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FEATURES

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Chemical Technology is endorsed by The South African Institution of Chemical Engineers

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Flying high above the rest at Electra Mining 2016

Regarded as leaders in innovation, Festo will present their AirPenguin and showcase their latest products for the mining sector.

Electra Mining will be returning to the Nasrec Expo Centre in Johannesburg from 12th to 16th September 2016. South Africa's largest mining, industrial, electrical and power trade show typically sees over 30 000 visitors come to see the industries' latest products, services, technologies and trends.

Festo is proud to be exhibiting at Stand A9 in Hall 5 at this huge event. It will also be one of four sponsors for the show. A key focus area for Festo is the mining industry. The company will have an extensive range of pneumatic and process automation products and solutions on offer as well as some of their latest training equipment. Its most impressive offering at the show will undoubtedly be its famous AirPenguin!

The AirPenguin is a product from Festo's research division, the Bionic Learning Network. This division is inspired by animals in nature and the tasks they perform with such ease and efficiency such as gripping, moving, controlling and measuring.

Whether as individual components or part of a system, automation technology carries out similar tasks every day. Festo examines these naturally occurring phenomena and develops innovative, cutting-edge Bionic technology which they then integrate into their products.

The AirPenguin is one of these products that incorporates human-machine interfaces, autonomy and flexibility. These are all qualities which are required in the mining sector.

The AirPenguin is an autonomously flying object that comes close to its natural archetype in terms of agility and manoeuvrability. It comprises a helium-filled ballonet, which has a capacity of ± 1 m^3 and thus generates approximately 1 kg of buoyant force. At each end of the ballonet is a pyramid-shaped flexible structure of four carbon fibre rods, which are connected at joints by a series of rings spaced about 10 cm apart. The rings, together with the carbon fibre rods, yield a 3D Fin Ray® structure that can be freely moved in any spatial direction. The Fin Ray® structure was derived from the anatomy of a fish's fin and extended here for the first time to applications in three-dimensional space.

Each pair of spatially opposed carbon fibre rods is connected via bowden wires and a double pulley, and can be extended and retracted in contrary motion by means of an actuator. This gives rise to rotation free of play both at the tip of the AirPenguin's nose and at the end of its tail. By superimposing two perpendicular planes of rotation, any desired spatial orientation can be realised.

A strut to which the two wings are attached passes through the helium-filled ballonet. This new type of wing design can produce either forward or reverse thrust. Each wing is controlled by two actuators: a flapping actuator for the up-and-down movement of the wings, and a further unit that displaces the wing strut to alter the pressure point of the wings. There is also a central rotational actuator for the two flapping wings that directs their thrust upwards or downwards, thus making the AirPenguins rise or descend. All three actuators are proportionally controlled. This makes for continuously variable control of the flapping frequency, forward and reverse motion, and ascent and descent.

The entire wing complex comprises a strut with flat flexible wings of extruded polyurethane foam. The wing strut, which is supported at the pivot point of the torso, can be moved either towards the front or rear edge of the wing. Displacing the strut towards the front, for example, causes the wing's pressure point to migrate forwards. The pressure of the airstream bends the cross-section of the wing in such a way as to produce a profile that generates forward thrust. If the wing strut is moved towards the rear edge of the wing, the pressure point is likewise moved to the rear, and the AirPenguin flies backwards. With this design, a self-regulating, wing pressure-controlled, passively twisting adaptive wing has been realised for the first time.

Autonomous, self-regulating systems with collective behaviour

The AirPenguins are also equipped with complex navigation and communication facilities that allow them to explore their 'sea of air' on their own initiative, either autonomously or in accordance with fixed rules.

The underlying project: A group of three autonomously flying Penguins hovers freely through a defined air space that is monitored by invisible ultrasound 'transmitting station'. The Penguins can move freely within this space; a microcontroller gives them free will in order to explore it. The microcontroller also controls a total of nine digital actuators for the wings and for the head and tail sections.

By means of XBee, based on ZigBee, large volumes of data can be transmitted between the Penguins and the transmitting stations by 2.4-GHz band radio. The Penguins recognise each other on the basis of their distances to the transmitting stations.

The rapid, precise control allows the AirPenguins to fly in a group without colliding, while also mastering height control and positional stability. As an alternative, they can act synchronously as a group.

A comprehensive central surveillance system provides security in case of sensor failure and reports low energy supply. Whenever necessary, it prompts the Penguins to return to the charging station.

Technology-bearers for the automation technology of tomorrow

If the 3D Fin Ray® structure of the head and tail sections is transferred to the requirements of automation technology, it can be used, for instance, in a flexible tripod with a very large scope of operation in comparison with conventional tripods. Fitted with electric drive mechanisms, the BionicTripod from Festo, for example, makes for precise, rapid movements, just like the AirPenguin.

Autonomous, versatile, adaptive self-regulating processes will acquire increasing significance in future for automation in production. The animal kingdom can provide insights here which, when implemented by resourceful engineers, lead to astounding new applications.

The ongoing development of sensor and control technology is thus also being promoted along the road to decentralised, autonomously self-controlling and self-organising systems thanks to inspiration from nature. The transfer to automation technology is also to be found by analogy in regulating technology from Festo, for example in the new VPPM and VPWP proportional-pressure regulators for servo-pneumatics.

Don't forget to visit Festo at Stand A9 in Hall 5 at the Electra Mining event to see this miraculous invention!

For more information on these and other Festo offerings, contact:
Kershia Beharie on 08600 FESTO (33786) or email her at kershia.beharie@festo.com or go to www.festo.co.za

Pilot valves for pharmaceutical, chemical and petrochemical plants

The pilot valves VOFD and VOFC reliably actuate butterfly valves, cylinders, diaphragm actuators and rotary actuators. Thanks to their sturdy design, high corrosion resistance and choice of solenoid coils with various ignition protection types, the valves can be used in potentially explosive atmospheres up to zone 1/21 – even in open-air applications.

The valves are certified to IEC 61508 and can be used in safety circuits up to SIL 3 as well as in emergency shut-down applications. With their hard emetalised housings, the valves benefit from long-term protection against corrosion and mechanical stresses.

The valves also offer high process reliability and plant availability. The VOFD operates reliably and safely in fail-safe applications. The indirectly controlled VOFC combines operation with internal and external pilot air in a single housing, which reduces the cost of maintaining stocks of different variants. The valves can be easily changed over using a screw. Depending on the required function, the pressure connection can be made independently of the working pressure as a positive-pressure or vacuum connection. New to this valves series are low-temperature variants for ambient temperatures down to -50° C, stainless steel versions and international certification to IEC Ex, Inmetro, Nepsi and Gost.

comment

Making our fraternity a generator of change

by Carl Schonborn, PrEng

A fact of life is the reduction over the years of the number of Chemical Engineers who belong to The South African Institute of Chemical Engineers, or SAIChE.

There are a number of ways in which this has manifested itself and some of them are probably very obvious. For example, the lower number of graduating Chemical Engineers, the tough economic times making subscriptions quite expensive unless the employer pays for them, the joining of Chemical Engineers to international bodies as the world becomes more of a global village, and graduates seeking opportunities all over the world, not just in South Africa.

However, we are fortunate to have a magazine like 'Chemical Technology' which is endorsed by SAIChE and the Southern African Association of Energy Efficiency (SAEE). The problem is that in these difficult economic times with pretty much zero world growth, is that a magazine has to depend on its advertising for revenue and if that is not forthcoming it puts enormous strain on the resources the magazine.

The editorial staff of 'Chemical Technology', a Crown Publications magazine respectfully requests the Chemical Engineering fraternity to embrace its magazine and make it, not only its mouthpiece, but a source of current and meaningful articles that will keep them up to date with developments in their fields.

We need Chemical Engineers to suggest or write articles that they consider would be beneficial to their colleagues and send them to the editor, Glynnis Koch at chemtech@crown.co.za. In addition, any feedback from our readers would assist the editorial staff to gauge what is of interest to them; please do send in comments on articles which have been published. The large pool of readers is a far better yardstick of what is needed to be published, than a small group of editorial staff which has to depend on research publications and the print and electronic media when sourcing articles of interest.

We are all aware that the world economy is in a very low growth phase and natural resources are in low demand, with overproduction still a problem. But, during the present lull in world markets, is the best time to spend more effort on reading technical journals and publications, so that when the rush returns, we are armed with the latest and best information in our fields.

Make this magazine your mouthpiece and build the Chemical Engineering fraternity into the powerful generator of change that it always has been.

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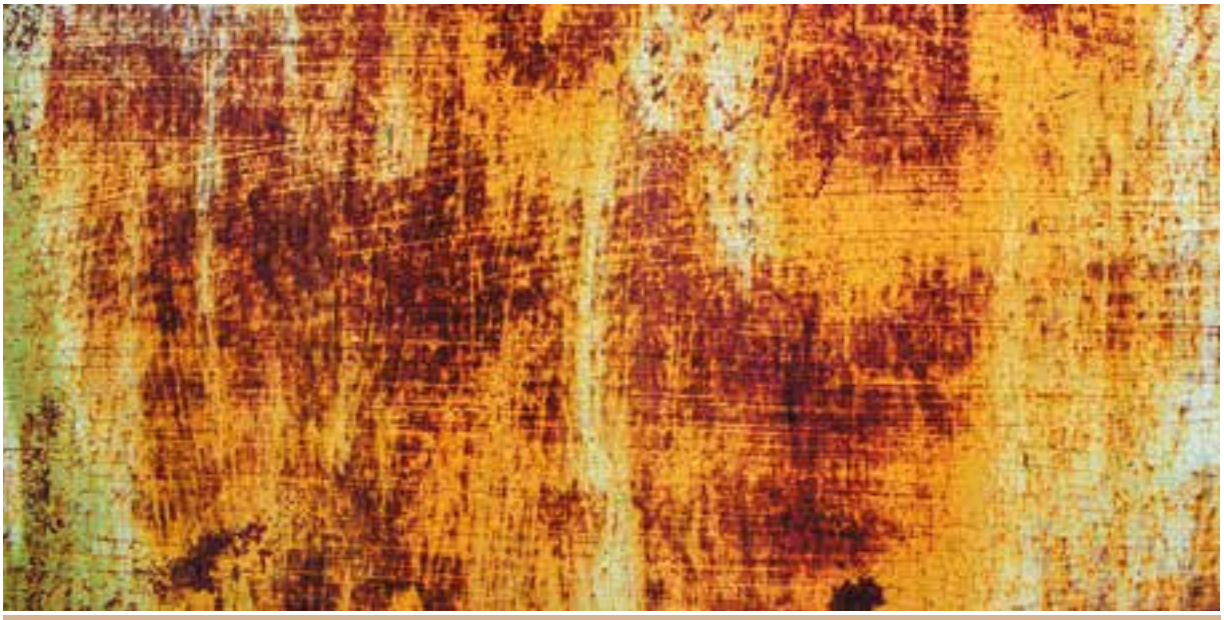

Cost-effective corrosion barriers

Novel epoxy nanoclay composites keep costs down whilst improving performance

by S Kenig - Shenkar College of Engineering and Design, Israel, and R Cafagna - Nanto Cleantech, Italy

Small quantities of functionalised nanoclays hold great potential for the performance of conventional paint systems. Exfoliation, chemical compatibility and orientation are critical to enhancing the barrier properties, resulting in improved corrosion resistance and fire retardancy. The novel coatings discussed in this article mean that a variety of different substrates can benefit from these properties.

Nanoclays offer new possibilities for anti-corrosion paints

The technology of nanoclay polymer composites is currently generating a great deal of interest due to its potential cost-effective advantages in reinforcement, fire retardancy and barrier properties [1-6].

Nanoclays (NCs) appear in nature in condensed structures. When properly exfoliated to single platelets, that possess a thickness of 1 nanometre (nm) with an aspect ratio of close to 500, they assume a surface area of 750 m^2/g. Uniform dispersion of the NCs platelets requires them to be chemically compatible with the host system. Due to their enormous surface area, only small amounts of the nanoparticles are needed to significantly enhance properties.

Table 1: Oxygen permeability of epoxy/NCs coatings (normalised to 200 microns)

Composition	Oxygen Permeability ($cc/m^2/day$
Epoxy – 0% NC	38.8
Epoxy – 5% 25A	48.8
Epoxy – 5% 30B	10.5
Epoxy – 5% Nanto 1	27.1
Epoxy – 3% Nanto 1	7.9
Epoxy – 5% Nanto 2	29.1

Figure 1: TEM micrograph of Nano1 NCs at 3% concentration (bar size – 20 nm).

Figure 2: TEM micrograph of "Cloisite 25A" NCs at 5% concentration (bar size – 20 nm).

Table 2: Water permeability of epoxy/nanoclay coatings

Composition	Thickness (Microns)	Water permeability g/m²/day
Epoxy – 0% Nantol	700	1.727
Epoxy – 1% Nantol	800	0.244
Epoxy – 3% Nanto	800	0.127
Epoxy – 5% Nantol	800	0.199

The emergence of commercial NCs (montmorillonite type) has opened up new avenues for anti-corrosion and fire retardant paints due to the high barrier to oxygen and humidity that NCs can impart to conventional paint formulations.

