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FEATURES

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- Innovations
- Plant maintenance, health, safety and quality
- Pumps and valves

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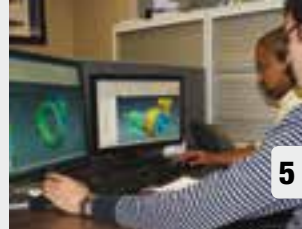
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GEMÜ valves — Made to last longer, even in the howling winds

GEMÜ is one of the world's leading manufacturers of valves, measurement and control systems. Since 1964, this globally focused, independent family-owned enterprise has established itself in important industrial sectors thanks to its innovative products and customised solutions for process media control.

A broad-based modular system and adapted automation components mean that predefined standard products and customised solutions can be combined to make over 400 000 product versions.

GEMÜ specialises in the manufacture of high-quality valves, measurement and control systems. The coating on the valve bodies in its series of concentric, soft-seated GEMÜ 480 Victoria® butterfly valves has recently been modified. In line with the new standard, a 250 µm epoxy coating is being used. The screws and bolts for fixing the actuators are manufactured from stainless steel. As a result of this and other measures, such as optimised workpiece pre-treatment before the coating process itself, all product configurations now comply with the requirements of the C5M, medium-durability classification as stipulated in DIN EN ISO 12944.

Back to basics

A windmill is a mill that converts the energy of wind into rotational energy by means of vanes called sails or blades. The wind wheel of the Greek engineer, Heron of Alexandria, in the first century is the earliest known instance of using a wind-driven wheel to power a machine. Centuries ago, windmills were most often used to mill grain, pump water, or both. Further developments led to the design of a wind

turbine, which is a windmill-like structure specifically developed to generate electricity. The first of these were built by the end of the nineteenth century, though the modern wind power industry began in 1979 with the serial production of wind turbines by Danish manufacturers. These early turbines were small by today's standards, with capacities of 20-30 kW each. Since then, commercial turbines have increased greatly in size, with the Enercon E-126 capable of delivering up to 7 MW, while wind turbine production has expanded into many countries.

Extracting energy from the wind

Worldwide, many thousands of wind turbines are now operating, with an estimated total nameplate capacity of 194 400 MW. Europe accounted for 48% of the total in 2009. A wind turbine installation consists of the necessary systems needed to capture the wind's energy, point the turbine into the wind, convert mechanical rotation into electrical power, and other systems to start, stop, and control the turbine.

In addition to aerodynamic design of the blades, design of a complete wind power system must also address design of the hub, controls, generator, supporting structure and foundation. Further design questions arise when integrating wind turbines into electrical power grids. As of 2015, Denmark generates 40% of its electricity from wind, and at

least 83 other countries around the world are using wind power to supply their electricity grids. In 2014 global wind power capacity expanded 16% to 369 553 MW. Yearly wind energy production is also growing rapidly and has reached around 4% of worldwide electricity usage, 11,4% in the EU.

Potentially, the advantages for wind power are tremendous – 20 times more than the entire human population needs, according to some estimations. In addition, it is a renewable source, since wind energy originates from the sun, so we cannot run out of it. It is also a 'green energy' source and does not cause pollution.

Unfortunately, wind is a fluctuating or intermittent source of energy and thus not suited to meeting the base load energy demand unless some form of energy storage is utilised and the manufacturing and installation of wind turbines requires heavy upfront investments – both in commercial and residential applications.

Wind turbines are often quoted as a threat to wildlife such as birds and bats and the noise the turbines make is reported as a problem by some homeowners in properties adjacent to the farms; of course, the aesthetics of onshore wind farms is a legitimate concern for some people.

Offshore wind farms

The ocean is an ideal place for harvesting wind power, but has only become popular of late. Some of the largest offshore plants have a production capacity of 8 MW and tower about 250 m upwards (one wing can be 140 m long). A growing number of them are appearing off the shores of countries globally.

With current available technology, offshore wind farms need to be in fairly shallow water because the turbines can only be built at depths of about 18 to 27 m, though, experimental turbines are being put out at greater depths approaching the 60 m level.

Luckily, sites for offshore wind farms are presently limited by only a few factors such as places used for bird flyways, boating lands and waste sites. Conditions out at sea can be very harsh. Salt spray causes corrosion and vibrations can be a serious matter. There are three butterfly valves per windmill, the failure of only one means that the entire windmill comes to a standstill. Critical to the effective functioning of the valves are the electrical actuators, which have to be able to stand extremes of temperature, possible corrosion issues due to the salt spray.

GEMÜ Butterfly valves in windmills

The GEMÜ 480 Victoria® Butterfly valve is a soft-seated valve, available in nominal sizes DN 25 to 600 and in various body versions such as Wafer, Lug and U section. It can be supplied with various operators. Areas of application include water treatment, the processing industries and power generation.

Additionally this series of valves features advanced seal design, extensive applications using a variety of materials, modular construction, simple installation and low torques. The new surface finish standard for this series mentioned earlier in the article, broadens the existing field of applications. The improved coating means that the butterfly valve can now also be used in coastal and offshore areas, as well



BFV DN 80 after running 20 000 opening/closing cycles

as in buildings with permanent condensation and pollution. At the same time, compliance with this standard affords the customer a certain degree of certainty when it comes to planning, as the service life of the valve is more predictable.

Testing the valves' behaviour

The objective of testing is to understand the behaviour of the GEMÜ Butterfly Valve Typ 480, in particular, selected conditions. The application for the GEMÜ 480 Victoria® Butterfly valve for use on the lubrication system, is as an installation of a set of valves with specific closing and opening directions.

The effects on the valve liner (wearing, tightness, and torque values) after a simulation of 20 000 cycles have to be measured under standard and random conditions, as expected in operation.

During the tests, the valves are operated 20 000 times; the liner material is NBR, suitable for oil; the disc is of reduced diameter, calculated to operate at a PS of 3 bar; the BFV works at a system pressure of maximum 0,5 Bar and is actuated electrically. The expected lifetime of the windmill is 25 years.

Preliminary evaluation of the test results after running 13 700 opening/closing cycles with the valve DN80, and 8 100 cycles with the valve DN200 indicated that the valves, after 20 000 opening/closing cycles were 100% tight before and after testing (according to EN 12266). Tests thus showed that a BFV PS 3 (reduced disc) was providing safe and efficient performance and perfectly meeting the requirements of the defined working conditions. The actuator has sufficient spare torque to safely operate the BFV at these specified working conditions.

Green energy

Whether using 50% less material for the first GEMÜ valve compared with conventional valves, or the launch of a recycling system in 1979, company management and staff members have continually addressed themes that have saved resources over the long term.

Customers are interested in how the products are manufactured – and what the consequences are. Initial surveys in 2009 led to GEMÜ's decision to sign up for EMAS certification.

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Photo courtesy www.123RF.com

South Africa leads Africa's e-learning market

African public-private partnerships are fast-tracking education improvement from primary school to university, potentially levelling the playing field for millions of students worldwide.

In the face of electricity shortages and over-crowding, African public-private partnerships are integrating technology in education to enhance learning. Broadband supports tablets, laptops, and on-line courses to reach students with poor or no access to education, improve teacher training, and lower costs, according to a recent report by UNESCO ("ICT in Education in Sub-Saharan Africa").

For example, Africa's e-learning market has doubled from 2011 to 2016, reaching US\$513 million, according to a report by market researchers Ambient Insights ("The Africa Market for Self-Paced eLearning Products and Services"). South Africa is Africa's largest e-learning market, along with Angola, Nigeria, and Tunisia. Meanwhile, Senegal, Kenya, Zambia, and Zimbabwe are posting 25% annual e-learning market growth.

"Africa is one the world's most dynamic education markets. Public-private partnerships show best practices for using technology to reach marginalised students with technology that students use in their

daily lives," said Trixie LohMirmand, Senior Vice-President, for Exhibitions and Events Management at Dubai World Trade Centre, host of GITEX Technology Week.

Supporting technology investment in Africa, GITEX Technology Week, held from 16-20 October 2016, will host the Africa Investment Forum, in partnership with Nigeria's National Information Technology Development Authority. Over 20 African countries will show how technology can enhance verticals, support foreign direct investment in ICT, and drive economic growth.

The Arabian Gulf states and South Africa enjoy strong trade ties, especially in electronics, construction, and defence. Trade between South Africa and the UAE, where Dubai is the largest city, reached about US\$3 billion in 2015, and the governments are hoping to double its value in the coming years.

African education projects are seeing the power of partnerships with local and international NGOs. The Rumie Initiative, a Canada-based NGO, has produced the Rumie tablet that is in the hands of more than 3 000 children in Africa, including in Benin, Egypt, Ethiopia, The Gambia, Kenya, Liberia, Sierra Leone, South Africa, Tanzania, and Uganda.

"Rumie saw an opportunity to

give disadvantaged students access to the kind of free digital learning materials that had been available only to affluent schools in the past," said Tariq Fancy, the founder and executive director of The Rumie Initiative.

The affordable Rumie tablet is pre-loaded with US\$5 000 worth of crowdsourced educational software and textbooks, with the impact of every dollar spent delivering 100 times the impact.

"Tablets can be sourced and distributed cheaply, the cloud provides low costs for storage, and crowd sourced content allows educators to provide students with the local resources that best meet their needs. Rumie is now untethering content from tablets so that any student with a mobile device can learn from anywhere at any time," added Tariq Fancy.

Further energising education innovation will be global technology companies, such as South Africa's Dimension Data. African startups at the 2016 GITEX Startup Movement, will be able to have their business plans validated by global investors, pitch for US\$160 000 in funding, and network with fellow innovators.

For more information on the 2016 event, running from 16-20 October 2016 at the Dubai World Trade Centre, visit www.gitex.com.

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Coal, pump design and smart maintenance

Pumps play a crucial role in the coal preparation process. Tony Lawson, engineering director at Weir Minerals Europe, explains how evolving pump design and condition monitoring are helping drive efficient production at coal mines around the world.

The complexity of a coal preparation plant varies according to the nature of the raw material, the requirements for the end product and the local regulations around water use and waste production. Some plants can require up to 15 different stages, whilst others have significantly fewer.

One thing that many plants have in common is that the coal is moved around the plant by slurry pumps. The pumps are vital components in the process, as the other pieces of equipment in the circuit – screens, hydro cyclones and separators, for example – are all gravity-driven. It is slurry pumps that provide the energy to lift the material to the top of the plant, to transport it from one stage to the next, and to carry waste slurry to the disposal facilities.

This crucial role means that the performance of pumps has a direct impact on the efficiency of an operation. A unit that does not perform efficiently can become a major bottleneck in the process.

The curved vane centrifugal slurry pump was developed in the middle of the 19th century, and the basic principle remains the same today. However, the increasing sophistication of computational fluid dynamics (CFD) and computer-aided design has seen engineers make significant advances in terms of understanding the complex flow of slurries and how it interacts with the impeller and casing inside a pump.

The research that has taken place in recent years has allowed engineers to continue to improve the efficiency,



The new Warman MDC pump is designed for heavy-duty slurry applications.

versatility and ease of repair of pump units and this has meant significant reductions in the total cost of ownership of pumps – the factor that determines the value delivered to the customer.

It was this challenge that led the research and development team at Weir Minerals to develop the latest model of Warman® slurry pump – the Warman WBH® pump.

Over the past 50 years, Weir Minerals' best selling pump

– not only for coal processing but also across many other applications in the mining industry – has been the industry standard Warman AH® pump.

In order to further enhance the performance of this benchmark pump, engineers at Weir Minerals took on the challenge of redesigning the whole pump. The aim was to design a brand new pump that would outperform the AH series in every way – wear-life, efficiency, safety and ease of maintenance.

The primary challenge of the project was to redesign the hydraulics of the pump to deliver slurry flow through the unit that was less turbulent, and therefore more efficient, and less likely to cause rapid wear to internal parts.

CFD modelling was used to develop wear prediction and performance analysis models. This revealed the areas of highest turbulence and the impact of particles against the impeller and casing for a range of different slurry mixtures. Digitally manipulating the shape and re-running the models allowed the design to be refined to deliver an optimised performance for the pump's intended duties.

This digital design process was supported by wear parts data from existing AH pumps, gathered over a period of several years, by examining worn impellers and casings that had been used on different kinds of slurry application.

One outcome of the design process was a new impeller which made a radical departure from the five vane design of the AH pump, replacing it with a new four vane arrangement that delivers improved slurry guidance and smoother hydraulic flow.

This new impeller, known as the Warman WRT® impeller, is also backwards compatible with the AH pump, bringing the benefits to those not looking to invest in a whole pump upgrade. Streamlining the volute liner and redesigning the cutwater to reduce turbulence delivered further improvements.

Since the new unit was launched in 2011, on-site performance has demonstrated the efficiency gains that have resulted from this ground-up redesign. The lifespan of wear parts has been increased, fuel consumption has been reduced and improved net positive suction head (NPSH) characteristics have been achieved.



The Warman WBH slurry pump undergoing testing at the Alrode manufacturing centre.

