first patented servo-operated straighten and cut machine, which enabled cutting of both short and long parts at high speeds without clutches or hydraulics.

Following the success and the improved reliability of this line, Videx is now launching its flying shear straightening and cut-off machine with the same patented servo-drive. Servo machines are quieter and more reliable, need less floor space and allow higher cut-off rates. The wire speed and cut-off rate are programmed on an HMI screen that stores the data and displays all possible interface and fault messages.

The VC-MSR machines are fully mechanical, combining the advantages of the reliable mechanical cut with the benefits of the servo-drive that replaces the traditional clutch used by other machines.



▲ Chamfered rods using Videx technology

The run-off guide is made from stainless steel, requiring no adjustment when changing wire diameters within the machine range. The gate of the run-off guide is pneumatically operated, and supports the wire during cut-off to assure a square cut face.

The wire transmits the cut-off signal, just before it hits the positive stop. The positive stop itself is mounted on a carriage that rides along the run-off guide. When the flag "feels" the wire, it actuates the cut-off cam to cut the wire and return to rest until the next time the wire hits the positive stop.

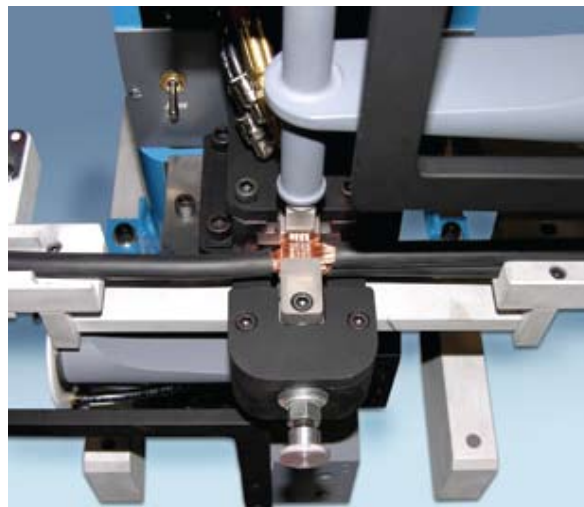
The VC machines are offered with an integral chamfer station that can chamfer, face and turn the bars after chamfering.

Videx Ltd – Israel
Fax: +972 3536 4802
Email: videx@videx.co.il
Website: www.videx.co.il

Advantages of ultrasonic welding

Ultrasonic welding is said to offer important advantages to manufacturers. It creates solid-state metallurgical bonds without the need for filler metal materials or for clipping, soldering, crimping, or dipping. The welding process is also accomplished without producing arcs, sparks, or fumes and without melting wires.

The Dual Head SpliceRite™ ultrasonic wire splicer – like other Sonobond Ultrasonics metal spot welders – utilises the patented Wedge-Reed system. This system combines



▲ Sonobond's Dual Head SpliceRite™ ultrasonic wire splicer accommodates bundles with cross-sectional areas up to 100mm²

high vibratory force with low amplitude coupling. During the welding process, the unit directs high frequency ultrasonic energy via the welding tip to the surface between the metals to be bonded.

The vibratory energy disperses the oxides and surface films, creating a true metallurgical weld. There is no melting of materials. In addition to creating a very reliable bond, the process is environmentally friendly, produces no waste, and consumes minimal energy.

True to its name, the Dual Head SpliceRite has two welding heads, one on each side of the weld area. As a result, larger wire bundles – those up to 100mm² – can be spliced in just one quick step. This is true even when wires are tinned or heavily oxidised. The resulting welds have excellent conductivity. In addition, the unit has a 3,500-watt power supply and a microprocessor controller that can store and recall up to 250 jobs. Welds can be controlled by height, by energy or by time.

All Sonobond metal spot welders feature heat-treated, tool steel taper lock tips. These tips can last for 100,000 welds or more. They are designed for quick tooling changes and foolproof placement. Sonobond units also have an important advantage in that they require only minimal training, being easy to operate.

Sonobond Ultrasonics – USA
Fax: +1 610 692 0674
Email: info@sonobondultrasonics.com
Website: www.sonobondultrasonics.com

Straightening solution

Condoroil Chemical has recently developed a new product for the straightening of steel and stainless steel bars.

The product, named Condorlube S 300, is water-based and free of hydrocarbon solvents or mineral oil. The straightened surface appears clean, dry and protected for in-house storage.

Condorlube S 300 straightening solution can be continuously purified and regenerated using the Athena unit supplied by Condoroil Chemical's sister company, Condoroil Impianti.

Condoroil Chemical – Italy
Email: info@condoroil.com

Fax: +39 0332 945303
Website: www.condoroil.it

Reconditioned & second hand machinery

If there were no economies associated with pre-owned machinery – if, in fact, it commanded a premium – a second- or third-hand unit might more readily be recognised as an excellent choice. A well-tended piece of used equipment – with its mechanical equivalent of muscle-memory, the kinks worked out and smooth running – can be well worth owning.

A number of specialist suppliers of such equipment can be found in this feature.

Second-hand equipment for cost and time savings

Advertorial on behalf of Wire & Plastic Machinery Corporation (WPMC)



▲ **Figure 1:** Original machine



▲ **Figure 2:** Machine is completely disassembled and cleaned and the old bearings removed



▲ **Figure 3:** Frame is painted and reassembly starts

It will allow visitors access to more inventory items and categories than ever before.

WPMC sales and engineering staff participate at all the important industry trade shows and technical seminars.

Wire & Plastic Machinery Group – USA
Email: sales@wireandplastic.com
Website: www.wireandplastic.com

Wire & Plastic Machinery Corporation (WPMC) is a global supplier of second-hand equipment for wire, cable, and optical fibre manufacturing. For 30 years, WPMC has been providing its customers with high quality equipment solutions, reconditioning services, and a comprehensive inventory of over 20,000 machines to choose from.

The company has grown from a single location in New Jersey to eight North American locations with 50 employees and 3 million square feet of inventory.

Equipment is offered in as-is condition for immediate delivery or may be cleaned, painted, test run, electronically and mechanically upgraded, or entirely rebuilt.

WPMC has two reconditioning workshops in Connecticut and Texas that are staffed by design, mechanical and electrical engineers. Customers of reconditioned equipment can request commissioning services anywhere in the world.

Due to the comprehensive range of manufacturers (OEMs) and machines kept in-stock, the engineering team has developed an extensive and broad knowledge of rebuilding for most applications.

As a global company that sells more than half of its equipment outside of the United States, WPMC has expertise in adapting for foreign voltage requirements.

Wire & Plastic Machinery Corporation is also the industry's leading buyer of used equipment. Many options are available including a trade-in programme and outright cash purchase.

Purchasing second-hand equipment presents ideal solutions for companies looking to source equipment quickly and maximise their value.

The cost of a used or reconditioned machine is often 30-70% of new and available with short or immediate delivery times.

Figures 1-6 show a Bartell tube type strander being rebuilt in various stages.

Work is currently underway on WPMC's website which will have a new look and feel.



▲ **Figure 4:** Drive shaft aligned, cradles and wire guides are reinstalled and the cradle assembly is completed



▲ **Figure 5:** Worn gears are replaced and a new motor installed



▲ **Figure 6:** Completed refurbished machine

Machinery retrofit: increase productivity and reduce operating costs

How do manufacturing companies reduce equipment operating costs while increasing productivity and production-security at the same time?

In dealing with this question, Niehoff after-sales department has analysed existing spare parts business and divided it into four categories: wear parts, spare parts, upgrade and service.

In this way, Niehoff addresses customer needs, while meeting its spare parts targets.



Wear parts are a considerable cost factor

▲ D 401 double twist bunching machine equipped with an energy-saving bow

of a manufacturing company's operating costs. Niehoff's re-design of annealer contact tubes is a good example of cost reduction solutions. The newly designed contact tube is a cylindrical "sleeve and tube" design. Rather than replacing the more expensive conventional tube, only the worn outer tube (sleeve) is now replaced. The sleeve purchase price is considerably lower than the price of a conventional tube. Niehoff also offers rework for conventional nickel contact tubes.

Niehoff assures each customer of a reliable supply of Niehoff spare parts and/or an equivalent customer specific solution regardless of the age of a Niehoff machine or line. Another advantage for every customer is a personal contact at Niehoff to answer technical questions directly or guide him to the appropriate specialist.

A new feature of the after-sales programme is the supply of retrofit measures to upgrade existing machines. One example is the NBAT automatic traversing system for D 631 type double twist bunching machines (where the machine is equipped with an S7 control). Another example is the newly introduced energy-saving bow for the D 631.

Niehoff offers all customers machinery inspection and evaluation services. The programme includes defined criteria that must be checked within certain periods by service technicians. Breakdowns can be predicted, repairs scheduled and planned for in advance thus reducing costs. Niehoff also provides machine operator and maintenance training courses and offers remote equipment troubleshooting and support via the Niehoff Tele-Service (NTS) system.

Maschinenfabrik Niehoff GmbH & Co KG – Germany

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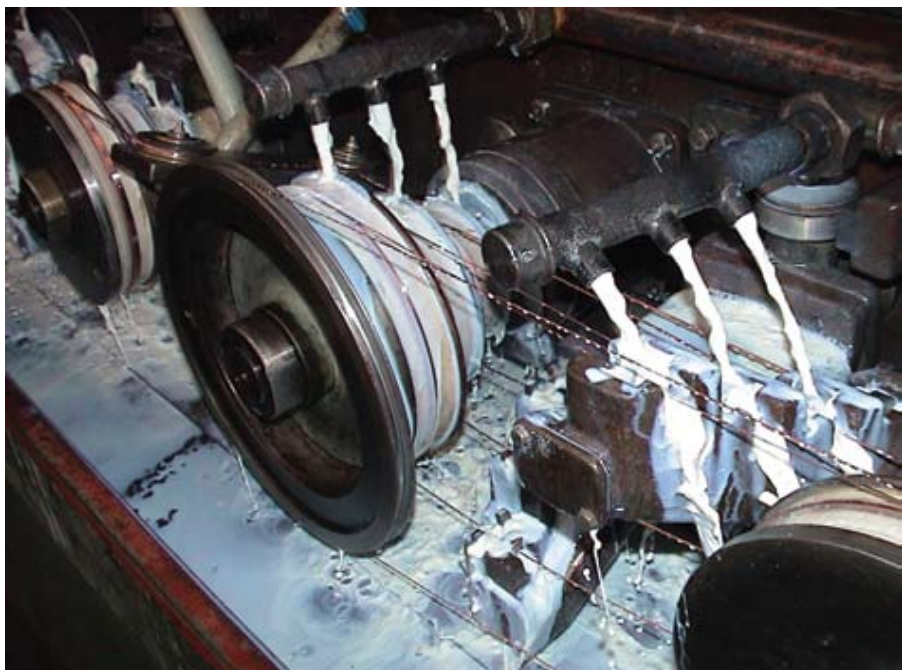
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Improving the mechanical properties of non-halogenated flame retardant compounds

By Jeremy R Austin, Herbert S.-I Chao, Sartomer Company

Abstract

Traditionally, plastic articles have been rendered flame retardant by the introduction of halogenated compounds, such as tetrabromobisphenol A, or TBBPA.

Recently, a movement to non-halogenated flame-retardants has been the focus of academic and industrial research, but these safer alternative technologies have a deleterious impact on mechanical properties.

Mineral fillers used as flame retardants require in excess of 60% by weight loading to fulfil flame requirements. In the current study, functionalised liquid polybutadienes (LPBD) are used to improve the elongation and tensile strength of aluminium trihydrate (ATH) filled ethylene vinyl acetate (EVA) compounds. Pre-dispersion of the coupling agents onto ATH led to gains in elongation of greater than 200%.

Low loadings of functionalities including maleic anhydride, epoxy and amine were proven to be most effective. Incorporation of a di-acrylic ionic monomer provided gains in tensile modulus unattainable by the LPBD materials.

1 Introduction

Scientific studies have indicated that halogenated flame retardants (HFR) are widespread contaminants for the environment. Hazardous emissions from manufacturing, disposal or recycling of plastic articles containing HFRs pose such a serious threat that some HFRs have already been removed from electronics and household goods, and the European Union has ratified regulations governing the plastics industry to eliminate them.

With similar legislature impending on all continents, several markets across the plastics industry are seeking alternative technologies.

Several non-halogenated flame retardants (NHFR), such as ammonium phosphates, melamine compounds, nanoclays or hydrated minerals, have been identified. Aluminium trihydrate (ATH) is a recognised flame retardant filler for polymers, and is free from halogens. Typically, flame retardants act to delay ignition by depriving the fire of fuel, or suppressing the ignition temperature.

ATH however, releases water vapour during decomposition, which is believed to withdraw heat from the substrate and dilute the fuel supply. Once charred, the residue of Al_2O_3 inhibits migration of oxygen and volatile compounds released by the polymer that can further proliferate the exothermic reaction.

In most applications, a simple replacement strategy can be employed, where one NHFR can replace an HFR. In some instances, such as the case of hydrated minerals such as aluminium trihydrate or magnesium hydroxide, the transition is more difficult. In order to achieve the required flame retardance high loadings of ATH are necessary, often in excess of 60% by weight.

Once the volume fraction of inorganic filler exceeds 50% there is a marked deterioration of physical properties in the compound. Plentz *et al*¹ demonstrated that in PP compounds containing ATH there existed a relationship between the filler loading and aggregate size.

This finding indicated that not only are physical properties compromised by the elevated filler loading, but that the ATH also would aggregate as the loading increased. Studies have shown that the addition of a functionalised polymer is an effective method to modify the interfacial adhesion at the organic/inorganic boundary in polymer composites^{2,3,4}.

Mai *et al*⁵ demonstrated that incorporation of graft modified acrylic acid into PP-ATH

compounds causes a chemical interaction between the carboxyl and hydroxyl groups in the polymer and filler respectively. Improving the interfacial adhesion was shown to improve both the thermal and mechanical properties.

Similarly, Wang *et al*⁶ introduced maleic anhydride grafted EPR into a PP-Mg(OH)₂ compound, and found that the EPR-g-MA resided exclusively at the interface.

Encapsulating the Mg(OH)₂ improved the dispersion of the filler, which was manifested as improved impact strength. Plentz *et al*¹ introduced an acrylic acid functional PP to their PP-ATH system, and demonstrated that improved interaction at the interface caused an increase in melt flow index and improved tensile and flex strength.

In all three cases, the functionalised additives interacted with the filler to overcome the deleterious effects of high hydrated mineral filler loadings.

Traditional functionalised materials have been investigated to overcome the deficiencies in flame retardant compounds containing ATH.

The current evaluation examines the effect of low molecular weight functionalised liquid polybutadienes (LPBD) as interfacial modification agents in a 60% filled ethylene vinyl acetate (EVA) wire and cable (W&C) system. Feedback from industry has indicated that migrating to an ATH solution reduces the tensile strength, ductility and flow to such a degree that the material cannot function in W&C.

Having a low molecular weight is thought to be advantageous to better seek and adhere to the filler surface, thereby enhancing the interfacial modification.

The type and loading level of the functionality was varied to assess the appropriate chemistry to best improve EVA-ATH compounds.

2 Experimentation

2.1 Materials used

Commercial EVA (DuPont Elvax® 550) containing 15% by weight vinyl acetate was used as received. ATH grade C-33 with a mean particle size of 50µm, density of 2.42g/cm³ and containing 35% chemically combined water, was supplied by Almatix Inc. The free flowing powder was not chemically modified during manufacture, and was used as received. Low molecular weight liquid polybutadienes, containing vinyl, maleic anhydride, epoxy or amine functionality, were supplied by Sartomer Company.

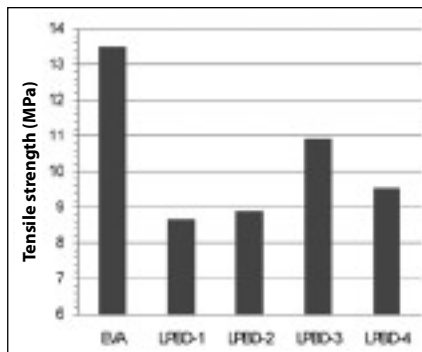
Table 1 illustrates the relevant properties of each of the liquid polybutadienes (LPBD) used in this study. The polybutadiene materials can be considered bi-functional, as Table 1 indicates both a primary functionality and pendant vinyl content. Materials containing 70% vinyl are considered cure active, and susceptible to crosslinking in the presence of free radicals. The 28% vinyl polybutadienes, conversely, are considered more stable.

Grafting of maleic anhydride occurs in the *cis-trans* moiety of the polybutadiene backbone, and consequently the higher vinyl content forces the functionality to reside in much closer proximity. In addition to Mn, this is a differentiating characteristic between LPBD-3 from LPBD-4.

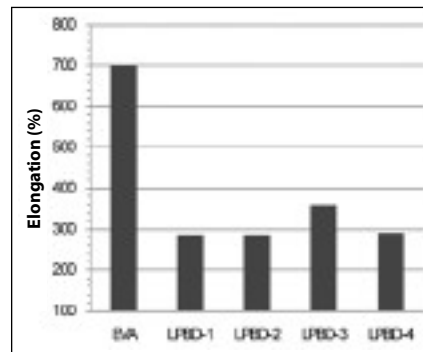
Introducing the liquid polybutadienes directly into the melt stream is prohibitive due to their physical form.

The coupling agents were pre-dispersed onto the ATH in a dry liquid carrier (DLC) in a high shear blender. The result is a 50% active free flowing powder that can easily be side-fed into the extruder.

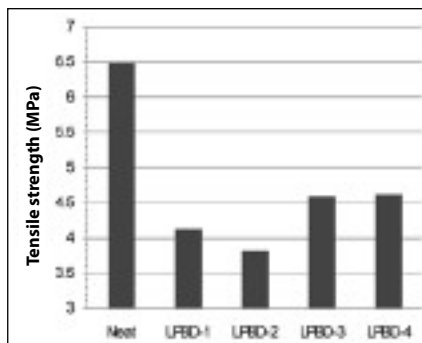
Previous work has demonstrated that incorporation of a di-acrylate functional ionic monomer into polyolefins results in the formation of an ionic crosslinked structure.



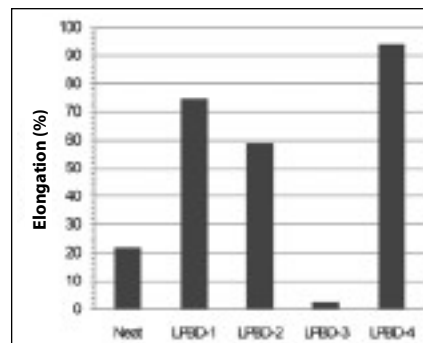
▲ Figure 1: Tensile strength results of functional versus non-functional LPBD compared to the base EVA. All products plasticised the EVA, however the MA LPBD to a lesser extent



▲ Figure 2: Elongation results of baseline study demonstrating that the anhydride functional LPBD influenced the EVA the least



▲ Figure 3: Tensile results for ATH containing systems demonstrating that anhydride functional LPBD least reduces tensile strength



▲ Figure 4: Elongation results for baseline study in EVAATH system demonstrating an ability to re-establish the elongation using LPBD

The mechanism relies on free radicals generated by heat and shear during compounding. An ionic monomer, grade SR-732, was supplied as a means to increase the mechanical properties in the ethylene regions of the EVA.

2.2 Sample preparation

A Brabender TSE-20 was used to melt blend each of the formulations examined in this study. The co-rotating twin-screw extruder has an L/D of 40:1, and a screw design configured to homogenise high loadings of filler. Additives were pre-dispersed onto the ATH and fed downstream at 20D. Experiments were carried out using a flat temperature profile of approximately 50°C over the Vicat softening temperature,

and 80rpm. A single strand extrudate was pulled through a water trough and pelletised. All formulations contained 60% by weight ATH, and 4% by weight of an LPBD. Baseline formulations were run to establish the effect of LPBD on EVA.

ASTM tensile specimens were moulded using a Boy Machines XS 11-T micro-injection moulder. A temperature profile analogous to extrusion was employed. Specimens were pulled on a Thwing-Albert tensile tester in accordance with ASTM D-638. Tensile strength at yield and elongation at break data was collected.

3 Results

A thorough understanding of the influence the LPBDs have on the EVA was imperative to understanding their influence on the ATH filled systems. Figures 1 and 2 illustrate the effect of a representative sample of LPBDs on the base EVA.

Both Figures 1 and 2 demonstrate that the LPBDs have a deleterious influence on the tensile strength at yield, and the elongation at break. The LPBDs were not compatible with EVA, and served to plasticise it. Unfunctionalised LPBDs 1 and 2 had an equal impact on the EVA properties, which suggested that Mw and vinyl content were not influential variables.

▼ Table 1: Properties of liquid polybutadienes used in this investigation, highlighting the functionality type and loading, molecular weight and vinyl content, * internally epoxidized polybutadiene, ** tertiary amine grafted polybutadiene

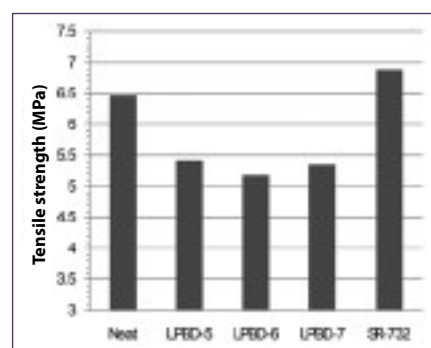
ID	Mn (g/mol)	Functionality (type/%)	Vinyl (%)
LPBD-1	1400	-	70
LPBD-2	4500	-	28
LPBD-3	2500	MA/17%	70
LPBD-4	5500	MA/17%	28
LPBD-5	4700	MA/5%	28
LPBD-6	4500	Epoxy*/5%	28
LPBD-7	5000	Amine**/5%	28

Conversely, the anhydride functionality containing analogues both provided higher tensile strength and, in the case of LPBD-3, better elongation. It seems evident that the anhydride functionality rendered the LPBD more compatible with the EVA phase, and that the lower Mw of LPBD-3 over LPBD-4 created smaller droplet dispersion.

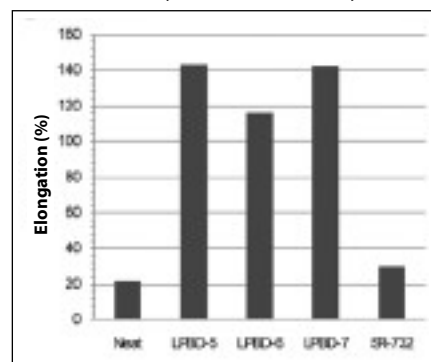
Introducing ATH into the system yielded the results presented in *Figures 3 and 4*. *Figure 3* demonstrates that the LPBDs all reduce the tensile strength at yield of the ATH filled EVA. The functionalised LPBD-3 and LPBD-4 outperformed their unfunctionalised counterparts, which in part suggests an improvement in interfacial adhesion between phases. In *Figure 4* all but LPBD-3 improved the elongation at break. In the case of LPBD-3, the cause of a further reduction in elongation is possibly two-fold.

First, the highly functional small chains (Mn 2,500) may have had multiple sites of interaction with the ATH surface and enveloped the mineral. Consequently, there would be no free chain segments to entangle with EVA to serve as a compatibiliser. Secondly, LPBD-3 was 70% vinyl, which could have crosslinked during compounding. An analysis of the elastic modulus indicated that LPBD-3 had induced a significant increase over the base material indicative of a crosslinked material.