In this study, the effectiveness of NCs as barrier elements to corrosion agents (oxygen and humidity) and the effect of NCs surface treatment on the barrier properties were investigated to obtain anti-corrosion and flame retardant paints. The objective was to evaluate the effectiveness of NCs as barrier elements to corrosion agents (oxygen, humidity) in epoxy paints and to study the effect of NC concentration on the barrier properties of epoxy paint systems. The paints containing NCs were evaluated as primers and intermediate layers for steel elements, and compared with epoxy paints of the same composition but without the compatibilised NCs.

Experimental

Proper exfoliation and orientation of the nanoclay platelets is expected to reduce permeability in the paint system. Reduction of permeability is attributed to the tortuous path available for diffusion of gases (oxygen) and liquids (water). Reducing permeability can inhibit the corrosion of metal structures. The study was composed of two parts. In the first part, the NCs were incorporated into neat epoxy systems. In the second part, the NCs were compounded into primer and intermediate epoxy paint formulations. The same basic epoxy resin and curing agent were used in the two stages. The epoxy resin used was based on diglycidyl ether of bisphenol A (DGEBPA) and a curing agent based on polyamidoamine. Two different NCs were used, one hydrophobic and one hydrophilic. Two novel NCs were also prepared from pristine NCs. The first was prepared by intercalation in non-organic solvent (Nano 1) and the second by an organic solvent (Nano 2). Compounding the dry NCs into epoxy or paint was by intensive mixing (0,5–9% by weight). Vacuum was applied to remove volatiles. Then the curing agent was added and mixed in using a ratio of 1 part curing agent to 4 parts epoxy. The paints were applied using a doctor blade apparatus. For oxygen permeability tests the paint samples were 180 to 250 microns thick and for water permeability tests the samples were 700 to 800 microns thick. The oxygen barrier of the nanocomposite paints was evaluated according to ASTM D 3985 at 25°C, 0% relative humidity and 1 atmosphere of oxygen. The humidity barrier was tested according to ASTM E 96, at 38°C and 90% relative humidity. Compounding of the dry NCs into epoxy or paint was by intensive mixing (1–5% by weight). The paint was applied by brush. The epoxy resin NCs morphology was followed by (TEM) Transmission Electron Microscopy. Salt spray testing (700 to 2 000 hrs) was performed according to ASTM B-117 using 10 x 10 cm steel specimens coated with various paints formulations. Blister formation was followed by visual inspection. Electrical impedance measurements were taken following salt spraying. Finally, the wet adhesion was measured following 1 000 hrs in an aqueous solution of both alkaline and acidic conditions.

Surface treatment key for greatest barrier properties

The reduced permeation of oxygen and humidity through the paint layer is expected to result in corrosion inhibition of metallic structures. In the case of the nanoclay platelets having a high aspect ratio (500 to 1 000), the reduction in permeability is due to the tortuous path for gas diffusion (oxygen and humidity). To achieve the highest barrier properties, the condensed NC structure should be exfoliated to the highest possible level (single platelets) and the single platelets homogeneously dispersed parallel to the surface. Consequently, the current study focused on the effect of nanoclay surface treatment with respect to the epoxy paint system, on the permeability to oxygen and humidity.

Hydrophilic nanoclay increases oxygen and humidity barrier

In stage 1, neat epoxy/NCs were studied with respect to the effect of NCs having various treatments for the NCs at different NC concentrations.

Table 1 on page 5 summarises the oxygen permeability of various epoxy/NC combinations.

As can be seen in Table 1, the best results were obtained with the hydrophilic NC treatments (Nanto1 and 30B). In the case of 3% NCs in Nanto1 a 5-fold reduction in oxygen permeability was achieved. The hydrophobic surface treatment (25A) exhibited the worst barrier performance, as it was incompatible with the epoxy system. The effectiveness of the Nanto 1 treatment compared with the commercial organoammonium ion treatment was confirmed by Transmission Electron Microscopy (TEM). TEM micrographs indicated that

the Nano1 treatment gave an exfoliated structure while the organo-ammonium hydrophobic treatment resulted in an agglomerated morphology. As can be seen in Figure 1, the Nano1 treatment at 3% NCs indicated good exfoliation and parallel tortuous path morphology.

As can be seen in the TEM micrograph in Figure 2, for the commercial nanoclay 25A (5% NCs), partial agglomeration of the NCs takes place with no parallel arrangement of the NC platelets which leads to increased oxygen permeabilities.

Table 2 depicts the humidity permeability of the epoxy nanocomposite coatings. In this case only the Nanto 1 NCs were studied with respect to their concentration effect.

Table 2 shows a more than 9-fold reduction in humidity permeation as a result of using 3% of the Nanto1 NCs. At lower (1%) and higher (5%) concentrations, the barrier properties are reduced compared with the optimal NCs level (3%).

Nanoclays reduce blistering and increase electrical resistance

In stage 2 of the study, epoxy paint formulations based on DGEBPA and polyaminoamide curing agent were used containing a variety of fillers [7]. NCs based on Nano1 treatment were used throughout the second stage. As the viscosity of the paint formulation is higher than the neat epoxy resin, the viscosities of the various formulations were evaluated as a function of the NC concentration compared with the epoxy paint that did not contain NCs, in addition to the number of blisters formed and electrical resistance following salt spray exposure (700 hours of exposure).

Table 3 describes the composition and attributes of the primer formulation. It shows that the viscosities of the primer formulation increased significantly with NC concentration. Furthermore, the number of blisters formed following salt spray was reduced with increasing NC concentration to 1% and 2%. In addition, electrical resistance increased by two orders of magnitude with increase of NCs to 1 and 2% by weight.

Table 4 summarises the results for the intermediate formulation. For the intermediate formulation the viscosities increased even more than for the primer formulation with increased NC concentration. The effect of the NCs on blister formation is very significant along with the increase in electrical resistance. The next attribute to be investigated was the pull off of the intermediate formulation as a function of various NCs in dry and wet adhesion following immersion for 1 000 hours in water.

Table 5 describes the dry adhesion results for dry as well as wet adhesion for Nanto1 and Cloisite 30B NCs at a concentration of 1% and 2%. As is evident, Nanto-treated NCs have an advantage for dry as well as wet adhesion pull off.

Following exposure to water, selected formulations were immersed in basic as well as acidic conditions according to Standard EN ISO 2812-1. Accordingly, panels were immersed for 7 days in 10% caustic soda solution and 10% sulphuric acid solution. Experimental results indicated that all specimens coated with paints containing NCs did not form blisters while all specimens coated with paints without NCs show blistering.

Table 3: Primer composition - viscosity-resistance-blisters

Composition	% NC	Visc. (1) mPaS	Thickness micron	No. blisters (2)	Resistance Ω cm²
Neat	-	27,000	150	4	$9x10^{7}$
Nanto1	1.0	37,100	140	2	$5x10^{9}$
Nanto1	2.0	52,400	142	2	$1x10^{9}$

(1) Rotational viscosity at 10 rpm

(2) After 700 h salt spray

(3 After 700 h salt spray at 80 microns thickness

Table 4: Intermediate composition viscosity-resistance-blisters

Composition	% NC	Visc. (1) mPaS	Thickness micron	No. blisters (2)	Resistance Ω cm²
Neat	-	26,600	160	20	$2x10^{10}$
Nanto1	1.0	51,400	135	3	$8x10^{11}$
Nanto1	2.0	85,700	130	5	$1x10^{11}$

(1) Rotational viscosity at 10 rpm

(2) After 700 h salt spray

(4) After 700 h salt spray at 150 microns thickness

Table 5: Dry and wet adhesion pull off strength of intermediate paint formulations

	Dry adhesion (MPa)			Wet adhesion (MPa)
	Value 1	Value 2	Average	
Without nanoclays	17.0	17.0	17.0	12.0
1% Nanto1	13.4	15.0	14.2	16.4
1% Closite 30B	5.2	6.0	5.6	3.6
2% Nanto1	15.0	17.0	16.0	19.0
2% Closite 30B	5.0	5.0	5.0	4.8

Table 6: corrosion resistance in salt fog and humidity chamber

	Corrosion test in artificial atmosphere/salt spray test according to ISO 9227		
	700 hours	2 000 hours	Performance improvement
Primer Epox NPC 9001 WITH NCs	no blistering	no blistering	+ 300%
Primer Epox NPC 9001 W/O NCs	no blistering	diffuse blistering rust around the incision area Test FAILED	

Finally, corrosion resistance in salt fog and humidity conditions was investigated according to ISO 9227 for 700 and 2000 hours.

As can be seen in Table 6, following 700 hours exposure no blisters developed in the primer containing NCs or in the NC-free formulation. However, following 2 000 hours of exposure the advantage of the primer formulation containing NCs is evident, with no formation of blisters.

Functionalised nanoparticles enhance flame retardancy

As NCs provide good barrier attributes to oxygen it may also be effective for fire retardancy (FR). Hence, novel FR coatings were developed based on functionalised NCs. The FR series could be used in a variety of applications such as civil, industrial and marine structures, as the coatings are suitable for applying on different substrates such as steel, wood, composites and concrete.

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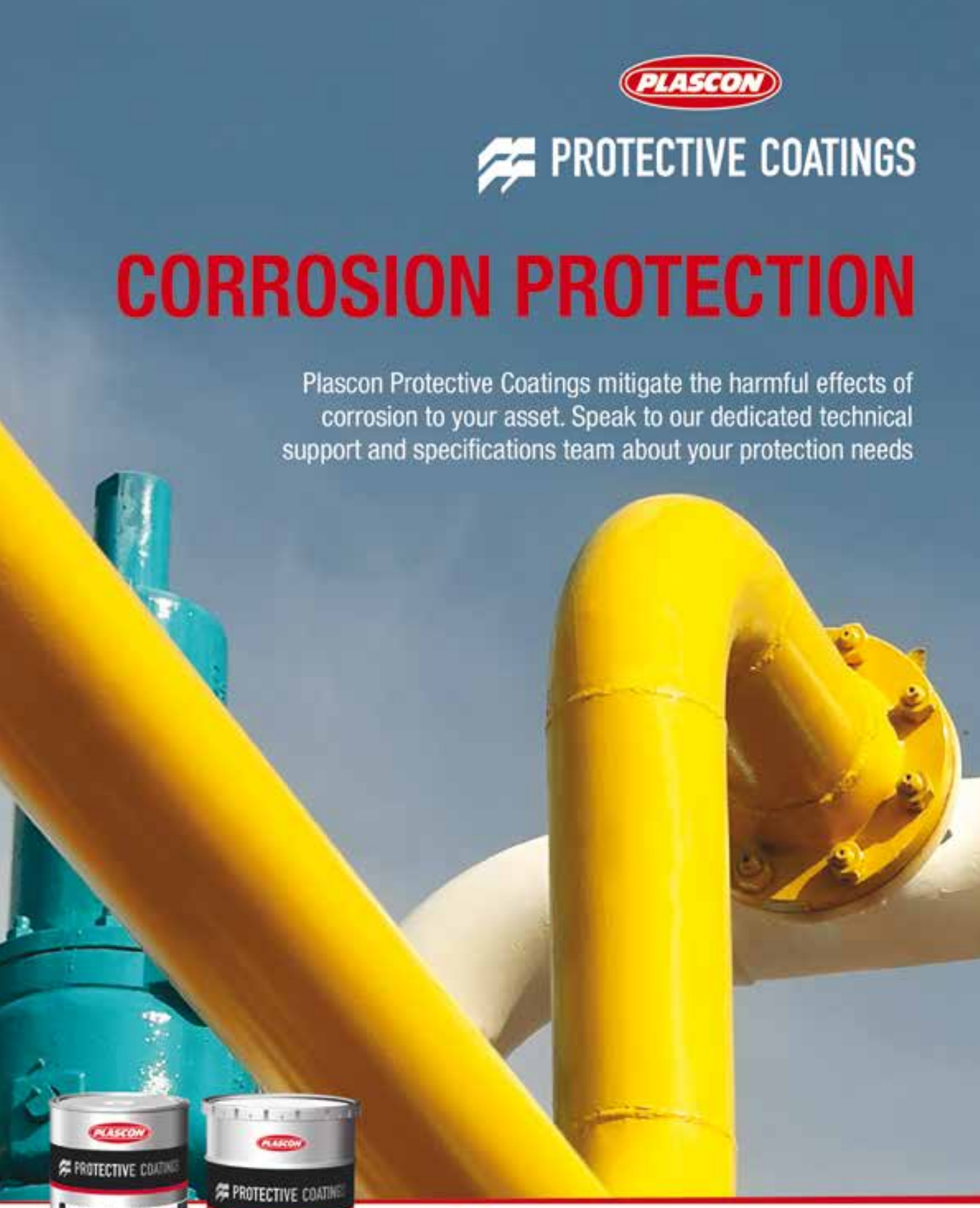

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The use of functionalised nanoparticles allows the replacement (fully or partially) of traditional fire retardant materials (ammonium polyphosphate, halogenated substances) with reduced cost and increased performance with respect to smoke emission reduction and enhanced flame retardancy.