Built for purpose

Another recent innovation in the Warman family of pumps is the Warman MDC® pump series, which has been designed specifically with the coal industry in mind. Featuring an unlined pump casing and a three-vaned impeller with maximised clearance, the pump is able to pass the very large particles common to coal processing applications.

The simple, low cost 'wet end' of the pump – the parts that come into contact with the slurry – can be mounted to existing Warman mechanical ends – the bearing assembly, drive shaft and mount – making on-site upgrades straightforward to implement.

In addition to re-designing and evolving existing units, Weir Minerals has also achieved considerable efficiency gains by finding innovative uses for existing products.

A good example of this is the increasing popularity in the coal industry of pumps that were originally designed to work efficiently with froth slurry streams containing a high proportion of air and which cause a major challenge for traditional centrifugal pump designs.

One of the key objectives of modern coal processing circuits is to optimise the removal of water from the waste slurry stream, creating a very thick paste. This is beneficial, as it maximises the capacity of tailings facilities, a common limiting factor in coal production, while also reducing levels of water loss in the process.

A little over 15 years ago, Weir Minerals developed the Warman AHF® froth pump, a modification of the Warman AH pump that features an oversized inlet and a four-vane impeller with innovative inducer blades that scoop the slurry at the inlet and help feed it into the pump, avoiding air locking and blockages.

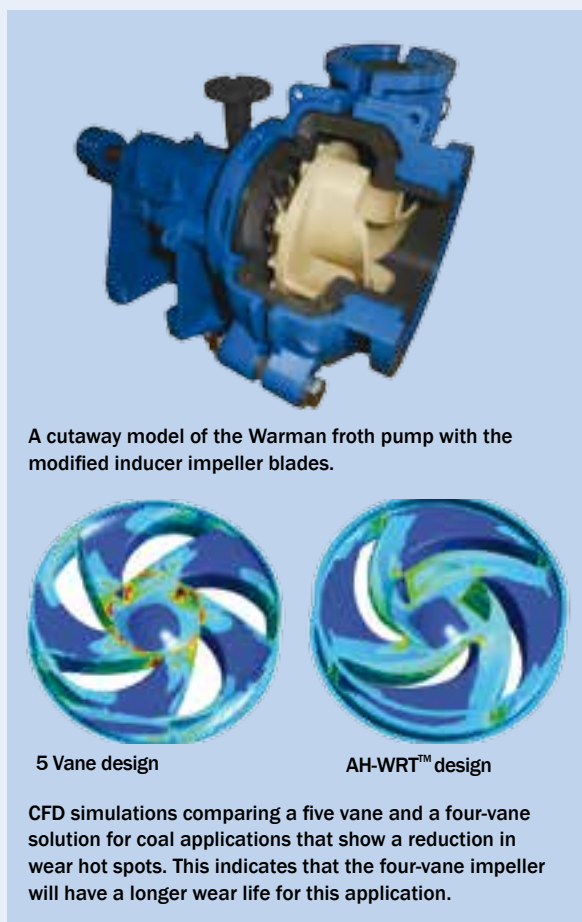
More recently, during testing, Weir Minerals engineers discovered that the flow inducing properties of the impeller design meant that the Warman AHF pump also delivered excellent performance in applications involving highly viscous slurries, moving them with higher efficiency than traditional centrifugal pump designs.

Weir Minerals has seen many coal mining customers adopting this solution and re-purposing their existing AH pump for thickened waste flow duties by applying the AHF pump modification, rather than investing in a new pump that is purpose built. This example clearly illustrates why, for those customers looking to minimise capital expenditure, making modifications to existing designs can be an excellent way of achieving efficiency gains that can quickly justify the expenditure.

Belt drive systems are one of the most popular means of delivering power to pumps, but they can also be a source of inefficiency, largely because of the need to replace drive belts periodically.

Pumps on-site often run with poorly aligned or tensioned belts, and this can lead to significant performance issues, not only because of increased downtime resulting from worn out belts, but also through lost energy as a result of belt slipping or bearing damage through vibrations.

A hydraulic belt tensioner such as Weir Minerals' Gemex® system solves this problem by effectively providing a quick-release system for drive belt replacement. Rather than needing to re-align and retension the system every



time the belt is changed, the hydraulics will return it to the optimum settings almost instantly.

Smart monitoring and maintenance

The high impact nature of a coal processing plant means that wear and tear is an unavoidable factor and, no matter how advanced the technology, maintenance will always be required throughout the lifespan of a pump for optimum performance to be sustained. It is therefore crucial that the right repair and maintenance strategies are in place for any given project so that potential problems are identified before expensive failures are allowed to take place. This also ensures reaction is fast if any unexpected issues arise.

The traditional approach to pump maintenance is reactive – to wait until major warning signs show themselves before taking action to make repairs. This is often caused by a commitment to keep the process running whenever possible, and only interrupting it when absolutely necessary.

In reality, approaching maintenance this way brings with it a number of demonstrable disadvantages. The first of these is that wholly reactive maintenance means accepting that sub-optimal performance and unexpected failures are inevitable. This should not be the case, as reacting to a problem in the process can prove much more costly in terms of downtime than would be the case with a well managed programme based on condition monitoring and scheduled servicing.

Poor performance or failure of pumps has a direct effect on the productivity of the entire process and an unforeseen issue can cause it to grind to a halt altogether. The duration of the resulting interruption can vary enormously depending

on the proximity of qualified maintenance engineers, how long it takes to diagnose the cause of the problem and how readily available any necessary parts are. In the worst cases, processes can be halted for a matter of days – at potentially significant cost to the business.

Scheduling regular system checks will allow the condition of critical parts to be monitored over time. This means that replacements can be made before excessive wear leads to sub-optimal performance or failure.

Examining the condition of internal parts such as the lining and impeller will mean taking it out of action for a short time. This is often worthwhile in order to avoid unexpected repairs and long periods of poor efficiency.

The frequency of these tests should be determined based on a good knowledge of the average operating lifespan of individual parts at the relevant levels of duty. This way, checks will be performed frequently enough to maintain efficient performance, but not more often than necessary, avoiding excessive costs.

Non-interruptive monitoring should also be carried out regularly, as this provides a way for any issue arising between scheduled checks to be noted. Temperature and vibration measurement of any moving parts, energy consumption and flow-rate monitoring can all be carried out while a pump is operational – supplying useful information without costly downtime.

All mechanical seals should also be regularly checked and, if necessary, adjusted – especially those around the drive shafts of pumps.

Advanced monitoring systems are available that use handheld devices connected to a central database to guide on-site personnel through the process. This ensures that no part is missed and that all monitoring data is stored centrally so maintenance can be properly prioritised across a whole site. In 2013, Weir Minerals launched a proprietary condition monitoring system, which is used by its maintenance engineers and is available to its customers. Many cases have been seen where automating the maintenance process at coal mining sites has delivered a significant improvement in equipment performance.

Systems, conditions and acceptable performance margins vary between different sites, so there cannot be a standard solution that meets the requirements of all. Consulting with an equipment supplier or maintenance expert is advisable to ensure that the right level of monitoring is in place.

It is Weir Minerals' mission as a pump manufacturer to deliver continuous improvement for its customers, whether in terms of increases in energy efficiency, reduction in the frequency with which parts need replacing and the ease with which this can be done.

It is important for those operating coal processing plants to keep abreast of the developments both in pump technology and in the support strategies that many suppliers are now beginning to adopt in order to ensure that the pumps driving their process are performing as well as possible.

Ultimately, using inappropriate or ill maintained systems can have a negative impact on the bottom line, but fit-for-purpose pumps running at optimum efficiency will bring significant production benefits.

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Instruvac

Air & Vacuum Technologies, based in Midrand, Gauteng, is recognised as one of the leading providers of a wide range of equipment to all parts of South and southern Africa.

Instrulab, originally founded to market and service a full range of laboratory equipment, is now the sales division of Air & Vacuum Technologies; Vacuum Technologies had originally been founded by Brian Burn to provide vacuum solutions. In 2000 the name changed to the present one. There are another three sales divisions today.

Instrulab is the sole agent for Precisa precision balances and moisture balances; Endecotts particle size analysis sieve shakers and precision sieves; DryVac, ChemVac & Ilmvac laboratory vacuum pumps; Instrulab range of peristaltic pumps & syringe pumps; LaboGene bench top and pilot size freeze dryers. Instrulab is also an appointed distributor for the complete Scientific Engineering range of general laboratory equipment and for the complete Labcon range of general laboratory equipment. The company is an appointed re-seller of the Brookfield range of viscometers and is responsible for Instrulab laboratory peristaltic pumps.

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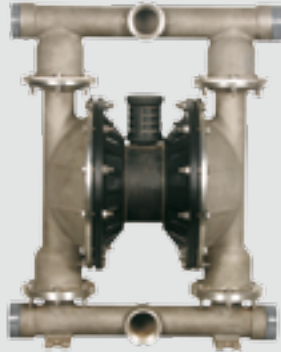
Instrupump is responsible for Flotronic ONE-NUT-PUMPS from the UK (Air Operated Double Diaphragm Pumps (AOD-DP)); Price Air Operated Double Diaphragm Pumps (AODDP); Instrulab industrial peristaltic pumps; and Pompetravaini liquid pumps, hot oil pumps and LPG pumps.

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and custom-made vacuum coupling components and vacuum chambers); Anest Iwata (range of oil free high vacuum scroll vacuum pumps); and HSR (manufacturers of Cryogenic pumps, Sputter pumps, Xenon pumps, and much more, as well as catalyser traps and helium compressors).

The company's workshop is able to work on almost any make of rotary vane and liquid ring vacuum pump, side

channel and Roots type blower/booster, and offers on-site service contracts. Its laboratory equipment workshop can calibrate and repair most makes of balances and moisture analysers.

For more information contact Mark Burn on tel: 0861 VACTEC (822 832); email: info@vactech.co.za or go to www.vactech.co.za

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Treatment of radioactive gaseous waste

This article focuses on the treatment of radioactive gaseous waste streams arising from the operations in fuel fabrication facilities, nuclear power plants, fuel reprocessing facilities and waste processing facilities. The extract from the original report (details on page 13) provides the user with an overview of the requirements for the management of radioactive gaseous waste.

Over the years the IAEA have issued a large number of publications covering various technological solutions in the area of pre-disposal management of radioactive waste. The following eight technical topics were identified as sufficient to provide adequate technical support.

1. Pre-treatment of low and intermediate level waste;
2. Treatment of low and intermediate level liquid waste;
3. Treatment of low and intermediate level solid waste;
4. Treatment of radioactive gaseous waste;
5. Conditioning of low and intermediate level liquid, solidified and solid waste;
6. Processing of high level waste and spent nuclear fuel declared as waste;
7. Characterisation and monitoring of radioactive waste, waste forms and waste packages, and
8. Storage of radioactive waste and conditioned waste packages.

These handbooks serve as a basis for development of

training material required for technology transfer to the IAEA Member States with less advanced nuclear programs.

Overview of the management of gaseous waste with respect to public protection

The performance requirement for an off-gas system arises from the process being operated and the gaseous products that it emits. The demand for gaseous cleanup is determined by the limitations on discharging the contents of the off-gas stream to the environment. These limitations are related to legal requirements, regulatory controls and any local restrictions. These restrictions will vary around the world and a few are listed. See Table 1 [1].

In the SI system, a millisievert (mSv) is defined as “the average accumulated background radiation dose to an individual for 1 year, exclusive of radon.”

1 mSv is the dose produced by exposure to 1 milligray (mG) of radiation). The whole-body exposure threshold for acute

Table 1: Dose constraints and the sources to which they apply for several countries.

| Country | Dose constraint (mSv/a) | Source |
|--------------------------|-------------------------|-------------------------------|
| Argentina | 0.3 | Nuclear fuel cycle facilities |
| Belgium | 0.25 | Nuclear reactors |
| China | 0.25 | Nuclear power plants |
| Italy | 0.1 | Pressurized water reactors |
| Sweden | 0.1 | Nuclear fuel cycle facilities |
| Ukraine | 0.08 | Nuclear power reactors |
| Ukraine | 0.2 | Nuclear fuel cycle facilities |
| United Kingdom | 0.3 | Nuclear fuel cycle facilities |
| United States of America | 0.25 | Nuclear fuel cycle facilities |

hematopoietic syndrome or “radiation sickness” is 500 mGy. It should be noted that the IAEA Safety Guide WS-G-2.3 [1] (published in 2000) is currently under revision in order to take into account significant developments in radiation protection policies since the publication of the Safety Guide.

Over the last decade, there has been an increasing focus on the application of Best Available Techniques (BAT).

Within the context of IPPC, BAT is defined as follows:

- ‘Best’ in relation to techniques, means the most effective in achieving a high general level of protection of the environment as a whole;
- ‘Available techniques’ means those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions.
- ‘Techniques’ includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.

Dose assessments and discharge limits

In 2006, ICRP revised its recommendations on the assessment of doses to members of the public. In 2002, the EC published a report with a view of developing a common methodology on the harmonisation of approaches for assessing doses to members of the public [10]. The potential exposure pathways are listed below. Although gaseous waste can be directly inhaled, this is not the only possible pathway. The most significant pathway to humans varies for different groups of the population, hence the concept of the most critical group.