▼ **Figure 5:** Tensile strength results for alternate functionalities indicating that LPBD with 5% functionality (anhydride included) impact the tensile strength less



▼ **Figure 6:** Elongation results using alternate functionalities demonstrating significant improvements in ductility over the neat EVA-ATH system



The unfunctionalised LPBDs served to better wet-out the mineral filler, so aiding in its dispersion. The LPBD-4 improved the elongation of the filled system by 450%. The LPBD-4 is likely to have had fewer interactions between the ATH surface hydroxyl functionality and the anhydride functionality, while maintaining a tail to compatibilise/entangle with the EVA.

In addition to molecular weight and vinyl content, alternate functionalised LPBDs were evaluated. *Figures 5 and 6* illustrate the results of these additives, in addition to the SR-732.

Figures 5 and 6 demonstrate that reducing the anhydride loading on the LPBD (LPBD-5) will increase both the tensile strength and elongation. As mentioned previously, it is imperative to have an association between the additive and the filler surface, but also to ensure that there is sufficient chain entanglement between the additive and EVA. Reducing the MA content on the additive decreased the probability of multiple bonds being formed with the ATH surface, thus increasing the average chain length remaining to entangle in the EVA. LPBD-6 and LPBD-7 demonstrate that alternate functionalities can replace maleic anhydride in the form of epoxy and amine. Both functional groups performed analogously to equal loadings of anhydride in terms of tensile strength and elongation.

Figures 5 and 6 also demonstrate the influence of the ionic monomer, SR-732, on the ATH/EVA system. Unlike the LPBD additives the SR-732 increased the tensile strength of the system and also statistically, if modestly, improved the elongation. It is believed that introduction of the ATH induced high shear environments within the melt during compounding that reacted with the acrylic functionality.

Previous work indicates that these monomers have a tendency to cluster within a polymeric compound, which creates an ionic bridge, or crosslink, between adjacent chains. At ambient temperature the cluster will serve to increase the mechanical properties of the system. Unlike the LPBDs, the SR-732 altered the bulk properties of the EVA as opposed to the interface.

4 Conclusions

Significant improvements in the elongation of highly filled ATH/EVA compounds were achieved by introduction of low molecular weight, functional polybutadienes.

The functionality of the additive served to compatibilise at the organic/inorganic interface by reaction with the ATH surface, and chain entanglements with the EVA.

Molecular weight, or chain length, was an important attribute in improving the elongation properties. Alternate functionalities to maleic anhydride, such as epoxy and amine groups, proved to be equally valuable at improving the elongation.

Increasing the tensile strength of the system was equally part of the objective. Introduction of a di-acrylic ionic monomer yielded improvement in tensile strength that the liquid polybutadienes could not obtain. Formation of an ionic network within the EVA is probably the mechanism by which the tensile strength was improved.

Future experiments will further examine the influence of molecular weight on low functional LPBD. Increasing the length of the free chain should further increase the elongation phenomenon. Examining mixed additives systems to include both a LPBD and the SR-732 to increase both the tensile strength and elongation will also be considered. ■

5 Acknowledgments

The authors would like to thank DuPont USA and Almatix, for supplying material for this investigation; the team at Boy Machines, for moulding the tensile specimens on an XS microinjection moulder; and Brett Robb for careful preparation and characterisation of the EVA-ATH materials.

6 References

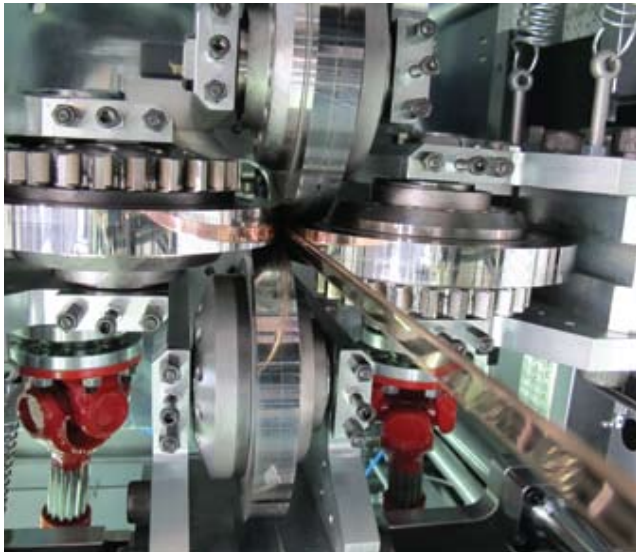
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Einführung einer neuen Kupferdrahtanlage



▲ Die neue Kupferdrahtanlage von Fuhr im Einsatz in Düsseldorf

Zur wire Düsseldorf nahm Fuhr GmbH & Co KG die Gelegenheit wahr, ihre neueste Entwicklung zur Herstellung hochpräziser rechteckiger Kupferdrähte vorzustellen.

Dank seines bisher größten Messestands (über 90m²) konnte Fuhr ein komplettes Walzwerk ausstellen, das Kupferdraht in Echtzeit von rund zu rechteckig mit einer Toleranz von ± 0.005 mm bearbeitet und gleichzeitig hervorragende Oberflächenqualität sowie Materialeigenschaften bietet. Das Unternehmen berichtet, daß eine große Anzahl an Besuchern präsent war, um sich die Einsatzmöglichkeiten der Maschinen und die Qualität des Endprodukts anzuschauen.

Ausgezeichnet durch eine Kombination von Horizontalaufwicklern (Abläufen), einem Duo-Walzapparat (WSR-Typ), zwei Kantenwalzvorrichtungen (WSE), zwei Universal-Türkenkopf (WST) -Walzmaschinen, sowie zwei kombinierten Tänzerrollen, drei Vollmer-Messsystemen und einer Oszillationsspulmaschine, eignet sich dieses sehr kompakte Walzwerk ideal zur Herstellung von hochpräzisen rechteckigen Kupferdrähten (wie z. B. CTC) oder Kupferflachdraht, wie z. B. PV-Band (das Draht mit Sammelschienen verbindet).

In der Regel bestehen die Anwendungen für CTC-Kabel in Transformator-, Motor- und Generatorwicklungen. Darüber hinaus werden hochpräzise rechteckige Kupferdrähte mit niedrigen Querschnitten für hocheffiziente Hybridmotoren und Windgeneratoren eingesetzt.

Durch das Aufkommen von CTC-Kabeln und deren entsprechenden Anwendungen, wurden die geforderten Toleranzen für diese rechteckigen Drähte auf $\pm 0,005 - 0,01$ mm reduziert, was sonst mit einer traditionellen Kaltwalztechnologie nicht erzielt werden kann.

Das nach dem aktuellen Stand der Technik ausgelegte neue Konzept und die moderne Anordnung der Drahtwalzmaschinen von Fuhr bieten ein Walzwerk, das runde Kupferdrähte in einer großen Auswahl an rechteckigen Flachprofilen bearbeiten und Breite-Dicke-Verhältnisse bis zu 40:1 erzielen kann.

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Türkischer Vertrag für Kabel

Draka Communications hat einen wichtigen Auftrag für CATV-Kupfer- und Glasfaser-Breitband-Infrastruktur in der Türkei bekannt gegeben. Gemäß der Vereinbarung, die Drakas türkischer Vertriebspartner Focabex initiiert hat, wird Draka das ganze Jahr 2010 hindurch rund 150km Glasfaserkabel mit hoher Faserzahl sowie etwa 600km dämpfungsarmes, koaxiales Kupfer-Weitverkehrskabel zur unter- und oberirdischen Anwendung liefern.

“Draka hat seit langem sehr gute Beziehungen zur Telekommunikationsindustrie in der Türkei. Deshalb freuen wir uns diesen wichtigen Vertrag durch unseren lokalen Partner bekannt zu geben, der ein direktes Resultat des gestiegenen Bedarfs an Backbone-Infrastruktur ist“, sagt Thilo Hamm, EMEA-Produktmanager für CATV- und RF-Produkte bei Draka Communications. “Diese Vereinbarung bestätigt einen Trend in all unseren Märkten, in denen die Übertragungsnetze grundlegende technische Optimierungs- und Erweiterungsprozesse durchlaufen.“

Draka Communications – Niederlande
Website: www.draka.com

Rautomead gründet Website auf Chinesisch

Der Spezialist für Stranggießtechnologie mit Sitz in den UK, Rautomead Ltd, hat die Einführung einer chinesischen Version seiner Website bekannt gegeben, um dem schnell anwachsenden chinesischen Markt einen einfacheren Zugang zu seiner Auswahl an Ausrüstungen zum Gießen von NE-Metallen zu bieten. Die neue Website finden Sie unter: www.rautomead.net.cn



▲ Rautomead ist nun auf chinesisich

Guy Henderson, Verkaufs- und Marketingleiter von Rautomead, bemerkte dazu: “Die Website auf chinesisich ist auf einem Server in China gehostet und wird jenen den Zugang zu den Produktinformationen von Rautomead vereinfachen, die chinesisiche Schriftzeichen in deren Suchmaschinen benutzen. Eine Website auf russisch (www.rautomead.ru), die in Rußland gehostet wird, ist seit Juli letzten Jahres aktiv. Trotz der wirtschaftlichen Lage, haben wir dort seit der Einführung dieser Website ein erhöhtes Nachfrage-Aufkommen verzeichnet.“

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wire Düsseldorf erfreut nochmals ihre Besucher



▲ Die wire 2012 wird vom 26. bis 30. März 2012 stattfinden

Die ersten Berichte über die Tube/wire Düsseldorf wiesen auf eine gut besuchte und optimistische Messe hin, die internationales Interesse erweckte. Auf der wire stellten 1.219 Firmen aus 52 Ländern, auf einer Ausstellungsfläche von 52.000m² aus, damit erhöhte sich die Ausstellerzahl um 7.3%. Nach Meinung von Benedikt Niemeyer, CEO von Schmolz & Bickenbach, dem weltweit tätigen Stahlunternehmen, läuft die wire gut und Kunden zeigen viel Interesse. Fast jeder hat das Gefühl das es wieder bergauf geht.

Howard Fanher, von Huestis Machine Corporation, spürte das vorliegende Interesse und, das man der Zukunft aufgeregt entgegen sieht. "Die wire Düsseldorf war eine lebendige und aufregende Messe mit Leuten die sich auf neue Technologien fokussierten und das Beste für ihr Geld bekamen. Mir wurde gesagt, daß die Besucherzahlen nicht so hoch waren wie bei vorherigen Messen, davon bin ich allerdings nicht überzeugt.

"Unser Stand war täglich mit engagierten Kunden, auf der Suche nach innovativen und neuem Zubehör, überfüllt. Ich sah viele neue Gesichter, jung und erwartungsvoll, Neulinge in der Draht- und Kabelindustrie, bemüht alles aufzunehmen und die besten Ideen mitzunehmen um die jeweiligen Firmen voranzubringen, sowie alles zu geben um den Erfolg zu fördern. Ich würde sagen, die Messe war ein Riesenerfolg.

Sehr gute bis gute Bewertungen vergaben die Besucher für die Veranstaltungen. An fünf Messetagen kamen insgesamt 69.200 Fachbesucher in die Messehallen. Der Anteil internationaler Messegäste ist traditionell hoch. Zur wire kamen rund 35.000 Fachbesucher aus 70 Ländern, 63% davon aus dem Ausland. Die Mehrzahl der wire-Besucher kam aus Großbritannien, Frankreich, den USA, Italien, Indien, den Niederlanden, Spanien, Brasilien, der Türkei, Österreich, der Schweiz, Belgien und Polen.

Messe Düsseldorf GmbH – Deutschland
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Website: www.wire.de

Stromverbindung zur Offshore- Plattform

ABB erhält einen Auftrag über 110 Millionen US-Dollar von Eni Norway AS, um eine Stromverbindung zwischen einer neuen Öl- und Gasplattform in der Barentssee und dem norwegischen Stromnetz zu bauen.

Die Goliat-Plattform wird teilweise über ein 106km langes Untersee-Starkstromkabel elektrifiziert. So muss weniger Strom mit den Gasturbinen der Plattform erzeugt werden, wodurch der Kohlendioxidausstoß von Goliat um bis zu 50 Prozent verringert werden kann.

"Die Kabelverbindung wird für eine zuverlässige Stromversorgung vom Festland sorgen und dazu beitragen, die Umweltauswirkungen der Plattform zu reduzieren", sagte Peter Leupp, Leiter der Division Energietechniksysteme von ABB.

Das VPE-isolierte 123-kV- (Kilovolt) /75-MW (Megawatt) -Kabel gilt als längstes und leistungsstärkstes Kabel, das je für eine Offshore-Anwendung geliefert wurde. Es wird die schwimmende Öl-/Gasförder-, Lager- und Verladeeinrichtung Goliat mit Drehstrom vom norwegischen Festlandnetz versorgen.

Das Kabel enthält Glasfasern zur Temperaturüberwachung, bietet allgemeine Kommunikationsdienste und umfaßt einen 1,5km dynamischen Abschnitt, der zudem die Bewegungen der schwimmenden Plattform aufnehmen kann.

Der Abschluss des Projekts ist für Ende 2013 vorgesehen, wenn Goliat den Betrieb aufnehmen soll.

Die VPE-isolierten seeverlegten Dreileiter-Hochspannungskabel von ABB zeichnen sich durch geringe elektrische Verluste, Lösungsmittel-, Öl- und Abriebbeständigkeit und durch exzellente Zugfestigkeit aus. Sie eignen sich ideal für die rauen Bedingungen auf hoher See.

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Verbesserung der mechanischen Eigenschaften von halogenfreien flammenhemmenden compounds

Von Jeremy R Austin, Herbert S.-I Chao, Sartomer Company

Übersicht

In der Regel werden halogenhaltige Compounds, wie z. B. Tetrabromobisphenol-A oder TBBPA, eingesetzt um flammenhemmende Kunststoffartikel herzustellen.

In der letzten Zeit haben akademische und industrielle Forscher ihr Interesse auf halogenfreie Flammschutzmittel konzentriert, diese zwar sichereren und alternativen Technologien haben jedoch eine schädliche Wirkung auf die mechanischen Eigenschaften. Mineralische Füllmaterialien, die als Flammschutzmittel eingesetzt werden, benötigen über 60% Gewichtsbelastung um die Flammtest-Anforderungen zu erfüllen.

In der aktuellen Studie werden funktionalisierte flüssige Polybutadiene (LPBD) eingesetzt, um die Dehnung und Zugfestigkeit der mit Aluminiumtrihydrat (ATH) gefüllten Ethylen-Vinylacetat (EVA) Copolymere zu verbessern. Die Vor-Dispersion der Haftvermittler auf dem ATH führt zu einer Erhöhung der Dehnung von über 200%. Niedrige Belastungen der Funktionalitäten, wozu Maleinsäure-Anhydrid, Epoxid und Amin gehören, haben sich als die wirkungsvollsten erwiesen. Die Einlagerung eines ionischen Diacryl-Monomers bietet Vorteile bei den Zugmodulen, die von den Materialien mit LPBD-Basis nicht erreicht werden können.

1 Einleitung

Wissenschaftliche Studien zeigten, daß halogenhaltige Flammschutzmittel (HFR) als weit verbreitete Schmutzstoffe für die

Umwelt gelten. Gefährliche Emissionen durch die Herstellung, Entsorgung oder Recycling von Kunststoffartikeln die HFR enthalten, stellen eine derart ernsthafte Bedrohung dar, daß einige HFR bereits von Elektro- und Haushaltsgeräten entfernt wurden, und die Europäische Union jene Richtlinien ratifiziert hat, die die Kunststoffindustrie auffordern, diese Werkstoffe zu beseitigen. Mit ähnlichen bevorstehenden Gesetzgebungen in allen Ländern, suchen Märkte im Bereich der Kunststoffindustrie alternative Technologien.

Verschiedene halogenfreie Flammschutzmittel (NHFR), wie z. B. Ammoniumphosphate, Melamin-Compounds, Nanoclays oder hydrierte Mineralien sind dafür anerkannt worden. Aluminiumtrihydrat (ATH) ist ein anerkannter flammenhemmender Füllstoff für Polymere, und ist eben halogenfrei. In der Regel bewirken Flammschutzmittel eine Verzögerung der Zündung, d. h. das Feuer des Treibstoffs wird entzogen oder die Zündungstemperatur unterdrückt.

Dennoch setzt ATH Wasserdampf während der Zersetzung frei. Man ist der Meinung, daß sich diese Wärme vom Substrat zurückzieht und die Treibstoffzuführung verdünnt. Nach der Verkohlung hemmt der Rückstand von Al_2O_3 die Migration von Sauerstoff und flüchtigen Compounds, die vom Polymer freigesetzt werden, das die exothermische Reaktion weiterhin stark vermehren kann.

In den meisten Anwendungen kann eine einfache Ersatzstrategie angewandt werden, wo ein NHFR ein HFR ersetzen kann.

In manchen Fällen, wie z. B. bei hydrierten Mineralien, d. h. Aluminiumtrihydrate oder Magnesiumhydroxid, ist der Übergang schwieriger.

Um die geforderte Flammbeständigkeit zu erzielen sind hohe Belastungen vom ATH erforderlich, oftmals mit 60% mehr Gewicht. Wenn der Volumenbruchteil von anorganischen Füllmaterialien 50% überschreitet, ergibt sich eine markierte Verschlechterung der physikalischen Eigenschaften im Compound.

Plentz *u. a.*¹ haben bewiesen, daß in den ATH-enthaltenden PP-Compounds ein Verhältnis zwischen der Belastung des Füllmaterials und der Abmessung der Aggregate entsteht.

Diese Feststellung zeigte daß nicht nur die physikalischen Eigenschaften durch die hohe Belastung des Füllmaterials beeinträchtigt werden, sondern daß sich auch der ATH mit der Erhöhung der Belastung aggregiert.

Studien zeigten, daß die Zugabe eines funktionalisierten Polymers eine wirksame Methode ist um die Grenzflächenhaftung an der organischen/unorganischen Grenze in Polymerverbunden^{2,3,4} zu ändern.

Mai *u. a.*⁵ haben bewiesen, daß die Einlagerung von gepfropften modifizierten Acrylsäuren in PP-ATH-Compounds eine chemische Interaktion zwischen den Karboxyl- und Hydroxylgruppen im Polymer bzw. Füllmaterial verursacht. Es wurde gezeigt, daß eine Verbesserung der Grenzflächenhaftung sowohl die thermischen wie die mechanischen Eigenschaften erhöht.

In ähnlicher Weise führte Wang u. a. ⁶ gepfropfte Maleinsäure-Anhydrid-EPR in ein PP-Mg(OH)₂-Compound ein, und stellte fest, daß sich EPR-g-MA nur auf der Grenzfläche befand.

Die Einkapselung von Mg(OH)₂ verbesserte die Dispersion des Füllmaterials, was wiederum eine verbesserte Schlagfestigkeit ergab.

Plentz u. a. ¹ führten in deren PP-ATH-System ein funktionelles Acrylsäuren-PP ein, und haben bewiesen, daß eine verbesserte Interaktion bei der Grenzfläche zu einer Erhöhung des Schmelzflußindex sowie der Zug- und Biegefestigkeit führt.

In allen drei Fällen ergab sich eine Interaktion der funktionalisierten Additive mit dem Füllmaterial, um die schädlichen Wirkungen hoher Belastungen von hydrierten Mineralfüllmaterialien entgegenzuwirken.

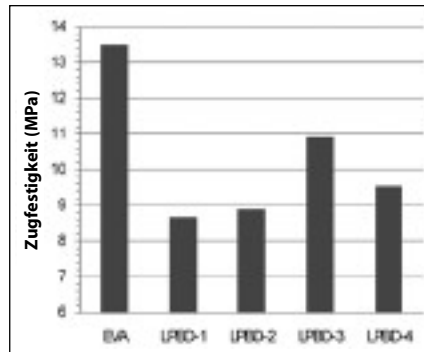
Traditionelle funktionalisierte Materialien wurden untersucht, um die Mängel der ATH-enthaltenden, flammenhemmenden Compounds zu überwinden.

In der aktuellen Bewertung wird die Wirkung funktionalisierter flüssiger Polybutadiene (LPBD) mit einem geringen Molekulargewicht als Agenten der Grenzflächenveränderung in einem um 60% gefüllten Ethylen-Vinylacetat (EVA) Draht- und Kabel-(W&C) System untersucht. Ein Feedback von der Industrie zeigte, daß durch die Migration zu einer ATH-Lösung, die Zugfestigkeit, die Duktilität und der Durchfluß derart reduziert werden, daß das Material nicht im W&C funktionieren kann.

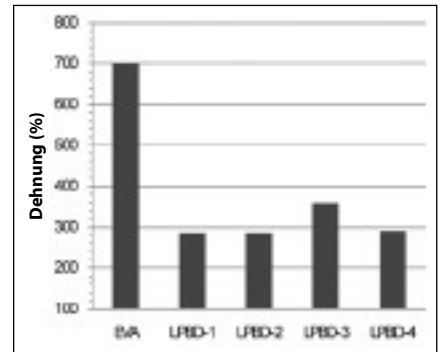
Ein niedriges Molekulargewicht gilt als vorteilhaft um die Füllmitteloberfläche besser erkennen zu können sowie daran zu haften, mit entsprechender Erhöhung der Grenzflächenänderung. Der Typ und das Belastungsniveau der Funktionalität wurde variiert, damit die geeigneten chemischen Bedingungen bewertet werden, um somit die EVA-ATH-Compounds bestens zu steigern.

▼ **Tabelle 1:** Eigenschaften der flüssigen Polybutadiene, die in der vorliegenden Untersuchung benutzt wurden, wobei Funktionalitätstyp und Belastung, Molekulargewicht und Vinylgehalt, * innerlich epoxidiertes Polybutadien ** und tertiäres Amin-gepfropftes Polybutadien hervorgehoben werden

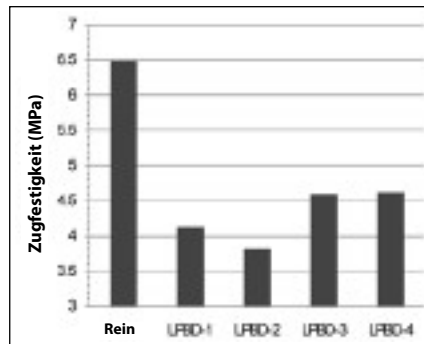
ID	Mn (g/mol)	Funktionalität (Typ/%)	Vinyl (%)
LPBD-1	1400	-	70
LPBD-2	4500	-	28
LPBD-3	2500	MA/17%	70
LPBD-4	5500	MA/17%	28
LPBD-5	4700	MA/5%	28
LPBD-6	4500	Epoxid*/5%	28
LPBD-7	5000	Amin**/5%	28



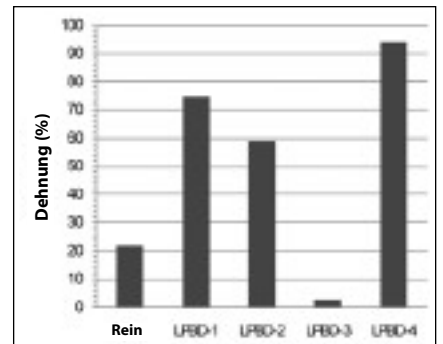
▲ **Bild 1:** Die Ergebnisse der Zugfestigkeit zwischen funktionellen und nichtfunktionellen LPBD verglichen auf Basis-EVA. Alle Produkte haben EVA weichgemacht, MA LPBD jedoch in einem geringeren Anteil



▲ **Bild 2:** Anhand der Dehnungsergebnisse der Basisstudie wird bewiesen, daß die funktionelle Anhydrid-LPBD den EVA am wenigsten beeinflusst



▲ **Bild 3:** Zugfestigkeitsergebnisse für ATH enthaltende Systeme, die beweisen, daß das funktionelle Anhydrid-LPBD die Zugfestigkeit weniger reduziert



▲ **Bild 4:** Dehnungsergebnisse für Basisstudie in EVA ATH-System, die eine Fähigkeit zur Wiederherstellung der Dehnung mit Einsatz von LPBD beweisen

2 Versuch

2.1 Eingesetzte Materialien

Handelsübliches EVA (DuPont Elvax[®] 550) mit 15% Vinylacetat nach Gewicht wurde wie geliefert eingesetzt. Die ATH Klasse C-33 mit einer durchschnittlichen Teilchengröße von 50µm und einer Dichte von 2,42g/cm³, die 35% chemisch kombiniertes Wasser enthält, wurde von Almatris Inc geliefert.

