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FEATURES

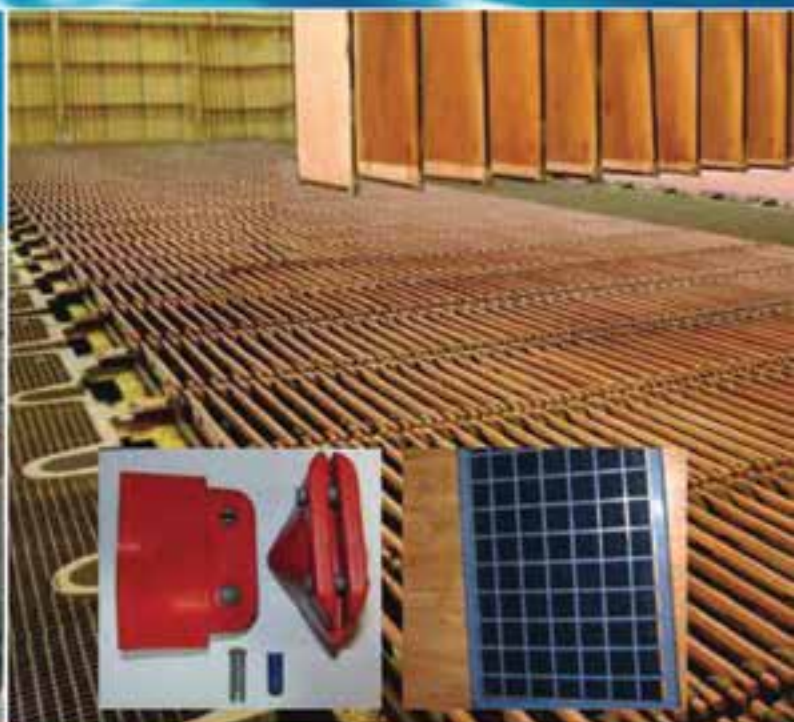
- Waste management
- Separation and filtration
- Plant maintenance, health, safety and quality
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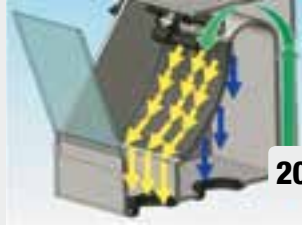
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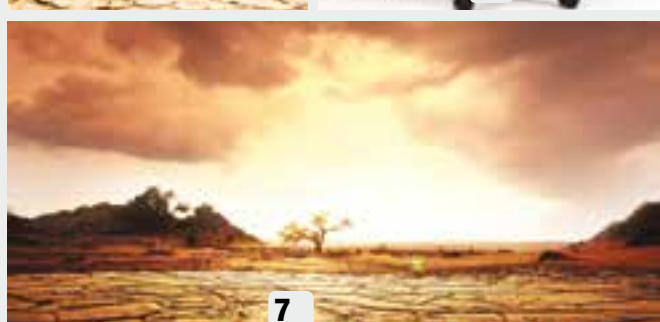
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How we feel about the cycle of the world economy

by Carl Schonborn, PrEng

To answer the above question, we could say any of the following: Optimistic, Cautiously Optimistic, Pessimistic or Negative.

A wonderful tool used by Control Systems in their design work, is the Cause-and-Effect Diagram. It is a graphic matrix that helps identify, sort, and display possible causes of a problem or quality characteristic. It is widely used to structure the inherent safety considerations during the start-up or shut-down of a plant and, in graphic form, allows the designer to build into the instrumentation, all those requirements to safely start up the unit or, conversely, to shut it down.

Can we as engineers, or more specifically, chemical engineers, not use some of these tools to try to understand quite what is happening in the world of macro-economics raging around us? We should be trying to do so because the current state of affairs results in a shortage of work opportunities and contracts for engineers, which consequently stifles the industry, a cause of grave concern.

More specifically, is the current downturn just a manifestation of the knock-on effect of an economy in a downturn like China? Or are we on the downwards slope of a Kondratieff wave, a concept which Russian economist, Nikolai Kondratieff, developed in the 1920s, stating there was a definite cyclic wave of economic indicators always either in ascent or decline.

He postulated that these waves fluctuated in phases of about 50 years; he also chose many of the indicators used by economists today such as trade balances, resource and commodity prices, interest rates, iron and steel production rates and unemployment rates. Fortunately there are other theories that indicate dips in these longterm trends that could explain the current worldwide economic downturn.

The Cause-and-Effect Diagram could be put to use in interpreting the causes of the current

downturn. Engineers could make a study of the available information regarding trends in the production rates and consumption rates of many of the natural resources and benefited materials that make up the major components of world trade.

By studying, for example, the units of supply and demand and current capacity, we can make our own predictions regarding whether the upturn in the Kondratieff wave may be a reality. As David Stockman, former businessman and Former Director of the US Office of Management and Budget said, in one of his online newsletters: "What really happened is that the central bank instigated global macro-economic bubble-ripped commodity pricing cycles out of their historical moorings, resulting in a one-time eruption of price levels that had no relationship to sustainable supply and demand factors in the mines and petroleum patch. What materialised, instead, was an unprecedented one-time mismatch of commodity production and use that caused pricing abnormalities of gargantuan proportions."

An interesting perspective is afforded by Warren Ingram, an executive at SmartRand, that "In times like these, it is important to remember that the markets always look forward and some investors will be in a perpetual state of gloom, as they believe things are going to get much worse. If you were to graph the rand versus the dollar since 2011, you would see that it has moved in a nearly straight line upwards. This means the potential for a reversal of this trend is increasing. That is not to say that the rand will recover to R5/\$, but a significant recovery from its current level is likely."

Let us continue plotting the curves and any change in the trends, from whichever Cause, could then be converted to an Effect, and allow for some considered and informed opinion.

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Our commitment to you is to support, to service and to optimise your processes. Based on our process knowledge, technical expertise and a uniform approach through clear procedures, we ensure that the work we conduct for you is done safely and properly.

Maintenance services

Ensure maximum availability and performance of your process with the correct type of maintenance. A full range of maintenance services is available to allow you to better manage your maintenance activities and resultant costs. From inspection to preventative maintenance services, Endress+Hauser supports you in defining the relevant maintenance activity and frequency based upon your installed base's maintenance requirements.

Specific and guaranteed reaction times for corrective (break down) maintenance on your critical assets can also be defined within a Service Level Agreement (SLA). Relevant and necessary spare parts holding is also an aspect to be considered within maintenance services. Spare parts and/or replacement units requirements should be evaluated and actioned based upon process criticalities of the respective assets.

Maintenance services can be formalised within a Service Level Agreement with Endress+Hauser. The management and scheduling of these activities are then the responsibility of Endress+Hauser and not the maintenance team on-site. These management activities include proactive scheduling, consumable and wear part stock holding and ordering, and documentation management for all relevant activities, including certificates.

The Service Level Agreement concept for maintenance services can further be developed into a performance-based agreement framework which is then managed by evaluation of formal Key Performance Indicators (KPIs). This allows for continuous improvement within the maintenance services portfolio.

Benefits

- Maintenance needs and overall operating expenses are



managed and optimised.

- Improved productivity by minimising process interruptions, resulting from device failure.
- Enhance On-Site knowledge by working closely with Endress+Hauser service specialists and technicians.
- Enable your personnel to focus effectively on the maintenance of the process.
- Ensure regular follow-up to monitor your critical measuring points.

Deliverables

- Maintenance report per device.
- Calibration Certificate per device (where relevant).
- Full traceability of the maintenance event and report per device (on demand).
- Guaranteed response from Endress+Hauser (within SLA).

Maintenance optimisation

Reducing costs related to asset maintenance, repair, and ultimate replacement of obsolete devices is typically one of management's main goals. Downtime in any network, manufacturing or computer system ultimately results not only in unexpected (and usually high) repair costs, but also in customer dissatisfaction and reduced revenue.

Equipment and plant availability needs to be continually increased, while maintenance efforts should be directed towards improving plant productivity and production quality and safety. To support you in achieving your maintenance goals, Endress+Hauser can propose several maintenance optimisation approaches to improve plant reliability and performance.

These include:

- Consulting directed at delivering maintenance recom-



mentations which support the customer in making decisions and defining actions to optimise the maintenance strategies for the respective installed base; and

- Endress+Hauser management of the customer's day-to-day maintenance processes and activities with specific focus on field instrumentation. This service is facilitated by a partnership agreement.