From the original cloud of contaminated air, the effluent can be deposited as: surface deposits on buildings and land which via run off to water bodies can end up in sand and sediment, aquatic plants, aquatic animals which then passes in to our food and drink and is ingested in to the body.

There can also be direct radiation from the Nuclear Facility, external radiation from surface deposits and clouds of contaminated air.

Examples of the setting of authorised limits

Examples of the setting of authorised limits for radioactive discharges by member states can be found in Regulatory Control of Radioactive Discharges to the Environment, IAEA Safety Series Guide No. WS-G-2.3 [1]. In the USA volatile gas emissions from a nuclear fuel recycle facility are addressed in several regulatory documents. The US Environmental

Protection Agency (EPA) has established annual dose limits resulting from nuclear fuel cycle facilities in the commercial sector [12].

Off-gas technology selection

The off-gas system should be designed to operate safely for the operators, co-located workers, the public and the environment, plus the system must be efficient and economically viable.

Gaseous waste

Gaseous waste is waste in its most mobile form and it is not feasible to store it as generated.

The off-gas treatment system must be designed to capture the gaseous contaminants with any secondary waste produced in a solid or liquid form that can be processed further for safe storage and disposal.

To design an appropriate off-gas system the following information relating to the off-gas stream must be known:

- Source of the waste;
- Type/mix of contaminants;
- Mass and concentrations of the contaminants;
- Quantity;
- Generation rates;
- Physical and chemical properties;
- Discharge limitations.

Many clean-up technologies depend upon residence time to achieve their effect. The off-gas treatment system designing is complicated by fact that each and every off-gas system is unique. This is because no gaseous waste streams are the same, as there are so many potential variables, the liquid and solid secondary waste forms can be different and the discharge limitations can also vary. Various types of constituents that may be present in a gaseous waste stream from a nuclear facility, eg:

- Aerosols;
- Radioiodine in NPPs (short lived);
- Radioiodine from reprocessing (long lived);
- Tritium;
- Noble gas control in NPPs;
- Noble gas control in reprocessing;
- Carbon-14;
- Semi-volatile radionuclides and other toxics;
- Toxic non-radioactive compounds.

Treatment of gaseous and airborne effluents

Operations involving radioactive material handling may generate airborne radioactive contamination. The basic difference between airborne effluents and radioactive waste in condensed (ie, liquid or solid) phases is that airborne material has no definite volume and its dispersion in the environment is rapid. Special technologies and equipment are therefore used for the localisation, collection and treatment of airborne effluents. Typical atmosphere airborne particulates and equipment generally used to remove them from air are shown in Table 2 [17].

Ventilation and air cleaning systems are a vital part of the general design of any nuclear facility. In nuclear facilities, in general, air streams from highly contaminated areas such as hot cells and process vessels are called off-

Table 2: Size distribution of airborne particulates and the most suitable purifying equipment.

| Particle Diameter μm | 10^{-3} | 10^{-2} | 10^{-1} | 1 | 10 | 10^2 | 10^3 | $4 \cdot 10^3$ |
|---------------------------------|----------------------|----------------|-----------|----------------------|----------------|-----------------------|-----------|----------------|
| | | | | Fumes | Dusts | Dusts/ | | |
| | Smoke | Smoke | Smoke | Smoke/Fog | Fog/Mist | Mist | Mist/Rain | Rain |
| | Permanent Impurities | Atmospheric | | Temporary Impurities | Atmospheric | Heavy Industrial Dust | | |
| | | | | Bacteria | | | | |
| | | | | | Plant Spores | | | |
| | Electrical Filters | Precipitation/ | Air | Air Filters | Dust Arrestors | Centrifugal Cleaners | | |

gas streams. Off-gas streams must be treated prior to mixing with the ventilation air for occupational and environmental safety reasons.

The general purposes of ventilation and air cleaning systems are:

- To control airborne contamination below safe working levels.
- To filter and monitor the air supply on a once-through basis.
- To maintain directional flow from the point of least contamination potential to the point of greatest contamination potential.
- To clean the exhaust air before discharge to the atmosphere.
- To monitor contaminants in the working areas and releases to the environment.

In nuclear facilities the ventilation and air cleaning systems are usually designed to serve for both normal and accidental conditions. The exhaust air is high efficiency particulate air (HEPA) filtered and, where appropriate, additional clean-up is provided. Typical containment and ventilation system components include: cells, caves, fume hoods, fume cupboards, glove boxes, filters, fans and dampers, all at negative pressure to avoid dispersion of radionuclides.

Treatment of off-gases from operating waste treatment systems is complex and expensive.

Table 3: illustrates the purification efficiency of typical aerosol removing equipment.

Table 3: Operational characteristics of typical aerosol removal equipment

| Type | Particle Size range μm | Gas Velocity, m/min | Pressure loss, mm of water column | Efficiency, % |
|--|-----------------------------------|---------------------|-----------------------------------|---------------|
| Wet Filters | 0.1-25 | 30 | 25-125 | 90-99 |
| HEPA (cellulose asbestos*) | <1 | 1.5 | 25-50 | 99.95-99.98 |
| HEPA (all-glass web) | <1 | 1.5 | 25-50 | 99.95-99.99 |
| Single-Stage electrostatic precipitators | <1 | 60-120 | 4-12 | 90-99 |

*Asbestos is now a banned substance.

For gaseous contaminants (eg, 14C oxides, iodine and noble gases), absorbers and scrubbing equipment can be used. Filtering systems may include several stages of filters, some of which may work at high temperatures (dry filters), others

(wet) filters can operate with aqueous solutions. Scrubbers and catalytic reactors can be used to remove sulphur and nitrogen oxides from gases. Coolers as well as dilution are used to decrease the temperature of off-gas streams and to facilitate removal of contaminants from gaseous streams (utilising condensation). The final step of gas cleaning involves HEPA filters (also termed absolute filters).

Spent fuel characteristics and challenge

Dissolution of spent fuel involves cropping the rods into short pieces and the cropping operation can be open to the cell or enclosed from it. The characteristic of the spent fuel depends principally upon the reactor and fuel type and the amount of burn-up. The radionuclides to be treated during reprocessing are reduced during the cooling period that the fuel spends in ponds at the reactor and/or reprocessing facility.

The radionuclide inventory of the fuel can have effects in the chemical treatment, such as the amount of heat emitted. This may affect the design of the equipment used in the facility and judicious choice of cooling period duration can have significant effect on the economics of the facility. After a cooling period of two to three years the majority of the short lived radionuclides will have decayed leaving the long life nuclides. The radionuclide inventory for light water reactors can be found in Reference [18] whereas calculated production rates for various types of reactors are given in references [19, 20].

Source terms

Off-gas treatment in a fuel reprocessing plant must address a number of gas streams containing iodine, among a number of volatile radionuclides and other flow streams;

- Dissolver off-gas (DOG);
- Vessel off-gas (VOG);
- Cell off-gas (COG);
- Waste off-gas (WOG).

The dissolver off-gas stream (DOG) stream is the off-gas from the head-end operations, which include the shear, the optional voloxidizer and the dissolver. The vessel off-gas stream (VOG) contains iodine and consists of process equipment off-gas (eg, the instrument air used in bubblers, air sparging discharges and in-leakage). The cell off-gas (COG) provides confinement to the process cell. The waste systems off-gas (WOG) originates from the operations which produce/solidify the solid waste forms. Each of these streams has unique characteristics and off-gas processing challenges.

An example of an off-gas system

There are many examples around the world of gaseous waste and off-gas systems operating successfully for a number of decades. One of those is the Thermal Oxide Reprocessing Plant (THORP) which is operating in the UK and the ventilation and off-gas systems of this plant demonstrate the complexity of designing off-gas systems. The ventilation and off-gas systems of THORP have been widely reported [28] and are as follows;

- Dissolver off-gas system (DOG);
- Vessel ventilation system (COG);
- Glove box extract system;
- C3 Extract system (Active maintenance areas);

- Building supply and extract systems.

The principle species to be treated in the THORP off-gas system are ^{129}I , CO , NO_x , fuel dust particles and aerosols containing plutonium and/or mixed fission products. THORP is designed on the principle of cascading depressions between areas to provide barriers against the spread of contamination. The main ventilation streams are kept separate until they enter the 125 m stack from which they are discharged into the atmosphere.

The prime task of the dissolver off-gas (DOG) system is to remove nitrogen oxides (NO_x) generated by the dissolution of the UO_2 fuel, together with the major volatile radioactive species released as the fuel is dissolved. The off-gas streams from different parts of the plant or from different types of equipment are combined into a series of "headers", which feed into the COG system at an appropriate point according to the type of decontamination required.

Overview of technology options

Table 4 gives a selection of treatment methods for gaseous and airborne waste [29].

Information and data on the components and elements of air cleaning and gas processing systems are the subject

Table 4: A selection of treatment methods for gaseous and airborne waste.

| Treatment Method | Features | Limitations | Secondary Waste |
|--|---|---|----------------------|
| HEPA High efficiency particulate filtration | Glass Fibre filter media, high efficiency 99,97%, widespread use, retention of sub-micron particles 0.3μ | Humidity control and prefilters required to protect HEPA filters | HEPA and prefilters |
| Sorption | Chemically impregnated charcoal or zeolites to remove inorganic and organic iodine in reactors. | Humidity control and charcoal has limited operating temperature. High cost. | Spent media |
| Cryogenic Trapping | Kr in offgases adsorbed on solid sorbent like charcoal. Operates at elevated pressure and reduced temperature. Kr can be recovered and sorbent used multiple times. | Further processing for storage is required. Commercial experience limited. | Spent sorption media |
| Delay / Decay | Used for decay of short lived noble gases | Large beds for retention time required | None |
| Wet Scrubbing | Scrubbing solution targets compounds and particulate matter. Used for process offgas treatment. Can be as simple as water or reagents targeting specific compounds | Not practical for high volume gaseous stream treatment | Liquid waste streams |

of a separate report. In addition to that the report covers:

- Fibrous filters, medium and high efficiency;
- Granular bed and sand filters;
- Iodine adsorbents;
- Modular iodine adsorbents;
- Monolithic iodine adsorbents;
- Mist eliminators, coalescers, etc.;
- Scrubbers and condensers;



- Cyclones;
- Electrostatic precipitators;
- Recombiners ($\text{H}_2\text{-O}_2$) and ($\text{NO}_x\text{-NH}_3$);
- Other considerations (fans, stacks, etc);
- System testing;
- New technologies.

References

References for this article are available from the editor, Glynnis Koch, at chemtech@crowm.co.za

Acknowledgement

This article is based on extracts taken from IAEA TECDOC No. 1744, IAEA, Vienna (2014): International Atomic Energy Agency, "Treatment of Radioactive Gaseous Waste" and is published here with the kind permission of the IAEA. For the complete publication, please see <http://www-pub.iaea.org/books/IAEABooks/10741/Treatment-of-Radioactive-Gaseous-Waste>. © IAEA

Systems for waste heat recovery improve commercial vehicles' CO₂ balance sheet



An example of a seal made of fluoro rubber.

Diesel engines in commercial vehicles today work extremely efficiently. For example, in long-haul trucks, it is possible to convert about 40% of the energy chemically bound up in the fuel into forward movement. A large portion of the currently-unusable energy escapes into the environment as exhaust heat. More and more manufacturers of commercial vehicles are working on new concepts, which convert some of the exhaust heat into kinetic energy. In this way, the fuel consumption of heavy trucks is expected to be cut by a minimum of 5%.

Freudenberg Sealing Technologies supports such developments with innovative sealing solutions.

The transformation of heat into mechanical energy is possible with the help of a thermodynamic process known as the Organic Rankine Cycle (ORC), named after the Scottish physicist William Rankine (1820-1872). This circulation process, so far used solely in industrial plants, works like this: A working fluid

is pumped from an accumulator into a heat exchanger along which hot exhaust gas is flowing. The fluid vaporises over the course of the process.

The steam is further heated, much as in a steam engine, to temperatures as high as 250° C. At the same time, the pressure rises as high as 40 bar. In an expansion engine, the pressure sets either a piston or a turbine into motion. This mechanical work can be passed directly on to the truck's driveshaft. Or, alternatively, a generator can be driven to produce electricity. The steam

is guided at reduced pressure into a condenser behind the expansion engine.

The condenser cools the working medium to the point that it is again fluid. As a result, fluid is not wasted – on the contrary, it is intended to flow in the circuit, as much as possible without leaks or need for maintenance. The sole purpose of the pressure-controlled accumulator tank is to make sufficient fluid available under all operating conditions.

High-tech seals are necessary to apply such concepts in the harsh conditions of heavy duty transport.

The manufacturers' minimum expectation for the system's lifespan is at least 6 million km. It is essential to seal the pipe connections between the condenser and the vaporiser as precisely as the inner workings of the pump, the valves and the expansion engine. The chemical composition of the working fluid represents a special challenge. There is no industry standard yet for the medium. But various scientific

investigations by German Research Association for Combustion Engines (FVV) and other organizations, show that ethanol would be a suitable fluid. This monohydric alcohol has a relatively low boiling point of 78° C in its favour, which means that it is possible to generate steam from exhaust heat without difficulty. At the same time, its freezing point, -115° C, is so low that it is impossible for the tank to freeze. In addition, ethanol, which is used in many cosmetic products, is non-toxic to human skin.