Nanoclays can enhance anti-corrosion performance and fire retardancy

Experimental results indicated that exfoliation, compatibility and orientation of the NCs are the decisive factors for anti-corrosion primers & intermediates. Optimal treatment and concentration of NCs in neat epoxy resins exhibited a 5-fold reduction in oxygen permeation and a 9-fold reduction in water permeation. In epoxy primers & intermediates, 1% to 2% of Nanto 1 NCs demonstrated the best results following salt spray with respect to the inhibition of blister formation, enhanced electrical resistance, enhanced chemical resistance and improved adhesion.

Low levels of nanoclays (3%) were needed to enhance the barrier properties of epoxy-based paints. The exfoliation, chemical compatibility and orientation of the nanoclays in the paint matrix are the decisive factors affecting the barrier properties of epoxy coatings. Steel specimens coated with optimally treated NCs demonstrated excellent resistance to salt spray testing for 2 000 hours. These results indicated that small amounts of optimised NCs led to a paint system that can be classified as Class C5M – high corrosion resistance according to the UNI EN ISO 12944 standard. These results indicate that small amounts of nanoclay in paints may enhance the anti-corrosion performance of conventional coatings and paints. The effectiveness of the novel treatment led to a patent on high-barrier paints [8]. The oxygen barrier properties of NCs were exploited for FR coatings using specially functionalised NCs.

Results at a glance

- Exfoliation, compatibility and orientation of nanoclays (NCs) are key factors for anti-corrosion primers & intermediates and for the barrier properties of epoxy coatings.
- The optimal concentration and treatment of NCs in neat epoxy resin substantially reduced oxygen and water permeation.
- 1-2% of treated NCs gave the best results in salt spray testing in terms of blister formation, electrical and chemical resistance and adhesion.
- Small amounts of nanoclays may enhance anti-corrosion performance and fire retardancy.

References

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

This article was first published in the 'European Coatings Journal', issue 07-08/2016. www.european-coatings.com

Reac Polyurethane Technologies launches new pump

Reac is a specialised trading and manufacturing company operating on the supply side to the polyurethane converting industry. The company's operations involve importing, exporting and manufacturing; it represents a number of companies on an exclusive basis, as agents and distributors for southern Africa.

Reac is privy to leading edge technology and developments by its association with Afros Cannon SPA (Milan, Italy) which is an independent machinery manufacturer specialising in the production of polyurethane dispensing plant and machinery. Other companies allied to Reac include Acmos Chemie (Bremen, Germany) a leading German manufacturer of mould release agents, for the industry and Beinlich Pumps (Gevelsberg, Germany), a well-respected pump manufacturer supplying pump systems for hydraulic systems, chemical manufacturing, mining, polyurethane processing and many more applications.

Progressive cavity pump optimised for the installation space

This cavity pump from Beinlich Pumps is one of the latest products available from Reac.

The nature of critical liquids as well as the advancement of production processes are constantly posing new challenges on existing pump technology. Often, gear pumps are no longer sufficient for the dosing and dispensing of such critical liquids. Furthermore, companies are now paying an increasing amount of attention to the optimisation of costs and space-saving properties of a system at the time of purchase.

With robots in particular, these properties are especially significant, since centrifugal forces during dynamic movements can have an enormous effect on the pumps. Beinlich Pumpen developed a progressive cavity pump which is not only optimised in regard to installation space, but is also easy to assemble and handle.

Gluing and sealing applications set extremely challenging and specific demands on the applied pumps, since exact dosing is essential here. Too much material can cause an uncontrollable time delay in the through hardening process. The components to be glued would potentially not adhere sufficiently or even loosen during transport. Too little material also prevents sufficient adhesion force of the substrate, meaning individual parts will not stick together properly. In addition, spillage or stringing due to excess bonding material can obstruct the machine or result in waste if cosmetic limits are not observed.

When selecting the pump unit, the respective viscosity of the media must be taken into account. Viscosity is known to be dependent on temperature and pressure, whereby some systems which cannot function volumetrically, and cannot achieve accuracy.

Time/pressure systems are inaccurate because they have to dispense a quantity with pressure Px within a certain time frame. Since pressurised air is compressible and viscosity is dependent on the factors named, material to be dispensed is lost due to inaccuracy. This can be expensive for the company when, for instance, gold or silver particles are used.

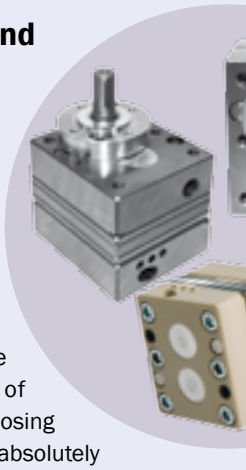
Pumps are often installed in a space-saving manner, whereby for mini-pumps, the housing is already very small and the required system pressure is correspondingly high. With regular start-up of the pump in particular, the pressure as well as the flow rate must be built up very quickly. Highly viscous media make for high friction losses, however, meaning high inlet pressures are not uncommon. Some shear-sensitive materials separate, thereby losing their properties. Often, these media must be transported through tight profiles or dispensing needles and volume-optimised lines. The market expects sturdy and long-lasting solutions for the exact dosing of such media.

Pressure and installation space optimisation through adapted geometries

The potential disadvantages of previous displacement pumps and progressive cavity pumps in particular are primarily the installation lengths and the joint used. Since the progressive cavity pumps have to convert an excentric movement, a corresponding space is needed in the pump housing. A long joint requires a large volume of the suction housing and must be especially sturdy to transmit the necessary force.

Beinlich Pumpen worked to perfect the geometries of the pump and the compensation of the inlet pressure in particular when developing the new VISCO.pump® progressive cavity pump. With the adaptation of the rotor and stator geometries, Beinlich managed to design the VISCO.pump® to be significantly smaller than earlier systems. This makes the progressive cavity pump particularly well-suited for use in small dosing robots, since the centrifugal forces in fast, dynamic traverse paths cannot influence the pump.

Moreover, the wall thickness of the rubber must be adapted to the counter-pressure so that the pump can function at optimal pulsation. The adapted geometry of the displacer reduces the necessary starting torque, whereby small, dynamic motors without transmissions can be assembled, thus reducing the weight and the installation length.



Dosing accuracy and simplicity of the application saves money

The newly developed VISCO.pump® is able to accurately dispense liquids and pastes with up to 60% filler content, whereby the external integration of the dosing pump is made possible independently of pressure regulators. The dosing quantity can be set to be absolutely linear; the standard deviation (as per 6σ) of dosing accuracy as well as repeatability is ± 1% and less.

An absolutely precise cavity as well as the optimal volumetric efficiency factor of the dosing pump enable a 'Plug&Go' control system. This considerably facilitates operation and handling for the user, which also reduces costs for installation and commissioning. The VISCO.pump® can be used anywhere, even if existing systems have to be modified.

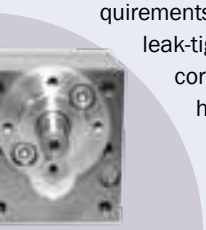
Application areas of the technology

The newly-developed pump can be used in many areas of industry. It is principally designed for precise dosing, such as bead and dot dispensing as well as filling cavities. Furthermore, it is well-suited for adhering magnets for motors and loudspeakers, for LED strips, underfilling, and for applying cooling paste on chips or for dispensing PU, amongst other applications.

Gear pumps in adhesive bonding technology

Adhesive bonding is a joining technology that is used in nearly every area of industry and the bar is set very high: the homogeneity and reproducibility of the bonded structures in the assembly sequence demands a high level of metering accuracy. Many media are liable to shear or inclined to enter into chemical reactions if the temperature increases.

To meet the required specifications it is necessary to find specific solutions for metering, in each case tailored to the application. A particular internationally active industrial company manufactures, among other things, metering equipment for use in the automotive industry and for manufacturing LED flat screens. In these fields of industry, high-performance adhesives are used which need to meet complex requirements. The bond must be guaranteed leak-tight against water, moisture and corrosive media. Plastic and metal housings are generally sealed in order to protect electronic components, switches, sensors or relays.



Adhesives also play an important role in sealing the edges of displays, and are applied to surfaces too. Even screw fixings need to be secured according to the required strength category. It is of fundamental importance nowadays to ensure that components are leak-tight. Gear pumps are particularly suitable for these types of task due to the delivery principle involved. They can be used for both dot and bead application, and deliver or meter the medium in precise, reproducible work stages.

As the media used include those with critical chemical properties – a tendency to polymerisation as a result of increases in temperature caused by bearing friction – the scope of the task was very complex. As a result, only gear pumps developed specifically for this application can be used. The pumps also need to be as efficient as possible, even at high differential pressures, and be able to provide precise volumetric metering at low viscosities.

The gear pump as part of an overall system

The industrial company's request found its way to Beinlich Pumpen in Gevelsberg. First of all, a full evaluation of the situation was carried out through intense discussions on site. The various tasks and the problems identified were analysed. It became clear that the metering equipment was difficult to clean and that, as previously, problems arose from media hardening during downtimes. Generally speaking, gear pumps are always part of an overall system. It was possible in this case to make use of the existing gearwheel set (modules and tooth number). Meanwhile, the housing components were adapted to the predefined geometry and specifications used in the industry.

The DARTec® pump: an application-specific solution made from standard parts

The result of this logical process was the DARTec®. Just like the vast majority of gear pumps, it consists of a front, a middle and a rear plate, with two thrust washers, a gearwheel set, a pump shaft and a drive shaft. The latter two are fed into high-precision bearings. The pump is specifically designed for use in areas requiring high reproducibility and metering accuracy. Attention should be drawn to its compact design, which enables it to be used in handling devices or robot applications. The enclosed bearing minimises dead space and prevents the risk of 'hardening' during downtimes. There is no bearing friction, meaning there is no fear of additional heat entering the medium.

The metering pump is easy to clean as this procedure need only be carried out on the gearwheel chamber, there being no contact between the media and the enclosed, self-lubricating bearing. Low drive torques mean it has a good energy footprint, with efficiencies of around 90% being possible even at low viscosities. The pump can deliver media with a very wide range of viscosities. The operational spectrum is between 1 and 1 million mPas.

Owing to its chemical stability it can also be used in adhesive bonding technology to deliver or meter aggressive media, amines, catalysts or peroxides. The DARTec® can also be used in applications in which the medium has a very low viscosity while at the same time the operating pressure can reach 200 bar. This means the pump can also be used in adhesive bonding technology in situations where low-viscosity media such as catalysts, hardeners, etc, are specified as the medium to be delivered.

Following the development phase, which lasted around four months, extreme and fatigue testing was carried out. It became clear from this that the expectations had been exceeded. This was true in almost all areas, both in terms of continuous performance and in the pressure ranges achieved. As well as in-house trial runs, several tests were also carried out in the context of the industrial application. It was clear that consistently good results were achieved in all these series of tests.

For more information contact:

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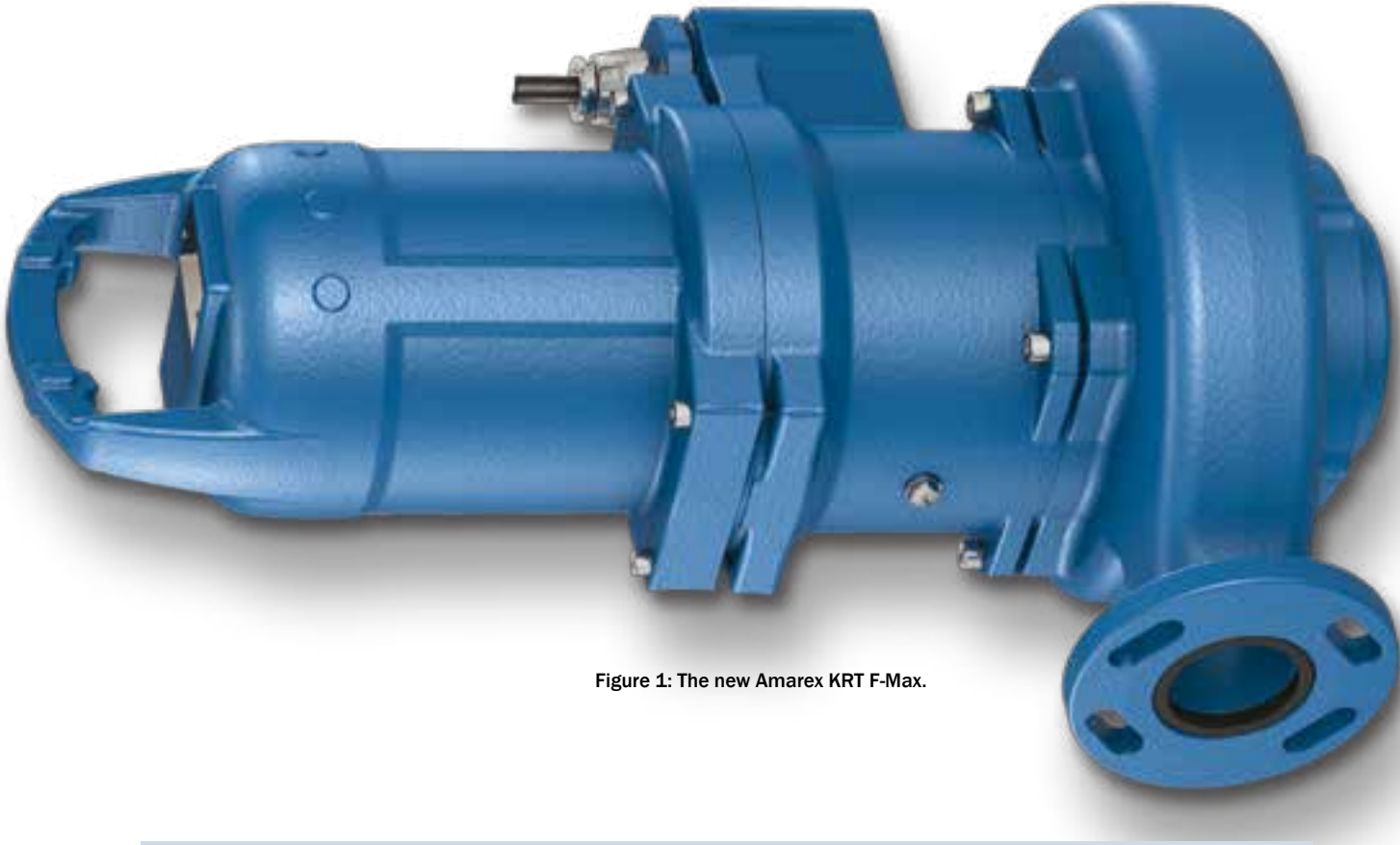


Figure 1: The new Amarex KRT F-Max.