Das freifließende Pulver wurde während der Herstellung chemisch nicht modifiziert und wie geliefert genutzt.

Flüssige Polybutadiene mit niedrigem Molekulargewicht, die Vinyl, Maleinsäure-Anhydrid, Epoxid- oder Amin-Funktionalität

enthalten, wurden von Sartomer Company geliefert. In der *Tabelle 1* sind die entsprechenden Eigenschaften jedes flüssigen Polybutadiens (LPBD) dargestellt, das in der vorliegenden Studie benutzt wurde.

Die Materialien aus Polybutadien können als bifunktional betrachtet werden, da in der *Tabelle 1* eine Primärfunktionalität sowie ein unbestimmter Vinylgehalt dargestellt werden. Materialien, die 70% Vinyl enthalten, werden als aushärtungsaktiv betrachtet, und empfindlich gegenüber der Vernetzung bei Anwesenheit von freien Radikalen.

Die 28% Vinylpolybutadiene werden dagegen als stabiler betrachtet. Das Pfropfen von Maleinsäure-Anhydrid erfolgt in der *cis-trans* funktionellen Gruppe der Grundstruktur des Polybutadiens, und demzufolge wird anhand des höheren Vinylgehalts, die Funktionalität gezwungen sich in allernächster Nähe zu befinden. Neben dem Mn, stellt dies ein differenzierendes Merkmal zwischen LPBD-3 und LPBD-4 dar.

Die Einführung flüssiger Polybutadiene direkt in den Schmelzfluß wird wegen deren physikalischen Form untersagt. Die Haftvermittler wurden auf dem ATH in einem DLC-Träger (dry liquid carrier) in einem Mischer mit hoher Schwerkraft vorverteilt.

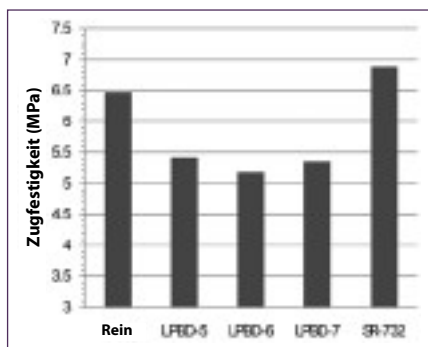
Das Ergebnis ist ein 50% aktives freifließendes Pulver, das seitlich leicht in den Extruder zugeführt werden kann.

Die vorherigen Studien haben bewiesen, daß die Einlagerung eines funktionellen ionischen Diacryl-Monomer in Polyolefinen zur Bildung einer ionischen vernetzten Struktur führt. Der Mechanismus setzt auf freie Radikale, die sich aus der Hitze und Scherung bei der Mischung ergeben. Ein ionisches Monomer, Klasse SR-732, wurde als Mittel geliefert, um die mechanischen Eigenschaften in den Ethenbereichen des EVA zu erhöhen.

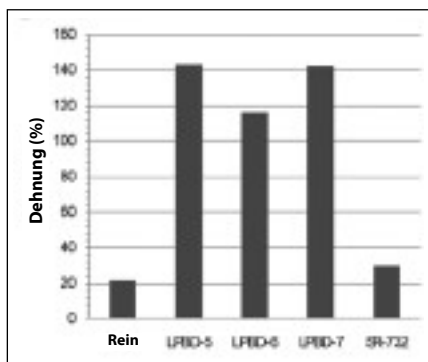
2.2 Vorbereitung der Probe

Um die Mischung jeder in dieser Studie untersuchten Rezeptur zu schmelzen, wurde ein Brabender TSE-20 eingesetzt. Der gleichsinnig drehende Zweischneckenextruder wies ein 40:1 L/D-Verhältnis auf, und einen Schnecken Aufbau, der zum Homogenisieren hoher Belastungen von Füllmaterial gestaltet ist. Additive wurden auf dem ATH vorverteilt und bei 20D nachgeschaltet versorgt. Versuche fanden mit Einsatz eines flachen Temperaturprofils von zirka 50°C über die Vicat-Erweichungstemperatur und bei 80 Upm statt. Ein einsträngiges Extrudat wurde durch eine Wasserwanne gezogen und granuliert. Alle Erarbeitungen enthielten 60% ATH und 4% LPBD nach Gewicht.

▼ **Bild 5:** Zugfestigkeitsergebnisse für alternierende Funktionalitäten zeigen, daß LPBD mit einer Funktionalität von 5% (Anhydrid eingeschlossen) eine geringere Wirkung auf die Zugfestigkeit hatte



▼ **Bild 6:** Dehnungsergebnisse mit Einsatz von alternierenden Funktionalitäten haben große Verbesserungen in der Duktilität gegenüber dem reinen EVA-ATH-System bewiesen



Grundlinien-Erarbeitungen wurden durchgeführt, um die Wirkung von LPBD auf EVA festzulegen.

ASTM-Zugproben wurden mit Einsatz des von der Firma Boy Machines hergestellten Spritzgießautomats für Mikrospritzguß der Baureihe XS 11-T spritzgegossen. Es wurde ein ähnliches Temperaturprofil wie jenes für die Extrusion benutzt.

Die Proben wurde auf einem Thwing-Albert Zugfestigkeitsprüfgerät entsprechend ASTM D-638 gezogen. Gesammelt wurden die Daten der Streckspannung und der Bruchdehnung.

3 Ergebnisse

Eine gründliche Kenntnis der Wirkung, die die LPBD auf den EVA haben war zwingend, um deren Wirkung auf den mit ATH-gefüllten Systemen zu verstehen. *Bild 1* und *2* stellen die Wirkung eines repräsentativen Beispiels von LPBD auf Basis-EVA dar.

Bild 1 und *2* zeigen, daß die LPBD eine schädliche Wirkung auf die Streckspannung und auf die Bruchdehnung haben. LPBD waren nicht mit EVA kompatibel und dienten zur Weichmachung von EVA. Nicht funktionalisierte LPBD 1 und 2 hatten eine gleichwertige Wirkung auf den Eigenschaften des EVA. Dies deutete darauf hin, daß der Mw- und Vinylgehalt keine einflußgebenden Variablen waren.

Dagegen zeigten beide Gegenstücke, die die Anhydrid-Funktionalität enthielten, eine höhere Zugfestigkeit und, im Falle der LPBD-3, eine bessere Dehnung. Es scheint offensichtlich, daß durch die Anhydrid-Funktionalität die LPBD mit der EVA-Phase kompatibler werden und daß der niedrigere Mw der LPBD-3 gegenüber LPBD-4 eine niedrigere Tröpfchendisposition kreierte.

Durch die Einführung von ATH ins System wurden die in *Bild 3* und *4* dargestellten Ergebnisse erzielt.

Bild 3 zeigt, daß alle LPBD die Streckspannung von ATH-gefüllten EVA reduzieren. Die funktionalisierten LPBD-3 und LPBD-4 übertreffen deren nicht funktionalisierte Gegenstücke, die teilweise auf eine Verbesserung der Grenzflächenhaftung zwischen den Phasen hinweisen. In *Bild 4* verbesserten alle die Bruchdehnung, außer LPBD-3. Im Falle der LPBD-3, liegt die weitere Dehnungsreduzierung wahrscheinlich an zwei Gründen.

Zunächst sollten die hochfunktionellen kleinen Ketten (Mn 2.500) mehrere Interaktionsstellen mit der ATH-Oberfläche

haben und das Mineral umhüllen. Demzufolge wären keine freien Kettensegmente mit den EVA zu verwickeln gewesen, die als Kompatibilisierer dienen würden.

Zweitens bestanden die LPBD-3 70% aus Vinyl, das sich bei der Mischung vernetzen konnte. Eine Analyse des elastischen Moduls erwies, daß LPBD-3 eine deutliche Erhöhung gegenüber dem Grundmaterial bestimmt hätte, was wiederum auf ein vernetztes Material hinwies. Die nicht funktionalisierten LPBD dienten dazu, das mineralische Füllmaterial besser zu nassen und demzufolge deren Dispersion zu unterstützen.

LPBD-4 verbesserten die Dehnung des gefüllten Systems um 450%. LPBD-4 hatte wahrscheinlich weniger Interaktionen zwischen der Hydroxyl- und der Anhydrid-Funktionalität auf der ATH-Oberfläche, während ein Endstück zum kompatibilisieren/verwickeln mit EVA beibehalten wird.

Neben dem Molekulargewicht und dem Vinylgehalt, wurden alternierende funktionalisierte LPBD bewertet. *Bild 5* und *6* stellen die Ergebnisse dieser Additiven, neben SR-732, dar.

Bild 5 und *6* beweisen, daß durch eine Senkung der Belastung von Anhydrid auf LPBD (LPBD-5), die Zugfestigkeit sowie die Dehnung erhöht wird. Wie bereits erwähnt, ist eine Verbindung zwischen dem Additiv und der Oberfläche des Füllmaterials zwingend, jedoch ist es auch wichtig sicherzustellen, daß eine ausreichende Kettenverwicklung zwischen dem Additiv und EVA besteht. Eine Reduzierung des MA-Gehalts auf dem Additiv senkt die Möglichkeit von Mehrfachverbindungen, die sich mit der ATH-Oberfläche bilden, dies erhöht wiederum die durchschnittliche Kettenlänge, die im EVA zur Verwicklung übrig bleibt.

LPBD-6 und LPBD-7 haben bewiesen, daß alternierende Funktionalitäten Maleinsäure-Anhydrid in der Form von Epoxid und Amin ersetzen können. Beide Funktionsgruppen zeigten in Bezug auf Zugfestigkeit und Dehnung ähnliche Leistungen bei gleichen Anhydrid-Belastungen.

Bild 5 und *6* haben auch den Einfluss des ionischen Monomers, SR-732, auf das ATH/EVA-System bewiesen. Im Gegensatz zu den LPBD-Additiven, erhöht SR-732 die Zugfestigkeit des Systems und zeigt statistisch - selbst wenn nur bescheiden - eine Verbesserung der Dehnung. Man nimmt an, daß die Einführung vom ATH hohe Scherungsbedingungen innerhalb der Schmelze während der Mischung verursacht, die mit der Acryl-Funktionalität reagiert.

Die vorherigen Studien zeigten, daß diese Monomere dazu neigen, sich innerhalb eines Polymer-Compound anzuheften, was eine ionische Brücke oder eine Vernetzung zwischen den anliegenden Ketten kreiert.

Bei Raumtemperatur dient die Anhäufung dazu die mechanischen Eigenschaften des Systems zu erhöhen.

Im Gegensatz zu den LPBD, modifizierte SR-732 die Masseneigenschaften von EVA gegenüber der Grenzfläche.

4 Schlussfolgerung

Wichtige Verbesserungen in der Dehnung von stark gefüllten ATH/EVA-Compounds wurden durch die Einführung funktioneller Polybutadiene mit niedrigem Molekulargewicht erzielt.

Die Funktionalität des Additivs diente als Kompatibilität bei der organischen/unorganischen Grenzfläche durch die Reaktion mit der ATH-Oberfläche und Kettenverwicklung mit dem EVA.

Das Molekulargewicht, oder Kettenlänge, stellte einen wichtigen Faktor bei der Verbesserung der Dehnungseigenschaften dar.

Alternierende Funktionalitäten gegenüber dem Maleinsäure-Anhydrid, wie z. B. Epoxid- und Amingruppen, haben sich als gleichfalls nützlich bei der Verbesserung der Dehnung erwiesen.

Die Erhöhung der Zugfestigkeit des Systems gehörte ebenfalls zur Zielsetzung.

Dank der Einführung eines ionischen Di-Acrylmonomers wurde eine Verbesserung der Zugfestigkeit erzielt, die man sonst mit flüssigen Polybutadienen nicht erreicht hätte.

Die Bildung eines ionischen Netzes innerhalb des EVA ist wahrscheinlich der Mechanismus, der die Verbesserung der Zugfestigkeit bewirkte.

Weitere Versuche werden zukünftig den Einfluss des Molekulargewichts auf niedrigfunktionellen LPBD erforschen.

Eine Zunahme der Länge der freien Ketten sollte das Dehnungsphänomen weiterhin steigern.

Darüber hinaus wird die Analyse von gemischten Additivsystemen berücksichtigt, die ein LPBD und den SR-732 einschließen, um die Zugfestigkeit sowie die Dehnung zu erhöhen. ■

5 Danksagungen

Die Autoren möchten DuPont USA und Almatris für das für diese Untersuchung gelieferte Material danken; die Mannschaft bei Boy Machines, für das Spritzgießen der Zugproben auf einem XS Spritzgießautomats für Mikrospritzguß und Brett Robb für die sorgfältige Vorbereitung und Beschreibung der EVA-ATH-Materialien.

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Diese Unterlage wurde während des in Charlotte, NC vom 8. bis 11. November 2009 stattgefundenen 58. International Wire & Cable and Connectivity Symposiums vorgestellt und ist mit der freundlichen Genehmigung der Veranstalter vervielfältigt worden.

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Презентация новой прокатной линии для производства медной проволоки



▲ Выставка wire Düsseldorf: новая прокатная линия для производства медной проволоки компании «Фур» в действии

На выставке wire Düsseldorf компания «Фур ГмБХ & Ко КГ» (Fuhr GmbH & Co KG) воспользовалась представившейся ей возможностью, чтобы показать свою последнюю разработку в области производства прецизионной медной проволоки прямоугольного сечения.

На самом большом за все время своего участия в выставке стенде (площадью более 1000 кв. футов) компания «Фур» смогла продемонстрировать в режиме реального времени работу всего прокатного стана, позволяющего вести обработку медной проволоки с обжатием заготовки круглого сечения в прямоугольный профиль с точностью до $\pm 0,005$ мм, одновременно обеспечивая высокое качество поверхности и отличные свойства материала. По сообщениям компании, большое число посетителей пришло на выставку, чтобы увидеть эксплуатационные возможности представленного оборудования и убедиться в качестве готовых изделий. Как предполагается, эта прокатная

линия весьма компактных размеров, объединившая в себе горизонтальное намоточное устройство (отдатчик), двухвалковую прокатную клеть (типа WSR), две машины для прокатки боковых граней (WSE), два прокатных стана с туркоголовыми вальками (WST), а также два комбинированных натяжных валика, три измерительных системы компании «Фолльмер» (Vollmer) и одно намоточное устройство маятникового типа, идеально подходит для производства изделий из прецизионной медной проволоки прямоугольного сечения (например, кабелей из проводников с равномерно распределенной транспозицией (СТС)) или плоской медной проволоки, таких как фотоэлектрические ленточные кабели (соединительные кабели и электрические шины).

В основном транспонированные провода типа СТС используются в обмотках трансформаторов, электродвигателей и генераторов. Кроме того, прецизионные

медные прямоугольные провода малого сечения используются в высокопроизводительных гибридных силовых установках и ветровых генераторах. С появлением транспонированных проводов типа СТС и расширением сферы их применения требуемые допуски на проволоку прямоугольного сечения были уменьшены до уровня $\pm 0,005-0,010$ мм, который не может быть обеспечен при использовании традиционной технологии холодной прокатки. Предложенные компанией «Фур» новая, передовая концепция и современная компоновка проволочно-прокатных станов позволили создать прокатную линию, на которой из круглой медной проволоки можно производить самые разные изделия прямоугольного и плоского профиля, в которых отношение ширины к толщине может достигать величины 40:1.

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Контракт на поставку кабеля в Турцию

Компания «Драка коммьюникейшнз» (Draka Communications) объявила о заключении крупного контракта на модернизацию магистральной инфраструктуры кабельного телевидения на основе медных и оптоволоконных кабельных линий в Турции. В рамках соглашения, подписанного через местного дистрибьютора «Драка» – фирму «Фокабэкс» (Focabex), в течение 2010 года компания поставит около 600 км медного магистрального кабеля с малым затуханием для подземных и воздушных линий в дополнение к 150 км многоволоконного оптического кабеля.

Draka Communications (Нидерланды)

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«Раутомед» открывает Web-страницу на китайском языке

Британская компания «Раутомед лтд» (Rautomead Ltd), специализирующаяся на технологии непрерывного литья, объявила об открытии версии своей Web-страницы на китайском языке с целью обеспечения большей доступности выпускаемого ею оборудования для литья цветных металлов на стремительно растущем китайском рынке. Новая Web-страница доступна для просмотра по ссылке www.rautomead.net.cn.



▲ Компания «Раутомед» выходит в Интернет на китайском языке

Директор «Раутомед» по сбыту и маркетингу Гай Хендерсон (Guy Henderson) так прокомментировал это событие: «Web-страница на китайском языке размещена на сервере в Китае и будет обеспечивать доступ к информации о продукции компании «Раутомед» для тех, кто использует в поисковых системах китайские иероглифы».

С июля прошлого года работает сайт компании на русском языке (www.rautomead.ru), размещенный на сервере в России. Несмотря на сложную экономическую ситуацию в этой стране, мы зарегистрировали увеличение количества запросов с тех пор, как эта Web-страница была открыта».

Rautomead Ltd (Великобритания)

Факс: +44 1382 622941

Адрес электронной почты: sales@rautomead.com

Web-страница: www.rautomead.com

Прорыв в технологии обжима

В этом году на выставке wire Düsseldorf компания «Сампсистемы» (Sampsistemi) под слоганом «прорыв в технологии обжима» представила линию RBL 1. В конструкции RBL 1 заложена технология непрерывного высокоточного контроля технологического процесса, которая обеспечивает экономию электроэнергии и материалов.

При работе с заготовками из меди и алюминиевых сплавов обжимная линия RBL 1 сможет выполнять от 9 до 17 обжатий 1, 2 или 4 нитей проволоки на скоростях до 40 м в секунду. Величина относительного удлинения проволоки при каждом обжатии полностью регулируется и может выбираться из широкого диапазона настроек.

Начальный диаметр для медной проволоки составляет 8–10 мм, а для проволоки из алюминиевого сплава – 9,5–12,7 мм; диаметр на выходе составляет 0,88–5,5 мм для медной проволоки и 1,25–5,5 мм для проволоки из алюминиевого сплава.

Как указывается, по сравнению с существующей технологией обжимная линия RBL 1 имеет следующие преимущества:

- управление технологическим процессом с помощью ЧПУ;
- режимы работы с учетом диаметра и удельной электропроводности;
- снижение энергопотребления на 30 %;
- пониженная шумность при работе (уровень шума составляет менее 80 дБА);
- безмасляная конструкция с прямым приводом;
- удобные в использовании системы управления и диагностики;
- дистанционное управление через сеть Интернет;
- отсутствие необходимости в проведении профилактического обслуживания.

SAMP SpA (Италия)

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Web-страница: www.sampsistemi.com

Силовая магистраль для морской платформы

Компания «АББ» (ABB) получила от «Эни Норвеж АС» (Eni Norway AS) заказ стоимостью 110 млн. долларов США на строительство силовой магистрали, которая соединит новую нефтегазовую платформу в Баренцевом море и норвежскую энергетическую систему.

Платформа «Голиаф» (Goliat) будет частично запитываться через подводный силовой кабель длиной 106 км, что может позволить снизить уровень выбросов углекислого газа почти на 50 % за счет снижения потребностей в электроэнергии, вырабатываемой установленными на платформе газотурбинными установками.

«Кабельная линия обеспечит надежное снабжение электроэнергией с берега и поможет уменьшить воздействие на окружающую среду в результате эксплуатации платформы», – сказал Питер Лойпп (Peter Leupp), руководитель подразделения систем энергоснабжения компании «АББ».

Как считается, этот кабель с изоляцией из сшитого полиэтилена, рассчитанный на напряжение 123 кВ и номинальную мощность 75 МВт, является самым протяженным и мощным кабелем, когда-либо поставлявшимся для использования на морских месторождениях. Он будет подавать питание переменного тока от береговой энергосети в Норвегии на «Голиаф» – плавучую установку для добычи, хранения и отгрузки нефти и газа.

В кабель интегрированы волоконные световоды для осуществления контроля температуры и обеспечения связи общего пользования. Предусмотрено также динамическое звено длиной 1,5 км для компенсации смещения плавучего основания.

Завершение проекта запланировано к концу 2013 года, когда установка «Голиаф» должна быть пущена в эксплуатацию.

Компания «АББ» уже поставила около 3000 км подводного кабеля переменного и постоянного тока с полимерной (безмасляной) изоляцией для различных проектов по всему миру, в том числе для силовых магистралей на нефтегазовые платформы в Персидском заливе и Северном море.

ABB Ltd (Швейцария)

Web-страница: www.abb.com



Улучшение физико-механических свойств негалогенизированных огнестойких компаундов

Джереми Р. Остин, Герберт С.-И. Чао (компания «Сартомер»)

Аннотация

Традиционно огнестойкость изделий из пластмассы обеспечивается введением галогенизированных соединений, таких как тетрабромобисфенол-А, или ТББФ-А. В последнее время в центре научных и промышленных исследований оказались вопросы перехода к использованию негалогенизированных ингибиторов горения, однако эти более безопасные альтернативные технологии отрицательно сказываются на физико-механических свойствах. Для выполнения требований к распространению пламени концентрация минеральных наполнителей, используемых в качестве ингибиторов горения, должна составлять более 60 массовых долей.

В настоящем исследовании для улучшения характеристик относительного удлинения и прочности при растяжении в сополимерах этилена и винилацетата (ЭВА), наполненных тригидратом алюминия (ТГА), используются функционализированные жидкие полибутадienes (ПБДЖ). Предварительное диспергирование связующих агентов с ТГА привело к увеличению относительного удлинения более чем на 200 %. Было доказано, что низкие концентрации функциональных групп, включая функциональные группы малеинового ангидрида, эпоксидные и аминовые группы, являются наиболее эффективными. Включение диакрилового ионного мономера обеспечило увеличение модуля упругости при растяжении, не доступное для материалов на основе ПБДЖ.