But ethanol poses a challenge to the elastomer seals that are traditionally used in vehicle manufacturing. Freudenberg Sealing Technologies has already developed ethanol-resistant seals. Seals made of fluoro rubber have already proven themselves in fuel-conducting components of the so-called flex-fuel engines. In systems with waste heat recovery, the material mixture must be adapted to the higher temperatures. Furthermore, systems that are designed to utilise hot air exhaust gases are installed near the engine in the tractor where the installation space is tight. Freudenberg Sealing Technologies now has such a sealing solution: its 'Plug & Seal' product.

In the future, whether in cars or heavy commercial vehicles, waste heat losses will not be a combustion waste product that at most helps to heat the interior. Instead, it will be a source of valuable mechanical or electrical energy.

For more information contact Ulrike Reich on tel: +49 (6201) 80-5713 or email: ulrike.reich@fst.com

Talbot & Talbot service offering grows

Talbot & Talbot is an industry leader in water and wastewater engineering, plant operations and maintenance, environmental laboratory testing and green energy solutions. The company prides itself in providing relevant and up-to-date services aligned to client needs.

In responding to the growing water risk on the continent and the associated operational, financial and legal implications to industry, Talbot & Talbot has launched a new business unit, Water Risk & Strategy (WRS). The launch of the new business unit sees Talbot & Talbot broaden its service offering and assure their clients of insight, innovation and quality.

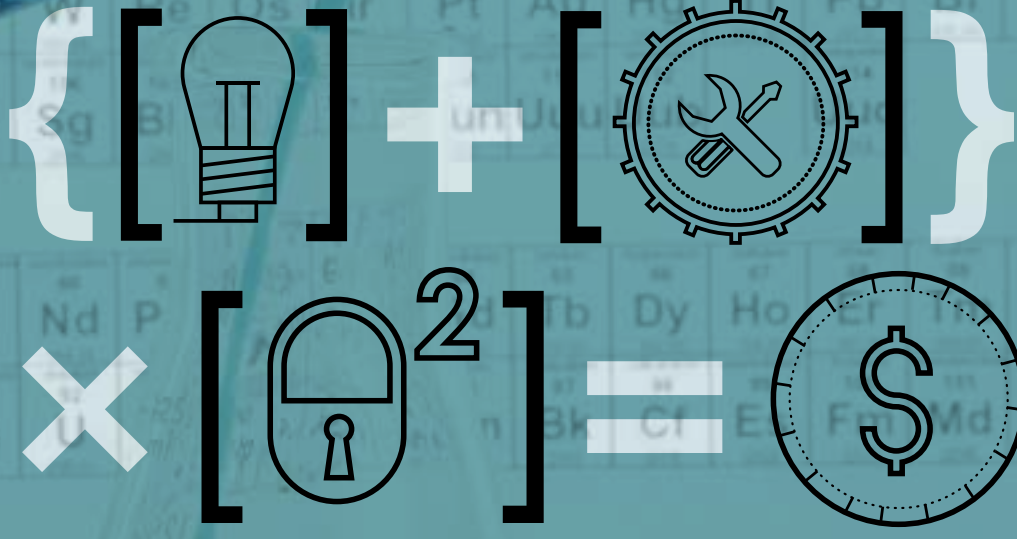
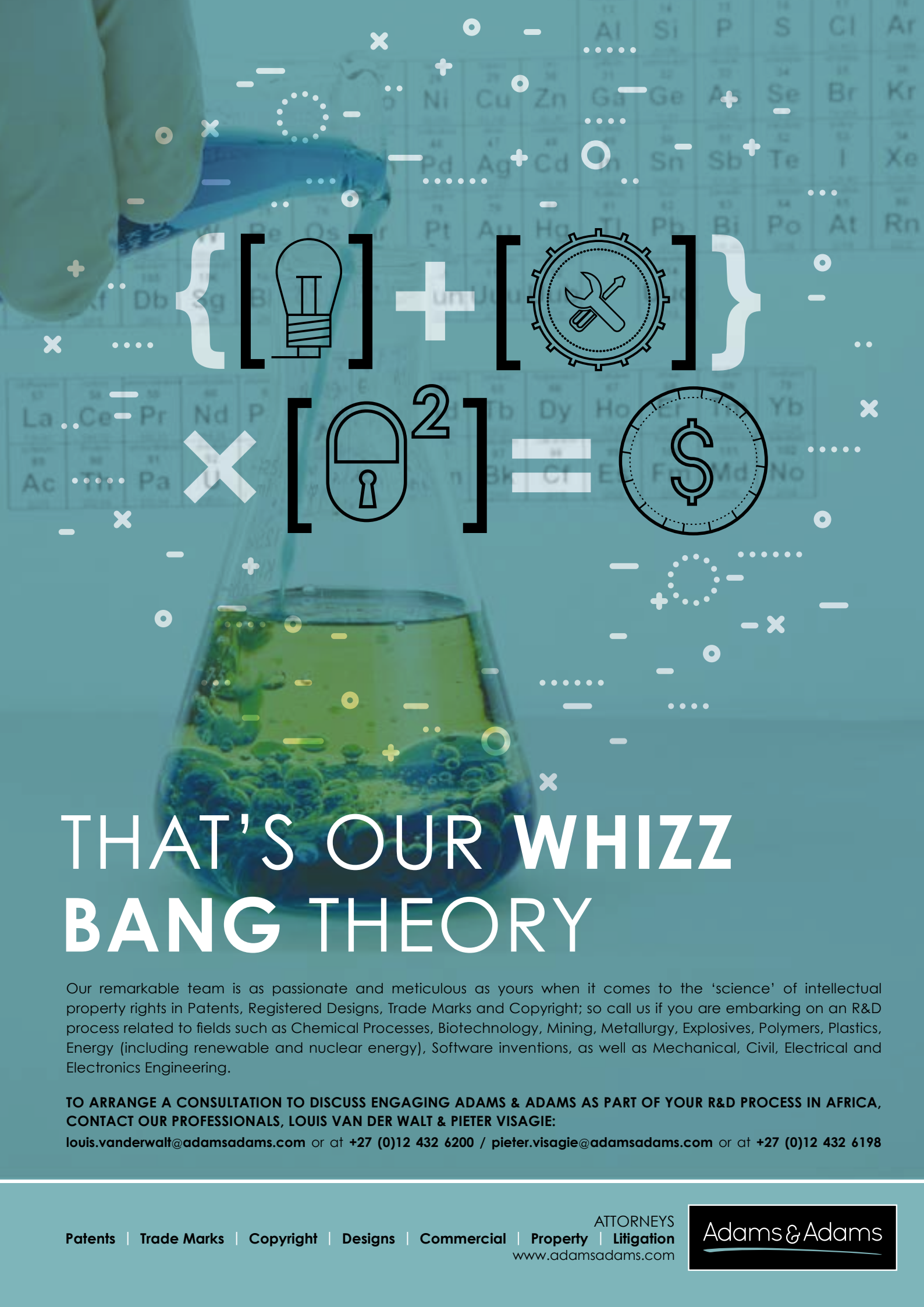
Primary services provided by WRS include:

- Water and wastewater balances
- Risk and opportunity profiling
- Scenario analysis and strategy development
- Reporting and analytics

The new business unit is led by Helen Hulett who has significant experience in the field of strategic water consulting, having developed water strategies for numerous blue chip clients nationally and internationally.

WRS forms part of Talbot & Talbot's integrated business units including Projects, Operations and Laboratories.

For more information tel: +27 33 346 1444 or email HelenH@talbot.co.za



THAT'S OUR WHIZZ BANG THEORY

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Waste management industry sees shift from landfilling to resource recovery



There has been an increased focus on resource recovery in Southern Africa's waste management landscape. Moving away from landfilling towards recycling, waste disposal alternatives and waste-to-energy initiatives, the industry at large is embarking on waste as a resource to ultimately lighten the load on the ever decreasing landfill airspace.

Resource recovery will be one of the main themes at the Institute of Waste Management of Southern Africa (IWMSA's) premier waste management conference, WasteCon 2016. Set to take place in Johannesburg from 17 to 21 October 2016, the conference and exhibition will delve into the many changes that the waste industry has witnessed over the past few years.

Jonathan Shamrock, Chairman of the WasteCon 2016 Organising Committee notes that the IWMSA, Southern Africa's waste management industry body, has over the course of its 40-year existence seen how practices have changed and ultimately helped divert waste from landfill sites. At WasteCon 2016, international and local experts will present on this shift seen in the industry.

"The conference will see papers presented on resource recovery, recycling, waste beneficiation as well as the waste economy, to name a few. Policy and legislative changes are also at the top of the agenda that will assist industry professionals to be compliant to the ever-changing waste management space," notes Shamrock.

Another vital element at the conference is the various workshops that will be presented, one of which is the Department of Environmental Affairs' Industry Waste Management Plans workshop.

Local and international waste management suppliers will also have the opportunity to exhibit their services and products to delegates and the general public.

"WasteCon 2016 is an important event on this year's environmental calendar. It will set the stage as to why waste should be seen as a resource rather than a burden," concludes Shamrock.

For more information about WasteCon2016 and to register, please visit www.wastecon.co.za.

Waste-to-Energy Middle East Conference to be held in November 2016 in Oman



The Waste to Energy Middle East Conference, supported by be'ah Oman, will be taking place from 29-30 November 2016 in Muscat, Oman, to network with regional decision makers representing Bee'ah Sharjah; be'ah Oman; Oman Power and Water Procurement Oman; Authority for Electricity Regulation Oman; Centre for Waste Management (TADWEER) Abu Dhabi, UAE; Ministry of Municipality & Environment Qatar, and many more.

The gulf region produces around 150 million tonnes of waste annually, with only 5% of it being recycled and vast quantities going to municipal dumps and landfill or, worse, being illegally dumped at unauthorised sites. This is a growing problem too, since the rapid urban expansion of Middle East (ME) countries means that their annual waste production rates are also on the rise.

For example, the UAE is expected to produce around 27% more solid waste

by 2017; an additional 6,6 million to 8,4 million tonnes, making 29 million tonnes in all. Even smaller ME nations still have big waste problems, as Oman produces around 1,8 million tonnes annually, a figure that has risen by 25% over the last decade due in large part to its growing population.

This waste is usually left to rot or burned in a manner that heavily contributes to air pollution. In order to address a problem that is causing such environmental damage while also eating into available land space, the respective Middle Eastern governments are set to radically change the way in which they manage waste by converting it to energy in specially designated facilities supported by cutting-edge technological innovations.

The Kabd WTE Project is presently underway, for example. Key stakeholders are Partnerships Technical Bureau (PTB). Kuwait produced 2,1 million tonnes of

solid waste in 2015 and is expected to produce 2,75 million tonnes by 2025. With only three operating landfill sites, the rising flow of solid waste is becoming increasingly difficult to manage. In response to this significant and growing issue, the Kuwaiti Government has tasked PTB with developing a construction agenda for a one million tonne capacity WTE plant that will be able to address up to 50% of the country's municipal solid waste. Once complete, the plant will be able to produce 650 Gigawatt hours per year as part of a design, build, operate, finance and transfer structure.

As a result of the utilisation of waste for energy generation, the country will be providing economic alternatives to natural gas as a fuel source, saving the subsidy that the government allocates on natural gas use, and tackling the issue of potable water capacity.

Visit www.wastetoenergyme.com

DST- CSIR Nanomaterials Industrial Development Facility (NIDF)

Call to industry, small, micro and medium enterprises (SMME's) and researchers in academia and science councils who need to scale up chemical processes that require an autoclave, process tanks and particle drying systems.

The Department of Science and Technology (DST) and CSIR Nanomaterials Industrial Development Facility (NIDF) is inviting applications for industry-led projects that require the use of the scale-up facility in order to accelerate the development and commercialisation of chemical and nano-based technologies. Officially launched in December 2015 by the Honourable Minister of Science and Technology, Mrs Naledi Pandor, the DST-CSIR NIDF was set up to bridge the gap between bench-scale developments and industry. The CSIR's scale-up facility which was established within the DST-CSIR National Centre for Nano structured Materials will support projects by offering:

- Flexible and multi-purpose scale-up plant equipped with autoclave reactors, filter press, wet mill, process tanks, rotary dryer, bag house and so forth;
- Access to skilled workforce with the right technological expertise (scientists and engineers trained and experienced in process development and scale up);
- Technical support with well-equipped workshop; and
- State-of-the-art equipment to characterise products during scale up for rapid process optimisation and quality assurance analysis.

We invite applications from industry, entrepreneurs and public institutions, and the following aspects need to be addressed in the proposal:

- The goal of the project;
- Clear understanding of the market need being addressed, industry dynamics and description of the competitive environment;
- Technology description including key features and competitive advantage;
- Cost benefit analysis (budgets, resource requirements, capital budgeting analysis); and
- Project time frame.