New impeller combines reliability and efficiency

by Bryan Orchard

Growing demands from the water and wastewater treatment industries for submersible motor pumps that resist clogging, deliver reliability and contribute to improving energy efficiency, have led to KSB AG's new centrifugal pump.

Against a background of growing demands from the water and wastewater treatment industries for submersible motor pumps that resist clogging, deliver reliability and contribute to improving energy efficiency, KSB AG has developed a new centrifugal pump, the Amarex-KRT F-Max (Figure 1) that addresses these issues. Improved hydraulic system and motor performance are delivered through the design of a new vortex impeller and a motor that offers efficiencies currently calculated according to the same IEC 60034-2 measurement method as that used for motors of dry-installed pumps.

In order to attain a pump's optimum operating point, it is essential to select the correct impeller and size of impeller for the application. Whilst free-flow or 'open' impellers enable suspended solids in wastewater to pass more easily through the pump than closed single channel or multi-channel impellers, they do not compare favourably when it comes to performance. It is for these reasons that KSB has focused on designing an open impeller that can achieve and even exceed the efficiency levels associated with single-channel impellers. To improve overall efficiency, KSB has looked to optimise the motors' efficiency in anticipation of future standards and market requirements is in compliance with IE3.This has enabled KSB to markedly reduce energy consumption.

Impeller development

The concept behind the design of the new pump is the elimination clogging, a problem that causes inefficient flows and possibly subsequent pump failure through the presence of solids in wastewater. According to KSB the first stage in finding a solution to clogging was to differentiate between rigid and non-rigid solids. Michael Lebkuecher, who headed the product management solid burden pumps, comments: "Rigid solids need to have sufficient space in the pump chamber for them to pass through the pump. When it comes to non-rigid solids we have to ensure that the presence of wet tissues and similar fibrous materials do not form a mass. These problems were resolved, but then the next challenge was to address overall efficiency."

Fibrous materials, such as hygienic wipes, have become a major problem in waste water transport as their use has markedly increased in the last few years. As a result of the trend towards conserving drinking water and separating stormwater and waste water, the waste water to be handled has become 'thicker'. This is why operators now demand non-clogging impellers that offer reliable operation without sacrificing high efficiencies, even for small waste water pumps.

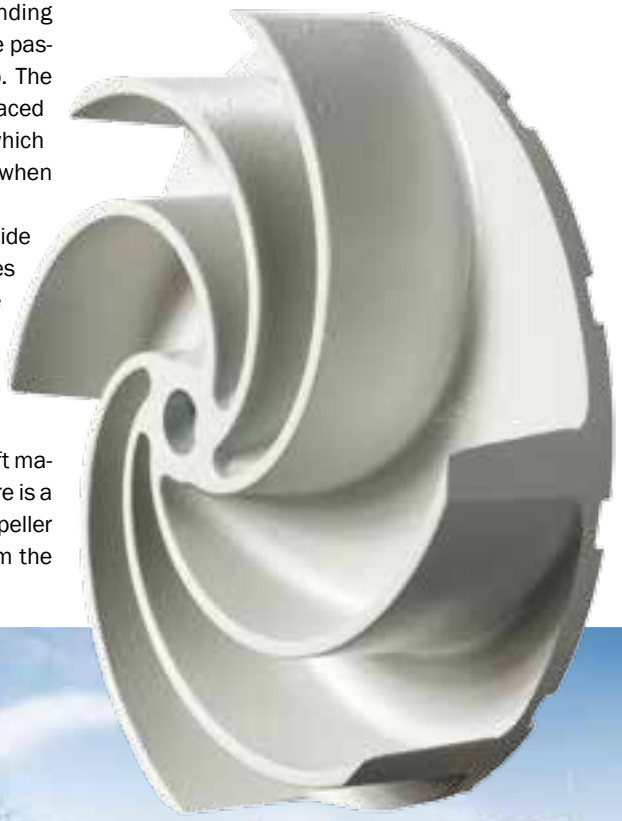
Based on decades of experience in free-flow impeller design, KSB's hydraulic experts employed Computational Fluid Dynamics (CFD) to gain detailed knowledge about the complex flow processes inside the pump via computer-aided simulations. The F-Max Impeller combines outstanding hydraulics efficiency in a vortex impeller with the free passage of rigid and non-rigid solids through the pump. The six vanes on the surface of the vortex impeller are spaced at irregular intervals (Figure 2) that creates gaps which allow rigid solids to pass through the impeller, even when the impellers is close to the suction cover.

Machining grooves into the surface of the reverse side of the impeller spread out from the centre balances the axial thrust. Making a groove rather than a vane means that the impeller can be moved closer to the suction cover, thereby minimising the gap.

Having resolved the issue with rigid solids, KSB's designers turned their attention to that of soft tissues and similar fibrous materials. Blockages involving soft materials start at the hub or 'eye' of the impeller and there is a physical reason for this. The revolving motion of the impeller introduces velocity and the greater the distance from the centre of the impeller is where the velocity is greatest. If there is material at the centre of the impeller, there is insufficient speed to eject the material which means that a swirl has to be created to remove the material. The swirl comes from the radius and shape inside the impeller vanes and this swirl is three-dimensional and it is this which moves the materials through the system.

The F-Max achieves a highly effective swirl motion through a slight convex profile at the hub of the impeller, achieving efficiencies that have previously only been

Figure 2: The six vanes on the surface of the vortex impeller are spaced at irregular intervals.



> “When it comes to calculating the motor efficiency of a submersible pump, every manufacturer applies its own methods.”

reached by single-channel impellers. When rotating, the impeller creates a strong swirl which keeps solids in suspension and significantly reduces the risk of clogging (Figure 3). Since the radial forces and vibrations created by the new impeller are usually lower than those of single-channel impellers, the service life of shaft seals and rolling element bearings is increased. Pumps with F-max impellers thus require only minimal maintenance. Replacing the impeller itself is also straightforward.

New motor IE3

The ErP directive on motor efficiency only applies to motors of dry-installed pumps, not for submersible motor pumps. In the absence of a standard for submersible pumps KSB has developed its new motor using calculations currently calculated according to the same IEC 60034-2 measurement method as used for motors of dry-installed pumps. It is for this reason that the Amarex KRT F-Max pump is described by KSB as being ‘in compliance with IE3’, in anticipation of future standards and market requirements.

When it comes to calculating the motor efficiency of a submersible pump, every manufacturer applies its own methods, with some accounting for the internal losses in the hydraulic system or in the motor’s efficiency. The losses of the individual components (motor, pump) occurring on a dry-installed pump can be clearly identified, whereas this is not so obvious on a submersible motor pump. In designing its new motor KSB looked at the overall efficiency, ie, the efficiency of both pump and motor.

KSB’s new IE3-like energy-saving motors – which take mechanical losses into account – benefit from a number

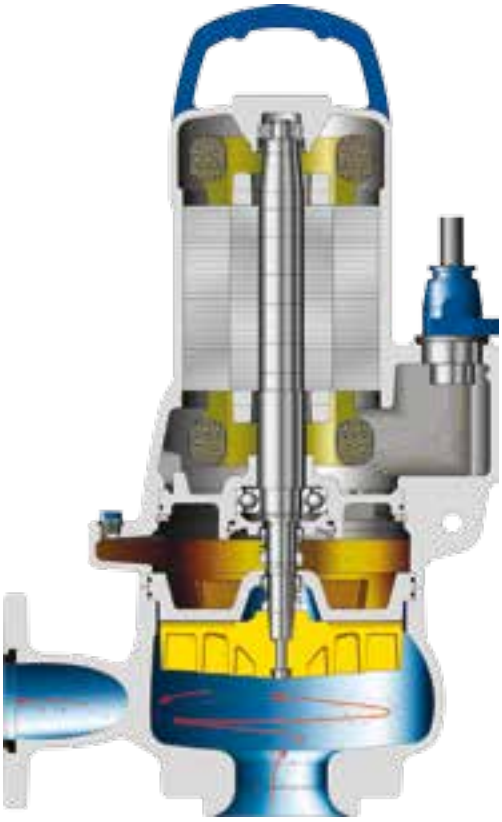


Figure 3: The principle elements of the Amarex KRT F-Max.

of important technical improvements, the key ones being improved aluminium rotors and materials and improved motor windings. By optimising the rotor, it has been possible to reduce the heat generated in the stator windings, rolling element bearings and rotor cage, the magnetic losses in the stator core, the friction losses incurred in the bearings, the operating temperatures of all motor parts and the electrical resistance in the motor windings and the rotor cage. This has resulted in a reduction of current consumption and an increase in service life of both the insulation material and the bearing grease.

Optimising the motor winding has had the positive effects of reducing magnetic flux losses and thus reduced magnetic losses, increasing power factor (cos phi) and therefore reduced rated current, and limiting the starting current ratio (Id/in) to very low values (< 8 compared with 10, customary in the market, hence a reduction by 20%).

Summary

The Amarex KRT F-Max offers the capabilities to handle wastewater, river water, stormwater, municipal waste water, sludges, industrial waste water, seawater and brackish water. In order to accommodate this extensive range, impellers are available in cast iron, stainless and acid-resistant duplex steel. The pump has the capability to deliver flow rates of up to 130 m^3/h and heads up to 60 m.

Manufacturing is now underway at KSB’s factories in Lille, France and Halle, Germany and plans are in place to extend manufacturing to its operations in India, China and Brazil thereby ensuring this new pump is available on a global basis.

High-quality angle seat globe valves for use in pure steam applications

Valve solutions must satisfy strict demands when used in complex pure steam systems, such as those in the foodstuff or pharmaceutical industries. The GEMÜ 505 and GEMÜ 555 pure steam valves are manufactured from high-quality materials, enable optimal processing of the individual materials and offer numerous advantages in terms of both function and servicing.

In the foodstuff industry in particular, but also in the chemical and pharmaceutical industries, products must sometimes be manufactured aseptically. As a result, stringent requirements are placed on the purity of the working media used during manufacturing and even the steam used. If steam comes into contact with surfaces or directly with liquid or gaseous products during aseptic production, this contact must satisfy the purity requirements of the products. The solution is found in complex pure steam systems at product requirement level. GEMÜ is able to meet these requirements with the aseptic GEMÜ 505 and GEMÜ 555 globe valves.

The pneumatic (GEMÜ 555) and hand-operated (GEMÜ 505) angle seat globe valves have been specially developed for isolating pure steam in close collaboration with well-known customers from the pharmaceutical industry and provide a genuine alternative to the valve types which are usually used. They require significantly less maintenance than diaphragm valves, for example, and are easier to clean than ball valves. The globe valves are available in nominal sizes DN8 to DN80.

All media-wetted parts are manufactured from high-quality stainless steel (316L) in order to meet the stringent requirements placed on the quality of the components used in the systems. The valve body is mechanically polished with high precision on the inside and electro-polished on the outside. With this surface finish, GEMÜ is able, thanks to the body geometry on the inside of the body as well as extensive technical expertise, not only to produce Ra values of down to 0,4 µm but to even reliably reproduce them.

Even in the actuators, the materials and the processing of the individual materials are impressive, as is the case with the stainless steel bellows which accomplishes up to 100 000 cycle duties without problems and enables the actuator to use non-ferrous metals, for example. The sealing at the valve seat is provided by a seal made of extremely inert, acid-resistant and heat-resistant thermoplastic synthetic material (PTFE).

The stringent requirements placed on products in the pharmaceutical and foodstuff industries call for, amongst others, the traceability of all media-wetted parts in order to guarantee product quality and product reliability. For this reason, valve bodies, the retaining nut, seat, valve plug, spindle, bellows and actuator seal of the GEMÜ 555 and GEMÜ 505 are manufactured in specific batches and combined together in one production run. As a result, material test certificates in accordance with 3.1 DIN EN 10204, amongst others, can be issued and supplied with the product where necessary.