Endress+Hauser (in consultation with the process owner) identifies, defines and then reports on areas of maintenance focus and potential improvements by means of Key Performance Indicators (KPIs).

This KPI framework positions the partnership to act effectively in addressing the respective maintenance requirements and improvement areas on-site. By combining your process competence with Endress+Hauser's automation know-how, we are able to collaborate as a team. Through a planned and practical approach we can improve your maintenance efficiency, while achieving or maintaining compliance with your safety, quality and environmental requirements. Our experts can propose improvement actions that are aimed at decreasing process interruptions and minimising your maintenance efforts and associated costs.

Benefits

- Decreasing the complexity of your installed base through standardisation. This allows for improved personnel efficiencies and optimising/minimising spare part stock holding;
- Achieve safety and quality compliance by optimising your maintenance efforts within an effective maintenance schedule;
- Minimise downtime by ensuring and preparing for ef-

fective responses to the break-down of critical assets within your process;

- Complete visibility and traceability of your installed base of assets. This extends to updated information and documentation availability throughout your installed base's life cycle.

Deliverables

- A comprehensive Installed Base Status Report listing recommended areas of improvement needed to achieve a balanced maintenance plan.

These areas include:

- Standardisation within the installed base
- Reactive maintenance preparedness
- Preventative maintenance strategy
- Migration relevance within the installed base based upon dynamic product statuses of the respective assets
- Quick and easy online access to all information related to Assets in the installed base using Endress+Hauser's Web Enabled Asset Management Platform (W@M)

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For more information contact

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Unsalting the earth

by Gavin Chait

The road along the border between Mauritania and Senegal is a beautiful, smooth sealed surface. Paid for through the benevolence of the European Union, it sees daily traffic of both people and goods moving between the villages along the wide flanks of the Senegal River.

For the first hour after leaving Saint Louis, the historic capital of French West Africa, the land is flat, dry and caked in a thick white crust. Salt. After that hour, the land gives way to an improbable plantation of sugar cane. Irrigation consists of a grid of channels cut into the baked clay and pumps which drive the water up from the river. The fields are flooded several times a day against the harshness of the 40 °C winter sun. The water evaporates quickly leaving behind a thin white rime.

Soon this land will become too salty to farm and the sugar cane plantations will move on, along the highway.

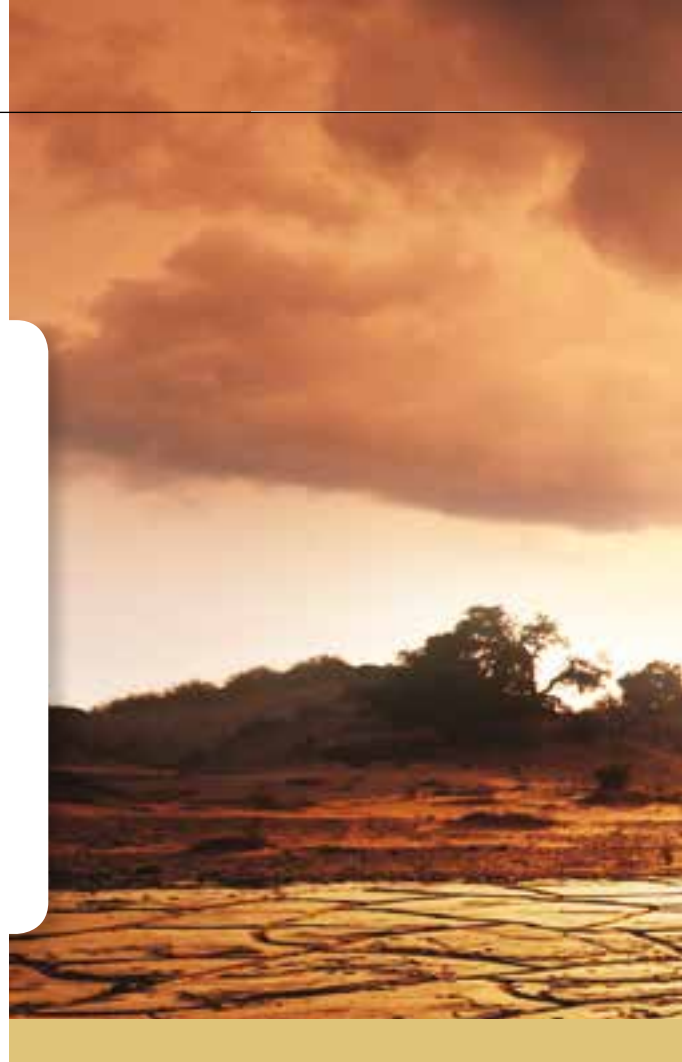
Another hour and there is grassland. Glass-dry and about as friable. Men and boys stalk small herds of cattle and goats through this expanse. The animals do not eat the grass. It is inedible. The animals are gaunt and their ribs jut out with horrifying bleakness. Soon this grassland, and the trees that hold the soil, will give way to the plantations.

And then the wind comes: the harmattan, blowing like mist, driving the fine soil away and meaning every breath must be chewed.

From the back of the seven-seat taxi, crammed into the far corner, I try and imagine how difficult it must be for these villages to survive the many-fold disasters of poor agricultural practice, arid soils, salination and climate change all coming together.

Each season, as the river slows before the rainy season, tides come further up the river and push ocean water into reservoirs and pools. A dam was built. It hasn't helped.

Speak it softly, but agricultural experts believe there is only one way to adapt to both salination and climate change: biotechnology.



A solution or two?

Many plants and animals survive in highly alkaline and saline environments and at tremendous temperatures. These 'halophiles' include mangrove trees and numerous species of algae. As Andrew Porterfield at the Genetic Literacy Project, puts it: "Because of global climate change, the USDA's Economic Research Service in November 2015 predicted that, from 2020 - 2080, yields will decrease for corn, soybeans, sorghum, rice, cotton oats and silage, but will increase for wheat, hay and barley. In addition, the costs of irrigation for all of these crops will rise, due to increases in temperature, more frequent drought conditions, and the increasing scarcity of ground- and surface water. These changes will also change our definition of 'normal', from heat waves, droughts, pests, and diseases."

The problem with salination is that it not only reduces water available to plants (since the chemical gradient plants normally use to absorb water from their roots is lost or even points the wrong way), but the salt ions themselves, when absorbed, are toxic. They impair enzyme function, inhibiting photosynthesis.

The first step involves a massive change in the mechanism of farming. In Senegal, agriculture is tremendously primitive, but industrial farms have the greater jump to make. The two main requirements are the growth of cover crops and conservation tillage.

Cover crops offer protection to soils to prevent erosion, evaporation and carbon emissions (a large dark surface gets very warm, and there's nothing to stop evaporation). Conservation tillage is a hybrid approach which includes 'no-till', 'strip-till', 'ridge-till' and 'mulch-till'. Last year's crops are kept on the field and the new crop is either planted in



untilled areas, or in a narrow strip or ridge. This reduces water loss during tilling, and the subsequent drying out that leads to soil loss and carbon emissions.

Commercial farmers are uncomfortable with no-till since land can become overwhelmed with competing plants. This is where biotech crops come in. Herbicide-resistant varieties have led to an increase in the use of no-till techniques by almost 70 %, and almost all adoption of no-till practices has come about as a result of biotech availability.

Note that this combination of biotech crops and no-till has a major impact on both yields and production costs. There are fewer pesticide applications (meaning fewer tractor runs and less chemical run-off), as well as less need to cultivate the soil. That in turn increases natural soil aeration from earthworms, and improved water filtration.

What about the old way?

Alternatively we could do it the old way with the usual consequence, according to Phil Beradelli, in his piece, "Dust Bowl Writ Large?" on ScienceNOW: "Each year, the world's agricultural land loses, on average, about 1 mm of topsoil. That might not seem like much, but it takes ten years for the soil to replace that loss, and any topsoil loss at all makes the land less able to support crops without expensive infusions of chemical fertilisers."

The biotech itself is focused on improving yields from poor quality soils. *Arabidopsis*, a small flowering plant related to cabbage and mustard, has been useful in understanding how plants survive stressful environments. Its genome is small, fully sequenced, and it has a short lifecycle. Engineering *Arabidopsis* has focused on increasing its ability

to limit salt ion uptake, increasing its extrusion rate for salt ions, and improving the compartmentalisation of absorbed ions in cell vacuoles to prevent interaction with cell functions. A series of genes have been identified which support plant survival (including the excitingly-named 'Salt Overly Sensitive1', or SOS1, gene). With these genes identified, engineering can begin.