It should be noted that successful applicants will not receive any funding through this process. Furthermore, resources allocated to projects will be agreed during the selection process.

APPLICATION DUE DATE:

A fully completed and signed proposal must be submitted to the NIDF (nidf@csir.co.za) not later than **30 October 2016**. Please limit proposal length to not more than 5 pages. All submissions will be treated as strictly confidential.

Please direct all queries to:

Dr Manfred Scriba (Program Manager: 0128414738, mrscriba@csir.co.za) and
Dr Mike Masukume (Nanostructure Scale-up Facility Manager: 0128414269, mmasukume@csir.co.za)



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Pressure relief device monitoring

How to detect releases, leaking and fugitive emissions

Every country has regulations to protect industrial plants and facilities against overpressure in various processes and operations. In the US, the American National Standards Institute (ANSI), the American Society of Mechanical Engineers (ASME) and the American Petroleum Institute (API) provide detailed information on best practices for overpressure protection.

‘Pressure Relief Device (PRD) Monitoring with WirelessHART® sensors: How to comply with environmental regulations and detect PRD malfunctions while minimising costs and cutting operating expenses’ is focused on PRDs and, in this article, we shall discuss the various types available, and the rules and regulations covering them.

Insurance companies and government agencies rely on the observance of these regulations to determine if designs are correct, and if operations are being conducted correctly. A new EPA regulation, issued in September 2015, requires better monitoring of pressure relief devices (PRDs) and bypass valves.

Pressure relief devices

The purpose of a process plant control system is to keep process variables at the desired operating point and within safety limits. PRDs can be Pressure Relief Valves (PRVs), Pressure Safety Valves (PSVs) and/or Rupture Discs (RD). They activate when the pressure gets too close to the Maximum Allowable Working Pressure (MAWP) of the vessel or process component.

Excessive pressure in the pressurised system is relieved by blowing process fluid (gas or liquid) to the environment, or to a closed recovery system.

Flare systems are the most commonly used method of

neutralising hazardous discharges, but are not perfect.

The term PRV or relief valve (RV) is generically used for both PRVs and PSVs; however, these two devices have different working principles.

A short explanation on the operating principles of each follows below.

PRV basic operating principles

PRVs are safety devices protecting a vessel against overpressure. Figure 1-1 shows a typical spring-loaded PRV. The disc between the process side (inlet piping) and the discharge side (discharge piping) is pushed against the seat by a compression spring. The spring force determines the PRV set-pressure and it is adjusted by the compression nut during calibration and certification.

When the process pressure exceeds the valve set pressure, the disc pushes the spring, opening the valve and forcing the process fluid to the discharge pipe. The valve will remain open until the process pressure drops approximately below 95% of set pressure. The ~5% dead-band, also known as ‘valve blow down’, prevents the valve from chattering when the process pressure varies close to the valve setpoint.

In the relief valve calculation, it is necessary to take into account the pressure on the discharge side. Sometimes

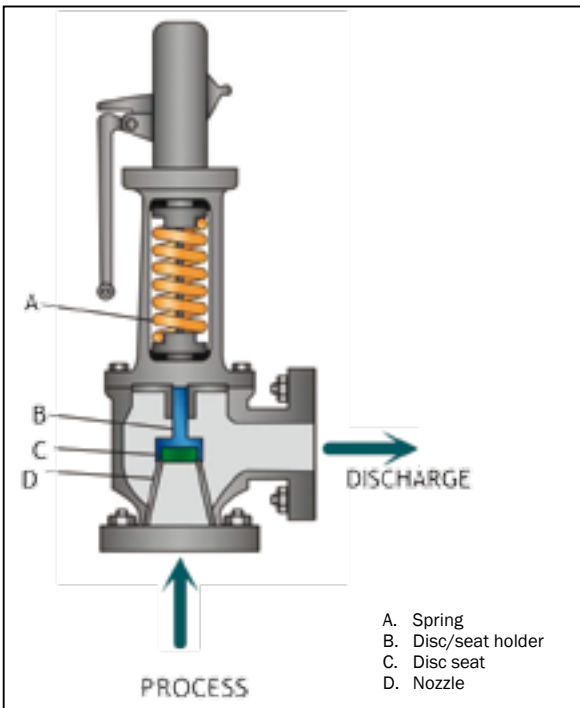


Figure 1-1: Pressure relief valve

there is a back pressure buildup caused by relief of other PRDs in the discharge header in the enclosed recovery system.

When things don't work as expected

Many times, when the process pressure returns to normal conditions, the PRV does not close completely. There are several reasons for this:

- Pressure increase on the discharge side
- Valve seat damaged after repeated actuations
- Deposition or formation of solids between the disc and the seat
- Altered process fluid
- Corrosion
- Mechanical malfunction.

Even a small leakage (0,1% from the PRV flow area) can cause losses of tens of thousands of dollars per year. Additionally, the leakage can cause significant emissions' violations, resulting in expensive fines and even required shutdowns.

Table 1-1: Example of petrochemical leakage loss costs

| Gas type | Gas per metric ton (\$) ⁽¹⁾ | Process pressure (psig) ⁽²⁾ | Leakage yearly losses (\$) |
|----------|--|--|----------------------------|
| Ethylene | 1,044 | 250 @ 212 °F | 740,000 |
| Ammonia | 500 | 250 @ -28 °F | 335,000 |
| Steam | 22 | 250 @ 400 °F | 7,800 |

1. July, 2015 Platts Global Petrochemical Prices.

2. Relief valve set pressure - 300 psig and ASME orifice type "G".

Pressure safety valves

This device is commonly known as a 'Pop Valve' because it opens completely and rapidly when the pressure exceeds the setpoint. The valve will remain open until the process pressure drops to approximately 95% of set pressure. These valves are mostly used for gas and steam.

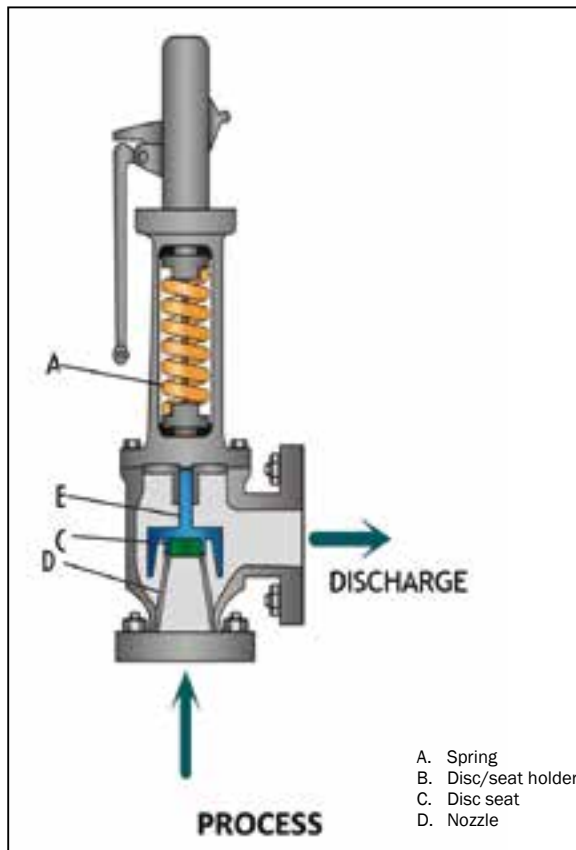


Figure 1-2: Pressure safety valve

PSVs are slightly different from PRVs. The disc blocking the nozzle has a small area and is contained in a larger diameter chamber. When the pressure exceeds the setpoint, the stem starts to lift, allowing the process fluid to flow to the chamber.

Rupture discs

Rupture discs (Figure 1-3) are safety devices for one time use. They consist of a membrane that bursts when the differential pressure between its two sides exceeds a set value. These devices are used alone or in combination with a PRV, providing a physical isolation layer between the process and the relief valve, especially on processes containing highly corrosive fluid. Some models are equipped with a sensor that indicates when the diaphragm is broken.

Rupture discs are very simple devices, with no moving parts. Unlike pressure relief or safety valves, the rupture disc will remain open until the ruptured diaphragm is replaced. Diaphragms are less susceptible to causing fugitive emis-

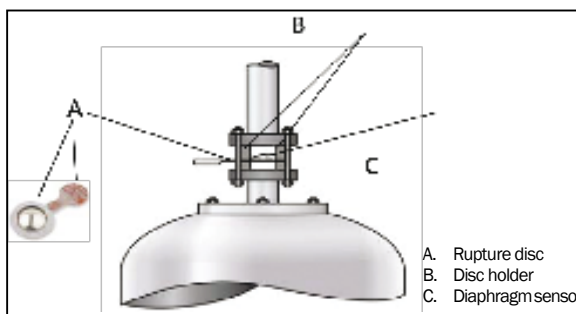


Figure 1-3: Rupture disc

sions, but there is always the possibility of pitting corrosion which creates pinholes, leading to undetectable leakage.

PRD bypass

Safety devices require shutoff valves and a bypass valve as shown in Figure 1-4. These valves are used for device maintenance and special process conditions. If a rupture disc diaphragm has to be replaced, for example, the

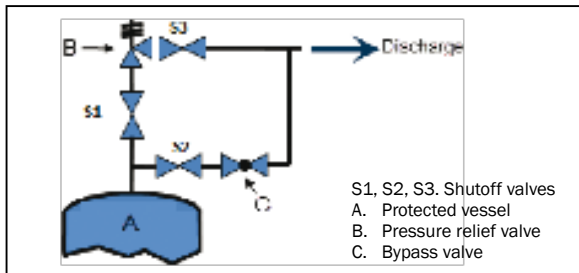


Figure 1-4: Pressure relief valve bypass

device has to be isolated using these valves. In some cases such as during startup, shutdowns, tests or load changes, it may be necessary to bypass the PRD.

It is not uncommon for plant personnel to forget and leave these valves in the open position or not close them properly, causing process fluid losses and emissions that can go undetected for a long time. Monitoring bypass valve position enables quick response to human error or defective equipment.

RV with rupture disc

In some applications, it is necessary to use a rupture disc installed upstream from the RV (Figure 1-5). The main reasons for this are:

- The rupture disc can prevent fugitive emissions through the RV.
- The rupture disc protects the RV against corrosive process fluids. The RV may not be available with the material required for long term resistance to the process fluids, or it may be too expensive. The rupture disc diaphragm works as a shield between the process and the relief valve.
- The rupture disc protects the RV against solid particles. These particles can damage or prevent the RV from working properly, failing to open, or remaining open after a release.

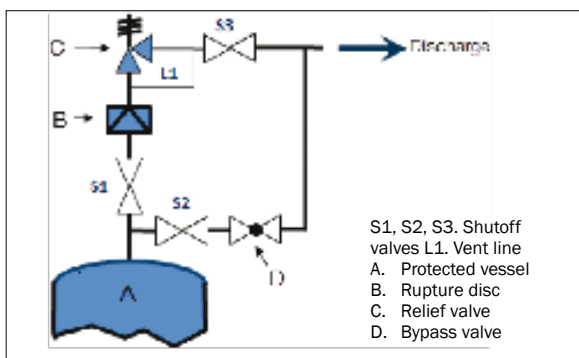


Figure 1-5: Typical installation schematic for an RV with rupture disc

- The rupture disc protects the RV against frozen vapours, material polymerisation, hydrate formation, or other problems that may prevent it from working properly.

EPA regulations

Many environmental protection agencies worldwide have been tightening regulations on hazardous material emissions. In the US, for example, the EPA has been issuing new and tighter regulations for several types of industries, ranging from food and beverage to nuclear power plants. The more stringent rules established by EPA and other environmental agencies can be generalised with three simple requirements:

1. Provide indication and location where a PRD event occurs through electronic monitoring.
2. Measure the time and duration of the PRD event for recording and reporting.
3. Notify the operator of the event so corrective action can occur.

There is another very compelling reason to monitor and curb fugitive emissions: leakages caused by PRD malfunctions can waste large amounts of valuable product, along with the energy required to produce these products.

Regulation details

Every national and international government has its own rules to control and monitor emissions of pollutants.

Amongst other things:

1. More stringent operating requirements for flare control to ensure good combustion. This is achieved, but not restricted, by:
 - Measuring and monitoring the flow of waste gas going to the flare;
 - Measuring and monitoring the content of the waste gas going to the flare;
 - Measuring and monitoring any air or steam added into the flare;
2. Emission control requirements for storage tanks, flares and delayed coking units at petroleum refineries;
3. Pollutant monitoring around the plant fence line as a development in practices for managing emissions of toxic pollutants from fugitive sources;
4. Elimination of exemptions during periods of startup, shutdown and malfunction.

An effective way to monitor PRD activation and leakage

A very reliable, effective and economic way to monitor PRDs is to use wireless acoustic transmitters. Process fluid flowing through valves and orifices generates acoustic waves in a wide and complex range of frequencies and magnitudes. Acoustic transmitters are able to detect ultrasound acoustic waves in the pipe wall as well as its temperature.