Above: GEMÜ 505; below: GEMÜ 555

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In-field valve positioner checks using a handheld ProcessMeter

Valves, the actuators that move them, and the electronic circuits that control them, are all subject to the effects of aging soon after they are installed. The valve seat wears not only from the repeated seating of the valve, but from the liquid or gas that passes through it. Depending on the application, a valve can be stroked from hundreds to tens of thousands of times over a one-year period.

This amount of mechanical motion inevitably causes screws to reposition, springs to weaken and mechanical linkage to loosen. In addition, electronic components change value over time. The results are valves that don't fully open or close, close prematurely, or operate erratically and cause improper regulation of the gas or liquid under its control. This is more commonly referred to as "calibration drift."

To keep a system operating properly, a good preventative maintenance program that mandates periodic checks of valve positoners is required. These checks need to be conducted quickly to minimise down time. When these checks reveal calibration drift, recalibration of the electronic valve positioner must be performed quickly. With the varied locations in which a valve can be installed and the difficulty in removing it, the equipment used to perform the checks must be brought to the valve positioner itself. Therefore, this "in-field" tester must be portable, easy to use and rugged.

The tester, with signal sourcing, must simulate a controller connected to a valve positioner's input. Through the controls on the ProcessMeter, the operator can set the positioner's input current to a specified level and visually inspect the reaction of the valve's position using the mechanical position indicator, the valve stem position or flow indicators. In addition, the process meter must continuously adjust the source current in a ramping or stepping fashion, allowing the user to check the valve's linearity and response time.

Always ensure that the personnel responsible for the process you are working on are informed of your intentions prior to making any checks of valve operation. Be alert when touching any moving machinery.

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High quality sealing products from BMG

BMG stocks a diverse range of sealing products to suit most sealing applications for the automotive, agricultural, mining, earthmoving, petrochemical, paper and pulp and general industrial markets.

"BMG's commitment to providing high quality sealing products is evident in the extreme care taken in brand selection, in terms of standardisation, reliability, flexibility and consistent quality controls," says Marc Gravett, business unit manager seals, BMG. "The company has secured the exclusive supply, service and distribution agreements with leading global seals manufacturers, which means quality branded components are readily available.

"An extensive range of sealing products is available through BMG, as well as from the company's exclusive seals outlets, trading as BMG Sealco. BMG Sealco branches specialise largely in hydraulic cylinder sealing for earthmoving, mining, agriculture and industrial applications."

BMG's sealing products include rotary shaft, torric, hydraulic and pneumatic seals, as well as allied products like O rings, waved washers, circlips, mechanical seals, gland packing and adhesives. Recent additions to the range are Mekrolek rotary couplings and the Spanjaard range of lubricants and allied chemical products.

Mekrolek rotary couplings or rotary joints, are designed to provide a reliable, leak-free seal for water, steam, oil, and air, between a stationary supply and a rotating workpiece. These robust rotary couplings - which are available in mono and dual flow configurations, in threaded, flanged or quick release options – can be manufactured in various materials, including stainless steel, brass and aluminium.

Important features include hydraulically balanced mechanical seal faces which reduce rotor torque and stainless steel rotors that prevent scale build-up. There are no springs in the media which results in optimal flow rates. Units with high wear resistant faces are designed for operation in harsh conditions. Non-standard couplings are also available from BMG.

BMG's Spanjaard range of lubricants and allied chemical products are suitable for industrial, consumer, automotive, marine and mining applications. These products include anti seize compounds, assembly and disassembly products, chain lubricants, cleaners and degreasers, electrical maintenance products and engineering and fabrication products. Also available are greases (including bearing greases) lubricating aerosols and open gear/wire rope lubricants, as well as paint and material protection products.

BMG also offers a manufacturing facility for custom designed sealing products, fabricated to exact specifications. This service also includes a full refurbishment facility for most brands of couplings. Every unit is inspected and pressure tested for optimum performance, according to stringent quality standards.

Mekrolek rotary couplings or rotary joints, are designed to provide a reliable, leak-free seal for water, steam, oil, and air, between a stationary supply and a rotating workpiece.

BMG's Spanjaard range of lubricants and allied chemical products are suitable for industrial, consumer, automotive, marine and mining applications.

For further information contact:
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Chemical industry sees return to quality pumps

Local manufacturers within the chemical and petro-chemical industry are shifting towards high technology pumps that meet the highest specifications in order to remain abreast of ever stricter international standards.

This is according to Kenneth McGeehan, KSB Pumps and Valves Projects Department, who adds that there is simultaneously a strong requirement to meet local content policies for almost all major projects that are happening or being planned for the future.

"This puts us in a unique position as a global technology leader in the pump industry with our own internationally accredited manufacturing plant right here in South Africa. That means that local users get the best of both worlds with the latest technology pumps developed on the global stage and manufactured locally.

"A good example is our standard RPH and the RPHmdp process pumps which are well proven in the market and undergo regular development and constant improvement to ensure they are at the leading edge of performance and efficiency. They can be configured for any API material where pressure and temperature are a key influencer in the pumps' manufacture. As a result, they can handle varying pressures and temperatures on chemical and petrochemical applications.

"These are exceptional pumps and there are many more equally and even more impressive pumps in our range. It is therefore safe to say that no matter what the application we will have a solution, or we will develop a solution, using the best of local and international technical talent at our disposal.

"Also, with the need for cleaner fuels and advanced chemicals there is a need for super efficiency and reliability in order to support uninterrupted manufacturing outputs. As a supplier of advanced, quality pumps our sales are buoyant as a result of the market's return to quality brands.

"Our local presence also means that we are fully committed to the local chemical and petrochemical industries and are easy to do business with, have shorter lead times and buyers get the benefit of authorised and accredited service and repair facilities in South Africa," says Kenneth. He concludes that the company supplies many of the largest chemical manufacturers in the country, yet remains easy to do business with and committed to its entire customer base – from the largest to the smallest.

For more information contact:
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A catalytic membrane reactor for mitigating water-induced catalyst deactivation in Fischer-Tropsch synthesis

by Michael O Daramola, PhD, CEng, MIChemE, School of Chemical and Metallurgical Engineering, University of the Witwatersrand, Johannesburg, South Africa

Fischer-Tropsch (F-T) synthesis is a surface-catalysed polymerisation reaction that involves conversion of synthesis gas (CO and H_2) derived from coal, natural gas, heavy oil or biomass into hydrocarbons. In this article, a catalytic membrane reactor is proposed for mitigating the effect of water-induced deactivation of F-T catalyst during synthesis.

In recent times, strict regulations and policies on environment to reduce environmental pollution and degradation are constantly being formed and implemented. Therefore, diversification of sources of fossil fuels, the major sources of environmental pollution, and the utilisation of stranded gas have re-awakened global interest in Fischer-Tropsch (F-T) synthesis. Synthetic liquid fuels, major products of F-T synthesis, have a very low content of sulphur and aromatic compounds compared to fossil fuels and are thus preferred as clean fuels for a clean environment. Besides the environmental concerns, abundant reserves of natural gas in many parts of the world have ignited global interest in F-T synthesis and new plants based on F-T synthesis technology are now commissioned periodically [1].

Fischer-Tropsch synthesis is a surface-catalysed polymerisation reaction that involves conversion of synthesis gas (CO and H_2) derived from coal, natural gas, heavy oil or biomass into hydrocarbons consisting of paraffins, olefins, alcohols and aldehydes. Production of the syngas from coal, natural gas, heavy oil or biomass could be through steam reforming (for natural gas) and gasification (for coal, oil and biomass). The long-chain linear paraffins obtained from F-T synthesis are cracked further into short-chain hydrocarbons in fluidised-bed catalytic cracking (FCC) units [2]. In addition, recent developments in the design of process-intensified bi-functional Co-based catalysts, that could combine F-T

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Table 1: Comparison between Co-based catalyst and Fe-based catalyst [1]

Parameters	Co-based Catalyst	Fe-based catalyst
Selectivity to linear paraffins	higher	lower
Selectivity to olefins	lower	higher
Catalytic activity	higher	lower
High quality feedstock (syngas from natural gas)	better	good
Low quality feedstock (syngas from coal, biomass)	good	better
High temperature FT(330-350 °C)	good	better
Low temperature FT (200-250 °C)	better	good
Activity at low conversion	comparable	comparable
Effect of water on catalytic activity	lower	higher
Productivity at high conversion of CO	higher	lower
Maximal chain growth probability	0.94	0.95
Water gas shift (WGS) activity	lower	higher
Maximal sulphur content	<0.1 ppm	<0.2 ppm
Flexibility (temperature and pressure)	less flexible	Flexible
H_2/CO ratio	~2	0.5-2.5
Attrition resistance	good	not good
Cost	more expensive	less expensive
Life time	better	good

synthesis and hydrocracking reactions in the same catalyst, are being explored by researchers [3,4] and could revolutionise F-T synthesis in the near future.

Catalysts and catalytic reactors in F-T synthesis

All group VIII metals have shown activity in the hydrogenation of carbon monoxide to hydrocarbons (HCs). The average molecular weight of hydrocarbons produced by all group VIII metals during FTS in descending order is: Ru > Fe > Co > Rh > Ni > Ir > Pt> Pd, making only ruthenium, iron, cobalt, and nickel members of the group that possess sufficient catalytic characteristics for commercial production [5]. However, nickel catalysts under practical conditions produce too much methane and ruthenium is too expensive with insufficient worldwide reserves for large-scale industry, leaving only cobalt and iron as viable options. Cobalt and Fe-based catalysts are prepared by dispersing nanoparticles of Co or Fe on a support such as Al_2O_3, SiO_2 or TiO_2. This support which acts as carrier only, may also contribute positively or negatively to the catalytic activity [2,6]. The comparison between Co-based catalyst and Fe-based catalyst presented in Table 1 shows that Co-based catalysts have high selectivity to C5+ linear HCs and low selectivity to methanation and water gas shift (WGS) reactions, making them preferable catalysts for low temperature F-T synthesis to produce long chain linear hydrocarbons. However, deactivation of both the catalysts is one of the major problems confronting their application in industry.

This article discusses catalyst deactivation and proposes strategies by which the problem could be solved, in particular water-induced deactivation. While a number of studies in literature have discussed the selection of reactors for F-T [1], issues such as exothermicity of F-T synthesis, diffusion limitations and hydrodynamics, and cost and material stability have been considered as problems in reactor selection for F-T synthesis.

Deactivation of catalysts in F-T synthesis

The mechanism involved in the conversion of syngas into HCs on F-T catalysts (eg, Co-based catalyst) involves a series of elementary reaction steps. Side reactions such as water gas shift (WGS), methanation and formation of oxygenates via oxygenation compete with conversion of syngas to HCs [7]. Performance and selectivity of F-T catalysts (eg, Co-based catalysts) in forming linear HCs depend on factors like catalyst synthesis method, type and stability of support, size of Co crystallites and oxidising and reducing pre-treatment methods [8].

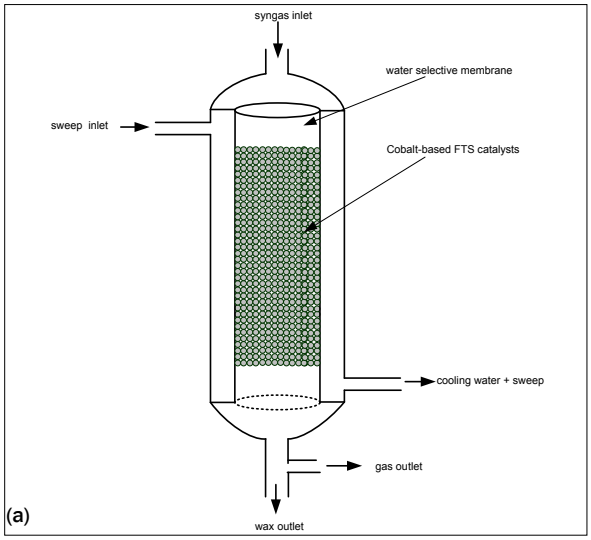
A number of studies are available in the literature on synthesis techniques, type and stability of support and steps involved in pre-treatment of the catalysts (eg, ref [8]). In spite of the enormous studies, deactivation of F-T catalysts is still a major problem. Typical deactivation kinetics of F-T catalyst (eg, Co-based catalyst) as described by Tsakoumis *et al*, involves an initial regime attributed to reversible deactivation and lasts for a few days to weeks, and a deactivation regime that is associated with irreversible deactivation (see ref [8] for more information). For example, some of the causes of deactivation of Co-based catalysts are oxidation of cobalt active sites, poisoning, sintering of cobalt crystallites, carbon deposition, and surface reconstruction [1,8]. The loss of catalytic activity is also related to the process operating conditions such as pressure, temperature, partial pressures of synthesis gas and steam and type of the reactor.