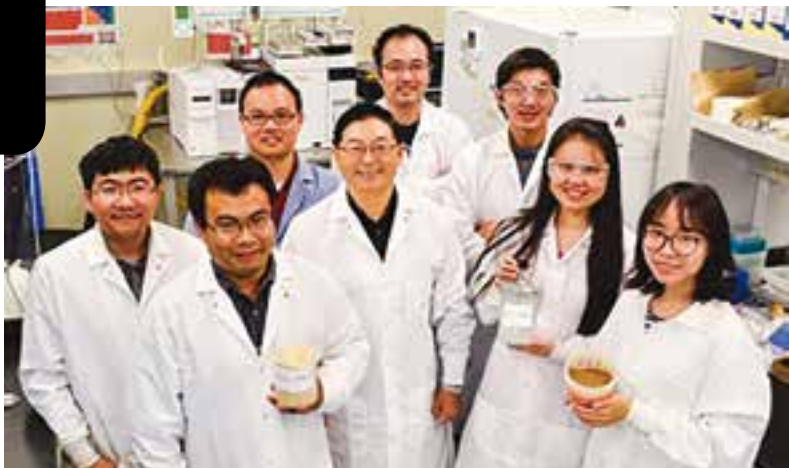
Research and development

India has been testing a number of different transgenic crops. Maharashtra is looking at drought-resistant Indonesian sugarcane. Sugarcane, which accounts for 4 % of the gross cropped area in the state, requires 71,5 % of the total water usage for agriculture, according to the Indian Commission for Agricultural Cost and Prices.

Scientists from the M.S. Swaminathan Research Foundation are looking at salt tolerance in rice, using genes from mangrove trees. This is complex and it is not yet clear if they will find the correct balance of genes but, as they say, engineering is faster than conventional breeding.

In Australia, especially prone to droughts, the University of Adelaide has developed a new salt-tolerant variety of wheat by extracting genes from older, hardier, varieties. "It confers salinity tolerance by withdrawing the salts from the xylem, retaining them in the roots and stopping them getting up the shoots where the salt damages the plant and stops it from photosynthesising," says Matthew Gilliham of the University of Adelaide's School of Agriculture. The problem, though, may be happening too quickly for researchers to find solutions for each food crop. An alternative is to find ways to fix the soils by extracting contaminants from them directly. **continued on page 8**

Converting wood by-product into hydrocarbon molecules for jet fuel



Bin Yang (centre) patented a catalytic process to convert lignin into jet fuel hydrocarbons. (Image credit: WSU)

Researchers at Washington State University (WSU) Tri-Cities have discovered a method to convert a common wood by-product into hydrocarbon molecules that could be used as jet fuel. A procedure developed and patented by Bin Yang, associate professor of biological systems engineering, uses a catalytic process to convert lignin, an organic polymer that makes plants woody and rigid, into a mix of hydrocarbons in a single reactor.

The product can be separated and purified to obtain hydrocarbons that are usable in turbine engines. Lignin

is one of the most abundant renewable carbon sources, with 40-50 million tonnes produced annually worldwide. However, it is generally treated as a waste by-product of the conversion of plant biomass into biofuels such as ethanol.

According to Ralph Cavalieri, director of WSU's Office of Alternative Energy, molecules derived from biomass currently must be combined with petroleum-based jet fuel to meet certification requirements. Yang's procedure, however, may be able to supply molecules that can be certified for jet engines without the addition of petroleum-based jet fuel.

Typically, jet fuel requires molecules that consist of 12-16 carbon atoms to fulfill jet engine requirements, Cavalieri says. By comparison, gasoline, a more volatile fuel, requires molecules with fewer carbon atoms. Diesel, an even less volatile fuel than gasoline, requires molecules of 16-20 or more carbon atoms. However, it begins to gel at cold temperatures.

Cavalieri says that jet fuel requires the same nominal range of molecules as kerosene, which isn't as volatile as gasoline but also doesn't freeze at the cold temperatures found at high altitude. "With the research being conducted by Dr Yang, it may be possible to develop a more complete suite of molecules required for turbine engine systems using only biomass feedstocks, making the process more economically feasible and efficient," he says. Yang's team is working with Boeing Co to develop and test the hydrocarbons targeted for use as jet fuel.

Latest trends in the field of natural refrigerants



David Blackhurst from Star Technical Solutions chaired a group discussion on operational safety aspects for the use of natural refrigerants.

At the eurammon symposium 2015 held last year in Schaffhausen, Switzerland, under the slogan "Be Smart, Go Natural", nine international speakers illustrated current trends in the field of natural refrigerants and presented pioneering application examples.

Once again, eurammon's lecture event was

fully booked with more than 60 participants from 10 countries. Mark Bulmer, member of the eurammon board, said: "Manufacturers and operators have started to change their approach. Natural refrigerants have become increasingly significant since the new EU F-Gas Regulation came into effect."

Elisabeth Munzert from the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety explained: "From now on, planners and system engi-

neers will no longer have to think in metric tons and kilograms, but in tons of CO₂ equivalent in order to take into account the global warming potential." During the second day of the symposium, Lambert Kuijpers illustrated the progress achieved in restricting the use of F-Gases through the Montreal Protocol.

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continued from page 7

Unsalting the earth

Enter bacteria

One of the largest physical biomass populations in the world is that of soil bacteria. The Pacific Northwest National Laboratory at the US Department of Energy national laboratory is investigating how bacteria might be used to clean up contaminated soils.

By studying how bacteria respond to the ecology of soils they can understand how they adapt to salinity and whether they could be used to remove salt from the soil (similar to the way plants remove carbon from the environment).

Given South Africa's paralysing drought, these sorts of solutions must be considered as we adapt to the new normal of reduced rainfall and increasing soil alkalinity.

As a recent *Economist* editorial declared, "Thinking caps should replace hair shirts, and pragmatism should replace green theology."

It may make the average upper-class South African nervous to contemplate buying genetically modified foods, but the science is clear: it is absolutely as safe as the alternatives, and without it, we'll probably run out of food.

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Cost-effective analysis of **wear metals and additives in oil** using an ICP-OES

This article will briefly consider flame AAS, sequential OES, and rotrode analysers, before focusing on the benefits of simultaneous ICP-OES technology.

The elemental analysis of used lubricating oil has become an essential part of condition monitoring – the use of physical and chemical techniques to assess the ongoing condition of machinery and equipment. Lubricating oil analysis can be applied to most mechanical systems, including engines, gear transmissions, and hydraulics. These are important components of critical, often high-value equipment in areas such as power generation, petrochemical and other industrial processes, construction machinery, and transportation (including aviation, fleet operations, and public transport).

Responsible personnel in all these areas as well as in contract service laboratories must analyse hundreds of oil samples per day for a wide range of elements. Aims: to find component wear by detecting the presence of foreign matter that may accelerate such wear, or detecting higher-than-normal concentrations of certain elements that may indicate it; and to analyse diminishing levels of any additives present for further help in determining the ‘health’ of the oil. Such systematic analyses of lubricating oils in service

can predict and enable correction of developing faults. This ‘early warning’ allows for fewer costly repairs, more effective maintenance programmes, reduced downtimes, and extended plant and equipment lifetimes – all of which can significantly lower operating expenses.

A number of spectrometric techniques have been employed to carry out these analyses. This article will briefly consider flame AAS, sequential OES, and rotrode analysers, before focusing on the benefits of simultaneous ICP-OES technology.

FAAS and other alternatives

For most elements, the concentrations involved are well within the scope of spectroscopic elemental analysis techniques such as flame atomic absorption spectrometry (FAAS; also known simply as AAS). However, although FAAS instruments have been a popular oil analysis method for many years, they suffer significant drawbacks.

Flame AAS atomises sample constituents using acetylene as fuel and either air or nitrous oxide as an oxidant





to reach the high flame temperatures required for determination of elements such as silicon and aluminum. AAS cannot measure sulphur content at all, and in determining phosphorus, its limits of detection are three orders of magnitude higher than those of another popular oil analysis technology known as ICP-OES (see below). Additionally, AAS possesses a relatively narrow linear dynamic range, so it has difficulty coping with wide concentration ranges, and often requires multiple sample dilutions. Further, because they depend on flames and pressurised flammable gases, AAS instruments cannot safely run unattended.