Relief valve monitoring

Acoustic wireless transmitters should be installed downstream of the relief valve (RV), as close as possible to the valve. RVs are usually installed with shutoff and bypass valves for maintenance and special operating conditions. Bypass valves may be inadvertently left open or not closed

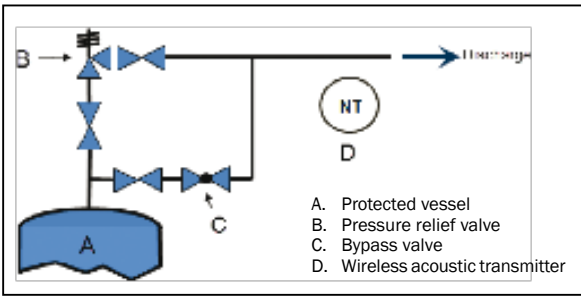


Figure 1-11: Wireless acoustic transmitter should be installed downstream, close to valve

completely, causing unexpected flow to the recovery system.

The wireless acoustic transmitter installed as indicated in Figure 1-11 (of the original paper) monitors not only discharges or leakages of the relief valve, but can also monitor flow through the bypass valve.

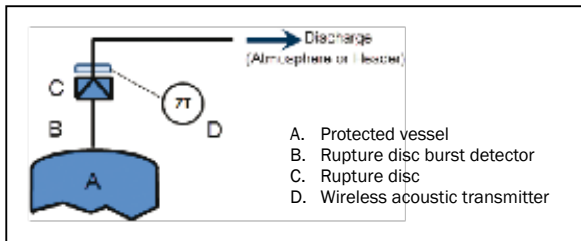


Figure 1-12: Rupture Disc Monitoring with Burst Detectors and Wireless Discrete Transmitter

Rupture disc monitoring

Some types of rupture discs are equipped with a burst detector that generates a discrete signal indicating disc rupture. There are also devices that can be installed on the rupture disc surface that can detect when the disc ruptures and indicate the event through a discrete signal.

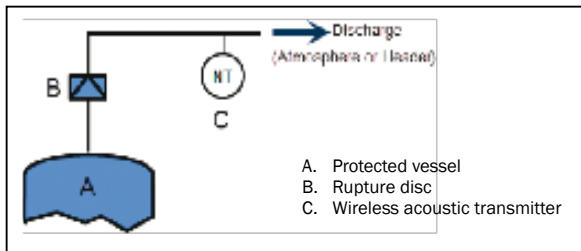


Figure 1-13: Rupture disc monitoring with an acoustic wireless transmitter

A more effective way to monitor rupture discs

Rupture discs can be better monitored with the use of a wireless acoustic transmitter as indicated in Figure 1-13. The transmitter can detect when the disc ruptured and the duration of the discharge, as it does for relief valves, but it may also detect even small leaks caused by pinholes.

Monitoring a combination

As discussed before, rupture discs are one-time devices. Once they burst, they cannot close again, so the process fluid will be discharged until there is not enough pressure to make it flow. RVs are a better solution, as they close when

the process pressure returns to normal conditions. However, in some applications, they must be isolated from harsh process conditions by using rupture discs. In normal operation, the relief valve is not in contact with corrosive, gumming or hot process fluids. If the vessel pressure reaches unsafe values, the rupture disc bursts, followed by the RV opening. The RV closes when the pressure returns to safe values.

A wireless acoustic transmitter installed downstream of the RV, as shown in Figure 1-14, provides dependable information about RV releases.

Please note: The rupture disk does not need to be replaced immediately after bursting, because the wireless acoustic transmitter is still monitoring pressure releases.

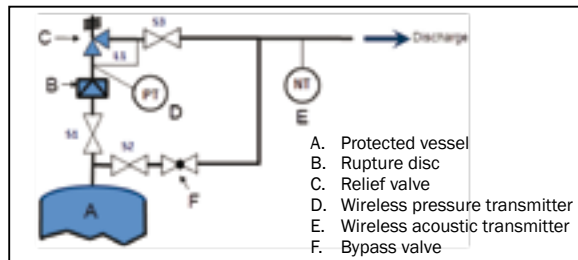


Figure 1-14: Monitoring a combination of relief valves with rupture discs

Wireless transmitters

The wireless devices mentioned in this article utilise WirelessHART technology. WirelessHART is an open standard that provides secure, reliable and flexible wireless communication. The devices form a self-organising, self-healing mesh network, with redundant communication paths.

Conclusion

Pressure Relief Device monitoring is necessary for environmental protection compliance and can avoid expensive fines, and possible process unit or plant shutdowns. Monitoring also prevents waste of costly material and energy, avoids bad publicity and helps improve plant personnel and neighboring communities' health.

Table 1-2. Total cost comparison

| Total cost of implementation ⁽¹⁾ 200 x PRDs | | |
|--|--------------------|--|
| | Traditional method | Pervasive Sensing™ Solution ⁽²⁾ |
| Total project cost (\$K) | \$3,520 | \$464 – \$1,088 |
| Total cost per PRD (\$K) | \$18 | \$2.3 – \$5.4 |
| Savings | N/A | 69% – 87% |
| Field installation | Intrusive | Non-intrusive |
| Cabling and trenches required | Yes | No |
| Technology | Wired | Wireless |
| Total compliance and operational improvement at fraction of the cost of traditional method | | |

1. Total costs include monitoring of the wireless system, tamper-proof secure data, and engineered services.

2. Cost range dependent on application: PRV only or PRV with rupture disc monitoring.

For more information, go to

www.emersonprocess.com/PRDWirelessMonitoring

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| 8 × univ. input, Ethernet + USB | R20187 | R19379 | R18774 |
| 4 × univ. input, + RS232/485 + Ethernet + USB | R18556 | R17814 | R17257 |
| Mathematics package, 4 × universal input, Ethernet + USB | R21828 | R20955 | R20300 |

*Refer to website for sales and supply conditions.



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Rio-Carb supplies total wear solution for chrome mine



This specific chute is critical in the mine's operation.

Chromium Carbide (CrC) liner expert Rio-Carb has provided a total wear solution for a chute project for a major chrome mine in the Rustenburg area in North West Province. This represents the first time that the company's chromium and manganese impact liner plates have been applied to the chrome mining sector.

The OEM applied its extensive expertise in an array of mining applications and sectors in order to offer its client a cost-effective solution for its C22 Head Chute, located on the head gear. "The conveyor belt conveys the ore onto the top of the head, from where it is offloaded onto the screens and crushers and processed into fines material," explains Technical Sales Consultant Karel Lewis.

The impact of the ore on the C22 Head Chute resulted in significant wear and abrasion, which meant it had to be refurbished. "This specific chute is critical in the mine's production process, as it conveys all of the run-of-mine (ROM) material. Hence there is a lot of impact," Lewis stresses.

He explains that the chrome mine had used standard 400 liner plates on this application-critical chute in the past. The traditional liners only lasted 12 to 18 months, whereas the total wear solution from Rio-Carb means that the new liners now have a minimum lifespan of five to six years.

"Due to the long-standing relationship we have with this client, we suggested a combination of our CrC liners and Impact plate as part of a total wear solution for this application," Lewis elaborates.

The C22 Head Chute is 1 m by 1 m, with a total height of about 8 m. The high abrasion rate of the ROM material meant that dead boxes had to be built in to reduce the impact. "Our total wear solution comprised a mild steel casing on the outside of the chute, with the liner plates fitted on the inside. We constructed this in our Alberton manufacturing facility as per the amended drawings, with delivery by end April. It has been installed and implemented, and is running 100%," Lewis reveals.

For more information contact Karel Lewis on tel: +27 11 908 1014; Email: info@riocarb.co.za or go to www.riocarb.com

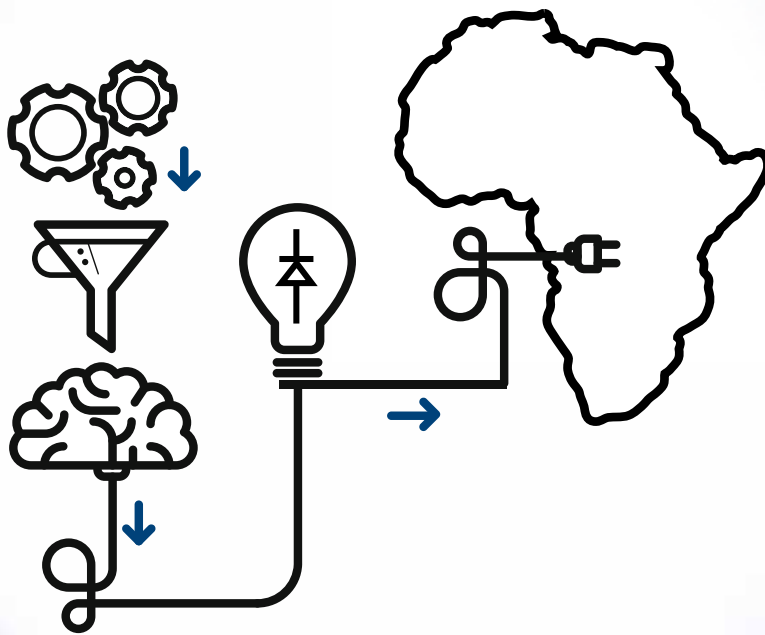


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Zooming in on leaky pipes saves a flood of problems

A pipeline assessment tool capable of pinpointing leaks and imperfections in water networks is helping to locate weak spots before they become costly pipe bursts. P-CAT is a condition assessment technology that allows pipeline owners and operators to accurately identify defects and develop cost effective solutions.

It was developed by researchers from the University of Adelaide in South Australia and commercialised by water management company Detection Services. P-CAT co-developer Martin Lambert said the technology was able to detect leaks, pipeline weak spots and blockages.

“What we are doing is using little pressure waves in a pipe and essentially we look at the reflection,” he said. “The wave travels down the pipe and when it hits a change in the pipe – a leak, a change in the wall thickness or a deteriorated section of the wall – it sends a reflection back to the sensors and you can tell where the defect is.

“It works a bit like a radar system at an airport where a radar pulse hits a plane and then comes back with a reflection. Then it’s a matter of determining or understanding what you are getting back.”

The technology creates a controlled water hammer event where a small pressure transient is directed into the pipeline and is able to run for up to 2 km. Sensor fittings are placed along the pipeline about every kilometre, which records the reflection of the wave as it passes each fitting.

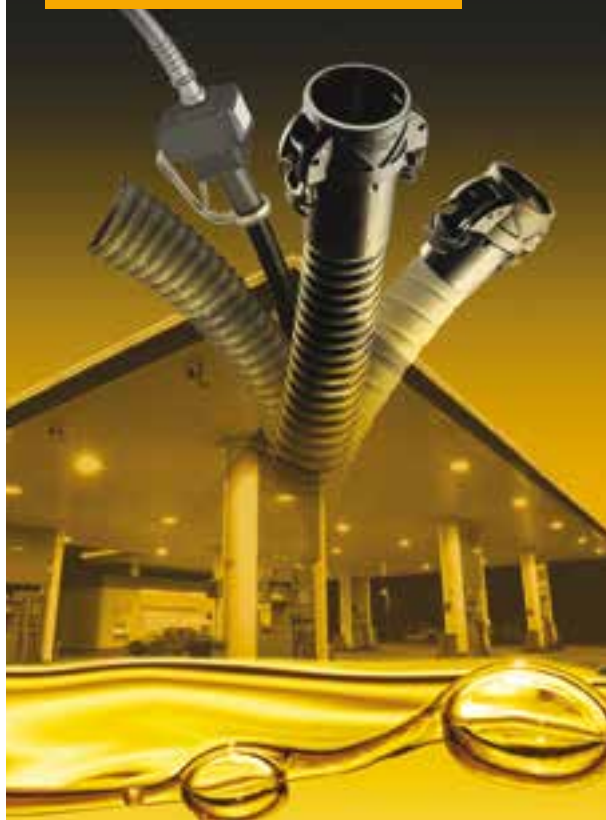
The wave speed slows down when sections of the pipeline are corroded or the wall thickness is reduced – it is able to determine and analyse the change in thickness down to about 0,2 mm.

P-CAT breaks up the data collection phase into multiple short stages to retrieve highly accurate information and collates a total of about 3-5 km of data per day. The results are then analysed and the identity of faulty sections of pipeline are determined.

Business Development Manager Kevin Jamie said P-CAT could save clients millions in replacement costs. “The primary benefit of P-CAT is determining pipe wall thickness,” he said. “It is a very common practice worldwide for water utilities that pipes have an internal cement lining – an erosion prevention lining – we will determine if there are any air or gas pockets in the internal lining. That’s important because an air pocket is not only a partial blockage or restriction, but you will find air or gas pockets will increase the corrosion rates. We could save clients replacing the whole pipeline, when they actually only need to replace a small section of it.”

For more information contact Robyn Mills, Media and Communications Officer, University of Adelaide, on tel: +61 8 8313 6341; email robyn.mills@adelaide.edu.au or go to www.adelaide.edu.au

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Using nature's own solvents for the preparation of pure lignin

Lignin can now be efficiently and cost-effectively separated from sawdust, by using eutectic solvents. VTT Technical Research Centre of Finland has developed solvents using which 50% of the lignin from wood can be extracted in a pure form that retains its natural chemical structure during processing. Using eutectic solvents, it may be possible to produce materials for use in the forest, food processing, pharmaceutical, packaging and mining industries in the future.