1 Введение

Научные исследования показали, что галогенизированные ингибиторы горения (ИГГ) – это широко распространенные вещества, которые

загрязняют окружающую среду. Вредные выбросы, образующиеся в результате производства, утилизации и вторичной переработки изделий из пластмасс, содержащих ИГГ, представляют настолько серьезную угрозу, что некоторые типы ИГГ уже изъяты из электронных устройств и бытовых товаров, а Европейский Союз ратифицировал нормативные акты, регламентирующие производство пластмасс, с целью запрещения использования этих веществ. С учетом предстоящего принятия аналогичных законодательных норм на всех континентах производители пластмасс на отдельных рынках в настоящее время заняты поиском альтернативных технологий.

К настоящему времени выделен ряд негалогенизированных ингибиторов горения (ИГНГ), таких как фосфаты аммония, меламиновые компаунды, наноглины и гидратированные минералы. Тригидрат алюминия (ТГА) является признанным антипиреновым наполнителем для полимеров и не содержит галогенов. Как правило, действие ингибиторов горения заключается в задержке воспламенения за счет перекрытия доступа к огню топлива или подавления воспламенения. Между тем, при разложении ТГА происходит высвобождение водяных паров, что, как считается, отводит тепло от субстрата и разрывает подачу топлива. После образования коксового слоя остаток Al_2O_3 препятствует миграции высвобождаемых из полимера кислорода и летучих соединений, которые могут способствовать распространению экзотермической реакции.

В большинстве областей применения можно использовать простой метод замены, когда один ИГНГ может заменить ИГГ. В отдельных случаях, например, с гидратированными минералами, такими как тригидрат алюминия или гидроксид магния, переход сопряжен с большими

сложностями. Для того чтобы обеспечить требуемую огнестойкость необходимы высокие концентрации ТГА, нередко составляющие более 60 массовых долей. После того как объемная доля неорганического наполнителя превысит 50 %, отмечается выраженное ухудшение физических свойств компаунда. Plentz et al ¹ продемонстрировали, что в полипропиленовых (ПП) компаундах, содержащих ТГА, существует взаимосвязь между концентрацией и крупностью наполнителя. Этот факт стал свидетельством не только того, что повышенная концентрация наполнителя отрицательно сказывается на физических свойствах, но и того, что ТГА также должен агрегироваться с увеличением концентрации.

Исследования показывают, что добавление функционализованного полимера является эффективным методом модифицирования межфазной адгезии на границе раздела между органической и неорганической фазами в полимерных композитах ^{2, 3, 4}. Mai et al ⁵ продемонстрировали, что включение в компаунды на основе ПП-ТГА модифицированной прививкой акриловой кислоты вызывает химическую реакцию между карбоксильными и гидроксильными группами соответственно в полимере и наполнителе. Было установлено, что улучшение межфазной адгезии повышает как термические, так и физико-механические свойства.

Аналогичным образом Wang et al ⁶ ввели в компаунд на основе ПП- $Mg(OH)_2$ привитый малеиновым ангидридом ЭПК и установили, что ЭПК-пр-МАН локализуется исключительно на межфазной границе раздела. Капсулирование $Mg(OH)_2$ повысило дисперсию наполнителя, что проявилось в повышении ударной вязкости. Plentz et al ¹ ввели в исследуемую ими систему ПП-ТГА функционализированный

акриловой кислотой ПП и продемонстрировали, что улучшенное взаимодействие на межфазной границе раздела привело к повышению индекса текучести расплава, а также прочности при растяжении и изгибе. Во всех трех случаях функционализированные добавки вступали во взаимодействие с наполнителем, уменьшая тем самым отрицательное влияние высокой концентрации гидратированных минеральных наполнителей.

Проведено исследование традиционных функционализированных материалов на предмет устранения недостатков, которые присущи не поддерживающим горения компаундам, содержащим ТГА. Целью настоящей оценки является определение действия низкомолекулярных функционализированных жидких полибутадиенов (ПБДЖ) в качестве модифицирующих агентов на межфазной границе раздела в кабельно-проводниковой продукции, изготовленной на основе сополимера этилена и винилацетата (ЭВА) с 60 % наполнением.

Согласно отзывам предприятий отрасли, при переходе на композиции на основе ТГА прочность при растяжении, пластичность и текучесть снижаются до такой степени, что функциональность материала в кабельно-проводниковой продукции не может быть обеспечена. Предполагается, что малая молекулярная масса дает преимущество для оптимизации определения поверхности наполнителя и обеспечения адгезии с ней, тем самым активизируя модификацию межфазных поверхностей.

Тип и уровень концентрации функциональной группы менялись с целью определения соответствующего химического состава для максимального улучшения характеристик компаундов на основе ЭВА-ТГА.

2 Экспериментальные исследования

2.1 Используемые материалы

Промышленно выпускаемый сополимер ЭВА (DuPont Elvax® 550), содержащий 15 массовых долей винилацетата, использовался без проведения после его получения какой-либо обработки. ТГА марки С-33 со средним размером частиц 50 мкм и удельным весом 2,42 г/см³, содержащий 35 % химически связанной воды, был предоставлен компанией «Алмэтикс инк» (Almatis Inc). Свободнотекущий порошок при изготовлении не подвергался химическому модифицированию и использовался без какой-либо обработки после его получения.

Низкомолекулярные жидкие полибутадиены, содержащие виниловую, малеиновую ангидридную, эпоксидную или аминную функциональную группу, были предоставлены компанией «Сартомер». В таблице 1 приведены соответствующие свойства каждого жидкого полибутадиена (ПБДЖ), использовавшегося в настоящем исследовании.

Полибутадиеновые композиции могут считаться бифункциональными, так как таблица 1 указывает на наличие как первичной функциональной группы, так и боковой виниловой группы. Материалы с 70-процентным содержанием винила считаются полимеризационно активными и восприимчивыми к поперечной сшивке в присутствии свободных радикалов. Полибутадиены с содержанием винила 28 %, напротив, считаются более стабильными. Привитая сополимеризация малеинового ангидрида осуществляется в звеньях основной молекулярной цепи полибутадиена цис- и транс-конфигурации, и, следовательно, более высокое содержание винила вынуждает

функциональную группу локализоваться на существенно более близком расстоянии. Наряду со среднечисленной молекулярной массой (Mn), это является отличительной характеристикой между ПБДЖ-3 и ПБДЖ-4.

Введение жидких полибутадиенов непосредственно в поток расплава невозможно вследствие их физического состояния. Связующие агенты были предварительно диспергированы с ТГА в безводном жидком носителе (DLC) в смесителе с большими сдвиговыми усилиями. В результате получен 50-процентный активный свободнотекущий порошок, который можно легко загружать в экструдер через боковую подачу.

Предыдущие работы продемонстрировали, что включение в полиолефины ионного мономера, функционализированного диакрилатом, ведет к образованию структуры с ионными поперечными сшивками. Механизм основан на свободных радикалах, образующихся под действием высокой температуры и сдвигового усилия при приготовлении смеси. Ионный мономер марки SR-732 подавался в качестве средства для улучшения физико-механических свойств на участках этиленовых звеньев в структуре сополимера ЭВА.

2.2 Подготовка образцов

Для смешения в расплаве каждой из изучаемых в настоящем исследовании смесей использовался экструдер TSE-20 компании «Брабендер» (Brabender). Этот двухшнековый экструдер с однонаправленным вращением имеет соотношение длины шнека к диаметру (L/D), равное 40:1, и конструкцию шнеков, рассчитанную для усреднения состава смеси при высоком содержании наполнителя. Добавки были предварительно диспергированы с ТГА и подавались в нисходящем потоке при уставке 20D. Экспериментальные исследования проводились при равном температурном режиме, приблизительно на 50 °С выше температуры размягчения по Вика, и при скорости вращения шнеков 80 об./мин. Одиночная лента экструдата выдавливалась через водяную ванну и гранулировалась. Все рецептуры содержали 60 массовых долей ТГА и 4 массовых доли ПБДЖ. Исходные рецептуры составлялись для определения воздействия ПБДЖ на сополимер ЭВА.

Образцы для испытаний на растяжение по стандарту АСТМ были отлиты с использованием микроинжекционной установки для литья XS 11-Т компании «Бой машинз» (Boy Machines). При этом использовался температурный режим, аналогичный режиму в процессе

▼ **Таблица 1.** Свойства жидких полибутадиенов, использовавшихся в настоящем исследовании, с указанием типа и концентрации функциональной группы, молекулярной массы и содержания винила * полибутадиен, подвергнутый внутримолекулярному эпоксидированию ** полибутадиен с привитым третичным амином

Маркировка	Среднечисленная молекулярная масса (г/моль)	Функциональность (тип)	Винил (%)
ПБДЖ-1	1400	-	70
ПБДЖ-2	4500	-	28
ПБДЖ-3	2500	МА/17%	70
ПБДЖ-4	5500	МА/17%	28
ПБДЖ-5	4700	МА/5%	28
ПБДЖ-6	4500	Эпоксид*/5%	28
ПБДЖ-7	5000	Амин**/5%	28

экструзии. Образцы подвергались растяжению на испытательном устройстве производства компании «Твинг-Альберт» (Thwing-Albert) в соответствии со стандартом ASTM D-638. Были получены значения прочности на растяжение при условном пределе текучести и относительного удлинения при разрыве.

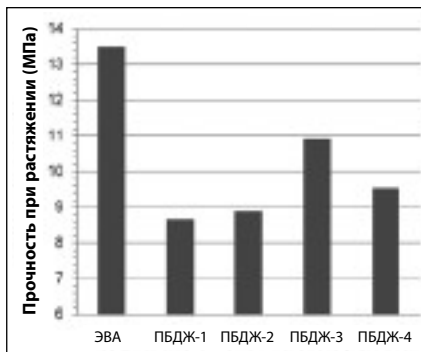
3 Результаты

Для понимания механизма воздействия ПБДЖ на наполненные ТГА системы необходимо полное понимание их влияния на сополимер ЭВА. На рис. 1 и 2 проиллюстрировано влияние репрезентативного образца ПБДЖ на исходный сополимер ЭВА.

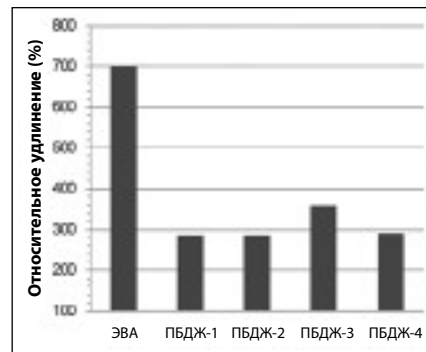
На рис. 1 и 2 показано, что жидкие полибутadiены пагубно влияют на прочность на растяжение при условном пределе текучести и на относительное удлинение при разрыве. ПБДЖ были несовместимы с сополимером ЭВА и оказали на него пластифицирующее действие. Нефункционализированные ПБДЖ-1 и ПБДЖ-2 в равной степени сказались на свойствах сополимера ЭВА, что позволило предположить, что средневесовая молекулярная масса (M_w) и содержание винила не являлись определяющими переменными. Напротив, аналогичные составы, содержащие ангидридные функциональные группы, обеспечили и более высокую прочность при растяжении, и, в случае с ПБДЖ-3, улучшенное относительное удлинение. Представляется очевидным, что ангидридная функциональность обеспечила большую совместимость ПБДЖ с фазовым состоянием ЭВА, и что меньшее значение M_w для ПБДЖ-3 по сравнению с ПБДЖ-4 способствовало образованию более слабой каплевой дисперсии.

За счет введения ТГА в композицию получены результаты, которые представлены на рис. 3 и 4.

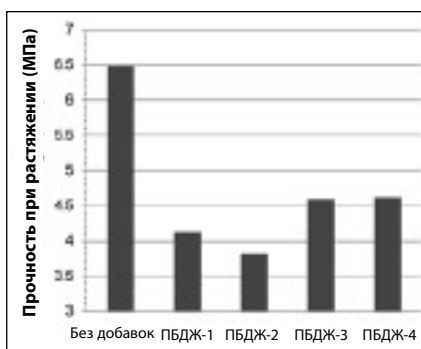
На рис. 3 видно, что все ПБДЖ снижают прочность наполненного ТГА сополимера ЭВА на растяжение при условном пределе текучести. Функционализированные ПБДЖ-3 и ПБДЖ-4 продемонстрировали лучшие параметры по сравнению с их нефункционализированными аналогами, что отчасти предполагает существование улучшенной адгезии на границе раздела фаз. Как показано на рис. 4, все ПБДЖ, за исключением ПБДЖ-3, способствовали увеличению относительного удлинения при разрыве. В случае ПБДЖ-3 дальнейшее уменьшение относительного удлинения, возможно, обусловлено двумя причинами.



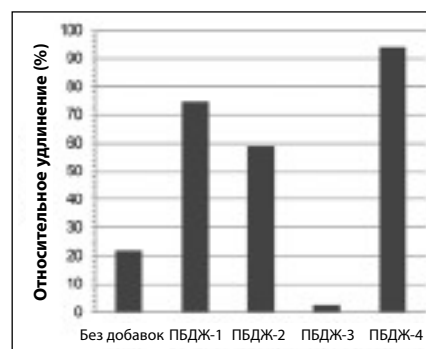
▲ Рис. 1. Сравнительные результаты испытаний на растяжение функционализированных и нефункционализированных ПБДЖ в сопоставлении с исходным сополимером ЭВА. Все композиции оказали пластифицирующее действие на сополимер ЭВА, однако ПБДЖ, модифицированный МАН, оказал пластифицирующее действие в наименьшей степени



▲ Рис. 2. Результаты базисного исследования относительного удлинения, свидетельствующие о том, что влияние функционализированного ангидридом ПБДЖ на сополимер ЭВА было наименьшим.



▲ Рис. 3. Результаты испытаний на растяжение для содержащих ТГА смесей, свидетельствующие о том, что ПБДЖ, функционализированный ангидридом, снижает прочность при растяжении в наименьшей степени



▲ Рис. 4. Результаты базисного исследования относительного удлинения в ЭВА-ТГА системе, свидетельствующие о возможности восстановления показателя относительного удлинения с использованием ПБДЖ

Во-первых, возможно, что высокофункциональные короткие цепи (M_n 2500) имели множественные участки взаимодействия с поверхностью ТГА и капсулировали минерал. Как следствие, свободных сегментов цепей, которые могли бы переплетаться с ЭВА, выступая в качестве улучшителя совместимости, не осталось.

Во-вторых, ПБДЖ-3 был на 70 % насыщен винилом, молекулы которого в процессе компаундирования могли оказаться сшитыми поперечными связями. Анализ модуля упругости показал, что ПБДЖ-3 вызвал его существенное увеличение по сравнению с исходным материалом до уровня, характерного для сшитых материалов. Нефункционализированные ПБДЖ способствовали улучшению смачивания минерального наполнителя, облегчая тем самым его диспергирование. ПБДЖ-4 увеличил относительное удлинение в наполненной системе на 450 %. В ПБДЖ-4 могло быть меньше число участков взаимодействия между поверхностными гидроксильными функциональными группами ТГА и ангидридными функциональными группами, при этом

сохранившийся остаток обеспечил улучшение совместимости/образовал переплетение молекулярных цепей с ЭВА.

Наряду с определением молекулярной массы и содержания винила, была проведена оценка альтернативных функционализированных ПБДЖ. На рис. 5 и 6 проиллюстрированы результаты анализа этих добавок, а также SR-732.

На рис. 5 и 6 видно, что снижение концентрации ангидрида, действующего на ПБДЖ (ПБДЖ-5), увеличивает как прочность при растяжении, так и относительное удлинение. Как упоминалось ранее, крайне важно обеспечить не только сопряжение между добавкой и поверхностью наполнителя, но и достаточную степень переплетения молекулярных цепей в добавке и ЭВА. Уменьшение содержания МАН в добавке снизило вероятность образования кратных связей с поверхностью ТГА, увеличив таким образом среднюю длину цепи, оставшуюся для создания переплетения молекулярных цепей в структуре ЭВА. ПБДЖ-6 и ПБДЖ-7 демонстрируют, что малеиновый

ангидрид может быть замещен альтернативными функциональными группами, представленными эпоксидами и аминами. По прочности при растяжении и относительному удлинению обе функциональные группы при равных концентрациях ангидрида проявили аналогичные свойства.

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На рис. 5 и 6 также показано влияние ионного мономера SR-732 на систему ТГА/ЭВА. В отличие от добавок на основе ПБДЖ, SR-732 повысил прочность системы при растяжении, а также увеличил, согласно статистике, относительное удлинение, хотя и незначительно. Считается, что введение ТГА способствовало образованию в расплаве в процессе компаундирования больших напряжений сдвига, действующих на акриловую функциональную группу. Предыдущие работы указывают на то, эти мономеры имеют тенденцию к агрегации внутри полимерных соединений, в результате чего образуется ионная мостиковая связь, или поперечная сшивка, между соседними цепями. При температуре окружающей среды агрегат должен способствовать повышению физико-механических свойств системы. В отличие от ПБДЖ, SR-732 изменил свойства сополимера ЭВА по всему объему образца, а не только на межфазной границе раздела.

Дальнейшие экспериментальные исследования позволяют более детально изучить влияние молекулярной массы на ПБДЖ с низкой функциональностью. Увеличение длины свободной молекулярной цепи должно способствовать еще большему эффекту повышения относительного удлинения. Кроме того, будет рассмотрена возможность исследования смешанных систем добавок с включением ПБДЖ и SR-732 для увеличения как прочности при растяжении, так и относительного удлинения. ■

5 Выражение признательности

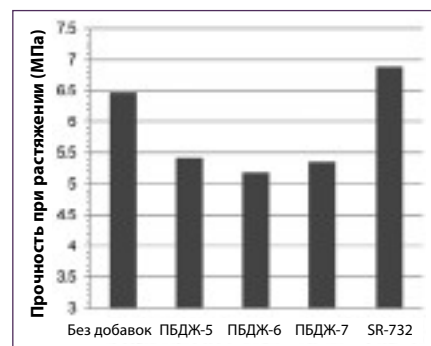
Авторы хотели бы поблагодарить компании «Дюпон Ю-Эс-Эй» и «Алмэтикс» за предоставленные материалы для настоящего исследования, сотрудников «Бой машинз» за изготовленные на микроинжекционной установке для литья XS образцы для испытаний на растяжение, а также Бретта Робба (Brett Robb) за тщательную подготовку и определение характеристик материалов на основе ЭВА-ТГА.

6 Справочная литература

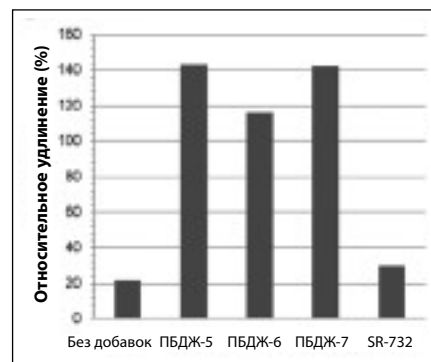
1. Plentz, RS, Miotto, M, Schneider, EE, Forte, MSM, Mauler, RS, and Nachtigal, SMB: Journal App. Polym. Sci., 101, 1799 (2006)
2. Jancar, J, and Kacera, J: Journal App. Polym. Sci., 30, 714 (1990)
3. Duval, J, Sellitti, C, Myers, C, Hiltner, A, and Baer, E: Journal App. Polym. Sci., 52, 591 (1994)
4. Sun, Y, Hu, G, Lamba, M: Polym. 37, 4119 (1996)
5. Mai, K, Li, Z, Qiu, Y, and Zeng, H: Journal App. Polym. Sci., 84, 110 (2002)
6. Wang, J, Tung, JF, Fuad, MYA, and Hornsby, PR: Journal App. Polym. Sci., 60, 1425 (1996)

Настоящая работа была впервые представлена на 58-ой Конференции Международного симпозиума IWCS по кабельно-проводниковой продукции и системам связи, состоявшейся в г. Шарлотте (шт. Северная Каролина) с 8 по 11 ноября 2009 года, и перепечатывается любезного разрешения организаторов.

▼ **Рис. 5.** Результаты определения прочности при растяжении для альтернативных функциональных групп, свидетельствующие о том, что ПБДЖ с 5-процентной функциональностью (включая ангидридную) в меньшей степени воздействуют на прочность при растяжении



▼ **Рис. 6.** Результаты определения относительного удлинения с использованием альтернативных функциональных групп, свидетельствующие о существенном улучшении пластичности по сравнению с системой на основе ЭВА-ТГА, в которой добавки не использовались



4 Выводы

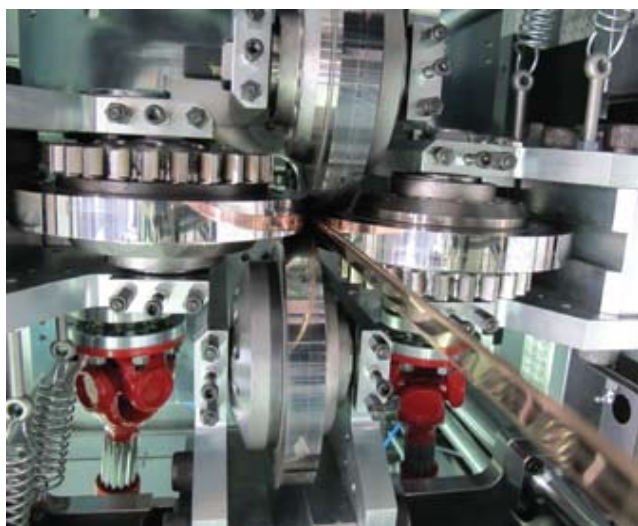
Существенное улучшение показателя относительного удлинения в соединениях ТГА/ЭВА с высокой степенью наполнения достигнуто посредством введения низкомолекулярных функциональных полибутиадиенов. Функциональность добавки способствовала улучшению совместимости на границе раздела между органической и неорганической фазами за счет взаимодействия с поверхностью ТГА и создания переплетения молекулярных цепей с ЭВА. Молекулярная масса, или длина цепи, стала важным фактором в улучшении параметров относительного удлинения. По сравнению с малеиновым ангидридом, альтернативные функциональные группы, такие как эпоксидные и аминовые, оказались в равной степени действенными для увеличения относительного удлинения.

Задачей исследования также ставилось увеличение прочности композиции при растяжении. Включение диакрилового ионного мономера обеспечило увеличение прочности при растяжении до уровня, который нельзя было получить в случае использования жидких полибутиадиенов. Образование ионной сетки в структуре сополимера ЭВА, возможно, служит тем механизмом, посредством которого была увеличена прочность при растяжении.

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Lancement d'une nouvelle ligne de fil cuivre



▲ La nouvelle ligne de fil de cuivre de Fuhr en fonction à Düsseldorf

À l'exposition de wire Düsseldorf, la société Fuhr GmbH & Co KG a saisi l'occasion pour présenter son tout dernier développement pour la production de fil de cuivre rectangulaire haute précision. Grâce à son stand de dimensions extraordinaires (plus de 1 000 pieds carrés), Fuhr a eu la possibilité d'exposer un laminoir complet, conçu pour le traitement de fil de cuivre en temps réel, allant des fils ronds aux fils rectangulaires, avec des tolérances de $\pm 0,005\text{mm}$ tout en offrant une qualité de surface et des propriétés des matériaux excellentes. La société a communiqué qu'un grand nombre de visiteurs a pu constater les performances opérationnelles des équipements et la qualité du produit final.