Finally, AAS instruments must normally measure each element in turn, instead of simultaneously (as with many ICP-OES devices). When faced with samples containing more than a few elements, this sequential examination demands relatively long analysis times – one of the major disadvantages of AAS technology.

Other approaches sometimes applied in oil evaluation also suffer from prolonged analyses. For example, some ICP-OES devices use sequential, not simultaneous,

technology. And *rotrode* instruments demand manual operation, contributing to their long analysis times and comparatively low throughput. In addition, they suffer from relatively low sensitivity and stability (compared to ICP-OES systems).

The ICP-OES solution

Where AAS techniques have proven unsatisfactory, several national and international standard methods describe or recommend the use of inductively coupled plasma optical emission spectrometry (ICP-OES) for the analysis of fuels and lubricating oils. (See ASTM methods D4951, D5708, D5185, D7111, D7260, D7691, D5184, D7040, and D7303, as well as EN 14538 and 16924.)

Thus ICP-OES has become the technique of choice for many users. Example: the Spectro Genesis simultaneous ICP-OES – an affordable, compact, but high-throughput instrument specifically developed for such routine analysis. Its advanced detector technology and remarkably low running costs provide a powerful and efficient tool. Also



Figure 1: Flame AAS, which incorporates a hollow cathode tube, for years has been the hot choice in wear element analysis. But the increasing affordability of advanced, high-productivity ICP-OES casts a brighter light on AAS disadvantages.

advantageous: its sample preparation usually requires only a single, simple dilution with a solvent such as kerosene. It uses proprietary software for continuous optical system monitoring plus optimum ease of use. And the instrument is available with a complete set of factory methods plus step-by-step standard operating procedures (SOPs) for used oil analysis, as well as an automated front-end sample introduction system. So users can move straight into 'plug and analyse' performance without time-consuming method development.

The challenge: condition analysis

In lubricated mechanisms, various causes of wear (such as friction between moving surfaces; abrasion by contaminants such as grit; corrosion processes; or entry of foreign matter, as by failing seals) give rise to the presence of microscopic particles in the lubricant as components wear away.

Quantitative measurement of elements present in the oil can therefore be a useful indicator of wear. Furthermore, as different materials are used to manufacture different components, elemental analysis can often provide a clue as to which components are subject to wear. Condition monitoring can also detect the presence and possibly the origin of foreign matter in the oil, such as dust that may have entered an engine via a defective filter. Additionally, it may signal undesirable changes such as dilution by fuels or contamination by water or antifreeze. Processes such as oxidation can lead to changes in lubricant properties like viscosity, leading to accelerated wear rates. And levels of additives introduced to extend lubricant life must be monitored, lest additive depletion lead to increased wear.

Unless wear is severe, metallic particles entering the lubricant are usually very finely divided (5 microns or less) and remain largely suspended in the oil without settling out. Typical concentration levels for wear metals lie in the

Table 1

Limits of Detection		
	λ [nm]	LOD (3σ) [$\mu\text{g/kg}$]
Ag	328.068	3.3
Al	308.215	25
B	249.773	3.0
Ba	455.404	0.5
Ca	315.887	7
Ca	317.933	5
Ca	393.366	0.3
Cd	214.438	2.1
Cd	226.502	2.2
Cr	283.563	2.9
Cu	324.778	2.4
Fe	259.940	4.2
Mg	279.079	28
Mg	280.270	0.3
Mn	257.610	0.4
Mo	202.095	6.3
Na	588.995	22
Ni	221.648	7
P	177.495	29
Pb	220.351	28
S	180.731	39
Si	251.612	9
Sn	189.991	17
Ti	323.452	1.9
V	311.071	3.6
Zn	213.856	3.1

range from 1 to 500 parts per million (ppm); some additive elements can be found at several thousand ppm.

Key ICP-OES components

In the basic ICP-OES technique, elements and ions emit a characteristic number of specific spectral lines with different wavelengths when excited within a high-temperature argon plasma. Emitted light is resolved into these separate lines by optical components such as diffraction gratings; the light is finally directed onto a detector array that quantifies light intensities at these different wavelengths. Thus differing elemental components of a sample can be measured, analysed, and quantified.

Powerful generator. Some ICP-OES systems suffer from plasma instability when attempting to analyse challenging organic matrix samples. In extreme cases, the plasma may even be extinguished. Fortunately, the Spectro Genesis analyser produces its plasma via an air-cooled, free-running RF generator that remains stable even under such heavy plasma loads.

Simple sample introduction system. For ICP-OES oil analysis, a single dilution of the sample with kerosene is normally sufficient to overcome viscosity effects and measure all elemental concentrations. (By contrast, AAS often requires several dilutions to bring different elements within the linear measurement range.) The design of the Genesis sample introduction system provides a very short sample pathway

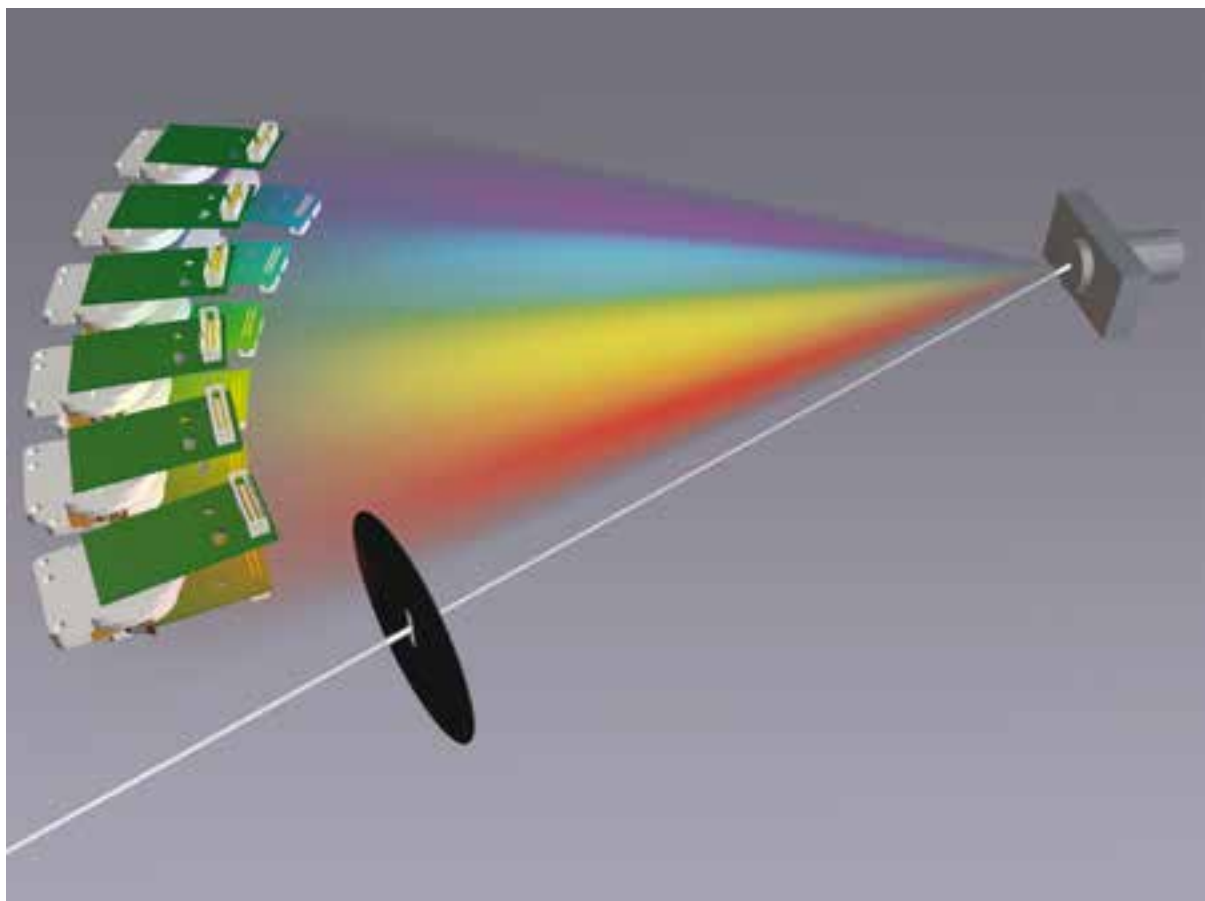


Figure 2: Advanced ICP-OES optics: the ORCA system in a Spectro Genesis analyser separates light emitted in the plasma, and enables full simultaneous measurement of the relevant spectrum and elements.

to the plasma, so signals stabilise quickly and very short flush times are achieved between samples. Genesis can be integrated with an autosampler/dilutor system under full computer control. When dealing with only a few elements per sample, some AAS instruments may exhibit slightly faster analysis. However, if an instrument must routinely analyse more than 50 samples and 10 elements per day, a heavy-duty, simultaneous ICP-OES such as Spectro Genesis can definitely deliver higher throughput rates, and will usually be the better choice.