The use of eutectic solvents presents a range of opportunities for using lignin in industrial applications. A VTT research programme aims to replace petroleum-based chemicals with cost-effective, environmentally friendly alternatives in forest, pharmaceutical and mining industry applications; these will provide Finnish companies with a competitive edge on the international markets.

One of the key results of the research is the separation of lignin from sawdust in such a manner that up to 100% of the lignin maintains its natural chemical structure.

Conventional processes provide lignin in a form which is much less usable in terms of its chemistry. This is why lignin has mainly been used for combustion in energy production. Lignin which has retained its natural organic structure is thought to be more reactive and homogeneous, and therefore easier to use in various applications. The research findings were recently published in the journal, *Scientific Reports* (Jaakko Hiltunen *et al.*) *Scientific Reports*, 2016, 6, Article number: 32420; DOI: 10.1038/srep32420).

VTT's research is also opening up new opportunities to use enzymes in fractionation and metabolising processes – according to the preliminary results, carbohydrate-metabolising enzymes can maintain their stability surprisingly well in certain DES solvents, whereas enzymes have tended to be relatively unstable in new biomass-degrading solvents, such as ionic liquids, which resemble DES solvents in many of their properties. The research findings were published this year in the *RSC Advances journal* (Ronny Wahlström *et al.* *RSC Adv.*, 2016, 6, 68100-68110; DOI: 10.1039/C6RA11719H).

Some components of eutectic solvents are fit for consumption. Interactions between the components enable chemical

reactions that would be impossible to create with conventional chemical processes.

Eutectic solvents are prepared simply by heating and stirring and are inexpensive compared to conventional ionic solvents. However, their recoverability and recyclability via industrial processes have to be investigated in each case.



For more information contact the Technical Research Centre of Finland, Jarmo Ropponen, Principal Scientist at jarmo.ropponen@vtt.fi, tel. +358 400215951;

Innovative passively cooled instrumentation shelters



At ADIPEC 2016, taking place in Abu Dhabi at the National Exhibition Centre from 7-10 November 2016, Intertec is exhibiting an innovative approach to housing remote instrumentation and communications equipment in harsh environments, in the form of a passively cooled walk-in shelter.

The shelter can greatly reduce the problems of installing equipment in remote locations, where reliable power is unavailable, and where dust and sand in the atmosphere can make it difficult to cool electronics equipment using conventional air conditioning systems.

Another major element of the shelter's performance is its construction from GRP (glass reinforced polyester) panels employing a composite 'sandwich' construction to provide a very high degree of insulation, plus surface protection that can survive the extreme challenges of the Middle East environment, including very high levels of UV and dust and sand abrasion. GRP is an inherently inert material that is virtually immune to corrosion and atmospheric pollutants. It is also resistant to a wide range of petrochemical media.

Intertec's shelter employs a highly efficient passive cooling system that exploits the energy storage capacity of water, which circulates by natural convection. This passive, unpowered system can be boosted by a small externally-mounted electrical cooler driven by solar panels to optimise performance on hot sunny days. Using this and other hybrid techniques, Intertec is able to provide

passively-cooled shelter solutions that are able to operate in equatorial regions, as well as the arid climates in which they are widely used today.

The high levels of insulation of Intertec's shelters can substantially reduce the total cooling power required compared with insulated steel shelters, and provide highly stable operating environments for sensitive equipment such as analysers. Intertec's composite GRP sandwich panels include thick polyurethane insulation layers, which are bonded inside GRP sheets. This style of fabrication and assembly eliminates the 'thermal short cuts' between shelter interior and exterior that can result from the fixings that are often used with traditional insulated metal constructions. Such conductive points often account for the majority of thermal losses: around 75% or more of the shelter totals in many instances. Intertec's multi-function composite material also ensures that the internal walls are smooth and stable, making it simple to mount the equipment.

For more information go to www.intertec.info

Flash of brilliance: CALIPSO satellite marks 'First Light'

CALIPSO is a joint NASA and CNES earth observation environmental satellite, built in the Cannes Mandelieu Space Centre, which was launched atop a Delta II rocket on April 28, 2006. Its speed on orbit was 7,51 km/s.

In an event known as "First Light," the satellite, whose name stands for Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation, began collecting lidar measurements of the vertical structure and properties of Earth's clouds and atmospheric aerosols.

Those aerosols are made up of things like dust, sea salt, ash and soot.

On its first day of operation, CALIPSO observed the layers of clouds and aerosols in an orbit over eastern Asia, Indonesia and Australia.

Since then, CALIPSO has used its lasers to take more than 5.7 billion lidar measurements. Here are just a few of the ways it has added to our understanding of atmospheric science:

- During NASA's Tropical Composition, Cloud and Climate Coupling mission in 2007, CALIPSO helped visualise the lifecycle of cirrus clouds that flow out of the tops of storm systems that form over warm tropical oceans.



CALIPSO has provided images of the vertical distribution of clouds in tropical cyclones — like Typhoon Choi-Wan, which formed in the Pacific Ocean in 2009

- In spring of 2010, CALIPSO gave researchers an unprecedented look at the enormous plume of ash, smoke and steam that belched forth from Iceland's Eyjafjallajökull volcano and brought air traffic over the Atlantic and parts of Europe to a grinding halt. (See above.)
- CALIPSO has also helped researchers quantify in three dimensions the way in which the strong winds that sweep through the Sahara Desert carry dust

across the Atlantic to the Amazon rain forest of South America.

"CALIPSO has been an extraordinarily successful mission," said project scientist Chip Trepte of NASA's Langley Research Centre in Hampton, Virginia. "It's transformed our understanding of clouds and given us tremendous insight into their vertical structure and where in the atmosphere they form."

CALIPSO is a joint venture between NASA and the French Centre National d'Etudes Spatiales, or CNES.

For more information contact Joe Atkinson, NASA Langley Research Centre, at larc-dl-public-inquiries@mail.nasa.gov

New class of fuel cells offer increased flexibility, lower cost

A new class of fuel cells based on a newly discovered polymer-based material could bridge the gap between the operating temperature ranges of two existing types of polymer fuel cells, a breakthrough with the potential to accelerate the commercialisation of low-cost fuel cells for automotive and stationary applications.

A Los Alamos National Laboratory team, in collaboration with Yoong-Kee Choe at the National Institute of Advanced Industrial Science and Technology in Japan and Cy Fujimoto of Sandia National Laboratories, has discovered that fuel cells made from phosphate-quaternary ammonium ion-pair can be operated between 80-200° C with and without water, enhancing the fuel cells' usability in a range of conditions.

The research is published in the journal *Nature Energy*. "Polymer-based fuel cells are regarded as the key technology of the future for both vehicle and stationary energy systems," said Yu Seung Kim, the project leader at Los Alamos. "There's a huge benefit to running fuel cells at the

widest possible operating temperature with water tolerance. But current fuel-cell vehicles need humidified inlet streams and large radiators to dissipate waste heat, which can increase the fuel-cell system cost substantially, so people have looked for materials that can conduct protons under flexible operating conditions. It is very exciting that we have now found such materials."

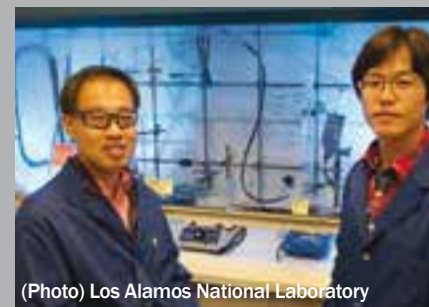
Los Alamos has been a leader in fuel-cell research since the 1970s. Fuel cell technologies can significantly benefit the nation's energy security, the environment and economy through reduced oil consumption, greenhouse gas emissions, and air pollution. The current research work supports the Laboratory's missions related to energy security and materials for the future.

The Los Alamos team collaborated with Fujimoto at Sandia to prepare quaternary ammonium functionalised polymers. The prototype fuel cells made from the ion-pair-coordinated membrane demonstrated ex-

cellent fuel-cell performance and durability at 80-200° C, which is unattainable with existing fuel cell technology.

What's next? "The performance and durability of this new class of fuel cells could even be further improved by high-performing electrode materials," said Kim, citing an advance expected within five to ten years that is another critical step to replace current low-temperature fuel cells used in vehicle and stationary applications.

For more information go to <http://www.electric-vehiclesresearch.com/articles/9869/new-class-of-fuel-cells-offer-increased-flexibility-lower-cost>



(Photo) Los Alamos National Laboratory



Solar cars cross the finish line as records tumble

The V&A Waterfront in Cape Town was the scene of celebration on the 1st of October 2016 as 11 teams from all over the world crossed the finish line after successfully driving just over 27 000 km collectively on public roads on solar power alone.

Dutch team Nuon won the Challenger class after completing 4 716 km, breaking the four-year old record of 4 630 km and beating Japanese team Tokai by 172 km. “We’re really excited – we already started celebrating in traffic as we came into Cape Town when we suddenly realised that we’d won. The team that is here has been working on the car for years, so they were very emotional,” said Sarah Bennink Bolt from the Nuon team.

The Dutch team had to have a perfect day today to stay ahead of strong competitor Tokai, who set the record in 2012 and won the World Solar Challenge on numerous occasions in the past.

“Tokai was really good last year in Australia at the World Solar Challenge, and while a lot of people thought we were a shoe-in for the Sasol Solar Challenge in South Africa, it wasn’t obvious

to us,” continued Bennink Bolt. “We had to work incredibly hard to beat them – they came out strong this year.”

With new regulations set for the global competition, all the teams will use the South African event to build completely new vehicles for the 2017 challenge in Australia, which is shorter than the Sasol Solar Challenge.

In South Africa, five teams held their own against the tough international competition. North-West University came in fourth position with 3 524 km under their belt, and high school team Maragon Olympus managed to beat the University of Johannesburg by just 40 km.

“We are very proud of the fact that Sirius x25, the NWU solar car, travelled through the whole of South Africa without ever once being put on a trailer,” said Jimmy Pressly from the NWU team. “The competition was great, and representing South Africa like this was a privilege. We plan on keeping the flag flying high by competing in the Bridgestone World Solar Challenge in 2017 with a brand new, better car.”

North-West University had to work hard to come back from an accident

during track testing just before the Challenge began. But the 28-member team worked long hours, beating two international and four South African teams on the event.

Another incredible achievement on the 2016 Sasol Solar Challenge was celebrated when high school team Maragon Olympus crossed the finish line in seventh place narrowly beating the University of Johannesburg.

For the Sasol Solar Challenge, a new record has been set, and teams are already planning their return in 2018 to improve on today’s achievement.

The Sasol Solar Challenge director, Winstone Jordaan, said that this has been the most competitive event to date.

The 2016 Sasol Solar Challenge is sponsored by Sasol as a vehicle of inspiration to young South Africans to become the country’s future engineers and scientists.

For more information contact Anzet du Plessis on tel: 0835572322; or email Anzet@proofafrica.co.za

Sanitary drum tipper with roller conveyor

A new TIP-TITE™ Sanitary Drum Tipper allows dust-free transfer of bulk materials from drums to downstream equipment, and rapid sanitising between changeovers.

Constructed of stainless steel and suitable for wash-down, the tipper is pneumatically powered and certified for use in areas with hazardous conditions.

A hydraulic cylinder raises and seats the drum against a discharge cone, after which a second hydraulic cylinder tips the drum to an angle of 45, 60 or 90 degrees with a motion-dampening feature. At full rotation, the outlet of the discharge cone mates with a gasketed receiving-ring fitted to the lid of any receiving vessel, creating a dust-tight seal and allowing controlled, dust-free discharge through a pneumatically-actuated butterfly valve into the vessel.

The hydraulic power unit enclosure with sight glass to

check gauges and valves, is located on the frame exterior for accessibility during set-up, inspection and maintenance, and houses a pneumatic motor to drive the unit.

It is equipped with a roller conveyor that can be fed by an optional or existing infeed conveyor, allowing drums to roll into place by gravity.

Other Flexicon drum tipper are available constructed of carbon steel with durable industrial finishes, or with material contact surfaces of stainless steel.

The company also manufactures high-lift drum tippers, drum fillers, box/container tippers, bulk bag dischargers, bulk bag conditioners, bulk bag fillers, flexible screw conveyors, tubular cable conveyors, pneumatic conveying systems, bag dump stations, weigh batching and blending systems, and engineered plant-wide bulk handling systems with automated controls.



TIP-TITE™ Sanitary drum tipper with explosion-proof motor from Flexicon transfers bulk materials from drums to downstream equipment dust-free.

For information contact Flexicon Africa on tel: +27 (0)41 453 1871; email sales@flexicon.co.za, or go to www.flexicon.co.za

2016SAEEEC, serving the energy field nationally

The 2016SAEEEC serves the dynamic industries of energy engineering, energy management, efficiency improvement, environmental, facilities and building management, renewable and alternative energy, co-generation, power generation, energy services and sustainability.