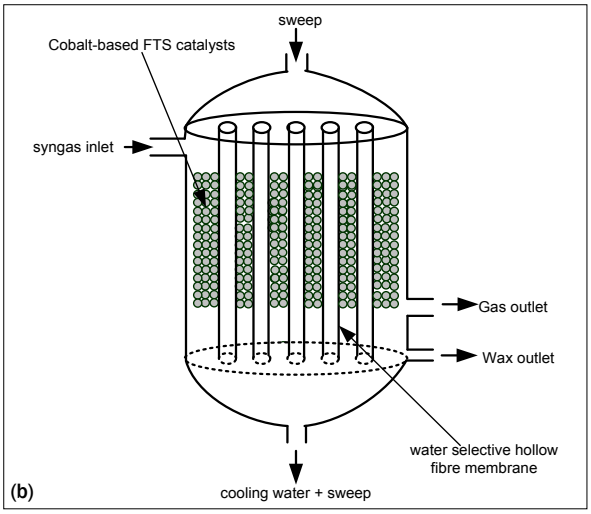
In this article, strategies for abating deactivation of F-T catalysts (eg, Co-based catalysts) are suggested.

Deactivation due to poisoning has been attributed to the presence of impurities like sulphur-containing compounds, nitrogen, alkali metal and alkali earth metal either in the feedstock (syngas) or catalyst support [8]. Poisoning is strong chemisorption of reactants or impurities on catalytic sites and these impurities block the available sites for catalytic reaction. Deactivation due to poisoning can be avoided by using high purity feedstock and catalyst support. Feedstock and support should be characterised very well to ascertain the level of impurities.

Deactivation of the catalyst due to carbon/wax/coke deposition [8-12] is another form of deactivation in F-T synthesis and could be minimised through the optimisation of process operating conditions to obtain an optimal H_2/CO ratio. In addition, periodical re-generation of the catalyst is necessary for de-waxing the wax-blocked Co-based F-T synthesis catalysts. In addition, the use of additives like Boron could minimise carbon deposition. Furthermore, the use of multifunctional catalysts having cracking ability could reduce the formation of carbon deposition, and reactor optimisation using supercritical media could be beneficial.

Since F-T synthesis is a highly exothermic reaction, the potential for sintering is relatively high. Sintering leads to a reduction of the active surface area either through atomic migration (Ostwald ripening) or/and crystal migration (co-





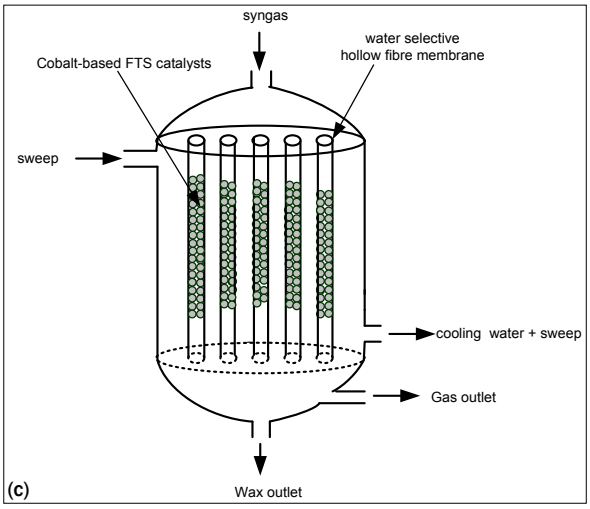


Figure 1: Proposed catalytic reactor configuration for minimising deactivation due to water production in the reactor showing Co-based catalyst: (a) packed within the waster-selective tubular membrane; (b) packed within the waster-selective hollow fibre membrane; (c) packed outside the waster-selective hollow fibre membrane.

alescence) [8, 10]. Catalyst deactivation due to re-oxidation occurs when cobalt-active sites are re-oxidised during F-T synhesis, forming inactive cobalt oxides and hence reduction in catalyst activity. High temperature operation and presence of water are two reasons proposed for sintering and re-oxidation [8,10]. Water (in the form of steam), a by-product of F-T synthesis from side reactions of surface oxygen and hydroxyl species that are removed from the catalyst surface via hydrogenation, promotes deactivation via re-oxidation [13]. A study by Storsæter *et al* suggested that the presence of water during F-T synthesis promotes deactivation of Co-based F-T synthesis catalysts. The authors showed that the rate of deactivation depends on the water (steam) content and deactivation is accelerated at increasing steam contents [14]. Also, sintering process generally takes place at high reaction temperatures and accelerates in the presence water vapour. Studies have shown that small crystallites are more sensitive to sintering, re-oxidation and solid state reactions with supports, thereby promoting and enhancing catalyst deactivation, especially promoted Co-based F-T synthesis catalysts [8, 10].

Sintering and re-oxidation process during F-T synthesis can be minimised by optimising F-T synthesis operating conditions with the aim of obtaining optimal operating temperature and H_2/CO ratio that will result in less sintering and surface re-oxidation. Reactor optimisation is also essential to ensure efficient heat removal to avoid hot spots due to temperature localisation. In view of the aforementioned statement, multi-tubular fixed-bed reactors are preferred to conventional fixed-bed reactors for effective and efficient heat removal during F-T synthesis. At the same time, reduction of water (steam) content during F-T synthesis, optimisation of crystallite size and optimisation of H_2/CO could be instrumental to reducing water-induced deactivation (re-oxidation).

Removal of water could be achieved with the use of water selective membranes incorporated into the F-T reactor system for in-situ removal of water. Microporous materials like sodalite could be a good option to fabricate the membranes. A number of studies on the synthesis and application of sodalite-based membranes have reported on the outstanding performance of sodalite membranes for selective removal of water from industrial process [15], for separation of H_2 during pre-combustion CO_2 capture [16] and for treating acid mine drainage [17]. Also sodalite membranes supported on α-alumina have been reported to be thermally stable up to 450ºC [18]. Therefore, sodalite membrane supported on α-alumina could be employed as water selective membranes in the form of Packed-bed Membrane Reactors (PBMRs) for F-T synthesis. In-situ selective removal of water during F-T synthesis could minimise water-induced deactivation, enhance CO conversion, HCs yields and prolong catalyst life time. Suggested configurations for the PBMRs are depicted in Figure 1.

The use of hollow fibre membranes in the reactor will enhance the surface area/volume ratio of the reactor system, thereby enhancing the production rate [19]. However, availability of reproducible high-flux defect-free sodalite membranes enabling commercial application could retard the development of this type of reactor configuration. In addition, the membrane flux should be able to cope with the rate at with water is generated during the F-T synthesis (ie, membrane flux = rate of water generation). Another problem is fouling of the membrane due to wax deposition. Concerted research efforts focused on the aforementioned

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Russia Oil output pumps to new record

Anna Belova, PhD, GlobalData's Senior Analyst covering Oil & Gas, said recently that Russian president, Vladimir Putin, ceremoniously opened the Arctic Gate marine oil terminal on May 25. The appropriately named facility provides access for Russia's Arctic-sourced crude to both European and Asian markets. The terminal was specifically timed to coincide with the commencement of commercial oil production at the Novoportovskoye field. Novoportovskoye is just one of five major planned oil fields scheduled to come online by year-end in Russia, and combined, their peak capacities promise to bring over 500 000 barrels per day (bd) of crude to the global market. When viewed in the context of the sustained resilience of Russia's mature fields, these projects promise that the country's two-year streak of record-breaking crude output is set to continue.

"By meeting with the Organization of the Petroleum Exporting Countries (OPEC) producers earlier this year, the Energy Ministry of Russia briefly signaled its openness to freezing crude production to stabilise global prices. However, while major Russian operators committed to support the ministry's ultimate decision, they openly spoke against a freeze and continued to invest heavily in new upstream developments. Russia was not invited to OPEC's June 2016 meeting.

"The five planned projects going into commercial production in Russia this year illustrate intensified capital investment, and the large numbers of pre-drilled wells at each project will allow several of the fields to realise peak production as early as 2017.

As is the case with most planned projects in Russia, the investments involved not only drilling campaigns and processing facilities, but also significant midstream components connect crude in the Caspian Sea, Arctic North, and East Siberia with domestic and international consumers. Construction on pipelines and export infrastructure for the five planned projects saw rapid progress in the first half of 2016. Commercialization of these projects serves as evidence of the growth approach taken by Russian operators, rather than the freeze advocated by other crude producers.

"The Russian ruble devaluation helped keep the country's operators afloat as global crude prices plummeted over the past two years. With most capital expenditure (capex) and operating expenditure (opex) denominated in rubles, Russian operators effectively decreased their dollar-denominated costs, and when the ruble lost half of its value, they continued to generate dollar-based revenues from crude exports. Russia's progressive taxation system, designed during the previous oil price run to capture the upside of high prices in the government vaults, further cushioned operators. When prices dropped, the Russian state took a large hit to its revenues, while Russian operators' revenues decreased by a smaller margin.

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Study shows BPS could be more harmful than BPA

A new study suggests that an increasingly common plastics chemical impacts the reproductive system as much, if not more, than the chemical it is gradually replacing.

Bisphenol S is used to make a variety of products, from plastic bottles to glues to receipt paper, particularly as a substitute for the much-maligned Bisphenol A, or BPA.

Numerous studies linked BPA to reproductive problems, and the substance was banned in baby products by many states. California this year began warning consumers about the risks associated with BPA at grocery stores and other retailers. Some scientists, however, expressed concern that the similar compounds used to replace it could also result in adverse health effects.to concentrations of BPA and BPS that mirrored the exposure level experienced by humans. The analysis found that the exposed worms had decreased fertility from both compounds, but that effects were seen at lower levels of BPS exposure than BPA. Researchers suggested that mammals could be similarly impacted and that BPS could damage women's eggs at lower doses than BPA.

"This study clearly illustrates the issue with the 'whack-a-mole' approach to chemical replacement in consumer products," said study author Patrick Allard. "There is a great need for the coordinated safety assessment of multiple substitutes and mixtures of chemicals before their use in product replacement."

The chemical industry, meanwhile, long defended BPA and similar compounds as safe and pointed to findings by regulators in the U.S. and Europe.

The American Chemistry Council said last year that California's decision to list the chemical under Proposition 65 "is not supported by the extensive scientific record presented to the committee and is completely contrary to explicit input provided by the US Food and Drug Administration."

Story by Andy Szal for
http://www.chem.info/news/2016/08

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In order to ensure employee safety and to prevent any infrastructural damage to a multi-billion dollar floating production, storage and offloading (FPSO) vessel located at a deep water oil project off the coast on Angola, a total of US$1 million-worth of MSA General Monitors (GM) fixed flame and gas detection products have been supplied to the project.

The order was placed by Malaysia-based international offshore oilfield services provider Bumi Armada Berhad (BAB), responsible for the chartering, operations and maintenance of the FPSO which, when completed by Q4 2016, will utilise an external turret with 18 risers and umbilicals connected to it, and a storage capacity of 1 800 000 barrels.

This fourth-generation FPSO will boast a crude oil production rate of 80 000 barrels a day and a water injection rate of 120 000 barrels per day, as well as a gas-handling capability of 120 000 million standard cubic feet. The FPSO will have a topside weight of 15 000 t, and will be moored at a water depth of 450 m. Reliable gas and flame detection is essential to a structure of this magnitude.

MSA Africa Director Colin Oliver explains that the products were delivered in late 2015. "As part of our value-added after-sales service offering, we have already provided product training to some BAB employees in Malaysia, and will also train the onsite employees once the FPSO is complete. Continuous technical support will also be provided."

For more information contact:
Colin Oliver on tel: +27 11 610 2600; email: Colin.Oliver@msasafety.com or go to www.msasafety.com

Engen celebrates women truck drivers this Women's Month

Engine truck drivers; Palesa Modiselle,Tebogo Sekowe and Nomagugu Dhlamini.

Engen's National Transport Manager, Llewelyn Snyman explains that there's nothing stopping women in an environment previously dominated by men. "We recruit drivers from around the country and they arrive with an EC Code Licence: if they are selected, we put them through our Professional Driver Learnership Programme to equip them with the necessary skills and mind-sets to transport diesel, petrol or paraffin. Thanks to our Bulk Truck Operator (BTO) Instructors who provide the dangerous goods training as well as mentoring and coaching, they emerge with a Professional Drivers Permit and are ready to join our team."

Working out of Engen's Langlaagte Depot, Palesa Modiselle began driving large rigs for Fast and Fresh before joining Engen in 2006. With Engen she has been given the opportunity to study Business and Transport Management. Now 37-years-old, Palesa, describes herself as 'very single' and finds driving fun. "I like the fact that the job is challenging: while it is a big responsibility, it's great for someone who likes her own company and being in control," she says.

Also from Langlaagte is Tebogo Sekowe who completed her learnership in 2009. She was was employed on a permanent basis in 2010. The 38-year-old is married without children. "I enjoy competing within a predominantly male team, whilst also enjoying the solitude of life on the road," says Tebogo.

Her colleague Nomagugu Dhlamini, who joined Engen in 2009, commends the company for its employee benefits such as medical aid, pension and school, car and housing support. Now 42-years-old, Nomagugu recognises that this kind of tough work is a man-sized job, and that it takes a lot out of a driver. She says she would welcome moving into an office position, once she gets to the end of her road.