Advanced optics and detectors. Spectro Genesis utilises a series of 15 charge coupled device (CCD) linear detector arrays with a concave grating arrangement. This fast, flexible, proprietary Optimized Rowland Circle Arrangement (ORCA) design covers the entire relevant spectrum from 175 to 770 nanometres (nm). The system's high-speed readout system can read all 15 CCD detectors and provide the complete emission spectrum in only 3 seconds. Finally, with a minimum number of optical components to attenuate light throughput, ORCA is highly luminescent; this contributes to analytical sensitivity plus low detection limits.

Resisting interference

Sample nebulisation and transport effects. A simple sample introduction system such as the one mentioned above, uses a pumped nebuliser/spray chamber design. The nebuliser converts the liquid sample into an aerosol spray, which is then transported (via a carrier gas, usually

Table 2

Analysis of NIST SRM 1084a			
	Certified Conc. [mg/kg]	Measured Conc. [mg/kg]	Recovery [%]
Al	(104)	102	98.1
Ag	101.4 ± 1.5	100.5	99.1
Cr	98.3 ± 0.8	101.1	102.8
Cu	100 ± 1.9	103.8	103.8
Fe	98.9 ± 1.4	106.5	107.7
Mg	99.5 ± 1.7	97.7	98.1
Mo	100.3 ± 1.4	103.3	103
Ni	99.7 ± 1.6	105.7	106
Pb	101.1 ± 1.3	103	101.9
Sn	97.2 ± 2.6	100.7	103.6
Ti	100.4 ± 3.8	104.3	103.9
V	95.9 ± 9.4	102.4	106.8
S	(1700)	1570	92.4
Si	(103)	106.9	103.8

argon) into the plasma. Where variations in sample viscosity might impair accurate measurement, instruments such as Spectro Genesis employ the internal standard technique — adding a known concentration of an element not found in the sample. Any variations due to sample introduction efficiency are reflected in the values obtained for the internal standard, and are used to automatically correct the measurements.



Figure 3: The Spectro Genesis analyser provides accurate, high-productivity assessment of component wear trends – along with low operating and consumables costs plus an optional automated sample introduction system.

Table 3

Analysis of FLX ASTMP-0116-01			
	Certified Conc. [mg/kg]	Measured Conc. [mg/kg]	Recovery [%]
Ca	5020	5390	107.3
P	10420	10530	101.1
S	5030	4830	96.0
Zn	5010	5300	105.8

Matrix effects. Organic matrix samples can significantly impact plasma excitation efficiency. The ability of an ICP-OES system to cope with variations in sample type and plasma loading is described as robustness. Spectro Genesis exhibits a high degree of this quality, with relative resilience to changes in the solvent or the matrix composition. Should matrix effects still remain, they are efficiently handled by the internal standard technique.

Plasma viewing. The choice of plasma viewing position – end-on, or axial, versus side-on, or radial – can significantly impact a spectrometer design's suitability for a given application. Axial viewing delivers higher sensitivity, but at the cost of increased complexity and more matrix effects. Instead, instruments such as Spectro Genesis are equipped with a radial interface, seeing only a 'slice' across the plasma from side to side. Providing sufficient sensitivity with less background radiation and noise, better stability and precision, no significant matrix interferences, and greater linear dynamic range, this is the clear choice for wear metal applications.

Measurable results

The Genesis achievable limits of detection (LODs) given below were obtained using organometallic standards relevant to real-world wear metal analysis. They were made up to constant volume with base oil, then diluted with kerosene (Table 1).

While these LODs show that Spectro Genesis has more than enough sensitivity to detect and measure the required elements in used oil, measurement precision and accuracy are equally, if not more, important. Table 2 shows the certified and measured values obtained on a certified reference material, NIST Standard Reference Material 1084a 'Wear Metals in Lubricating Oil'.

Excellent agreement is found between certified and measured values. Results for some elements not in this certified standard, but encountered in oil additives, were obtained on a commercially available standard material – Fluxana (Table 3).

Conclusion

Simultaneous ICP-OES has many advantages for the analysis of used oils and other petroleum products. In particular, the Spectro Genesis spectrometer is optimised to eliminate most of the difficulties associated with using a new technique or instrument. It is simple to commission and operate, delivers good precision and throughput, and is a cost-effective tool for elemental analysis in wear metal condition monitoring.

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Non contact radar level sensors increase reliability on river sluices



VEGA water radars alongside ultrasonic sensors mounted in stilling tubes

On the River Weaver in the northern England county of Cheshire, the Dutton sluice site consists of eight large sluice gates lifted by Rotork actuators. The water level in the river determines when to open or close the sluice gates and navigation is closed to river traffic if the water level is too high.

The Dutton sluice site is a key measurement point and the level monitoring needs to be very accurate. Consequently the level of the River Weaver is now measured by four instruments. The first two are ultrasonic sensors (for redundancy) mounted in stilling tubes. These tubes are required in order to reduce loss of echo issues from weather and surface conditions. However the tubes can require substantial engineering to install, and generally they need continuous on-site maintenance to prevent blockages, or repairs to keep measurement errors to a minimum.

Even with this stilling tube installation, the SCADA Maintenance engineer has commented, "In recent years we have experienced issues where either one or both of the ultrasonic sensors loses echo or drifts, causing level sensor failure alarms to be sent out."

As a result the Canal & River Trust (CRT) has installed two other devices alongside the ultrasonic sensors, as test instruments. Designed and manufactured by German company VEGA, the radar level sensors VEGAPULS WL61 are unaffected by weather or surface conditions and were simply mounted on a unistrut adjacent to the stilling tubes. CRT has compared the data from both sets of instruments over several months and found that there was no drift with the WL61 water radars since installation.

"Whilst we have seen occasions where the water level on one or both of the ultrasonic units rises, the radars have not," commented the engineer. "As far as I can see, the WL61 radars provide more reliable data than the ultrasonic devices. My concern with the ultrasonic sensors is that drift could create nuisance alarms and result in staff call outs." There are also the ongoing maintenance requirements associated with the stilling tubes. "I do not have these concerns with the WL61s. In addition, I have confidence in the support from VEGA should an issue arise with any of the instruments at a later date."

This yet another example of how radar is increasing reliability and accuracy on open water applications.

For more information on VEGA products in South Africa, please contact VEGA Controls SA on +27 11795 3249 or email chantal.groom@vega.com.

Compact combi switchbox with high air output

The GEMÜ 4212 combi switchbox with integrated 3/2-way pilot valve is capable of intelligent and precise position detection and has additional diagnosis options.

In comparison with external variants, the integrated pilot valve offers both functional and economic benefits, such as fast reaction times, automatic programming of end positions and lower compressed air consumption. Local programming of the end positions is also possible without a connection to the control unit and without opening the housing.

The combi switchbox is designed to be assembled on a variety of medium to large valves with linear actuators using variable mounting kits. In specific terms, this equates to a valve stroke of 5 – 75 mm. The colour LEDs of the high-visibility display are very bright and can be seen from all around through the transparent housing cover. A 'location function' can be used to activate an optical signal and identify the valve in the plant. High-quality electronic components complemented by a robust yet compact housing produce a qualitatively

sophisticated overall image.

Thanks to the integrated manual override, the installation costs during servicing work in particular are significantly reduced, as there is no need for electrical energy to supply compressed air to the valve. The combi switchbox is available in a 24 V, AS-interface or DeviceNet versions as well as with an IO-Link interface.

GEMÜ is one of the world's leading manufacturers of valves, measurement and control systems. Over the course of more than 50 years, this globally focused, independent family-owned enterprise has established itself in important industrial sectors thanks to its innovative products and customised solutions for process media control. GEMÜ is the world market leader for sterile valve applications in the pharmaceutical and biotechnology industries.

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



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SKF solutions extend fan and blower MTBF

SKF's quality products and services help increase Mean Time Between Failure (MTBF), deliver increased uptime, and reduce maintenance.