This event provides a national scope for end-users and energy professionals in all areas of the energy field. It is the one truly comprehensive forum where you can assess the 'big picture' and see exactly how all the economic, regulatory developments and industry trends merge to shape the critical decisions on your organisation's energy and economic future.

This convention, with parallel seminar sessions and exhibition hosting more than 50 exhibitors, targets the complete spectrum of technologies and services of great importance to delegates and includes, among many others:

- Energy engineering,

- innovation and technologies
- International and local standards
- Financial, tax and carbon incentives
- Renewable, biofuel and alternative energy
- Co-generation and distributed generation
- Lighting efficiency and management
- Nuclear energy
- Green building standards, technologies and maintenance
- Facilities management optimisation
- Supply chain management
- Demand side management
- Load shifting and shedding
- Solar and fuel cell technologies
- Water heating technologies
- Energy services and project financing
- National energy management programmes
- Business and human resource structures

More than a decade of information dissemination and awareness creation will be celebrated at the Southern African Association for Energy Efficiency (SAEE) flagship event, The Southern African Energy Efficiency Convention (2016SAEEEC) for the 11th consecutive year. Running concurrent with the Convention on 08-09 November 2016 at Emperors Palace, Gauteng, is the well-known exhibition drawing the latest products, services, technologies and solutions to educate and inform the niche market delegates drawn each year.

The official opening of the 2016SAEEEC is marked at the SAEE Annual Banquet and Awards Ceremony, where the latest excellence in energy efficiency is rewarded to deserving candidates.

For more information tel: +27 (0) 18 290 5130; email: convention@saeec.org.za; or go to www.saeec.org.za

Interview with Prof Thokozani Majozi by Michelle Low



This month we speak with Professor Thokozani Majozi (PEng, PhD), who holds the NRF/DST Chair in Sustainable Process Engineering at the University of the Witwatersrand, Johannesburg, School of Chemical and Metallurgical Engineering.

He is an author of two textbooks, chairman of the Board of Directors at CSIR (Council for Scientific and Industrial Research) and a recipient of many

achievements and awards. He is a role model and a man of great integrity. This year, he won the Research and Engineering Capacity Development award at the National Science and Technology Forum (NSTF)-South32 Awards. The prize was shared with Professor Sue Harrison (University of Cape Town-UCT) and Professor Peter Dunsby (UCT).

ML: What made you decide to study chemical engineering and pursue your PhD?

TM: I just happened to fall in love with mathematics and physical science during my secondary school years and decided to pursue a career that would allow me to continue doing math after finishing school. Coincidentally, my school had a visit from Anglo American Corporation (AAC), who had embarked on a steep recruitment drive for young black talent at the time. The year was 1988. I was introduced into engineering for the first time and decided to pursue it as a career. The choice of chemical engineering, as a discipline, was premised on the fact that it was considered to be one of the most challenging and I was up for that chal-

lenge. I am not certain if that was the best way of choosing a career. Nonetheless, I have never had any regrets.

ML: What kind of research do you do?

TM: I work in an area of Process Integration, which falls within a broader field of Process Systems Engineering. In short, Process Integration entails analysis, synthesis and optimisation of processes with emphasis on the unity of a process. Within Process Integration, there is a further division between batch (time-dependent) and continuous processes at steady state (time-independent). For the first decade of my full-time research career, I focused mainly on batch chemical processes, where we have developed novel techniques capturing the essence of time. Central among all our contributions is the continuous-time feature of the resultant mathematical formulations, which renders our models applicable to real-life or industrial scale problems. This work has also been extended to optimum design and synthesis of some of the most combinatorially complex facilities, the so-called multipurpose batch plants. We have also applied our mathematical

SAICHe IChemE Gauteng event: New registration process for Professional Engineers

A lot of young graduates and some of the more experienced of us have the ambition to register as Professional Engineers. However, it seems there have been many changes at the Engineering Council and people were given conflicting reports.

Therefore, the Gauteng committee of SAICHe thought it was a good idea to hold an event to have the facts explained to us about the New Registration Process (NRP).

Indeed, it was a good idea! The event was very well attended with 64 engineers learning, socialising and making new connections. The function was held on the 22nd September at 18:30 at Worley Parsons and the main highlights included:

- The registration system (the purpose, benefits and all the requirements),
- The registration process (all the documentation to be completed and especially the outcomes-based approach to be included in the engineering reports submitted), and
- The application registration process that is followed.

All questions were answered by the three

presenters who had previously attended the ECSA one-day registration evaluation course), and who regularly conduct Pr Eng interviews. As a result, everybody who attended learned something. The presenters were Alan Cousins from Fluor, Dominique Tharandt from WorleyParsons and Nige! Coni from ISHECON.

For example, did you know that if you have more than ten years' experience, that there is a simpler form to be completed? And did you know how you can use this registration process as a career planning tool and not just a form-filling exercise? Under the current system approximately 50% of applicants had to make corrections to their forms which cost valuable time and effort, so the importance of getting it right first time was emphasised. All of this and more was discussed on the evening. More than that, it was also an opportunity to have great food and wine, chat to



fellow engineers about their experiences and certainly served as a great motivational factor for more of us to get registered!!

This is how SAICHe IChemE is benefiting you! The next event coming up is all about really cool apps and is presented by Carl Sandrock; you definitely do not want to miss that one, happening on Thursday, 27th October 2016. Register for it now. Go to www.saiche.co.za and find the event under the Gauteng section of the website. See you all there!

Written by Dominique Tharandt, secretary of the SAICHe IChemE Gauteng Members Group

models in resource optimisation, with a particular focus on water and energy. The last five years, however, have seen our research group diversifying to processes that tend to assume a steady-state behaviour. Our main research focus in this area is utilities debottlenecking, and very recently, simultaneous water and energy optimisation. Some of our work has also been applied in industries like Johnson & Johnson, Eskom, African Explosives Limited (AEL), Sappi and Amul Dairy, India.

ML: You have industrial and academia experience. How do you merge the two in your line of work?

TM: This comes naturally, particularly in engineering. In essence, I attribute most of my success in my career to this attribute. Engineering is an applied science. Consequently, we only begin to appreciate its relevance where scien-

tific fundamentals merge with practice. Whenever we develop a new method, our ultimate goal is test it in practice. This also explains our extensive collaborations with industry, locally and internationally.

ML: What does this award mean to you?

TM: Overall, an award is mainly an acknowledgement of one's efforts and impact thereof. However, the added benefit is always visibility. It is not common for the general public media, particularly in South Africa, to publish scientific accomplishments, which I consider a critical void to be filled.

Making our science visible to the general public would ensure that the younger generation gets to know what South Africa is up to in the space of science. This would go a long way in assisting the youth to choose their careers wisely. The NSTF-South 32 Awards seem to be closing that gap.

ML: What's next? Or anything we can expect from you in the near future?

TM: Yes, there is a third book on the horizon. It will be published by CRC Press/Taylor and Francis Group and we aim to launch it in April 2017. The book is on state-of-the-art techniques for the optimum design and synthesis of sustainable batch processes.

Our efforts on the development of novel techniques for simultaneous water and energy optimisation remain on a steep upward trajectory. One hopes something meaningful is going to come out of this.

ML: Any advice for students and colleagues?

TM: To students – Identify your passion very early and pursue it with all your capabilities, for as long as you possibly can. To my colleagues – let us never relent in our quest to make this world a better place.

UCT wins Intervarsity Brewing Challenge

'Dunkel Breaking My Heart' took top honours of Castle Lager Best Bru Award at the Intervarsity Brewing Challenge 2016, for the second year in a row. The beer, a dark lager, earned University of Cape Town (UCT) the overall title and added to the title it earned in 2012.

UCT took first place in three other categories: Carling Black Label Best Lager, Redds Best Cider and Castle Milk Stout Best Winter Warmer, according to a recent statement.

'Dunkel Breaking My Heart' was judged as having a "simple style with a clean lager flavour and the correct balance of hops. They also used good brewing procedures for a style that requires precision in brewing technique."

Category winners

Castle Best Bru (overall winner):

University of Cape Town (Dunkel Breaking my Heart)

Carling Black Label Lager: 1st: University of Cape Town (Dunkel Breaking My Heart) 2nd: University of Limpopo (Amber Lady Lager) 3rd: University of Pretoria (10 Hour Eisbock)

Redds Best Cider: 1st: University of Cape Town (Ceres Harvest Cider) 2nd: University of KZN Pietermaritzburg (Ghenta Belgian Mango IPA) 3rd: Cape Peninsula University of Technology (King Regal)



No. 3 Fransen Street Best Speciality Beer:

1st: University of KZN Pietermaritzburg (Southmalle Trappist Single) 2nd: University of the Free State (Trappist) 3rd: Central University of Technology Free State (Tinted Ale)

Hansa Pilsner Best Pilsener Light:

1st: 1000 Hills Chef School 2nd: University of Witwatersrand (Little Petr Pilsner) 3rd: Nelson Mandela Metropolitan University (Jester of the Abbey)

Castle Milk Stout Winter Warmer:

1st: University of Cape Town (Double Agent) 2nd: University of KZN Westville (Westville Black Beer) 3rd: North West University Potchefstroom (Dubhghlas)

Best Label Design: 1st: Cape Peninsula University of Technology 2nd: University of Witwatersrand 3rd: University of the Free State

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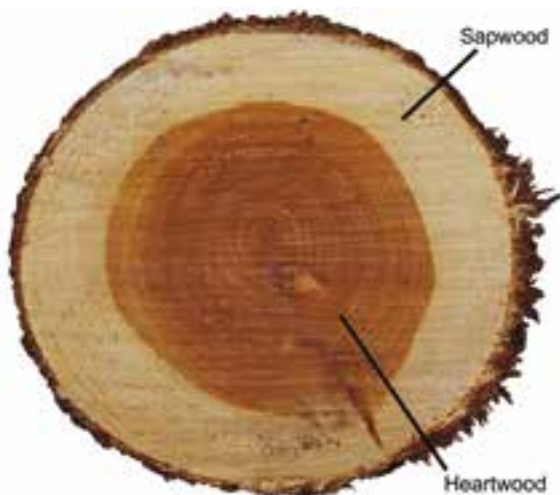


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Treatment specs of new eucalyptus hybrids



An academic study is being undertaken by the South African timber industry to determine if the current specifications for the treatment of eucalyptus poles are still relevant for new eucalyptus hybrids.

“The hybrids were cultivated in a bid to cope with climatic changes, to ensure quicker growth of the trees, and to prevent biological attack,” says Dolphin Bay’s Managing Director, Bertus Coetzee. “Interestingly, they were introduced for the pulp industry, which uses most of the wood grown in plantations, rather than the timber industry.”

The research comes amid concerns about the new hybrids’ varying ‘sapwood ratios’.

“The ‘sapwood ratio’ is the proportion of the total volume of the tree that is sapwood. These are the soft, outer layers of a tree which contain living cells and can absorb chemical preservatives. It is important for treaters to know this ratio so that they are able to calculate the optimal strength of their CCA solution.

“Heartwood, on the other hand, is the

denser inner portion of a tree in which the cells have died. It provides structural support to the growing tree, and is mainly found in older trees. By its nature, heartwood is protected from most biological attacks, and cannot absorb preservatives.

“Sapwood, alone, constitutes the treatable zone of eucalyptus poles; and the sapwood ratio of the new hybrids that have been introduced in recent decades is different,” says Coetzee.

He adds that the fact that the specifications are being reviewed in South Africa, prompts a realisation that the broader industry, in other African countries, should also review specifications.

“There are many specifications authorities in the various African countries, and we believe that in many cases, the suitability of these specs for the changing eucalyptus species has not been assessed.”

In the light of these realisations, Coetzee says Dolphin Bay has informed wood treaters of the potential hazards of neglecting the sapwood ratio of eucalyptus poles, and

recommended a possible way forward.

“The ultimate aim of our efforts is to help develop cutting-edge standards which we hope will ultimately be incorporated into legislation. The sustainability of our industry depends on us getting it right.”

Dolphin Bay has received many queries from timber treaters about what sapwood is, and how to determine the correct sapwood retention, in relation to the treatment of eucalyptus poles. These questions are very important, as the answers have a direct bearing on the optimal treatment of timber. This means that the sapwood, alone, constitutes the treatable zone of eucalyptus poles.

In the light of these realisations, Dolphin Bay has published another edition of Industry Note, to inform wood treaters of the potential hazards of neglecting the sapwood ratio of eucalyptus poles, and to recommend a possible way to proceed.

For more information, contact Tracy Britz at tracy@hwb.co.za or on +27 21 421 0430.

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SUDOKU NO 120

Complete the grid so that every row across, every column down and every 3x3 box is filled with the numbers 1 to 9. That’s all there is to it! No mathematics are involved. The grid has numbers, but nothing has to add up to anything else. You solve the puzzle with reasoning and logic. For an introduction to Sudoku see <http://en.wikipedia.org/wiki/Sudoku>

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**Solution
for SUDOKU
119**

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