Engen's Pretoria Terminal Manager, Kebone Dlamini appreciates the commitment she sees in Engen's women drivers. "You get a sense that they are working for their families and that they are proud of what they do. These women are certainly on the same level, professionally as their male counterparts."

Professionalism and excellence go hand-in-hand in an environment that has zero tolerance for error. Twice annually all drivers undergo assessments. Continuous improvement is fostered through on-going training.

For more information contact: Samantha Walt on tel: +27 87 997 0111

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problems during the development of PBMRs for F-T synthesis could proffer solutions to them. It is expected that concerted research efforts in the area of membrane development involving multidisciplinary efforts from Chemical Engineering, Materials Science and Engineering, Chemistry and Catalysis Engineering could accelerate the feasibility of the proposed reactor system for F-T synthesis.

Conclusion

In summary, optimisation of the existing reactor design and operating conditions might be essential to mitigate catalyst deactivation. In addition, design of new catalyst through the in-depth understanding of the nature of the catalyst through molecular modelling approaching using Density Functional Theory (DFT) might be instrumental to the design and synthesis of deactivation-resistant catalyst for F-T synthesis. Huge success recorded in each step could pave the way for the actualisation of optimised Co-based F-T synthesis catalysts displaying little or no deactivation.

References

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

Natural emollient esters
from bio-based succinic acid

by Tara J Mullen, Manager of Application Engineering and Technical Support, BioAmber Inc, Minnesota and Susan Raffy, president of Susan Raffy Consulting, California, USA

Bio-based succinic acid is a natural raw material, that can be used produce a wide range of personal care ingredients including ester solvents, emollient esters, and surfactants.

Made from plants, bio-based succinic acid can be reacted with natural alcohols to produce bio-based esters. C8-C18 esters have been shown to exhibit unique emollient properties for skin and hair care. While this article will focus on the performance of selected emollient esters, C2-C5 succinate esters have been shown to be excellent solvents for personal care applications including fragrance carriers and nail enamel removers. Additionally, bio-based succinic acid is an effective preservative and effervescent agent.

Natural emollient esters based on the company's bio-based succinic acid have been found to exhibit a range of feels depending on their molecular weights. The emollient esters are soluble in a variety of cosmetic base fluids, providing ease of formulation with these natural ingredients. The emollients have a dry-feel, and provide a silky, powdery non-greasy sensory signal. In addition, the succinate esters provide excellent shine and gloss.

BioAmber bio-based succinic acid is carbon neutral at industrial capacity. The Ontario, Canada, plant will generate a savings of more than 100% greenhouse gas emissions, and uses 60,9% less energy compared to petrochemical production of adipic acid kilogram per kilogram [1].The use of bio-based succinic acid immediately reduces the overall footprint of any product, when used as a direct replacement for energy and carbon intensive petrochemicals.

Bio-based succinic acid can be used to make natural succinate esters that can be formulated into personal care

applications that are 100% natural and non-GMO. Diesters from this bio-based succinic acid are renewable alternatives to petroleum-based emollient esters for personal care. They provide high shine, excellent feel, are easily formulated, are mild and non-irritating, and can be up to 100% derived from plants when using plant-based alcohols.

Formulations

Three natural succinate diesters were synthesised by reacting bio-based succinic acid with the corresponding alcohols (Table 1). After screening a number of diesters for feel, three succinate esters were selected in order to examine the properties they impart to skin and hair care formulations. Oleyl alcohol (unsaturated C18 straight chain alcohol) was reacted with bio-based succinic acid to form dioleyl succinate (DOS). Dioleyl succinate is a natural, heavy-feel emollient ester. Stearyl alcohol (saturated C18 straight chain alcohol) was reacted with bio-based succinic acid to form distearyl succinate. Distearyl succinate is a solid diester that has potential as a heavy-feel emollient, as well as a pearlescent agent. A mixture of caprylic and capric alcohols was used to synthesise the mixed ester, octyl decyl succinate (ODS). ODS is a light-feel succinate ester that is soluble in a range of cosmetic fluid bases. All of these succinate esters are natural emollients' esters, made from plants, with up to 100% bio-based carbon as defined by ASTM D6866.

The succinate esters were evaluated for feel, and formulated into skin and hair care products based on their performance. The sensory evaluations of the diesters, the formulations, and the evaluation of the formulated products compared to the controls were conducted by Susan Raffey Consulting [4].

Results and discussion

Octa decyl succinate

ODS was tested for its solubility in a variety of cosmetic fluids (Table 2). 10 Wt-% of ODS was combined with solvent at room temperature. While ODS was insoluble in water and butylene glycol, it was soluble in a number of other cosmetic fluids including a variety of oils, dimethicone fluid, and isopropyl myristate. The wide range of solubility allows for easy formulations of the natural succinate diester into a variety of personal care formulations.

ODS was tested for skin irritation using the Repeat Insult Patch Test conducted at AMA Laboratories. Testing was conducted on neat ODS with a semi-occlusive patch on 50 subjects. The patch was applied directly to the skin for 24 hours, and then removed. The procedure was repeated for nine consecutive exposures with 24 hours between each exposure, for three consecutive weeks. Skin reactions are scored just before applications 2 to 9. After a 10 -14 day rest period, a retest dose was applied to a previously unexposed area. RIPT testing showed no response for any test subject over the course of the test [3] indicating ODS is a mild and non-irritating natural emollient ester.

Octyl decyl succinate (ODS) has a high refractive index at 1,45, which makes it most suitable as a natural glossing agent. On its own, ODS was found to have a substantial 'glide' feel, similar to jojoba or castor oils. In addition, the ODS has very low odour, making it an excellent candidate for non-fragranced formulations.

Due to the high shine of ODS, it was formulated into a Hair Shine Serum at 5,0 wt-%. A positive control was also formulated, which contained 5,0 wt-% of cyclopentasiloxane (Cosmetic fluid 995).

Table 1: Natural succinate Emollient Esters

Succinate ester	Succinate Ester Molar Mass (g/mol)	Physical State
Octyl Decyl succinate	371 on average	Liquid
Dioleyl succinate	619	Liquid
Distearyl succinate	623	Solid (mp 67 °C)

Table 2: Solubility of octyl decyl succinate [2]

Solvent (INCI Name)	Solubility
Water	Insoluble
Butylene glycol	Insoluble
Isopropyl myristate	Soluble
Caprylic/capruic triglyceride	Soluble
Dimethicone fluid	Soluble
Ethyl trisiloxane	Soluble
Safflower oil	Soluble
Castor oil	Soluble
Mineral oil	Soluble
Hydrogenated polyisobutylene	Soluble

Diesters are renewable alternatives which are easily formulated, mild and non-irritating and can be 100% derived from plants.

Natural emollient esters impart a light, dry, non-greasy sensory signal to skin care formulations

ODS was compatible with the silicone base fluid, and the hair shine serum containing the natural octyl decyl succinate was found to have equal clarity and colour compared to the control. The ODS containing hair shine serum was also found to have a richer and more luxurious feel, was less greasy compared to the control, and dry evaporated to a velvety finish. Overall, the ODS was found to impart positive sensory attributes to the hair shine serum, as well as provide a bio-based natural ingredient.

Heavy feel emollients: dioleyl succinate and distearyl succinate

Dioleyl succinate was formulated into a hair conditioner at 5,0 wt-% and was used as a one-for-one replacement of 350 cps dimethicone. The hair conditioner using dioleyl succinate had better opacity compared to the control formulation. In addition, the conditioner was significantly creamier and richer. Finally, the dioleyl succinate imparted a more substantial feel during rub out.

Distearyl succinate was formulated into a moisturising cream at 3,0 wt-%. It was used as a one-for-one replacement of dimethicone and dimethicone cross-polymer. The moisturising cream with distearyl succinate was thicker than the control formulation at room temperature. The cream had excellent feel, with an average rub-out. After rub-out, the formulation with distearyl succinate had slightly lower gloss, but better creaminess. The lower gloss is most likely due to distearyl succinate being a solid succinate ester.

Conclusion

Bio-based succinic acid is a versatile intermediate for new natural personal care ingredients. Made from non-GMO plant feedstock, BioAmber's bio-based succinic acid can be used as a preservative, an effervescent agent, and an intermediate for natural emollient esters and solvents. Additionally, the bio-based succinic acid is carbon neutral at industrial scale. When reacted with natural alcohols, a range of natural emollient esters can be produced. These emollient esters impart a silky, powdery light, dry, non-greasy sensory signal to hair and skin care formulations.

In addition, liquid emollient esters are excellent glossing agents, imparting high shine to hair care formulations. The esters are easily formulated into oil in water emulsions, and are up to 100% derived from plants. Finally, the esters are mild and non-irritating, giving an excellent combination of performance and environmental profile.

References

1. "Field-to-Gate Energy and Greenhouse Gas Emissions Associated with Succinic Acid Produced At BioAmber's Facility In Sarnia Ontario," Riffel Consulting, March 2013
2. Solubility testing conducted at Cosmetech Laboratories, 39 Plymouth Street, Fairfield, NJ.
3. RIPT testing conducted at AMA Laboratories, 216 Congers Road, New City, NY. Dermatologist signed full reports available upon request.
4. Formulations and sensory evaluations conducted at Susan Raffy Consulting, 3420 W Macarthur Blvd., Santa Ana, CA

BioAmber is a next generation chemicals company, with a portfolio of renewable chemicals: a C4 Platform, based on bio-based succinic acid and its derivatives; and a C6 Platform, which includes bio-based adipic acid and other bio-based C6 chemicals. As a platform chemical, bio-based succinic acid has a wide range of applications, including as an intermediate for natural emollient esters. For more information, visit the company's web site at www.bio-amber.com.

A message from the SAEE President, Karel Steyn

Women's month – an exclusive group

August is not only supposed to be the last cold month of winter during which electricity is typically more expensive, but it is also the month dedicated to women. We all have important women in our lives and usually do very little to acknowledge that. We often forget what they really mean to us.

In the modern post-WW2 era, there have been notable political women leaders. Golda Meir, Maggie Thatcher, Indira Ghandi, Benazir Bhutto stand out, Cristina Kirchner less so. Some were major reformers (Maggie), others mothers to their nation (Golda). Some were thoroughly detested (going strictly by Kissinger).

But they were only mostly a sprinkling in their time, though each a torch bearer, breaking old moulds. Today, we have a whole bevy of women leaders in the most senior political positions around the world, and fate may be about to turn them into a posse. There is Angela Merkel in Germany, Theresa May in Britain, Nicola Sturgeon in Scotland, Dalia Grybrauskaite in Lithuania, Beata Szydlo in Poland, Erna Solberg in Norway, Arneenah Gurib in Mauritius, Marie Preca in Malta, Janet Yellen at the Fed, Christine Lagarde at the IMF. And waiting in the wings are Clinton in the US and Le Pen in France. And of course Nkosazana Dlamini-Zuma in SA. Although not in the political sphere, but still worth mentioning, we also have our own SAEE president elect, Lisa Reynolds taking over the reins from November this year.

Karel Steyn

Of these many notable ladies in power at present, some stand out, especially Merkel, May, Yellen and Lagarde. The one thing about all four of them is the extreme caution they exercise, this in sharp contrast to the arrogant flamboyance of some of their male competitors for high office, or interlocutors in high office, whose peacock-like strutting on the world stage needs no reminder.

On their own, they often have had to maintain themselves in an all-male world. But with their numbers (and projected power) dramatically on the increase (especially if Clinton were to join the fraternity from next year, and assuming Merkel gets another term, and May survives her Conservative Party), we have here an interesting break with the past.

The most serious question would be whether their caution would continue and come to prevail even more persuasively, or whether as a group they would turn more activist-like? The most serious challenge facing these ladies is economic in nature. How to get their particular regions to perform better and thereby the world at large. A close second challenge is how to contain the male peacocks and dominant bulls of their time. One thinks of a Putin, Trump, Xi, and Erdogan. But also Iranian mullahs, Syria's Assad or the North Korean boy wonder. And not forgetting Juncker in Brussels and Schulz in Strasbourg.

Among this sisterhood only May, today controls the nuclear button. No doubt a very special feeling, and hopefully light to the touch. But if Clinton and Le Pen were to join the club, things could get more interesting, not least because Merkel would be outclassed.

The pecking order among them would not be a simple matter, because you could control a superior economy but not a nuclear button, or control a nuclear button but not be able to control your husband. Then again, would you represent the richest continent, or could you insinuate representing one? Never mind an empire that has long gone, though still leaving tell-tale signs, in language, words, names and memories? And who could possibly compete with controlling the pre-eminent central bank of modern times, capable of all these mysterious tricks, conjuring trillions out of nowhere and these going nowhere, yet upsetting much?

Keeping things even more clubby would see Lagarde swapping the IMF for the presidency of France, with Le Pen not really fitting into their cosy world. And if Clinton were not to make it, a Three Musketeers all-girl band from Europe of Merkel, May & Lagarde (sounds more like a superior retail store) would be left facing the three cardinals (Trump, Putin & Xi – sounds more like a law firm from hell, and would be).

Lagarde's knowledge of global financial affairs, after very long stints as finance minister in France and head of the IMF, would stand the three sisters in great stead, provided they would rely on each other much more thoroughly than their male compatriots ever did.