Air handling equipment operates under challenging conditions; heat, dust, corrosive vapours, and wash-down exposure shorten fan and blower life. Premature bearing failure results from lubrication loss or contamination, shaft misalignment, or excess vibration and cause unscheduled downtime, production losses, and costly emergency repairs. Making matters worse, accessing the equipment is usually difficult and can also be dangerous.

SKF's comprehensive, cost-effective fan and blower solutions which include bearing and seal, lubrication, alignment and reliability solutions, reduce the chance of premature failure. SKF specialised bearings and seals tolerate harsh operating conditions while SKF lubrication systems, and shaft/belt alignment tools contribute to improve the service life of the fan. Condition monitoring services and equipment to identify failures before they become catastrophic, are also available.

Bearing and seal solutions include: Ball and roller bearing mounted units, SKF concentra bearing units, CARB® bearings, SKF Explorer bearings, fan wheel hub bushings,



split housing units, contact seals and flinger seals, and labyrinth seals.

Lubrication solutions include: Specialised SKF lubricants, SKF multipoint lubricators, and SYSTEM 24 with 24/7 lubricators. Alignment solutions include: Laser shaft alignment tools as well as Laser belt alignment tools. Reliability solutions offer portable data collectors, on-line data collection systems, failure analysis as well as machine balancing.

As drop-in replacements, or part of an integrated maintenance system, SKF fan and blower solutions extend Mean Time Between Failures (MTBF), reduce unplanned downtime, reduce maintenance and repair costs, enhance plant safety, and increase productivity.

For more information contact Samantha Joubert, on tel: +27 11 821 3602 or email Samantha.joubert@skf.com.

CrC-lined chutes improve productivity and efficiency at power plant



Rio-Carb has ensured a saving of more than R100 000 for a power plant in Secunda, after successfully refurbishing three chutes.

Chromium Carbide (CrC) liner plate expert Rio-Carb has ensured a saving of more than R100 000 for a power plant in Secunda, after successfully refurbishing three chutes and fitting them with CrC liner plates, according to a recent report.

Rio-Carb director Martin Maine explains that the project, which has been ongoing for five years, was extended due to the impressive performance of the R-C 700 liner plates. "Rio-Carb had already installed liner plates, in the three 60 m² chutes at the plant. We have also been tasked with supplying the

utility with R-C 700 pipes, which outlast the current pipes tenfold."

The chutes at the plant were previously fitted with ceramic two metre bolted liners, which were not suitable for the project's specific wear rate, thereby resulting in erosion and blockages in the chutes. Rio-Carb replaced the ceramic liners with 500 mm x 500 mm R-C 700 liner plates, which are manufactured to the chute specifications. The refurbishment included sand-blasting, welding and re-fitting.

Rio-Carb repaired the holes in the chutes,



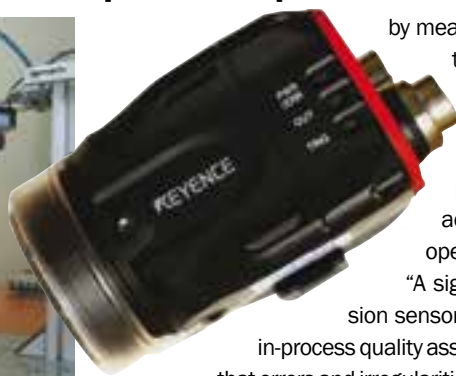
Rio-Carb Director Martin Maine

and then standardised the liner sizes to an easy-to-handle weight.

According to Maine, the average chute lasts for at least three years. "Standard refurbishments cost at least R2-million every three months, while with Rio-Carb's R-C 700, it is around R1-million every three years. Using MaxCS technology, Rio-Carb is able to take the properties of CrC and cast it via a welding process onto a mild steel backing plate, which gives it an optimum hardness of 58 RC, and additional flexibility for moulding and shaping."

For more information contact Martin Maine on tel: +27 11 908 1014, or email: info@riocarb.co.za

Latest vision sensors for process inspection and quality control



by means of a visual inspection process. When an object fails to match these parameters, the manufacturing process is able to react accordingly and an operator is alerted.

"A significant benefit of vision sensors is that they provide in-process quality assurance, which means that errors and irregularities are detected earlier along the production line, reducing the possibility of repeated inconsistency in production," Rob Howes, technical sales manager at Peter Jones, comments.

The vision sensors can test up to 99 inspection windows simultaneously, which not only improves the response time dramatically, but also helps to remove the element of human error in quality testing.

The development of a single-sensor vision sensor has resulted in significant cost-savings. Demonstration equipment is on hand to be used for customer training. Peter Jones also has access to the Keyence Technical Centre in Japan, which means it can assist with on-site commissioning as well.

While still in its infancy, visual inspection and profiling systems are fast becoming accepted as global best practice in process inspection and quality control.

An example of this technology is the IV Series Vision Sensor from Keyence of Japan, distributed locally by Peter Jones Electronic Equipment. Peter Jones falls under Actum Electronics, part of the Actum Group, which also comprises Actum Industrial.

The IV Series Vision Sensor is programmed with customised parameters that correlate, for example, with the material thickness or the presence of a barcode. The CCD scanner head, the heart of the sensor, compares the object being tested with the preset parameters

Howes adds that the IV Series Vision Sensor is extremely user-friendly. "Generally someone with no experience with vision systems can find their way around the software and start programming it within 30 minutes," he highlights.

Actum has represented Keyence in South Africa for more than 20 years, during which time it has invested heavily in nurturing the skills needed for visual-inspection processes and quality-control sensors. Keyence focuses on the niche sector of industrial control, for which it has developed a range of proximity and estimation systems, such as its advanced two-dimensional and 3D profiling systems. The company also specialises in presence or absence detection, identification, safety and quality assurance before and after production, concludes Howes.

The Actum Group has diversified to become a leading importer and distributor of components, instrumentation, automation and industrial products. More recently, four businesses have been acquired as part of the Group: Altico, Connecta, Peter Jones Electronic Equipment and Dowson & Dobson Industrial.

For more information contact Kevin Klaff on tel: 11 608 3001 or email: kevin@actum.co.za.



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The recycling of grey water

by Carl Schonborn, PrEng

Grey water recovery and recycling systems have been providing sustainable water solutions for the urban environment for some time. A range of systems has been designed to make homes, offices and commercial undertakings more water-self-sufficient.

Envirowater, a company based in Durban, specialises in the design and installation of grey water treatment and recycling technology. The tests performed on the Envirowater technology according to the Australian Guidelines for Water Recycling, proved it was able to deliver treated and recycled water to the standards required by the Australian State of New South Wales Water and Energy's "Guidelines for Management of Private Recycled Water Schemes"; the State of Queensland's "Queensland Plumbing and Waste water Code"; and the EPA Victoria Guidelines for Environmental Management's "Dual pipe water recycling schemes, Health and Environmental Risk Management" (Publ. 1015).

Most of the solutions discussed in this article focus on solutions for the more demanding, commercial and multi-dwelling environments. They are designed for architects, hydraulic consultants and engineers, developers and hydraulic contractors and plumbers and are aimed at helping them understand how it is possible to tackle the special requirements these environments present.

Envirowater commercial grey water treatment (CGT) systems

The CGT Series of products is designed as a packaged plant able to be tailored to the specific application required by the

end-user. It has been developed from the highly successful and well-proven single-dwelling system using the same core technology but can also be equipped with enhanced disinfection capability, control systems and remote management systems.

Common across all Envirowater's systems is the ability to treat and recycle grey water to a high level of quality. Grey water can originate from showers, baths, basins and laundries but excludes wastewater from kitchens, dishwashers, toilets and urinals. The patented technology enables the safe re-use of the recycled water for a range of residential and commercial applications including cooling tower make-up, surface landscape irrigation, toilet flushing and water features. The Department of Water Affairs and Technology, South Africa (DWAF) regulates which of these applications are allowable and ensures an effective and reliable treatment process. There are four key steps to the process.

1 Pre-screening

The pre-screening system uses an automatic self-cleaning mechanical screen to remove hair, lint and other coarse materials to prevent blockages and fouling of the system. Due to its unique design the pre-screen requires limited maintenance interventions and is able to operate effectively at high processing volumes.





2 Bio-filtration

The second and principal stage of treatment in the system occurs in the patented submerged, aerated biofilter. Grey water flows through the biofilter under gravity and contaminant removal is achieved through a combination of physical removal, adsorption and microbial-induced aerobic degradation.