Équipé avec une combinaison de bobinoir horizontal (dérouleur), un laminoir duo (WSR-type), deux dispositifs de laminage sur chant (WSE), deux laminoirs universels à tête de Turc (WST), ainsi que deux rouleaux fous combinés, trois systèmes de mesure Vollmer et un bobinoir oscillant, ce laminoir très compact est considéré idéal pour la production de fils de cuivre rectangulaires haute précision (tels que le CTC) ou le fil plat de cuivre, tel que le ruban PV (fil d'interconnexion avec barres omnibus).

En général, les câbles CTC sont conçus pour des applications telles que les spires dans les transformateurs, les moteurs et les générateurs. En outre, les fils de cuivre rectangulaires haute précision avec des sections de petites dimensions sont utilisés pour les moteurs hybrides et pour les éoliennes haute performance.

Avec l'apparition des câbles CTC et les applications correspondantes, les tolérances requises pour ces types de fils rectangulaires ont été réduites à $\pm 0,005-0,01\text{mm}$, ce qui ne peut pas être réalisé avec la technologie de laminage à froid traditionnelle.

Le nouveau concept de pointe de Fuhr et la configuration moderne de ses équipements de laminage pour fils offre un laminoir conçu pour le traitement de fils ronds de cuivre dans une gamme de formes plates rectangulaires, en atteignant ainsi des rapports largeur-épaisseur arrivant jusqu'à 40:1.

Fuhr GmbH – Allemagne
Email: mail@karl-fuhr.com
Website: www.karl-fuhr.com

Fax: +49 175 2200329

Contrat pour câbles en Turquie

Draka Communications vient d'annoncer la signature d'un contrat important pour la réalisation de l'infrastructure à bande large de câbles de cuivre et à fibres optiques CATV en Turquie.

Selon l'accord stipulé par l'intermédiaire de l'agent local de Draka Focabex, la société fournira environ 600km de câbles téléphoniques à grande distance coaxiaux de cuivre caractérisés par une atténuation réduite, pour l'utilisation souterraine ou aérienne, en plus de 150km de câbles HFC au cours de l'année 2010.

"Draka a une relation étroite avec le secteur des télécommunications turc depuis longtemps, et nous sommes donc fiers d'annoncer ce contrat important par l'intermédiaire de notre agent local, suite à l'augmentation de la demande d'infrastructures pour dorsales" a déclaré Thilo Hamm, responsable de la production pour la zone EMEA, des produits CATV et RF de Draka Communications.

Draka Communications – Pays Bas
Website: www.draka.com

Rautomead installe un site web en chinois

La société Rautomead spécialisée dans le secteur de la technologie de la coulée continue, basée au Royaume-Uni, vient d'annoncer le lancement de son site web en langue chinoise visant à rendre sa gamme d'équipements pour la coulée de métaux non ferreux plus accessible au marché chinois en plein essor. Le nouveau site web peut être visité à l'adresse www.rautomead.net.cn



▲ Rautomead commence à fonctionner en chinois

Guy Henderson, Directeur du marketing et des ventes de Rautomead a déclaré: "Le site web en langue chinoise est hébergé sur un logiciel serveur en Chine et facilitera l'accès aux informations sur les produits de Rautomead aux personnes utilisant les caractères chinois dans leurs moteurs de recherche. Un site en langue russe (www.rautomead.ru), hébergé en Russie, est actif depuis juillet 2009. Malgré la situation économique, une augmentation des demandes de renseignement a été enregistrée depuis l'activation du site web".

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wire Düsseldorf satisfait ses visiteurs encore une fois



▲ L'exposition wire 2012 se tiendra du 26 au 30 mars 2012

D'après les premiers comptes-rendus de Tube/wire Düsseldorf, l'exposition s'annonce pleine de vitalité et optimiste et semble attirer l'intérêt à un niveau international. À l'occasion de wire, 1 219 entreprises provenant de 52 pays ont occupé 52 000m² de la surface d'exposition, en enregistrant une augmentation de 7,3% des exposants. "Le fil a du succès et l'intérêt des clients est élevé. Presque tout le monde a la sensation d'une reprise," a déclaré Benedikt Niemeyer, Président Directeur Général de Schmolz + Bickenbach, acteur global du secteur sidérurgique.

Howard Fancher, de la société Huestis Machine Corporation, a perçu un intérêt et une espérance pour le futur. "L'exposition wire Düsseldorf était vitale et animée, les participants étaient attirés par les nouvelles technologies et par le désir d'investir de la meilleure façon possible leur argent. J'ai appris que le nombre des visiteurs était inférieur par rapport aux expositions précédentes, mais cela n'a pas été le cas pour moi. Notre stand était chaque jour submergé par des clients à la recherche d'équipements inédits et innovants, en mesure de leur fournir tout le nécessaire pour amener au succès leurs activités. J'ai vu un grand nombre de nouveaux visages, jeunes et confiants, et inhabituels dans le secteur du fil et du câble, essayant de le pénétrer à fond et d'en remporter les meilleures idées pour en faire profiter leurs sociétés respectives. En général, en ce qui me concerne l'exposition a obtenu un énorme succès".

Les visiteurs ont classé les événements de "très bon" à "bon" Durant les cinq jours de l'exposition commerciale, 69 200 visiteurs ont visité les salles d'exposition. Le taux de présences internationales à l'exposition est traditionnellement élevé. 35 000 visiteurs du secteur provenant de 70 pays ont participé à wire, dont 63% étaient étrangers. La majorité des visiteurs de l'exposition provenaient du Royaume-Uni, de France, des États-Unis, de l'Italie, de l'Inde, des Pays Bas, d'Espagne, du Brésil, de Turquie, d'Autriche, de Suisse, de Belgique et de Pologne.

Messe Düsseldorf GmbH – Allemagne
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Liaison à la plate-forme offshore

ABB vient de signer un contrat d'un montant de 110 millions de dollars américains avec la société Eni Norway AS, pour la réalisation d'une liaison entre une nouvelle plateforme pétrolière et de gaz en mer de Barents et le réseau de transport de l'électricité norvégien.

La plateforme Goliat sera partiellement électrifiée avec un câble de puissance sous-marin de 106km pouvant diminuer les émissions de dioxyde de carbone de la plateforme jusqu'à 50% en réduisant le besoin en électricité produite par les turbines à gaz de la plateforme.

"Le câble de connexion assurera la fourniture de puissance électrique du continent et contribuera à réduire l'impact environnemental de la plateforme", a déclaré Peter Leupp, responsable de la division Systèmes de Puissance de ABB.

Le câble isolé XLPE de 123kV (kilovolts) et 75MW (mégawatts) est considéré le câble le plus long et plus puissant jamais réalisé pour une application offshore. Il fournira un courant alternatif (AC) du réseau situé sur le continent en Norvège à la plateforme Goliat, une unité flottante de production, de stockage et de déchargement du pétrole.

Le câble est pourvu de fibres optiques intégrées pour le monitoring de la température, il fournit des services de communication générale et comprend une section dynamique de 1,5km pour s'adapter au mouvement de la plateforme flottante.

L'achèvement du projet est prévu d'ici fin 2013, lorsque la plateforme Goliat sera opérationnelle.

Les câbles sous-marins XLPE tripolaires haute tension, isolés avec des matériaux polymériques de ABB, sont caractérisés par des pertes électriques réduites, ils sont résistants aux solvants, au pétrole et à l'abrasion, et ils présentent une résistance à la traction excellente. Ils sont également parfaits pour les environnements difficiles. La société ABB a fourni environ 3 000km de câbles sous-marins à courant continu et à courant alternatif isolés avec des matériaux polymériques (sans huile) pour des projets dans le monde entier. Ces fournitures comprennent des liaisons aux plateformes pétrolières et de gaz dans le Golfe persique et dans la Mer du Nord.

ABB Ltd – Suisse
Website: www.abb.com



Amélioration des propriétés mécaniques des composés retardeurs de flamme non halogénés

Par Jeremy R Austin, Herbert S.-I Chao, Sartomer Company

Résumé

Généralement, l'on utilise des composés halogénés comme le tetrabromobisphénole A ou TBBPA pour réaliser des articles en plastique ignifuges.

Récemment, la recherche académique a été penchée sur les retardeurs de flamme non halogénés, mais ces technologies alternatives plus sûres ont un impact très négatif sur les propriétés mécaniques.

Les matériaux de bourrage minéraux utilisés tels que les retardeurs de flamme exigent une charge de 60% en poids en excès pour répondre aux spécifications ignifuges.

Dans cette étude, l'on utilise les polybutadiènes liquides fonctionnalisés (LPBD) pour améliorer l'allongement de rupture et la résistance à la traction des composés d'éthylène à base d'acétate de vinyle (EVA) chargé avec trihydrate d'aluminium (ATH). La prédispersion des agents de pontage dans le ATH a permis d'améliorer l'allongement de plus de 200%. Il a été démontré que les résultats meilleurs ont été obtenus avec des charges réduites de fonctionnalité, comme l'anhydride maléique, l'époxyde et l'amine.

L'inclusion d'un monomère ionique diacrylique a permis une amélioration du module de traction, impossible à obtenir avec des matériaux à base de LPBD.

1 Introduction

Des études scientifiques ont indiqué que les retardeurs de flamme halogénés

(HFR) sont des polluants très répandus dans l'environnement. Les émissions dangereuses générées par la fabrication, l'élimination ou le recyclage des articles en plastique contenant des retardeurs de flamme halogénés (HFR) constituent une menace tellement grave que certains d'entre eux ont été déjà éliminés des appareils électroniques et d'usage domestique, et l'Union Européenne a ratifié des lois pour régler l'industrie des produits plastiques en ce qui concerne leur élimination.

Face à une législation similaire en vigueur dans tous les pays, plusieurs marchés dans le secteur des matériaux plastiques sont à la recherche de technologies alternatives.

Plusieurs retardeurs de flamme non halogénés (NHFR) ont été identifiés, tels que les phosphates d'ammonium, les composés de mélamine, les nanoparticules d'argile ou les minéraux hydratés.

Le trihydrate d'aluminium (ATH) est un matériau de bourrage ignifuge pour les polymères approuvé et il est sans halogènes.

Généralement, l'action des retardeurs de flamme consiste à retarder l'allumage en enlevant le feu du combustible ou en réduisant la température d'allumage. Toutefois, l'ATH dégage de la vapeur d'eau durant la décomposition, qui l'on estime enlève de la chaleur du substrat et dilue l'alimentation du combustible.

Une fois carbonisé, le résidu de Al_2O_3 inhibe la migration de l'oxygène² et des composés volatiles dégagés par le polymère qui peut faire augmenter davantage la réaction exothermique.

Dans la majorité des applications, l'on peut utiliser une simple stratégie de substitution, en remplaçant un HFR par un NHFR. Dans quelques cas, comme dans le cas des minéraux hydratés tels que le trihydrate d'aluminium ou l'hydroxyde de magnésium, la transition est plus difficile. Afin d'obtenir la propriété ignifuge requise, des charges élevées de ATH souvent en excès de 60% en poids sont nécessaires. Lorsque la fraction de volume du matériau de bourrage inorganique dépasse 50%, les propriétés physiques du composé subissent une détérioration marquée.

Plentz *et al*¹ ont démontré que dans les composés de PP contenant ATH, il existait une relation entre la charge du matériau de bourrage et les dimensions de l'agrégat. Cette découverte indique qu'une charge élevée de matériau de bourrage, outre à compromettre les propriétés physiques, cause également l'agrégation de l'ATH au fur et à mesure que la charge augmente.

Plusieurs études ont démontré que l'addition d'un polymère fonctionnalisé représente une méthode efficace pour modifier l'adhérence de l'interface à la limite organique/inorganique dans les composés polymériques^{2,3,4}.

Mai *et al*⁵ ont démontré que l'inclusion d'acide acrylique modifié au moyen de greffage dans les composés PP-ATH entraîne une interaction chimique entre les groupes carboxylique et hydroxylique respectivement dans le polymère et dans le matériau de bourrage.

Il a été également démontré que l'amélioration de l'adhésion de l'interface entraîne également l'amélioration des propriétés thermiques et mécaniques.

Pareillement, Wang *et al*⁶ ont introduit le EPR greffé avec anhydride maléique dans un composé PP-Mg(OH)₂, et ont découvert que l'EPR-g-MA était présent exclusivement dans l'interface.

L'encapsulation du Mg(OH)₂ a permis d'améliorer la dispersion du matériau de bourrage, qui a été mise en évidence par l'amélioration de la résistance au choc.

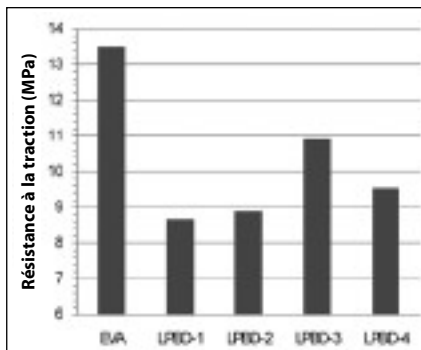
Plentz *et al*¹ ont présenté un polypropylène fonctionnel avec acide acrylique dans leur système PP-ATH et ont démontré qu'une meilleure interaction au niveau de l'interface entraînait une augmentation de l'indice de viscosité du matériau fondu ainsi qu'une amélioration de la résistance à la traction et à la flexion. Dans tous les trois cas, les additifs fonctionnalisés ont interagi avec le matériau de bourrage afin de compenser les effets négatifs des charges élevées du matériau de bourrage de minéral hydraté.

Les matériaux fonctionnalisés traditionnels ont été étudiés pour compenser les défauts présents dans les composés retardeurs de flamme contenant l'ATH.

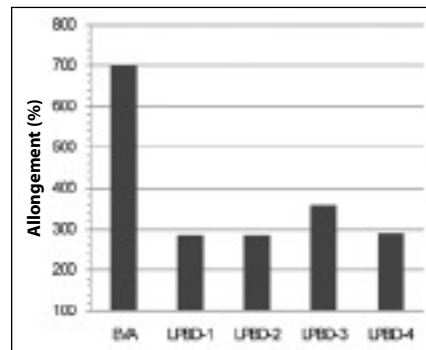
Cette évaluation analyse les effets des polybutadiènes liquides fonctionnalisés (LPBD) à poids moléculaire réduit en tant qu'agents de modification interfaciale dans un système de fils et de câbles (W&C) d'acétate de vinyle-éthylène (EVA), avec 60% de charge.

D'après les informations fournies par le secteur industriel, le choix d'une solution utilisant le ATH, la résistance à la traction, la ductilité et le flux se réduisent tellement que le matériau ne peut pas fonctionner dans le système W&C. Un poids moléculaire réduit est considéré avantageux puisqu'il consent une meilleure adhérence à la surface de la charge, en optimisant ainsi la modification interfaciale.

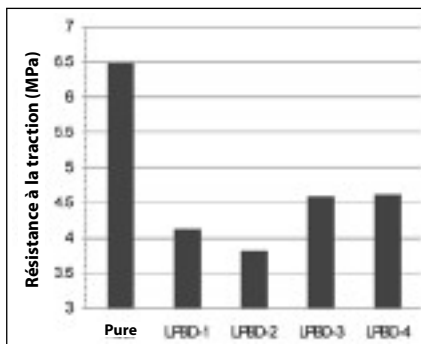
Le type et le niveau de la charge ont été ainsi modifiés pour évaluer les conditions chimiques les plus appropriées pour optimiser les composés EVA-ATH.



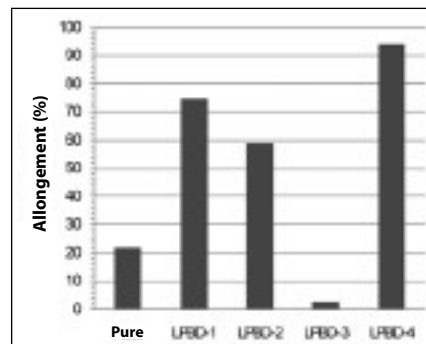
▲ **Figure 1:** Résultats de la résistance à la traction du LPBD fonctionnel par rapport au LPBD non fonctionnel en comparaison avec l'EVA de base. Tous les produits ont plastifié l'EVA; toutefois, le MA LPBD en mesure mineure



▲ **Figure 2:** Résultats de l'allongement d'une étude de base démontrant que l'LPBD fonctionnel à base d'anhydride a l'influence mineure sur l'EVA



▲ **Figure 3:** Résultats relatifs à la traction pour les systèmes contenant ATH, attestant que le LPBD fonctionnel à base d'anhydride réduit en mesure mineure la résistance à la traction.



▲ **Figure 4:** Résultats relatifs à l'allongement pour une étude de base du système EVA ATH démontrant la possibilité de rétablir l'allongement en utilisant les LPBD

2 Expérimentation

2.1 Matériaux utilisés

On a utilisé l'EVA commercial (DuPont Elvax[®] 550) avec 15% en poids d'acétate de vinyle ainsi qu'il a été reçu.

Le trihydrate d'aluminium du type C-33, avec des particules ayant une dimension moyenne de 50µm, une densité de 2,42g/cm³ et contenant 35% d'eau combinée chimiquement, a été fourni par la société Almatris Inc.

La poudre libre n'a pas été modifiée chimiquement durant la production et a été utilisée dans son état d'origine.

La société Sartomer a fourni les polybutadiènes liquides à bas poids moléculaire, contenant: vinyle, anhydride maléique, fonctionnalité époxy ou de l'amine.

Le *Tableau 1* illustre les propriétés correspondant à chaque polybutadiène liquide (LPBD) utilisé dans cette étude.

Les matériaux à base de polybutadiènes peuvent être considérés bi-fonctionnels, comme représenté au *Tableau 1*, indiquant une fonctionnalité primaire et une teneur en vinyle indéterminée.

Les matériaux contenant 70% de vinyle sont considérés actifs à la vulcanisation et susceptibles de réticulation en présence de radicaux libres. Par contre, les polybutadiènes de vinyle (28%), sont considérés plus stables.

Le greffage de l'anhydride maléique a lieu dans le groupe fonctionnel *cis-trans* de la chaîne principale du polybutadiène, et par conséquent, la teneur la plus élevée de vinyle force la fonctionnalité à se positionner à une distance plus proche. Outre le Mn, il s'agit-là d'une caractéristique qui différencie le LPBD-3 du LPBD-4.

L'introduction de polybutadiènes liquides directement dans le flux du matériau

▼ **Tableau 1:** Propriétés des polybutadiènes liquides utilisés dans cette étude, avec référence à: type de fonctionnalité et de charge, poids moléculaire et contenu vinylique*, polybutadiène époxydé intérieurement, ** polybutadiène greffé avec amines tertiaires

ID	Mn (g/mol)	Fonctionnalité (type/%)	Vinyle (%)
LPBD-1	1400	-	70
LPBD-2	4500	-	28
LPBD-3	2500	MA/17%	70
LPBD-4	5500	MA/17%	28
LPBD-5	4700	MA/5%	28
LPBD-6	4500	Époxyde*/5%	28
LPBD-7	5000	Amine**/5%	28

fondu n'est pas possible à cause de leur état physique. Les agents de pontage ont été prédispersés dans le trihydrate d'aluminium (ATH) dans un entraîneur DCL (dry liquid carrier) dans un mélangeur à haute capacité de coupe.

On a ainsi obtenu de la poudre libre active à 50% pouvant être aisément alimentée latéralement dans l'extrudeuse.

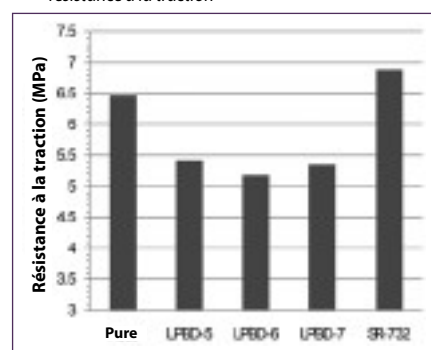
Quelques travaux précédents ont démontré que l'inclusion d'un monomère ionique fonctionnel di-acrylate dans les polyoléfines entraîne la formation d'une structure réticulée ionique. Le mécanisme se base sur des radicaux libres générés par la chaleur et la coupe durant la formation du composé.

Un monomère ionique, type SR-732, a été fourni comme moyen pour augmenter les propriétés mécaniques dans les zones d'éthylène de l'EVA.

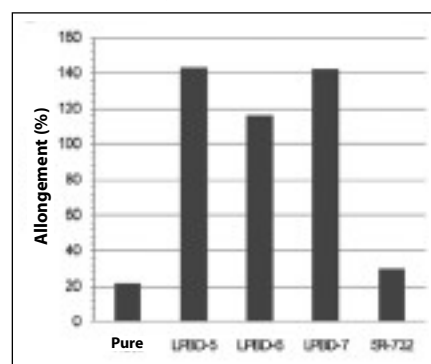
2.2 Préparation de l'échantillon

On a utilisé un Brabender TSE-20 pour fondre le mélange des formulations analysées dans cette étude. L'extrudeuse à double vis co-rotative présente un rapport L/D de 40:1, et une structure de la vis configurée pour homogénéiser des quantités de charge élevées. Les additifs ont été prédispersés dans l'ATH et ils ont été alimentés en aval à 20D.

▼ **Figure 5:** Les résultats de la résistance à la traction pour les fonctionnalités alternatives indiquent que les LPBD avec une fonctionnalité de 5% (y compris l'anhydride) influencent en mesure mineure la résistance à la traction



▼ **Figure 6:** Les résultats de l'allongement en utilisant des fonctionnalités alternatives démontrent des améliorations significatives en termes de ductilité par rapport au système pur EVA-ATH



Des expériences ont été réalisées en utilisant un profil de température plat d'environ 50°C outre la température de ramollissement Vicat, à 80rpm. Un produit extrudé avec une seule ligne a été fait passer à travers un bac d'eau et ensuite bouleté.

La totalité des formulations contenaient 60% en poids de ATH et 4% en poids de LPBD. Des formulations de base ont été réalisées pour déterminer l'effet du LPBD sur l'EVA.

Des échantillons soumis à des essais de traction ASTM ont été moulés en utilisant une presse pour micro-injection du type Boy Machines XS 11-T. On a utilisé un profil de température similaire à celui de l'extrusion.

Les échantillons ont été étirés sur un dispositif d'essai de traction Thwing-Albert conformément à la norme ASTM D-638. Les données concernant la résistance à la traction et l'allongement à la rupture ont été recueillies.

3 Résultats

Une connaissance détaillée de l'influence des LPBD sur l'EVA a été fondamentale pour comprendre leur influence sur les systèmes chargés avec ATH. Les Figures 1 et 2 illustrent l'effet d'un échantillon représentatif de LPBD sur l'EVA de base.

Les Figures 1 et 2 démontrent que les LPBD ont une influence négative sur la résistance à la traction à la limite élastique et sur l'allongement à la rupture. Les LPBD n'étaient pas compatibles avec l'EVA et ils ont produit sa plastification.