I suspect Lagarde would be the great champion for European structural reform, assisted by modest fiscal activism where possible. Merkel would of course ever so politely resist, while May could for a while prove to be at her wits end on how to stay in the club rather than exiting completely.

Exciting stuff, for which reason membership of this exclusive club really is at a premium. Clinton would get in without a sweat, but others need not even apply. And still it remains mostly a man's world where the peacocks give you endless uphill. But undoubtedly exciting, as the early impressions of May holding court attest. Good luck, ladies. You will need it. Holding thumbs. Rooting for you.

The Southern African Association for Energy Efficiency (SAEE) is one of more than 90 chapters of the American Association of Energy Engineers (AEE). The SAEE supports the AEE's mission to promote the scientific and educational interests of those engaged in the energy industry and to foster action for sustainable development.

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Celebrating women in Chemical Engineering

by Michelle Low

In celebration of National Women's Day in South Africa on 9 August, I decided to search for women who had studied chemical engineering, in particular, those who are excelling in spaces such as research, science and technology, non-profit or innovation. This turned out not to be an easy search. Therefore, in this Spotlight article, I am featuring women I know of, or I have heard about. As a consequence, this is not a complete list, and if you know any female chemical engineer in South Africa making an impact in her workplace, please let me know via the email given at the end of this article.

Sue Harrison, based at the University of Cape Town (UCT), is the Director: Centre for Bioprocess Engineering Research, DST/National Research Foundation (NRF) Chair: South African Research Chairs Initiative (SARChI), Bioprocess Engineering, UCT. Professor Harrison holds a PhD in Chemical Engineering from Cambridge University. In 2016, Professor Harrison was awarded the 2015/2016 NSTF-South32 Award for engineering capacity development over the last five to ten years.
More info: http://www.ceber.uct.ac.za/

Diane Hildebrandt is based at the University of South Africa (Unisa) and is the co-director for the research Unit MaPS (Material and Process Synthesis) at Unisa and a professor. In 1998 Professor Hildebrandt became the first woman in South Africa to be made a full professor of chemical engineering when she was appointed as the Unilever Professor of Reaction Engineering at the University of the Witwatersrand. She is a board Member of SANEDI (South African National Energy Development Institute) and Member of the University of Johannesburg Council.
Find out more http://www.unisa.ac.za/default.asp?Cmd=ViewContent&ContentID=97559

Claire Jannish is the founder and head of biomimicrySA, and co-founder of Imaginature and of The Genius Lab. She holds a BSc and an MSc Degree in Chemical Engineering. Claire was selected by the 'Mail & Guardian' as one of 200 young South Africans in 2009, 2010 and 2011. She is also on the Wisdom Board for the upcoming Sustainability Summit in September 2016.
See more http://biomimicrysa.co.za/ or http://www.imaginature.co/

Alison Lewis is based at the University of Cape Town (UCT) where she is a Professor and Dean of the Faculty of Engineering & the Built Environment. She is also the Director of the Crystallization and Precipitation Research Unit at UCT. Professor Lewis is UCT's first female dean. Furthermore, in 2012 for her outstanding contribution to building South Africa's scientific and research knowledge base, she was awarded the "Distinguished Woman Scientist" award from the Ministry of Science and Technology. Find out more http://whoswho.co.za/alison-lewis-1872936

Boni Mehlomakulu has been the CEO (Chief Executive Officer) of the SABS (The South African Bureau of Standards) since 2009, and has a PhD in Chemical Engineering from the University of Cape Town. Dr Mehlomakulu has served on many boards in South Africa; this includes Board of Eskom Holdings, and the Technology Innovation Agency.
https://www.sabs.co.za/About-SABS/about_executive.asp

Rethabile Melamu is based at the Gauteng Provincial Government as Director: Green Economy, Gauteng Department of Economic Development, and currently Acting Chief Director: Sector and Industry Development, Gauteng Department of

SAICHE ICHEME NEWS

Member group news: KZN

The South African Institution of Chemical Engineers KwaZulu-Natal branch hosted its annual Research Day on the 13th of July 2016 at the University of KwaZulu-Natal School of Engineering building.

Six researchers from local universities and research institutes participated in the event, delivering talks on biomass valorisation, chemical intermediates and gas hydrate separations technology. The participants also presented posters on their topics during a mid-programme poster session and refreshment break.

The overall winner was Prelene Naidoo, a BSc student working with the SMRI Sugarcane Biorefinery Research Team.

Economic Development. She has a PhD in Chemical Engineering from the University of Cape Town. You can find Dr Melamu at impactful events related to energy such as African Utility Week (moderator), and as a panellist at the Biogas Conference 2015 and Directors Event. She is on the Wisdom Board for the upcoming Sustainability Summit in September 2016.

Hannelie Nel is an Extraordinary Associate Professor at the School of Mechanical & Nuclear Engineering - North West University, Managing Director of Tennelli Industries and Research Associate with the Faculty of Engineering and the Built Environment at the University of Johannesburg (UJ). Her BSc Degree is in Chemical Engineering from the University of Pretoria, and she has a Doctorate in Engineering Management from UJ. In 2014 Dr Nel was a finalist in the Standard Bank Top Women in Business Awards. She will be speaking at the SciTech Women in University-Industry Collaboration Summit in October 2016.
See more http://www.hannelienel.co.za/

Hema Vallabh is the founder and CEO of The Passionate Professional, and co-Founder of WomEng and JourneyMap. Hema holds a BSc and an MSc Degree in Chemical Engineering. Hema was selected in the 'Mail & Guardian' 200 young South Africans in 2011 and she was selected to attend the FORTUNE/US State Department Global Women's Mentoring Program. She is also the Program Director and Founder of the School of Mentorship with the IDM Business School.
See more
https://www.thepassionateprofessional.org/ or http://www.womeng.org/

Want to nominate someone in the Spotlight? Contact Michelle Low at:
Michelle.Low.za@gmail.com

Her presentation was entitled "Production of bagasse briquettes: a first step in the upcycling of residues". In second place was Nadia Croeser, an MSc student within the Thermodynamics Research Unit at UKZN. Her work on the treatment of vinasse using gas hydrate technology was funded in part by the SMRI Sugarcane Biorefinery Research Chair. Tamrat Tasfaye, a researcher at the CSIR Forestry and Forest Products Research Centre and PhD candidate, came third overall for his work on the valorisation of mango seed via the extraction of starch. His study has significance to his home country, Ethiopia, where large quantities of mango seed waste are generated each year with little commercial value.

Dr Maggie Chetty, chair for the event, thanked all attendees for supporting this edition of the Research Day, and encouraged the participants to submit their work to the 'South African Journal of Chemical Engineering'.

Written by David Lokhat on behalf of SAIChE IChemE KZN Members Group

Process design practices

Date:	7 to 11 November 2016
Venue:	Kopanong Hotel and Conference Centre in Benoni, Gauteng
Registration:	Before 31 August 2016 to avoid late registration fee.

SAIChE accredited for 5 CPD credits (SAIChE-139) and now also accredited as an IChemE Approved Course with 30 hours CPD.

SAIChE IChemE

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Sanitary bulk bag weigh batch unloader automatically conveys materials downstream

A new BULK-OUT™ Bulk Bag Weigh Batch Unloading System with Manual Dumping Station and Flexible Screw Conveyor automatically conveys weighed batches of contamination-sensitive materials to downstream processes and allows rapid sanitising.

BULK-OUT™ Sanitary Bulk Bag Weigh Batch Unloading System with integral flexible screw conveyor and BAG-VAC™ dust collector shown with safety interlocked doors in open position and manual dumping station bag tray in lowered position.

The BFC model discharger frame is equipped with a cantilevered I-beam with electric hoist and trolley for positioning of bulk bags without the use of a forklift. A SPOUT-LOCK™ clamp ring atop a TELE-TUBE™ telescoping tube securely connects the clean side of the bag spout to the clean side of the equipment intake, and maintains constant downward tension on the bag as it empties and elongates, promoting complete discharge from the bag.

At timed intervals, FLOW-FLEXER™ bag activators increasingly raise opposite bottom edges of the bag as it lightens, ultimately forming a steep V-shape that promotes complete discharge of free- and non-free-flowing materials from the bag.

A bag dump station with folding bag shelf allows manual dumping of minor additions into the hopper from hand-held packaging and containers.

The hopper is vented to a BAG-VAC™ dust collection system that draws airborne dust from manual dumping activities away from the operator when the hopper lid is open. When the hopper lid is closed during bulk bag discharging, the dust collection system additionally prevents displaced air and dust from entering the plant atmosphere, and collapses empty bags prior to tie-off, preventing dust generated when empty bags are flattened manually.

A FLEXI-FORCE™ lump breaker integral to the hopper reduces agglomerates and promotes the continuous flow of material into the charging adapter of the flexible screw conveyor.

Load cells supporting the entire system are linked to a PLC that stops the flexible screw conveyor once the system has lost a pre-set amount of weight.

The flexible screw is the only moving part contacting material, and is driven above the point at which material exits the conveyor, preventing material contact with seals and allowing rapid sanitising in place. The screw can also be removed through the bottom of the tube for sanitising and inspection.

Positioned above the clamp ring is a POWER-CINCHER™ pneumatically-actuated flow control valve that cinches the spout concentrically, allowing re-cinching of partially empty bags for leak-free tie-offs.

The entire system is constructed of stainless steel finished to sanitary standards, and is rated for wash down.

Flexicon also manufactures tubular cable conveyors, pneumatic conveying systems, bulk bag conditioners, bulk bag fillers, bag dump stations, drum/box/container tippers, weigh batching and blending systems, and automated plant-wide systems for handling of bulk food, dairy, pharmaceutical, chemical and mineral products.

For information contact:
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SUDOKU NO 117

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

							3	1
				1				
			5		2		9	
5	6		1		8	2		
	3				6			
	7		4				5	
		8		9	7	6		
2				6		3		
					5			

Solution for SUDOKU 116

9	7	2	5	4	3	6	1	8
6	8	4	7	1	9	2	3	5
3	5	1	2	8	6	9	4	7
7	3	5	8	2	4	1	6	9
8	4	9	1	6	5	3	7	2
1	2	6	3	9	7	5	8	4
5	1	3	9	7	8	4	2	6
4	9	8	6	3	2	7	5	1
2	6	7	4	5	1	8	9	3

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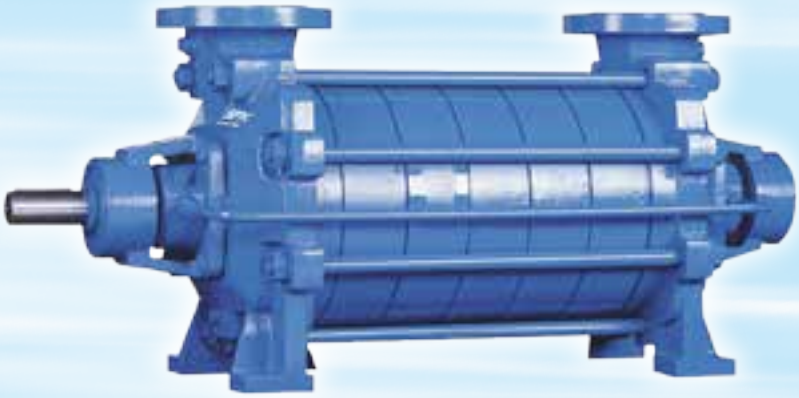

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FLEXI-DISC™ Tubular Cable Conveyors gently slide fragile foods and non-foods through smooth stainless steel tubing routed horizontally, vertically or at any angle, over short or long distances, dust-free. Single or multiple inlets and outlets.

DUMP

FLEXICON™ Manual Dumping Stations allow dust-free dumping of bulk material from bags and other containers. Automatic reverse-pulse filter cleaning allows continuous, efficient operation. Available with integral bag compactors for total dust containment.

UNLOAD

BULK-OUT™ Bulk Bag Dischargers unload free- and non-free-flowing solids from bulk bags automatically. Allows untying, discharging, retying and collapsing of bulk bags—all dust-free. Available with weigh batching controls.

USDA

CONDITION

BLOCK-BUSTER™ Bulk Bag Conditioners loosen materials that have solidified during storage and shipment. Variable height turntable positions bag for hydraulic rams with contoured conditioning plates to press bag on all sides at all heights.

FILL

SWING-DOWN™, REAR-POST and TWIN-CENTREPOST™ Bulk Bag Fillers can fill one bulk bag per week or 20 per hour at the lowest cost per bag. Numerous performance options. Available to industrial or sanitary standards.

USDA

CONVEY

FLEXICON™ Flexible Screw Conveyors transport free- and non-free-flowing bulk solid materials from large pellets to sub-micron powders, including products that pack, cake or smear, with no separation of blends, dust-free at low cost. No bearings contact material. Easy to clean quickly, thoroughly.

USDA

3-A

CONVEY

PNEUMATI-CON™ Pneumatic Conveying Systems move a broad range of bulk materials over short or long distances, between single or multiple inlet and discharge points in low to high capacities. Available as dilute-phase vacuum or positive pressure systems, fully integrated with your process.

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