The physical removal mechanisms are those typical of granular medium filters; straining, sedimentation, impaction, interception and adhesion. However, the patented system is superior to conventional granular medium filters as it provides additional treatment through the proprietary media.

The properties of the media allow a significant degree of adsorption to occur which complements the physical removal mechanisms. The combined capacities for physical removal, adsorption and bacterial degradation create an extremely robust treatment system.

To meet the regulatory standards required in commercial and multi-dwelling applications the system offers a powerful, 'triple-barrier' approach to disinfection consisting of the following:

1 Ultrafiltration

A 0,02 micron, automatic backwashing, ultra-filtration membrane system is used to provide a barrier to bacteria,

viruses and parasites such as *Cryptosporidium* and *Giardia*, and to improve turbidity.

The system incorporates online membrane integrity testing and automatic 'clean-in-place' technology.

2 Ozonation

Ozonation is the most powerful water sanitiser available for domestic and commercial use, being up to 3 000 times faster-acting than chlorine, yet leaving no chemical residues in the water. The only by-product from the sterilising process is oxygen. Ozonation rapidly kills bacteria, coliforms and viruses. It is effective for the removal process of iron, manganese, organically-bound heavy metals, cyanides, some phenols and other organics.

It does not require the water to be clear to be totally effective and can eliminate the use of sanitising chemicals in the water supply. Additionally it is a completely natural product produced on-site from electricity and air and is tasteless, odourless and pH neutral. Running costs are very low (about the cost of a 100 watt light for the ozone generator).

3 Chlorination

As a final step, the recycled water is chlorinated to ensure a level of residual disinfection in the recycled water distribution system.

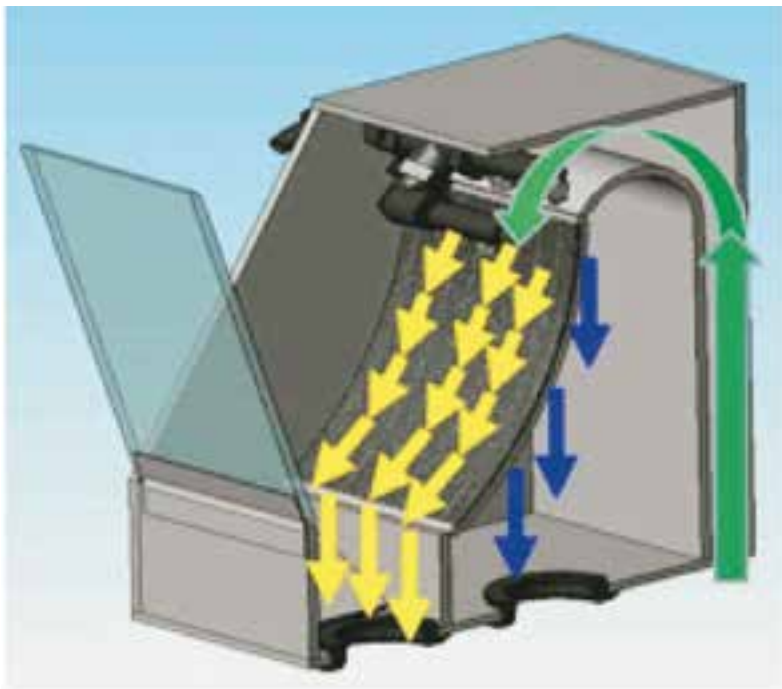


Figure 1: Self-cleaning pre-screen separates incoming grey water from solids.

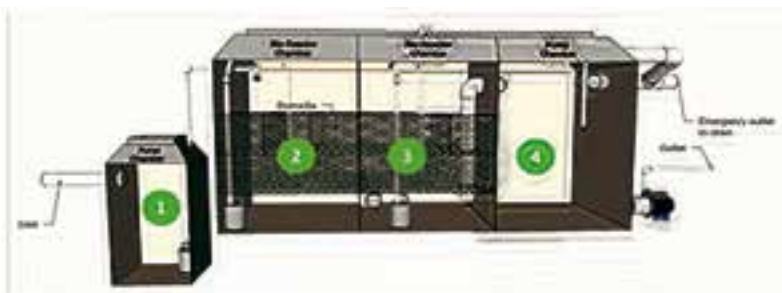


Figure 2: The second, and principal, stage occurs in the patented, submerged, aerated biofilter.

Monitoring water quality

Critical to ensuring that the recycling system is operating to the required standard is the ability to constantly monitor the quality of the treated water. The CGT Series incorporates real-time water quality assurance using a multi-parameter on-line analyser. The water quality analyser is configured to measure turbidity, pH and free chlorine. It directly controls chlorine dosing using proportional control. It offers a proprietary control system that integrates, coordinates and optimises a number of subsystems such as:

- Flow meters
- Pressure sensors
- Level sensors
- Water quality monitors
- Sub-system status alerts
- Manual inputs via touch-screen interface.

The controller is a combination of systems which enables it to monitor, process-control, event-log and manage the entire process. The core of the system is an industrial PLC. The treatment process of the CGT Series achieves a very

high degree of organic, nutrient and pathogen removal. The biofilter is designed to utilise a combination of microbial degradation, straining, impaction and interception to cause the media to retain a significant portion of organic matter and pathogens. Further retention of particulate organics plus dissolved organics and nutrients is achieved by adsorption. Retained contaminants are discharged to sewer during the automatic backwash cycle.

Supplementing the biofilter, the multiple disinfection stages achieve a very high kill rate of pathogenic organisms. If the treated water is to be used for irrigation, then an important element of grey water recycling is the degree of nutrient (nitrogen and phosphorus) removal. The CGT Series typically removes more than 40 % of both phosphorus and total kjeldahl nitrogen.

Conclusion

For users wanting to implement a safe grey water recycling system the critical reference point is The Australian Guidelines for Water Recycling. This is a detailed analysis of the risks, to both human health and the environment, which arise from water recycling. The document sets out guidelines for managing these risks to levels which are considered acceptable.

Envirowater has used these guidelines to develop its water quality targets and risk management protocols and to ensure that risks are managed to acceptable levels on an ongoing basis.

The CGT Series operates within the conventional system of public water, sewage, distribution and collection. Potable water, sewerage pipes and stormwater infrastructure are still utilised with no additional infrastructure required.

The system is designed so that it can be taken offline for maintenance without requiring alterations or modifications to any building plumbing infrastructure. The system is taken offline by a single valve which routes all grey water directly to sewer. Once offline, the system may be serviced without interference to waste water disposal.

Overflow and drain pipes connect all components of the CGTs to sewer. In the event of extreme flows or system malfunction, grey water is automatically or manually diverted to sewer.

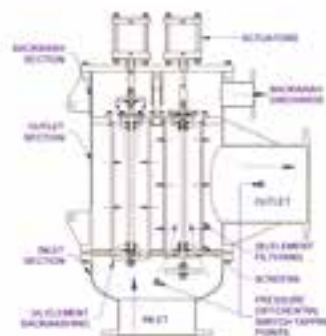
The CGT Series is appropriate for multi-dwelling, commercial and industrial applications, The modular and scalable nature of the system allows for water flows from 500 to 100 000 litres per day to be managed.

Operating costs for the CGT Series vary with the system capacity and application but are very low compared to alternative technology.

To summarise the advantages of CGT treatment systems:

- 1 The system has very low power consumption;
- 2 There are minimal consumable items and the system uses no expensive chemicals;
- 3 Water loss through backwashing is typically around 3 %.

Fully automatic backwashing filter/strainer removes suspended solids



Debris often needs to be removed from water to protect various types of equipment and systems including: effluent, irrigation, membrane pre-filtration, process and plant supply water, sea and ground water cooling systems, and washing and spray systems. Production problems are often caused by blockages in the water system, filters may be unreliable, with too many moving parts and excessive attention to them required.

Kleerflo is a fully automatic backwashing filter/strainer; regardless of whether the source of water is ground, sea, final effluent or certain liquids, the Kleerflo is designed to remove suspended solids from them.

It uses a unique integral backwash system that utilises a simple backwards and forwards shuttle movement to effect backwashing and with no spinning or rotating parts which ensures

minimal wear and low maintenance. When required it is simple and easy to maintain regardless of size.

Filtration is achieved by passing liquid through several tubular, stainless steel, wedge wire filter elements. These are available in a wide range of screening apertures, with the quantity depending on the flow rate and level of liquid contamination.