Les LPBD 1 et 2 non-fonctionnels ont eu un même impact négatif sur les propriétés de l'EVA, en indiquant que la teneur en Mw et la teneur en vinyle n'ont pas représenté des variables décisives. Par contre, les deux homologues contenant la fonctionnalité anhydride offraient une résistance à la traction supérieure, et dans le cas des LPBD-3, un allongement meilleur.

Il apparaît évident que la fonctionnalité anhydride a rendu le LPBD plus compatible avec la phase EVA, et que la valeur de Mw du LPBD-3 inférieure à celle du LPBD-4, a réduit la dispersion des gouttes.

L'introduction de ATH dans le système, a donné les résultats présentés dans les Figures 3 et 4.

La Figure 3 démontre que les LPBD réduisent la résistance à la traction à la limite élastique de l'EVA chargé avec ATH. Les LPBD-3 et les LPBD-4 fonctionnalisés ont dépassé les performances de leurs

homologues non fonctionnalisés, qui en partie indiquent une amélioration dans l'adhérence interfaciale entre les phases.

À la Figure 4, tous les LPBD à l'exception des LPBD-3 ont amélioré l'allongement à la rupture. Dans le cas du LPBD-3, la cause d'une réduction supplémentaire dans l'allongement peut être double.

Premièrement, il est possible que les petites chaînes hautement fonctionnelles (Mn 2 500) aient eu de multiples points d'interaction avec la surface de l'ATH et qu'elles aient enveloppé le minéral. Par conséquent, il n'y aurait pas de segments de chaînes libres à lier à l'EVA et à utiliser comme compatibilisateur.

Deuxièmement, le LPBD-3 était composé pour 70% de vinyle qui pourrait avoir subi une réticulation durant la formation du composé. Une analyse du module d'élasticité a indiqué que le LPBD-3 a déterminé une augmentation significative par rapport au matériau de base, propre d'un matériau réticulé.

Les LPBD non fonctionnalisés ont été utilisés pour mieux mouiller la charge minérale en favorisant ainsi la dispersion. Le LPBD-4 a amélioré de 450% l'allongement du système chargé. Probablement, le LPBD-4 a eu un nombre mineur d'interactions entre la fonctionnalité hydroxyle et la fonctionnalité anhydride sur la surface de l'ATH en maintenant en même temps une extrémité pour la compatibilisation/enchevêtrement avec l'EVA.

En plus du poids moléculaire et de la teneur en vinyle, des LPBD fonctionnalisés alternatifs ont été évalués. Les Figures 5 et 6 illustrent les résultats de ces additifs en plus du SR-732.

Les Figures 5 et 6 démontrent que la réduction de la charge d'anhydride sur l'LPBD (LPBD-5), entraîne une augmentation tant de la résistance à la traction que de l'allongement.

Comme indiqué précédemment, il est extrêmement important d'avoir une association entre l'additif et la surface de la charge, mais également d'assurer qu'il y a un enchevêtrement suffisant des chaînes entre l'additif et l'EVA.

La réduction du contenu de MA dans l'additif a diminué la probabilité de formation de liaisons multiples avec la surface de l'ATH, en augmentant ainsi la longueur moyenne de la chaîne résiduelle à enchevêtrer dans l'EVA.

Les LPBD-6 et LPBD-7 démontrent que des fonctionnalités alternatives peuvent remplacer l'anhydride maléique sous la forme d'époxyde et amine.

Les deux groupes fonctionnels ont offert des performances similaires à parité de charges d'anhydride en termes de résistance à la traction et d'allongement.

En outre, les *Figures 5* et *6* démontrent l'influence du monomère ionique, SR-732, sur le système ATH/EVA. Contrairement aux additifs LPBD, le monomère SR-732 a augmenté la résistance à la traction du système et, bien que de façon négligeable, a amélioré aussi statistiquement l'allongement.

Il est estimé que l'introduction de l'ATH a entraîné des conditions de coupe élevée dans le matériau fondu durant la formation du composé, qui a réagi avec la fonctionnalité acrylique. Des études précédentes indiquent que ces monomères ont tendance à se regrouper dans un composé polymérique, en créant un pont ionique ou une réticulation entre les chaînes adjacentes.

À température ambiante, le regroupement permet d'augmenter les propriétés mécaniques du système. Contrairement aux LPBD, le SR-732 a altéré les propriétés de la masse de l'EVA par rapport à l'interface.

4 Conclusions

Grâce à l'introduction des polybutadiènes fonctionnels à poids moléculaire réduit, des améliorations significatives ont été réalisées dans l'allongement des composés ATH/EVA hautement chargés.

La fonctionnalité de l'additif a permis de compatibiliser l'interface organique/inorganique au moyen de la réaction avec la surface ATH et la formation des enchevêtrements de la chaîne avec l'EVA.

Le poids moléculaire, ou la longueur de la chaîne, a constitué un élément important pour améliorer les propriétés d'allongement.

Les fonctionnalités alternatives à l'anhydride maléique, comme les groupes époxydiques et aminiques, se sont également révélées pour améliorer les propriétés d'allongement.

L'objectif était également d'obtenir la résistance à la traction du système. L'introduction d'un monomère di-acrylique ionique a entraîné une amélioration de la résistance à la traction autrement impossible avec les polybutadiènes liquides.

La formation d'un réseau ionique à l'intérieur de l'EVA est probablement le mécanisme qui a permis d'améliorer la résistance à la traction.

Des expériences futures analyseront davantage l'influence du poids moléculaire sur le LPBD à fonctionnalité réduite. L'augmentation de la longueur des chaînes libres devrait entraîner une augmentation majeure du phénomène d'allongement. En outre, une analyse de systèmes d'additifs mixtes LPBD et SR-732 sera considérée afin d'augmenter la résistance à la traction et l'allongement. ■

5 Remerciements

Les auteurs désirent remercier DuPont USA et Almatris, pour avoir fourni le matériau pour cette étude, l'équipe de Boy Machines, pour avoir modelé les échantillons soumis aux essais de traction sur une presse pour micro-injection à rayons XS et Brett Robb pour la préparation méticuleuse des matériaux EVA-ATH.

6 Références bibliographiques

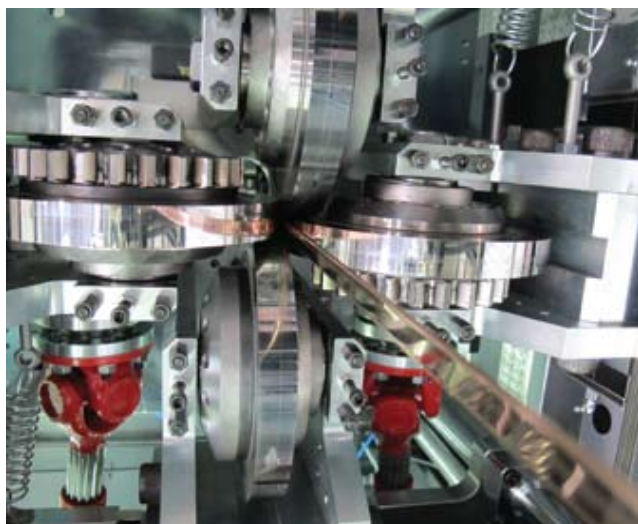
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Presentazione di una nuova linea di filo di rame



▲ Nuova linea di filo di rame di Fuhr in funzione a Düsseldorf

All'esposizione di wire Düsseldorf, la società Fuhr GmbH & Co KG ha colto l'occasione per presentare il suo ultimo sviluppo per la produzione di filo di rame rettangolare ad alta precisione.

Grazie all'imponente spazio espositivo della società (oltre 1.000 piedi quadrati), Fuhr ha avuto la possibilità di esporre un laminatoio completo, progettato per il trattamento di filo di rame in tempo reale, dai fili tondi ai fili rettangolari, con tolleranze di $\pm 0,005\text{mm}$ e nello stesso tempo con una qualità di superficie e proprietà di materiali eccellenti.

La società ha comunicato che le prestazioni degli equipaggiamenti e la qualità del prodotto finale sono state apprezzate da un gran numero di visitatori.

Equipaggiato con una combinazione di un avvolgitore orizzontale (svolgitore), un treno di laminazione duo (tipo WSR), due dispositivi per la laminazione dei bordi (WSE), due treni universali a testa di turco (WST), nonché due rulli folli combinati, tre sistemi di misurazione Vollmer e un avvolgitore oscillante, questo treno di laminazione molto compatto è considerato ideale per la produzione di fili di rame rettangolari di alta precisione (quali il CTC) o il filo piatto di rame, come il nastro PV (filo d'interconnessione con blindosbarre).

In generale, i cavi CTC sono progettati per applicazioni come gli avvolgimenti nei trasformatori, i motori ed i generatori. Inoltre, i fili di rame rettangolari ad alta precisione con sezioni di piccole dimensioni sono utilizzati per i motori ibridi e per i generatori eolici di alte prestazioni.

Con la comparsa dei cavi CTC e le relative applicazioni, le tolleranze richieste per questi tipi di fili rettangolari sono state ridotte a $\pm 0,005-0,01\text{mm}$, cosa che non può essere realizzata con la tradizionale tecnologia di laminazione a freddo.

Il nuovo concetto d'avanguardia di Fuhr e la moderna configurazione dei suoi equipaggiamenti di laminazione per filo, offrono un laminatoio progettato per il trattamento di fili tondi in un'ampia gamma di forme piatte rettangolari, ottenendo così dei rapporti larghezza-spessore fino a 40:1.

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Contratto turco per cavi

Draka Communications ha annunciato l'acquisizione di un importante ordine per la realizzazione dell'infrastruttura a banda larga di cavi di rame e a fibre ottiche CATV in Turchia. In base all'accordo stipulato tramite l'agente locale di Draka Focabex, la società fornirà circa 600km di cavi telefonici a grande distanza coassiali di rame caratterizzati da una bassa attenuazione, per utilizzo sotterraneo ed aereo, oltre a 150km di cavi HFC nel corso del 2010.

"Draka intrattiene stretti rapporti con il settore delle telecomunicazioni turco da lunga data, e siamo dunque lieti di annunciare questo importante contratto tramite il nostro partner locale, come risultato diretto dell'aumento della richiesta di infrastrutture per dorsali" ha dichiarato Thilo Hamm, responsabile della produzione della zona EMEA, dei prodotti CATV ed RF di Draka Communications. "Questo accordo rafforza una tendenza presente in tutti i nostri mercati dove sono in corso una vasta modernizzazione e processi di espansione delle reti di diffusione."

Draka Communications – Paesi Bassi
Website: www.draka.com

Rautomead crea un sito web in cinese

La società britannica Rautomead Ltd, specializzata nel settore della tecnologia della colata continua, ha annunciato la creazione del proprio sito web in lingua cinese al fine di rendere la sua gamma di equipaggiamenti per la colata di metalli non ferrosi più accessibile al mercato cinese in pieno sviluppo. Il nuovo sito web può essere visitato all'indirizzo www.rautomead.net.cn



▲ Rautomead inizia a funzionare in cinese

Guy Henderson, Direttore di marketing e delle vendite di Rautomead ha dichiarato: "Il sito web in lingua cinese è ospitato su un server in Cina e faciliterà l'accesso alle informazioni sui prodotti di Rautomead per le persone che utilizzano i caratteri cinesi nel loro motore di ricerca. Un sito in lingua russa (www.rautomead.ru), ospitato in Russia, è attivo da luglio 2009. Malgrado la situazione economica, dall'attivazione del sito web è stato registrato un aumento delle richieste d'informazione".

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wire Düsseldorf soddisfa ancora i propri visitatori



▲ *Lesposizione wire 2012 si terrà dal 26 al 30 marzo 2012*

Dai sondaggi preliminari su Tube/wire Düsseldorf, l'esposizione si annuncia al completo e ottimistica e sembra attrarre interesse a livello internazionale. In occasione di wire, 1.219 imprese provenienti da 52 paesi hanno occupato 52.000m² della superficie espositiva, registrando un aumento del 7,3% degli espositori. "wire ha successo e l'interesse dei clienti è elevato. Quasi tutti hanno la sensazione di una ripresa" ha dichiarato Benedikt Niemeyer, Presidente Direttore Generale di Schmolz + Bickenbach, attore globale del settore siderurgico.

Howard Fancher, della società Huestis Machine Corporation, ha percepito un interesse ed una speranza per il futuro. "L'esposizione wire a Düsseldorf era vitale ed animata, i partecipanti erano attratti dalle nuove tecnologie e dal desiderio di investire al meglio il proprio denaro. Mi è stato detto che il numero [di visitatori] era inferiore rispetto alle precedenti esposizioni, ma secondo me questo non può essere confermato. Il nostro stand era sommerso quotidianamente da clienti impegnati nella ricerca di equipaggiamenti nuovi e innovativi, e che potessero offrire ciò che gli serviva per avere successo nella propria attività. Ho visto molti volti nuovi, giovani e fiduciosi nonché nuovi nel settore del filo e del cavo, che tentavano di penetrare a fondo e cogliere le migliori idee a vantaggio delle rispettive società. Nel complesso considero l'esposizione un enorme successo".

I visitatori hanno classificato gli eventi da "molto buono" a "buono". I cinque giorni dell'esposizione hanno visto la presenza di 69.200 visitatori affollare gli stand. Il tasso di presenze internazionali all'esposizione è tradizionalmente elevato. 35.000 visitatori del settore di 70 paesi hanno partecipato a wire, di cui il 63% provenienti dall'estero. La maggioranza dei visitatori dell'esposizione proveniva dal Regno Unito, Francia, Stati Uniti, Italia, India, Paesi Bassi, Spagna, Brasile, Turchia, Austria, Svizzera, Belgio e Polonia.

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Collegamento alla piattaforma offshore

ABB si è aggiudicata un ordine del valore di 110 milioni di Dollari americani con la società Eni Norway AS, per la realizzazione di un collegamento fra una nuova piattaforma per l'estrazione del petrolio e del gas nel mare di Barents e la rete elettrica norvegese.

La piattaforma Goliat sarà parzialmente elettrificata con un cavo di potenza sottomarino di 106km che può diminuire le emissioni di anidride carbonica della piattaforma fino al 50% riducendo il fabbisogno di elettricità prodotta dalle turbine a gas della piattaforma.

"Il cavo di collegamento assicurerà la fornitura di potenza elettrica dalla terra ferma e contribuirà a ridurre l'impatto ambientale della piattaforma", ha dichiarato Peter Leupp, responsabile della divisione Sistemi di Potenza di ABB.

Il cavo isolato XLPE da 123kV (kilovolt) e 75MW (megawatt) è considerato il cavo più lungo e più potente che sia mai stato realizzato finora per un'applicazione offshore. Fornirà corrente alternata (AC) dalla rete sita sulla terra ferma in Norvegia alla piattaforma Goliat, sistema di produzione galleggiante con stoccaggio ed impianto di caricamento del greggio.

Il cavo è provvisto di fibre ottiche integrate per il monitoraggio della temperatura, fornisce servizi di comunicazione generale e comprende una sezione dinamica di 1,5km per adattarsi al movimento della piattaforma galleggiante.

Il completamento del progetto è previsto entro la fine del 2013, quando la piattaforma Goliat diventerà operativa.

I cavi sottomarini XLPE tripolari ad alta tensione, isolati con materiali polimerici di ABB sono caratterizzati da perdite elettriche ridotte, sono resistenti ai solventi, al petrolio e all'abrasione e presentano un'eccellente resistenza alla trazione. Sono inoltre ideali per ambienti marini difficili.

La società ABB ha fornito circa 3.000km di cavi sottomarini a corrente continua e a corrente alternata isolati con materiali polimerici (senza olio) per progetti in tutto il mondo. Tali forniture includono collegamenti a piattaforme petrolifere e di gas nel Golfo Persico e nel Mare del Nord.

ABB Ltd – Svizzera
Website: www.abb.com



Miglioramento delle proprietà meccaniche dei composti ritardanti di fiamma non alogenati

A cura di Jeremy R Austin, Herbert S.-I Chao, Sartomer Company

Riassunto

Generalmente, si utilizzano composti alogenati come il tetrabromobisfenolo A o TBBPA per realizzare articoli di plastica ignifughi.

Recentemente, la ricerca accademica e industriale ha centrato l'attenzione sui ritardanti di fiamma non alogenati, ma queste tecnologie alternative più sicure hanno un impatto deleterio sulle proprietà meccaniche.

I materiali di riempimento minerali utilizzati come ritardanti di fiamma richiedono una carica in eccesso di 60% in peso in eccesso per soddisfare i requisiti ignifughi. Nel presente studio, si utilizzano i polibutadieni liquidi funzionalizzati (LPBD) per migliorare l'allungamento e la resistenza a trazione dei composti di etilene vinil-acetato (EVA) caricati con triidrato di alluminio (ATH).

La predispersione degli agenti di accoppiamento nell'ATH hanno consentito di migliorare l'allungamento di oltre il 200%. È stato dimostrato che i risultati migliori sono stati ottenuti con cariche ridotte di funzionalità, come l'anidride maleica, l'epossido e l'amina.

L'inclusione di un monomero ionico diacrilico ha consentito un miglioramento del modulo di trazione, irrealizzabile con i materiali a base di LPBD.

1 Introduzione

Degli studi scientifici hanno indicato che i ritardanti di fiamma alogenati (HFR) sono sostanze contaminanti assai diffuse

nell'ambiente. Le emissioni pericolose originate dalla fabbricazione, dallo smaltimento o dal riciclo di articoli di plastica contenenti i ritardanti di fiamma alogenati (HFR) costituiscono una minaccia talmente grave che alcuni di essi sono stati già eliminati dagli apparecchi elettronici ed elettrodomestici, e l'Unione Europea ha ratificato i regolamenti che disciplinano l'industria dei materiali plastici per la loro eliminazione.

A fronte di una legislazione simile in vigore in tutti i paesi, numerosi mercati nel settore dei materiali plastici sono alla ricerca di tecnologie alternative.

Sono stati identificati vari ritardanti di fiamma non alogenati (NHFR), come i fosfati di ammonio, i composti di melamina, le nanoparticelle di argilla o i minerali idrati. Il triidrato di alluminio (ATH) è un noto filler ignifugo per polimeri ed è privo di alogeni.

Generalmente, l'azione dei ritardanti di fiamma consiste nel ritardare l'accensione privando il fuoco del combustibile o riducendo la temperatura di accensione.

Tuttavia, l'ATH rilascia vapore acqueo durante la decomposizione, che si ritiene prelevi calore dal substrato e diluisca l'alimentazione di combustibile. Una volta carbonizzato, il residuo di Al_2O_3 inibisce la migrazione dell'ossigeno e dei composti volatili rilasciati dal polimero che può far aumentare ulteriormente la reazione esotermica.

Nella maggior parte delle applicazioni, si può utilizzare una semplice strategia di sostituzione, sostituendo un HFR con un NHFR.

In alcuni casi, come nel caso dei minerali idrati quali il triidrato di alluminio o l'idrossido di magnesio, la transizione è più difficile.

Al fine di ottenere il requisito ignifugo richiesto, sono necessarie elevate cariche di ATH, spesso in eccesso del 60% in peso. Quando la frazione di volume del materiale di riempimento inorganico supera il 50%, le proprietà fisiche del composto subiscono un vistoso deterioramento.

Plentz *et al*¹ hanno dimostrato che nei composti di PP contenenti ATH esisteva una relazione fra la carica del filler e le dimensioni dell'aggregato. Questa scoperta indica che una carica elevata di filler, oltre a compromettere le proprietà fisiche, provoca anche l'aggregazione dell'ATH con l'aumentare della carica.

Diversi studi hanno dimostrato che l'aggiunta di un polimero funzionalizzato rappresenta un metodo efficace per modificare l'adesione interfacciale al confine organico/inorganico nei composti polimerici^{2,3,4}.

Mai *et al*⁵ hanno dimostrato che l'inclusione di acido acrilico modificato tramite innesto nei composti di PP-ATH provoca un'interazione chimica fra i gruppi carbossilico e idrossilico rispettivamente nel polimero e nel filler. È stato inoltre dimostrato che migliorando l'adesione interfacciale, si migliorano anche le proprietà termiche e meccaniche.

Analogamente, Wang *et al*⁶ hanno introdotto dell'EPR innestato con anidride carbonica maleica in un composto PP-Mg(OH)₂, e ha scoperto che l'EPR-g-MA era presente esclusivamente nell'interfaccia.

L'incapsulamento del Mg(OH)₂ ha permesso di migliorare la dispersione del filler, evidenziata dal miglioramento della resistenza all'urto. Plentz *et al*¹ hanno introdotto un polipropilene funzionale con acido acrilico nel loro sistema PP-ATH ed hanno dimostrato che una migliore interazione a livello dell'interfaccia determinava un aumento dell'indice di viscosità del materiale fuso ed un miglioramento della resistenza alla trazione e alla flessione.

In tutti e tre i casi, gli additivi funzionalizzati interagivano con il filler per contrastare gli effetti negativi di elevate cariche di filler di minerale idrato.

I materiali funzionalizzati tradizionali sono stati studiati per compensare i difetti nei composti ritardanti di fiamma contenenti ATH. Questa valutazione analizza gli effetti dei polibutadieni liquidi funzionalizzati (LPBD) a ridotto peso molecolare come agenti di modifica interfacciale in un sistema di fili e cavi (W&C) di acetato di vinile-etilene (EVA), con un 60% di carica.

Secondo le informazioni provenienti dal settore industriale, il passaggio ad una soluzione che utilizza l'ATH, la resistenza a trazione, la duttilità ed il flusso si riducono ad un punto tale che il materiale non può funzionare nel sistema W&C.

Un ridotto peso molecolare è considerato vantaggioso poiché consente una migliore identificazione e adesione alla superficie del filler, ottimizzando così la modifica interfacciale.

Sono stati così variati il tipo ed il livello di carica della funzionalità per valutare le condizioni chimiche più appropriate per migliorare i composti EVA-ATH.

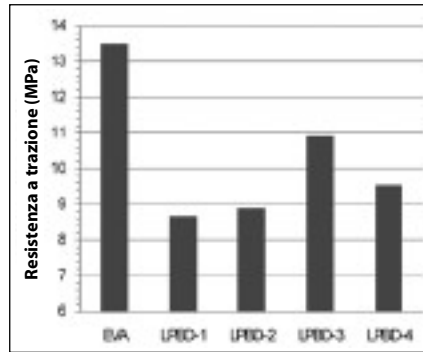
2 Sperimentazione

2.1 Materiali utilizzati

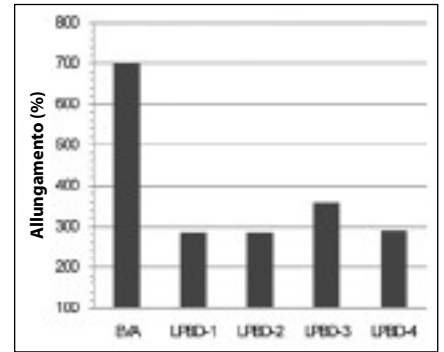
È stato utilizzato l'EVA commerciale (DuPont Elvax[®] 550) con il 15% in peso di acetato di vinile così come è stato ricevuto.

▼ **Tabella 1:** Proprietà dei polibutadieni liquidi utilizzati in questa ricerca, con evidenziazione del tipo di funzionalità e carica, peso molecolare e contenuto vinilico*, polibutadiene epossidato internamente, ** polibutadiene innestato con ammine terziarie

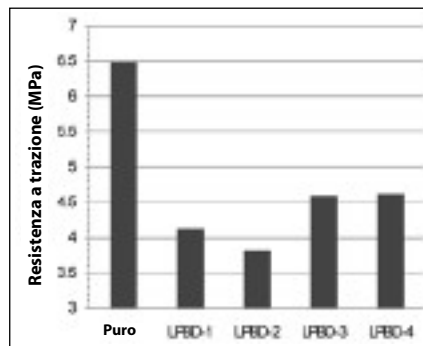
ID	Mn (g/mol)	Funzionalità (tipo/%)	Vinile (%)
LPBD-1	1400	-	70
LPBD-2	4500	-	28
LPBD-3	2500	MA/17%	70
LPBD-4	5500	MA/17%	28
LPBD-5	4700	MA/5%	28
LPBD-6	4500	Epossido*/5%	28
LPBD-7	5000	Ammina**/5%	28



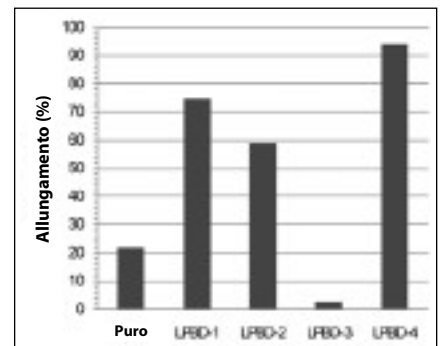
▲ **Figura 1:** Risultati della resistenza a trazione dell'LPBD funzionale rispetto all'LPBD non funzionale paragonati all'EVA di base. Tutti i prodotti hanno plasticizzato l'EVA; tuttavia il MA LPBD in misura minore



▲ **Figura 2:** Risultati dell'allungamento di uno studio di base che dimostrano che l'LPBD funzionale a base di anidride ha la minore influenza sull'EVA



▲ **Figura 3:** Risultati relativi alla trazione per sistemi contenenti ATH che attestano che l'LPBD funzionale a base di anidride riduce in misura minore la resistenza a trazione



▲ **Figura 4:** Risultati relativi all'allungamento per uno studio di base del sistema EVA ATH che attestano la possibilità di ristabilire l'allungamento utilizzando gli LPBD

Il triidrato di alluminio, del tipo C-33, con particelle della dimensione media di 50µm, della densità di 2,42g/cm³ e contenente il 35% di acqua combinata chimicamente, è stato fornito dalla società Almatris Inc. La polvere sfusa non è stata modificata chimicamente durante la produzione ed è stata utilizzata allo stato originario.

La società Sartomer ha fornito i polibutadieni liquidi a basso peso molecolare, contenenti vinile, anidride maleica, funzionalità epossidica o amminica.

La *tabella 1* illustra le proprietà corrispondenti a ciascun polibutadiene liquido (LPBD) utilizzato nel presente studio.

I materiali a base di polibutadiene possono essere considerati bi-funzionali, come illustrato nella *Tabella 1* indicante sia una funzionalità primaria sia un contenuto di vinile indeterminato.

I materiali contenenti il 70% di vinile sono considerati attivi alla vulcanizzazione e suscettibili di reticolazione in presenza di radicali liberi.

I polibutadieni di vinile (28%), al contrario, sono considerati più stabili. L'innesto dell'anidride maleica avviene nel gruppo funzionale *cis-trans* della catena principale del polibutadiene, e conseguentemente, il maggiore contenuto di vinile forza la funzionalità a posizionarsi ad una distanza più ravvicinata. Oltre al Mn, si tratta di una caratteristica che differenzia il LPBD-3 dal LPBD-4.

Non è possibile introdurre i polibutadieni liquidi direttamente nel flusso del materiale fuso a causa del loro stato fisico.

Gli agenti di accoppiamento sono stati pre-dispersi nel triidrato di alluminio (ATH) in un veicolo DCL (dry liquid carrier) in un miscelatore ad elevata capacità di taglio.

È stata così ottenuta una polvere sfusa attiva al 50% che può essere alimentata lateralmente nell'estrusore con facilità.

Dei lavori precedenti hanno dimostrato che l'inclusione di un monomero ionico funzionale di-acrilato nelle poliolefine determina la formazione di una struttura reticolata ionica. Il meccanismo si basa sui radicali liberi generati dal calore e dal taglio durante la formazione del composto.

Un monomero ionico, tipo SR-732, è stato fornito come mezzo per aumentare le proprietà meccaniche nelle aree di etilene dell'EVA.

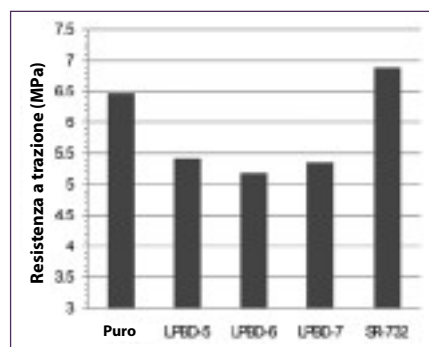
2.2 Preparazione del campione

È stato utilizzato un Brabender TSE-20 per fondere la miscela delle formulazioni analizzate nel presente studio. L'estrusore a doppia vite co-rotante presenta un rapporto L/D di 40:1, ed una struttura della vite configurata per omogeneizzare elevate cariche di filler.

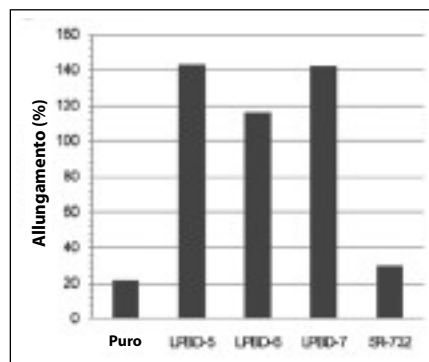
Gli additivi sono stati pre-dispersi nel triidrato di alluminio ATH ed alimentati a valle a 20D. Sono stati effettuati degli esperimenti utilizzando un profilo di temperatura piatto di circa 50°C oltre la temperatura di rammollimento Vicat e a 80rpm.

Un prodotto estruso su una sola linea è stato fatto passare attraverso un canale d'acqua e ridotto in granuli. Tutte le formulazioni contenevano il 60% in peso di triidrato di alluminio (ATH) e il 4% in peso di LPBD.

▼ **Figure 5:** I risultati della resistenza a trazione per le funzionalità alternative indicano che gli LPBD con una funzionalità del 5% (inclusa l'anidride) influenzano in misura minore la resistenza a trazione



▼ **Figura 6:** I risultati dell'allungamento utilizzando funzionalità alternative dimostrano miglioramenti significativi nella duttilità rispetto al sistema puro EVA-ATH



Sono state realizzate delle formulazioni di base per determinare l'effetto del LPBD sull'EVA.

Dei campioni sottoposti a prove di trazione ASTM sono stati modellati utilizzando una pressa per micro-iniezione del tipo Boy Machines XS 11-T. È stato utilizzato un profilo di temperatura analogo a quello dell'estrusione. I campioni sono stati trafilati su un dispositivo di prova di trazione Thwing-Albert conformemente alla norma ASTM D-638.

Sono stati raccolti i dati relativi alla resistenza alla trazione allo snervamento e all'allungamento a rottura.

3 Risultati

Una conoscenza dettagliata dell'influenza degli LPBD sull'EVA è stata determinante per comprendere la loro influenza sui sistemi caricati con ATH. Le Figure 1 e 2 illustrano l'effetto di un campione rappresentativo di LPBD sull'EVA di base.

Entrambe le Figure 1 e 2 dimostrano che gli LPBD hanno un'influenza negativa sulla resistenza a trazione allo snervamento e all'allungamento a rottura. Gli LPBD non erano compatibili con l'EVA e hanno prodotto la sua plastificazione.

Gli LPBD 1 e 2 non funzionalizzati hanno avuto un impatto analogo sulle proprietà dell'EVA, indicando che il contenuto di Mw e di vinile non ha rappresentato una variabile determinante. Al contrario, i due omologhi contenenti la funzionalità anidride offrono una maggiore resistenza alla trazione e, nel caso degli LPBD-3, un migliore allungamento.

Appare evidente che la funzionalità anidride abbia reso l'LPBD più compatibile con la fase EVA, e che il valore più basso di Mw del LPBD-3 rispetto al LPBD-4 ha prodotto una dispersione inferiore delle gocce.

L'introduzione di ATH nel sistema ha dato i risultati presentati nelle Figure 3 e 4.

La Figura 3 dimostra che tutti gli LPBD riducono la resistenza alla trazione allo snervamento dell'EVA caricato con ATH.

Gli LPBD-3 e gli LPBD-4 funzionalizzati hanno superato le prestazioni delle controparti non funzionalizzate, che in parte indicano un miglioramento nell'adesione interfacciale fra le fasi.

Nella Figura 4, tutti gli LPBD eccetto gli LPBD-3 hanno migliorato l'allungamento a rottura. Nel caso del LPBD-3, la causa di un'ulteriore riduzione nell'allungamento può essere duplice.

Innanzitutto, è possibile che piccole catene altamente funzionali (Mn 2.500) abbiano avuto molteplici punti di interazione con la superficie dell'ATH ed abbiano avvolto il minerale.

Di conseguenza, non vi sarebbero segmenti di catene libere da aggrovigliare all'EVA e utilizzare come compatibilizzante.

Secondariamente, l'LPBD-3 era costituito al 70% da vinile che potrebbe essere stato reticolato durante la formazione del composto. Un'analisi del modulo elastico ha indicato che il LPBD-3 ha determinato un aumento significativo rispetto al materiale di base, proprio di un materiale reticolato. Gli LPBD non funzionalizzati sono stati utilizzati per inumidire meglio la carica di minerale favorendone così la dispersione. L'LPBD-4 ha migliorato del 450% l'allungamento del sistema caricato.

Probabilmente, l'LPBD-4 ha avuto un numero minore di interazioni fra la funzionalità idrossile e la funzionalità anidride sulla superficie dell'ATH mantenendo contemporaneamente un'estremità per la compatibilizzazione/aggrovigliamento con l'EVA.

In aggiunta al peso molecolare e al contenuto di vinile, sono stati valutati degli LPBD funzionalizzati alternativi. Le Figure 5 e 6 illustrano i risultati di questi additivi oltre al SR-732.

Le Figure 5 e 6 dimostrano che la riduzione della carica di anidride sull'LPBD (LPBD-5), aumenta sia la resistenza a trazione, sia l'allungamento. Come indicato precedentemente, è estremamente importante avere un'associazione fra l'additivo e la superficie del filler, ma anche assicurare che vi sia un aggrovigliamento sufficiente delle catene fra l'additivo e l'EVA.

La riduzione del contenuto di MA nell'additivo ha diminuito la probabilità di formazione di legami multipli con la superficie dell'ATH, aumentando così la lunghezza media della catena restante da aggrovigliare nell'EVA.

Gli LPBD-6 e LPBD-7 dimostrano che delle funzionalità alternative possono sostituire l'anidride maleica sotto forma di epossido e ammina. Entrambi i gruppi funzionali hanno offerto prestazioni simili a parità di cariche di anidride in termini di resistenza a trazione ed allungamento.

Le Figure 5 e 6 dimostrano inoltre l'influenza del monomero ionico, SR-732, sul sistema ATH/EVA.

Diversamente dagli additivi LPBD, il monomero SR-732 ha aumentato la resistenza a trazione del sistema e, sebbene in forma modesta, ha migliorato statisticamente l'allungamento.

Si ritiene che l'introduzione dell'ATH abbia indotto condizioni di taglio elevate nel materiale fuso durante la formazione del composto, che ha reagito con la funzionalità acrilica.

Alcuni studi precedenti indicano che questi monomeri tendono a raggrupparsi in un composto polimerico, creando un ponte ionico o una reticolazione fra catene adiacenti.

A temperatura ambiente, il raggruppamento permette di aumentare le proprietà meccaniche del sistema. A differenza degli LPBD, l'SR-732 ha alterato le proprietà della massa dell'EVA rispetto all'interfaccia.

4 Conclusioni

Grazie all'introduzione di polibutadieni funzionali a ridotto peso molecolare, sono stati ottenuti miglioramenti significativi nell'allungamento di composti ATH/EVA altamente caricati.

La funzionalità dell'additivo ha consentito di compatibilizzare l'interfaccia organica/inorganica mediante la reazione con la superficie ATH e la formazione di grovigli della catena con l'EVA.

Il peso molecolare, o lunghezza della catena, ha costituito un elemento importante per migliorare le proprietà di allungamento.

Le funzionalità alternative all'anidride maleica, come i gruppi epossidici e amminici, si sono rivelate altrettanto preziose per migliorare le proprietà di allungamento.

L'obiettivo era anche l'aumento della resistenza a trazione del sistema. L'introduzione di un monomero di-acrilico ionico ha comportato un miglioramento della resistenza a trazione che non sarebbe stato possibile ottenere con i polibutadieni liquidi.

La formazione di una rete ionica all'interno dell'EVA è probabilmente il meccanismo che ha consentito di migliorare la resistenza a trazione.

Esperimenti futuri permetteranno di analizzare ulteriormente l'influenza del peso molecolare sull'LPBD a bassa funzionalità.

L'aumento della lunghezza delle catene libere dovrebbe comportare un maggiore aumento del fenomeno di allungamento.

Sarà inoltre considerata l'analisi di sistemi di additivi misti LPBD e SR-732 per aumentare sia la resistenza a trazione sia l'allungamento. ■

5 Ringraziamenti

Gli autori desiderano ringraziare DuPont USA e Almatris, per aver fornito il materiale per il presente studio, il team della Boy Machines, per aver modellato i campioni sottoposti a prove di trazione su una pressa per microiniezione XS e Brett Robb per l'accurata preparazione e la descrizione dei materiali EVA-ATH.

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Lanzamiento de una nueva línea de producción de hilo de cobre de cobre



▲ La nueva línea de laminación de hilo de cobre de Fuhr en marcha en Düsseldorf

En wire Düsseldorf la sociedad Fuhr GmbH & Co KG aprovechó la ocasión para presentar su última novedad para la producción de hilo de cobre de sección rectangular para aplicaciones de alta precisión. Su imponente puesto, de más de 1 000 pies cuadrados, permitió a Fuhr exponer todo un tren de laminación, capaz de elaborar hilo de cobre en tiempo real de sección redonda a rectangular con tolerancias de $\pm 0,005\text{mm}$ de calidad superficial y propiedades del material excelentes a la vez. La empresa comenta que un elevado número de visitantes fue a ver la capacidad operativa de las máquinas y la calidad del producto final.

La línea de laminación super compacta, equipada con una bobinadora horizontal (desenrollador), una laminadora de dos líneas de alta velocidad (de tipo WSR), dos dispositivos de laminado de cantos (WSE), dos laminadoras de cabeza de turco universal (WST), además de dos rodillos libres combinados, tres sistemas de medida Vollmer y una bobinadora oscilante, está indicada principalmente para la producción de hilo de cobre de sección rectangular para aplicaciones de alta precisión, como conductores CTC, o hilo de cobre plano, como cinta fotovoltaica (hilo de interconexión con barras colectoras).

En general, las aplicaciones de conductores CTC (conductores transpuestos continuamente) comprenden los bobinados de los transformadores, motores y generadores. Además, los hilos de cobre rectangulares para aplicaciones de alta precisión de pequeña sección son utilizados para motores híbridos y generadores eólicos de alta eficiencia.

Con la aparición de los conductores transpuestos continuamente (CTC) y sus aplicaciones correspondientes, las tolerancias requeridas en este tipo de hilos de sección rectangular han sido bajadas a $\pm 0,005\text{--}0,01\text{mm}$, que no pueden ser cumplidas con tecnología de laminación en frío tradicional.

El nuevo concepto de vanguardia y el diseño contemporáneo de las máquinas de laminación de hilo de Fuhr ofrecen una planta de laminación capaz de convertir hilos de cobre de sección redonda en una amplia gama de formas rectangulares y planas, con una relación ancho-espesor de hasta 40:1.

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Contrato de suministro de cables para Turquía

Draka Communications ha anunciado que se ha adjudicado un importante contrato de suministro de cables para la red dorsal de televisión por cable de cobre y fibra de Turquía. En un acuerdo tomado a través del distribuidor local de Draka, Focabex, la empresa despachará unos 600km de cable troncal de cobre de baja atenuación, para uso subterráneo y aéreo, además de 150km de cable de alta densidad de fibras a lo largo de todo el 2010.

“Draka mantiene una duradera y estrecha relación con el sector de las telecomunicaciones en Turquía, por eso nos complace anunciar este importante contrato obtenido a través de nuestro partner local, resultado directo de las crecientes demandas de infraestructura dorsal,” dijo Thilo Hamm, jefe de productos para la zona EMEA, productos para redes de televisión por cable y radiofrecuencia, Draka Communications. “Este acuerdo refuerza la tendencia de todos nuestros mercados en los que las redes de radiodifusión están efectuando amplias mejoras técnicas y trabajos de expansión”.

Draka Communications – Países Bajos
Website: www.draka.com

Rautomead lanza una versión china de su web

El especialista británico en tecnología de colada continua, Rautomead Ltd, ha anunciado el lanzamiento de una versión china de su página web con la que pretende mejorar la accesibilidad del creciente mercado chino a su gama de equipos de colada de metales no ferrosos. La nueva versión de la web puede ser visitada en www.rautomead.net.cn



▲ Rautomead ahora también en chino

El jefe de ventas y marketing de Rautomead, Guy Henderson, comentó: “La web china está alojada en un servidor de China y facilitará el acceso a información sobre productos de Rautomead a todos aquellos que usen caracteres chinos en sus buscadores de contenido. En julio del año pasado la compañía activó otra página web en ruso (www.rautomead.ru), alojada en un servidor de Rusia. A pesar de la situación económica que se está viviendo en esas latitudes, hemos registrado e incrementado el número de peticiones de información desde que la versión rusa fue creada.”

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wire Düsseldorf satisface una vez más a sus visitantes



▲ La feria wire 2012 será celebrada del 26 al 30 de marzo de 2012

Los primeros sondeos sobre Tube/wire Düsseldorf revelan una feria concurrida y optimista que ha despertado el interés internacional. En la feria del cable se reunieron 1219 empresas de 52 países que ocuparon 52.000 m² de superficie de exposición, correspondiente a un aumento del 7,3% en el número de expositores. "La feria del cable marcha bien y la clientela muestra gran interés. Casi todos notan que los negocios van mejor", comentaba Benedikt Niemeyer, director ejecutivo de Schmolz + Bickenbach, participante global del sector del acero.

Howard Fancher, de Huestis Machine Corporation, percibió interés y excitación por el futuro. "wire Düsseldorf hizo gala de innovación y entusiasmo, con participantes centrados en las nuevas tecnologías y tratando de obtener el máximo de sus inversiones. Me dicen que el número de visitantes fue inferior al de ferias anteriores, pero no pueden probarlo, en mi opinión. Nuestro puesto se vio desbordado todos los días por clientes entusiasmados que buscaban equipos nuevos e innovadores, además de darles lo que necesitan para cosechar éxito en sus negocios. Ví muchas caras nuevas, jóvenes y entusiasmadas, además de desconocidas en el sector del cable y alambre, intentando aprender todo lo posible y llevarse las mejores ideas para impulsar sus respectivas empresas. En general, considero la feria un enorme éxito."

Los visitantes calificaron los eventos de "muy bueno" a "bueno". En cinco días de feria desfilaron por los pabellones un total de 69.200 visitantes. El índice de presencia internacional es elevado, por lo general. A la feria del cable acudieron 35.000 visitantes del sector procedentes de 70 países, correspondiente a un 63% de presencia extranjera. La mayoría de los visitantes de la feria del cable venían del Reino Unido, Francia, Estados Unidos, Italia, La India, Países Bajos, España, Brasil, Turquía, Austria, Suiza, Bélgica y Polonia.

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Enlace de suministro eléctrico para plataforma costa fuera

ABB ha conseguido un pedido valorado en 110 millones de dólares americanos de Eni Norway AS para construir un enlace de suministro eléctrico entre una nueva plataforma de petróleo y gas situada en el mar de Barents y la red de suministro eléctrico de Noruega.

La plataforma Goliat será electrificada parcialmente mediante un cable eléctrico submarino de 106km, que puede bajar las emisiones de anhídrido carbónico de la plataforma hasta un 50% reduciendo la necesidad de electricidad producida por las turbinas de gas de la plataforma.

"El cable de enlace proveerá suministro eléctrico fiable procedente de tierra y ayudará a reducir el impacto ambiental de la plataforma", dijo Peter Leupp, jefe de la división de sistemas de suministro eléctrico de ABB.

El cable con aislamiento de XLPE de 123kV y 75MW es considerado el más largo y potente realizado hasta ahora para una aplicación costa fuera. Suministrará corriente alterna de la red eléctrica noruega a la plataforma Goliat, planta flotante de producción, almacenamiento y descarga de petróleo y gas.

El cable lleva fibra óptica para monitorizar la temperatura y ofrecer servicios de comunicación generales, e incluye además un tramo dinámico de 1,5km para adaptarse al movimiento de la plataforma flotante.

La finalización del proyecto está programada para finales de 2013, cuando la plataforma tiene prevista la puesta en marcha.

Los cables submarinos de tres conductores aislados con XLPE de alta tensión de ABB presentan menos pérdidas eléctricas, son resistentes a los disolventes, aceite y abrasiones y tienen una resistencia a la tracción excelente. Son ideales para aplicaciones en duras condiciones marinas. ABB ha entregado aproximadamente 3000km de cable submarino de c.a. y c.c. aislado con polímeros (sin aceite) para proyectos realizados en todo el mundo. Esto comprende enlaces de suministro eléctrico con plataformas de petróleo y gas en el Golfo Pérsico y Mar del Norte.

ABB Ltd – Suiza
Website: www.abb.com



Mejoras de las propiedades mecánicas de los compuestos retardantes a la llama no halogenados

Por Jeremy R Austin, Herbert S.-I Chao, Sartomer Company

Resumen

Normalmente, se utilizan compuestos halogenados, como el tetrabromobisfenol A o TBBPA, para fabricar artículos de plástico con propiedades de retardo a la llama.

Recientemente, la búsqueda académica e industrial se ha centrado en productos retardantes a la llama no halogenados, pero estas tecnologías alternativas más seguras tienen un efecto negativo en las propiedades mecánicas.

Para cumplir los requisitos de retardo a la llama, los rellenos minerales usados como retardantes a la llama requieren una carga en exceso de un 60% en peso.

En este estudio se utilizan polibutadienos líquidos funcionalizados (LPBD) para mejorar el alargamiento y la resistencia a la tracción de los compuestos de etileno vinil acetato (EVA) cargados con trihidrato de aluminio (ATH).

La dispersión previa de los agentes de acoplamiento en el ATH ha permitido mejorar el alargamiento más de un 200%.

Se ha demostrado que los mejores resultados se obtienen con bajas cargas de funcionalidades, como anhídrido maleico, epoxi y amino.

Con la incorporación de un monómero iónico diacrílico se ha obtenido una mejora del módulo de tracción irrealizable con materiales a base de LPBD.

1 Introducción

Algunos estudios científicos han demostrado que los retardantes a la llama halogenados (HFR) son contaminantes del medioambiente ampliamente difundidos.

Las emisiones peligrosas causadas por la fabricación, eliminación o reciclaje de productos plásticos que contienen HFRs constituye una amenaza tan seria que algunos HFRs ya han sido eliminados de los artículos electrónicos y electrodomésticos, y la Unión Europea ha aprobado normas para que la industria de los plásticos los elimine.

Con normas de este tipo aplicadas en todos los continentes, varios mercados de la industria de los plásticos están buscando tecnologías alternativas.

Se han identificado varios retardantes a la llama no halogenados (NHFR), como los fosfatos de amonio, los compuestos melamínicos, los nanocompuestos de arcilla o los minerales hidratados. El trihidrato de aluminio (ATH) es un relleno retardante a la llama para polímeros reconocido y no tiene halógenos.

Normalmente, los retardantes a la llama actúan retrasando la ignición quitándole combustible al fuego o bajando la temperatura de ignición.

Sin embargo, el ATH desprende vapor de agua durante la descomposición, que se supone permite extraer calor del sustrato y diluir la alimentación de combustible.

Una vez carbonizado, el residuo de Al_2O_3 impide la migración del oxígeno y de los compuestos volátiles liberados por el polímero que pueden aumentar posteriormente la reacción exotérmica.

En la mayoría de las aplicaciones, se puede utilizar una simple estrategia de sustitución, reemplazando el HFR por el NHFR. En algunos casos, como en el de los minerales hidratados como el trihidrato de aluminio o el hidróxido de magnesio, la transición es más difícil.

Para conseguir el retardo a la llama requerido, se necesita de altas cargas de ATH, a menudo un 60% en exceso, en peso. Cuando la fracción de volumen del relleno inorgánico supera el 50%, se produce un fuerte deterioro de las propiedades físicas del compuesto.

Plentz *et al*¹ han demostrado que en compuestos de PP que contienen ATH existe una relación entre la carga del relleno y el tamaño del agregado. Esto indica que una carga de relleno elevada, además de afectar negativamente a las propiedades físicas, causa también la agregación del ATH a medida que aumenta la carga.

Varios estudios han mostrado que la agregación de un polímero funcionalizado es un método eficaz para modificar la adherencia interfacial en la capa límite orgánica/inorgánica de los compuestos poliméricos^{2,3,4}.

Mai *et al*⁵ han demostrado que incorporando un ácido acrílico modificado

por injerto en compuestos de PP-ATH se genera una interacción química entre los grupos carboxilo e hidroxilo en el polímero y en el relleno respectivamente.

Se ha demostrado que mejorando la adherencia interfacial se mejoran tanto las propiedades térmicas como las mecánicas. De manera análoga, Wang *et al*⁶ han introducido el EPR injertado por anhídrido maleico en un compuesto PP-Mg(OH)₂ y han observado que el EPR-g-MA se quedaba solamente en la interfaz.

La encapsulación del Mg(OH)₂ permitía mejorar la dispersión del relleno, aumentando la resistencia al impacto. Plentz *et al*¹ han introducido un PP funcional con ácido acrílico en su sistema PP-ATH y han demostrado que la interacción mejorada en la interfaz causaba un aumento del índice de fluencia en fusión y mejoraba la resistencia a la tracción y a la flexión.

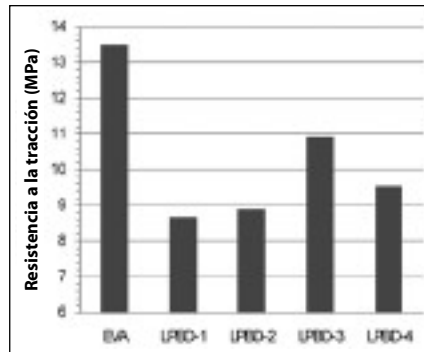
En estos tres casos, los aditivos funcionalizados interactuaban con el relleno para superar los efectos negativos de las altas cargas de relleno de mineral hidratado.

Los materiales funcionalizados convencionales han sido estudiados para superar los defectos de los compuestos retardantes a la llama que contienen ATH.

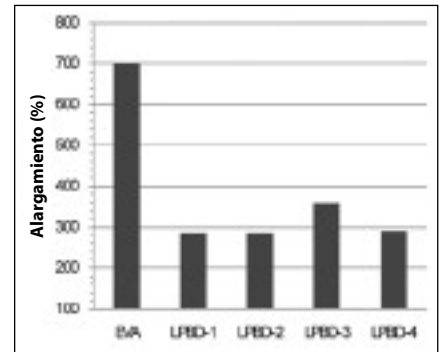
Esta evaluación examina el efecto de los polibutadienos líquidos funcionalizados (LPBD) de bajo peso molecular como agentes de modificación interfacial en un sistema de alambres y cables (W&C) de etileno vinil acetato (EVA) con un 60% de carga.

La respuesta del sector industrial ha indicado que adoptando una solución que utiliza el ATH, la resistencia a la tracción, la ductilidad y el flujo se reducen a un nivel tan bajo que el material no puede funcionar en el sistema W&C.

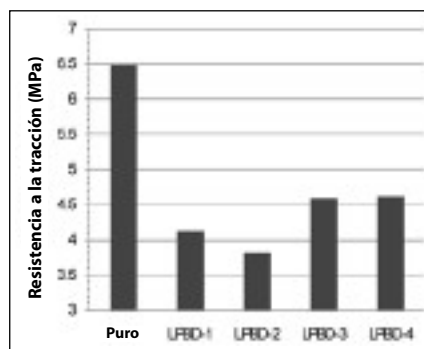
Se supone que un bajo peso molecular puede ser una ventaja para una mejor



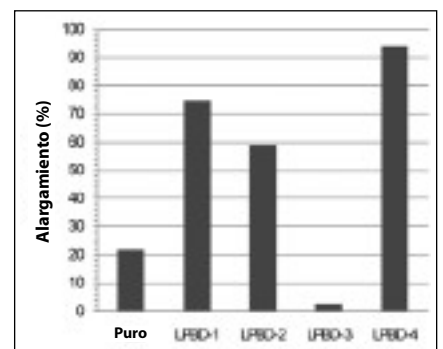
▲ **Figura 1:** Resultados de la resistencia a la tracción del LPBD funcional respecto al LPBD no funcional comparados con la base EVA. Todos los productos han plastificado el EVA, pero el MA LPBD en menor grado



▲ **Figura 2:** Resultados del alargamiento de un estudio de referencia que demuestra que el LPBD funcional a base de anhídrido ha tenido la menor influencia sobre el EVA



▲ **Figura 3:** Resultados pertinentes a la tracción para sistemas que contienen ATH que demuestran que el LPBD funcional a base de anhídrido produce menor reducción de resistencia a la tracción



▲ **Figura 4:** Resultados pertinentes al alargamiento para un estudio de referencia del sistema ATH EVA que demuestran que usando el LPBD es posible restablecer el alargamiento

identificación y adherencia a la superficie del relleno, optimizando de tal manera la modificación interfacial. Por lo tanto, se ha variado el tipo y el nivel de carga de la funcionalidad a fin de verificar las condiciones químicas más apropiadas para mejorar los compuestos EVA-ATH.

2 Experimentación

2.1 Materiales usados

Se ha usado EVA comercial (DuPont Elvax[®] 550), tal como se ha recibido, con contenido de acetato de vinilo de

un 15% en peso. Almatris Inc. suministró el ATH de tipo C-33 con partículas de tamaño mediano de 50µm, densidad de 2,42g/cm³, que contenían un 35% de agua combinada químicamente. No se ha modificado químicamente el polvo de flujo libre durante la fabricación, utilizándolo tal como había sido recibido.

Sartomer Company suministró los polibutadienos líquidos de bajo peso molecular, que contenían la funcionalidad vinilo, anhídrido maleico, epoxi o amino.

La *Tabla 1* ilustra las propiedades correspondientes a cada uno de los polibutadienos líquidos (LPBD) usados para este estudio. Los materiales a base de polibutadieno pueden ser considerados bifuncionales, como se ilustra en la *Tabla 1* que indica tanto una funcionalidad primaria como un contenido de vinilo indeterminado.

Los materiales que contienen un 70% de vinilo son considerados activos al curado, y capaces de entrecruzarse cuando hay radicales libres presentes. Los polibutadienos de vinilo (el 28%), al contrario, son considerados más estables.

El anhídrido maleico se injerta en el grupo funcional (*cis-trans*) de la cadena principal

▼ **Tabla 1:** Propiedades de los polibutadienos líquidos usados para esta investigación, destacando el tipo de funcionalidad y carga, peso molecular y contenido de vinilo *, polibutadieno epoxidado internamente, ** polibutadieno injertado con amino terciario

ID	Mn (g/mol)	Funcionalidad (tipo/%)	Vinilo (%)
LPBD-1	1400	-	70
LPBD-2	4500	-	28
LPBD-3	2500	MA/17%	70
LPBD-4	5500	MA/17%	28
LPBD-5	4700	MA/5%	28
LPBD-6	4500	Epoxi*/5%	28
LPBD-7	5000	Amino**/5%	28

del polibutadieno, y por consiguiente, el mayor contenido de vinilo obliga a la funcionalidad a situarse mucho más cercana. Además del Mn, ésta es una característica discriminante entre LPBD-3 y LPBD-4.

La agregación de polibutadienos líquidos directamente en el flujo del material fundido no es posible debido a su estado físico.

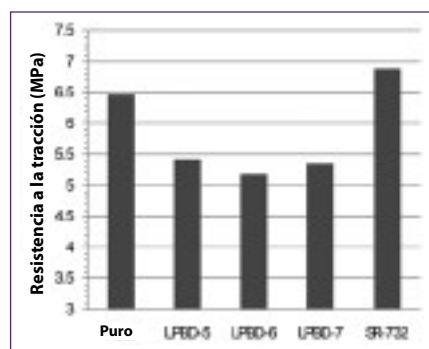
Los agentes de acoplamiento han sido predispersados en el ATH en un portador líquido seco DLC (dry liquid carrier) en un mezclador de alto corte. Se ha obtenido un polvo de flujo libre activo al 50% que puede ser alimentado lateralmente en la extrusora con facilidad.

Algunos trabajos anteriores han demostrado que la incorporación de un monómero iónico funcional de diacrilato en poliolefinas genera una estructura entrecruzada iónica.

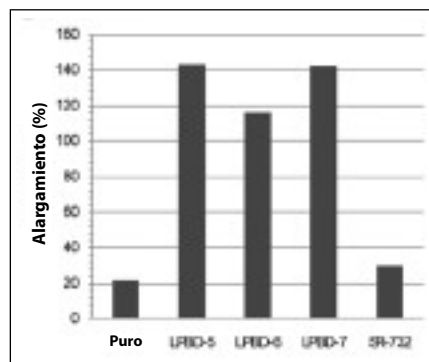
El mecanismo se basa en los radicales libres generados por el calor y el corte durante la formación del compuesto.

Un monómero iónico, tipo SR-732, ha sido provisto como medio para aumentar las propiedades mecánicas en las zonas etilénicas del EVA.

▼ **Figura 5:** Los resultados de la resistencia a la tracción para funcionalidades alternativas indican que el LPBD con un 5% de funcionalidad (anhídrido incluido) tienen un impacto menor en la resistencia a la tracción



▼ **Figura 6:** Resultados del alargamiento usando funcionalidades alternativas que demuestran mejoras significativas en la ductilidad respecto al sistema puro EVA-ATH



2.2 Preparación de la muestra

Se ha usado un Brabender TSE-20 para fundir la mezcla de las formulaciones examinadas en este estudio. La extrusora de tornillos gemelos corrotantes tenía una relación L/D de 40:1, con diseño del tornillo configurado para homogeneizar altas cargas de relleno. Se han predispersado los aditivos en el ATH alimentándolos aguas abajo a 20D.

Se han realizado experimentos usando un perfil de temperatura plano de aproximadamente 50°C por encima de la temperatura de ablandamiento Vicat, a 80rpm. Un producto extrusionado en una sola línea ha sido pasado a través de un canal de agua, y ha sido peletizado.

Todas las formulaciones contenían un 60% en peso de ATH y un 4% en peso de LPBD. Se han realizado formulaciones de base para establecer el efecto del LPBD sobre el EVA.

Se han moldeado probetas para la prueba de tracción ASTM usando una moldeadora por microinyección Boy Machines XS 11-T.

Se ha utilizado un perfil de temperatura análogo a la extrusión. Las probetas han sido estiradas en un probador de tracción Thwing-Albert según las normas ASTM D-638. Se han recogido los datos de la carga de fluencia y del alargamiento de rotura.

3 Resultados

El conocimiento detallado de la influencia de los LPBDs sobre el EVA ha sido determinante para conocer su influencia sobre los sistemas cargados con ATH.

Las Figuras 1 y 2 ilustran el efecto de una muestra representativa de LPBDs en la base EVA.

Las Figuras 1 y 2 demuestran que los LPBDs tienen una influencia negativa en la carga de fluencia y el alargamiento de rotura. Los LPBDs no eran compatibles con el EVA y han producido su plastificación.

Los LPBDs 1 y 2 no funcionalizados han tenido un impacto igual en las propiedades del EVA, lo que indica que el contenido de Mw y de vinilo no han sido variables influyentes. Por el contrario, los dos homólogos que contenían la funcionalidad anhídrido ofrecían una mayor resistencia a la tracción, y, en el caso del LPBD-3, un mejor alargamiento.

Parece evidente que la funcionalidad anhídrido ha vuelto al LPBD más compatible con la fase EVA, y que el menor Mw del LPBD-3 respecto al LPBD-4 ha producido menor dispersión de gotitas.

La introducción de ATH en el sistema ha llevado a los resultados presentados en las Figuras 3 y 4.

La Figura 3 demuestra que todos los LPBDs reducen la carga de fluencia del EVA cargado con ATH. Los LPBD-3 y LPBD-4 funcionalizados han resultado mejores que sus homólogos no funcionalizados, lo que en parte indica una mejora de la adherencia interfacial entre fases.

En la Figura 4, todos los LPBDs a excepción del LPBD-3 han mejorado el alargamiento de rotura. Para el LPBD-3, la causa de una mayor reducción del alargamiento puede tener dos razones.

Primero, las pequeñas cadenas altamente funcionales (Mn 2.500) pueden haber tenido múltiples puntos de interacción con la superficie ATH y haber envuelto el mineral. Por consiguiente, no han quedado segmentos de cadenas libres para enredarse con el EVA y hacer de compatibilizador.

En segundo lugar, el LPBD-3 tenía un 70% de vinilo, que probablemente se había entrecruzado durante la formación del compuesto. Un análisis del módulo elástico ha indicado que el LPBD-3 ha provocado un aumento significativo respecto al material de base, propio de un material entrecruzado.

Los LPBDs no funcionalizado han sido usados para humedecer mejor el relleno mineral ayudando a su dispersión.

El LPBD-4 ha mejorado el alargamiento del sistema cargado en un 450%. Probablemente, el LPBD-4 ha tenido menores interacciones entre la funcionalidad hidroxilo y la funcionalidad anhídrido en la superficie del ATH, manteniendo una cola para compatibilizarse/enredarse con el EVA.

Además del peso molecular y del contenido de vinilo, se han evaluado LPBDs funcionalizados alternativos. Las Figuras 5 y 6 ilustran los resultados de estos aditivos, además del SR-732.

Las Figuras 5 y 6 demuestran que reduciendo la carga de anhídrido en el LPBD (LPBD-5), se aumenta la resistencia a la tracción y el alargamiento.

Como se ha dicho antes, es de gran importancia tener una asociación entre el aditivo y la superficie del relleno, pero también asegurar que haya suficiente enredo de las cadenas entre el aditivo y el EVA.

La reducción del contenido de MA en el aditivo ha disminuido la probabilidad de formación de enlaces múltiples con la superficie del ATH, aumentando de esta

manera la longitud media de la cadena que quedaba para enredarse en el EVA.

El LPBD-6 y el LPBD-7 demuestran que hay funcionalidades alternativas que pueden reemplazar el anhídrido maleico en forma de epoxi y amino.

Ambos grupos funcionales se han comportado análogamente con iguales cargas de anhídrido por lo que se refiere a la resistencia a la tracción y al alargamiento.

Las Figuras 5 y 6 demuestran también la influencia del monómero iónico, SR-732, en el sistema ATH/EVA. A diferencia de los aditivos LPBD, el SR-732 ha aumentado la resistencia a la tracción del sistema y ha mejorado estadísticamente, aunque modestamente, el alargamiento.

Se cree que la agregación de ATH ha creado ambientes de corte alto en el material fundido durante la formación del compuesto, que han reaccionado con la funcionalidad acrílica.

Algunos trabajos anteriores indican que estos monómeros tienden a agruparse en un compuesto polimérico, creando un puente iónico, o un entrecruzamiento, entre cadenas adyacentes.

A temperatura ambiente, la agrupación permite aumentar las propiedades mecánicas del sistema. A diferencia de los LPBDs, el SR-732 ha alterado las propiedades de la masa del EVA respecto a la interfaz.

4 Conclusiones

Gracias a la agregación de polibutadienos funcionales de bajo peso molecular se han obtenido mejoras significativas del alargamiento de compuestos ATH/EVA altamente cargados.

La funcionalidad del aditivo ha permitido la compatibilización en la interfaz orgánica-inorgánica por reacción con la superficie ATH, y la formación de enredos de la cadena con el EVA. El peso molecular, o longitud de la cadena, ha sido un atributo importante para mejorar las propiedades de alargamiento de rotura.

Funcionalidades alternativas al anhídrido maleico, como los grupos epoxi y amino se han demostrado igualmente valiosas para mejorar las propiedades de alargamiento.

El objetivo era también el aumento de la resistencia a la tracción del sistema. La introducción de un monómero diacrílico iónico ha aportado mejoras de resistencia a la tracción, que no se podían obtener con los polibutadienos líquidos.

La formación de una red iónica en el EVA es probablemente el mecanismo que ha permitido mejorar la resistencia a la tracción.

Experimentos futuros permitirán estudiar aún más la influencia del peso molecular en el LPBD de baja funcionalidad.

El aumento de la longitud de las cadenas libres podría llevar a un mayor aumento del fenómeno de alargamiento. Se considerará también el examen de sistemas de aditivos mezclados LPBD y SR-732 para aumentar ya sea la resistencia a la tracción ya sea el alargamiento. ■

5 Agradecimientos

Los autores expresan su agradecimiento a DuPont USA y Almatris por el material suministrado para esta investigación, al equipo de Boy Machines, por el moldeado de las probetas de tracción en una moldeadora por microinyección XS, y a Brett Robb, por la cuidadosa preparación y caracterización de los materiales EVA-ATH.

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Cometo Snc	36	Pave Automation Ltd	14, 34
Condoroil Chemical.....	44	Pressure Welding Machines.....	15, 43
Decalub.....	31	PS Costruzioni Meccaniche Srl	33
Delisi Srl	42	Queins & Co GmbH.....	48
Dow Wire & Cable.....	38	Rautomead Ltd	15, 53, 60, 65, 71, 77
Draka Communications	53, 59, 65, 71, 77	Redex Andantex	38
FMS Force Measuring Systems AG.....	26	Rosendahl Maschinen GmbH	28
FTTH Council.....	11	S&E Specialty Polymers.....	16
Fuhr GmbH	24, 53, 59, 65, 71, 77	SAMP SpA.....	25, 26, 60
Fushi Copperweld.....	12	SAS Engineering & Planning Srl.....	29
GER SA	48	Sheng Chyeen Enterprise Co	35
IBA Industrial.....	11	Sikora AG	14, 30, 37
Ideal-Werk	42	Sonobond Ultrasonics	44
Mathiasen Machinery Inc.....	48	Techna International Ltd	42
Messe Düsseldorf GmbH.....	10, 16, 54, 66, 72, 78	Tratos Ltd.....	28
netzwerkdraht association	11	Videx Ltd.....	44
Nexans.....	30, 35	Wire & Plastic Machinery Group	46
Niehoff Maschinenfabrik GmbH.....	13, 47	Zumbach Electronic AG	26, 39

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Alloy Wire International Ltd.....	25	Messe Düsseldorf GmbH - wire Southeast Asia 2011.....	9, 35
Anbao (Qinhuangdao) Wire & Mesh Co Ltd.....	12	Nantong Zhengyang Steel Rope Co Ltd.....	31
Beijing Holland Tech Co Ltd	14, 31, 36	Nextrom.....	3
Bongard Trading GmbH & Co KG.....	16	Pave Automation Design & Development... Back cover	
Candor Sweden AB.....	13	Pressure Welding Machines Ltd.....	29
Changzhou Wujin Hengtong Metal Steel Wires Co Ltd.....	38	Rautomead Ltd	15
Cometo snc.....	34	Rosendahl Maschinen GmbH	3
Decalub	15	SF Diamond Co Ltd.....	30
Enshiang Machinery Enterprise Co Ltd.....	27	Shanghai Nanyang Equipment Factory	20
Eurolls Group	1	Supermac Industries India Ltd	13
Gauder Group.....	49, 59	Trafco srl.....	5
Goodwin Machinery Ltd.....	47	Windak OU.....	23
Huestis Industrial.....	33	Wire & Plastic Machinery Corp	Front cover, 37
Ideal-Werk C+E Jungeblodt GmbH & Co KG	19	Wire & Steel Trading NV	43
Jiashan Winsun Industrial Co Ltd	36	Yangzhou Qunye Electric Machinery Factory.....	11
Locton Ltd.....	30	Zumbach Electronic AG	Inside front cover
Messe Düsseldorf GmbH.....	39		

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corporate news

Exhibitors happy with wire Düsseldorf activity

Reports from 'TradeWire Düsseldorf' confirm a busy and successful show attracting international interest. At over 1270 exhibitors from 52 countries and 52,000 of exhibition space, corresponding a 27% rise on exhibitor numbers.

"We are going well and customer interest is high. Almost everyone that has been exhibiting so far has been very happy and excited with people focused on new technology and getting the best bang for their capital spending dollar."

Howard Fuchs of Harsco Machine Corporation stated interest and excitement for their "The wire Düsseldorf" show was high and exciting with people focused on new technology and getting the best bang for their capital spending dollar.

"I am told that the Düsseldorf numbers were lower than previous years, but that could be just a price effect. Our booth was swamped with sales with eager customers looking to find equipment that is new and inspiring, as well as giving them what they need to be successful in their business. I saw many new young faces trying to soak it all in and take away the best ideas to further their respective companies. That's the show a huge success."

Visitors gave "very good" to "good" ratings for the event. The trade fair Düsseldorf has a total of 50,000 trade visitors over the exhibition days. The number of exhibitors from 52 countries is a historically high, with new exhibitors by 20,000 trade visitors from 50 countries, 2,500 exhibitors in total.

The majority of wire visitors came from the United Kingdom, France, USA, Italy, India, Turkey, Spain, Austria, Switzerland, Belgium and Poland.

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Feature

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 selected, selected or other packaging operation does not merely complement a finished production run. It is an essential element of the delivery system that ultimately results in a satisfied customer.

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A number of unmentioned choices can be demanding, not only to the wire and cable being prepared for transport, but also to a company's bottom line. The products and services appearing in this section are intended to aid wire decision-making.

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