The backwash system consists of actuators and shuttle valves which create a reversal of flow of filtered liquid through the elements. This discharges the contaminants to waste.

Debris is captured on the inner surface of the elements. As the debris accumulates it blocks the gaps in the elements creating an increase in the pressure required to force the liquid through the filter.

A signal from a control system starts the backwash cycle, either on a pre-

determined time interval, or when the differential pressure reaches a predetermined limit. Only one element at a time is backwashed and thus the filter never goes off line during backwashing. With a dwell period between each element backwashing, to allow for system recovery, there is no interruption to the process and flow loss is minimum.

The filters can be operated with a variety of control systems, electro-pneumatic, fully pneumatic, or hydraulic from the line pressure. Alternatively, the filters can be operated via site supplied control systems.

For more information contact Superior Filtration Limited on tel: +44 20 8989 1171, email: sales@superior-filtration.com or go to www.superior-filtration.com.



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Lanxess launches new reverse osmosis elements onto the market



At its Bitterfeld site, Germany, LANXESS produces membranes for water treatment under the brand name Lewabrane.

Lanxess has recently introduced its novel reverse osmosis (RO) elements at the AMTA/AWWA Membrane Technology Conference & Exposition, held in San Antonio, Texas, USA.

"We succeeded in a very short time in developing a market-ready, novel feed spacer used in the membrane element. It provides for optimised flow in the RO element and thus lower energy consumption. Combining it with our proven, Lewabrane-brand reverse osmosis membrane results in high-performance products suitable for any number of applications," explained Dr Carsten Schellenberg, head of Research and Development at the membrane facility operated by the Liquid Purification Technologies (LPT) business unit in Bitterfeld, Germany.

Initially, two new products are to be introduced: Lewabrane B400 LE ASD and Lewabrane B400 FR ASD. Optimised for applications in brackish water, these elements have standard geometries and are characterised by very low energy consumption and high fouling resistance.

The new products in the Lewabrane line were developed as part of a cooperative research project involving Lanxess as well as regional and international partners. The feed spacers incorporated in the membrane elements are multifunctional. They create space between the membrane surfaces for fast-flowing water, support the membrane in the process and cause turbulent water flow. Although turbulent flow helps to lower salt concentrations at the surface of the membrane, and to reduce the extent of concentrate polarisation, it also causes an increased pressure drop compared, for instance, to laminar flow.

The optimal design of the feed spacers, therefore, is of critical importance to the properties of the elements. Filaments or strands of different thickness are used for the novel feed spacers. The new product family is named after this alternating strand design (ASD).

For more information contact Marthie Kotze on tel +27 11 457 4014 or email marthie.kotze@lanxess.com.

Source: Filtration+Separation Weekly, <http://www.filtsep.com/>

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The Draft Carbon Tax Bill

Part 1 - How the tax is calculated

by Carl Schonborn Pr Eng

In November, 2015, the South African National Treasury published for comment the Draft Carbon Tax Bill. To enable engineers to better understand the Bill, its contents have been edited for brevity and examples included to introduce the structure of the Bill as a commentary. This is a three-part series.

Part 1 (How the tax is calculated based on CO₂ equivalent emissions for stationary and non-stationary/mobile sources) is covered in this article.

Part 2 – Allowances and Offsets, will follow in a future issue as will Part 3 – Fugitive emissions, Industrial emissions. The Bill as published is the Carbon Tax Act, 2017, which will come into operation on January 1, 2017. It is to provide for the imposition of a tax on the carbon dioxide (CO₂) equivalent of greenhouse gas emissions, to be levied and collected for the benefit of the National Revenue Fund, or to be known as the Carbon Tax.

In brief, the Preamble to the Bill states the following:

- Greenhouse gas emissions have been scientifically confirmed.
- The inevitable climate change impact needs to be managed.
- It is necessary to make a contribution to the global effort to stabilise greenhouse gas concentrations in the atmosphere.
- The costs must be paid for by those responsible for harming the environment.
- The government is desirous to utilise measures to address the challenges posed by climate change.
- This will require the deployment of carbon and economic incentives, as well as the use of emissions offsets.
- The government believes that imposing a tax on greenhouse gas emissions and concomitant measures, such as providing tax incentives for rewarding the efficient

use of energy, will provide appropriate price signals to help nudge the economy towards a more sustainable growth path.

Abbreviations

“allowance” means any amount allowed to be taken into account in determining the carbon tax payable;

“carbon budget” means a limit on total greenhouse gas emissions from a specific company

“carbon tax” means a tax on the CO₂ equivalent of greenhouse gas emissions

“CO₂ equivalent” means the concentration of CO₂ that would cause the same amount of radiative forcing [1] (the difference of sunlight absorbed by the earth and energy radiated back to space) as a given mixture of CO₂ and other greenhouse gases.

“combustion” means the exothermic reaction of a fuel with oxygen.

“Commissioner” means the Commissioner for the South African Revenue Service.

“emissions” means the release of greenhouse gases or their precursors and aerosols into the atmosphere over a specified area and period of time.

“emission factor” means the average emission rate of a given greenhouse gas for a given source, relative to the activity data of a source stream, assuming complete oxidation for combustion and complete conversion for all other chemical reactions: GHG emission factor (CO₂e) per tonne.





(The determination of the emission factors used in the Tables is not discussed in the Bill but the interested reader is referred to the IPCC Guidelines for National Greenhouse Gas Inventories [2] and to the article on the regional emission factors for the power sector in Southern Africa [3]).

“emissions intensity” means an indicator of the result of the measurement of the quantity of greenhouse gas emissions in relation to an activity.

“emissions intensity benchmark” means the result of the measurement in respect of an activity that creates greenhouse gas emissions—

- expressed as a predetermined value of the quantity of specified greenhouse gas emissions;
- in relation to an activity that is differentiated from other activities by means of a product, a type of fuel or a technology; and
- compared against the quantity of greenhouse gas emissions, in relation to an identical activity undertaken by another person.

“fugitive emissions” means emissions that occur from the release of greenhouse gases during the extraction, processing and delivery of fossil fuels.

“greenhouse gas” means gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation, and includes carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

“industrial process” means a manufacturing process that chemically or physically transforms materials.

“Minister” means the Minister of Finance.

“person” includes a partnership and a trust.

“process emissions” means greenhouse gas emissions other than combustion emissions occurring as a result of intentional or unintentional reactions between substances or their transformation, including the chemical or electrolytic reduction of metal ores, the thermal decomposition of substances, and the formation of substances for use as product or feedstock.

“product use” means greenhouse gases used in products and product applications.

“Republic” means the Republic of South Africa.

“taxpayer” means a person liable for the carbon tax in terms of section 3.

“tax period” means a calendar year period in respect of which tax is payable.

The numbering used in this commentary will correspond to the Sections in the Draft Bill.

Persons subject to tax

3 A person is—

- a taxpayer; and
- b. will pay an amount calculated by a formula for the calendar year starting January 1, 2017, and thereafter each calendar year.

ANNEXURE 1: EMISSION SOURCE GROUPS, ASSOCIATED DATA PROVIDERS, EMISSION REPORTING REQUIREMENTS AND RELEVANT AUTHORITIES as defined in the NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT 39 OF 2004

Grp	Emission Source	Data Provider	NAEIS* Reporting Requirements	Relevant Authority
A	Listed activity published in terms of section 21(1) of the Act which states that "emissions the Minister or MEC reasonably believes have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage"	Any person that undertakes a listed activity in terms of section 21(1) of the Act (as defined in column 1.)	Emission reports must be made in the format required for NAEIS and should be in accordance with the atmospheric emission license or provisional atmospheric emission license.	Licensing authority.
B	Controlled emitter declared in terms of section 23(1) of the Act which defines it as "an appliance or activity which will result in atmospheric emissions which through ambient concentrations, bioaccumulation, deposition or in any other way, present a threat to health or the environment. "	Any person that undertakes a listed activity in terms of section 21(1) of the Act.(as defined in column 1) And uses an appliance or conducts an activity which has been declared a controlled emitter in terms of section 23(1) of the Act. (as defined in column 1) Any relevant air quality officer receiving an emission report as contemplated under notice made in terms of section 23 of the Act.	Any information that is required to be reported in terms of the notice published in the Gazette in terms of section 23 of the Act (as defined in column 1)	The relevant air quality officer as contemplated under the notice made in terms of section 23 of the Act, (as defined in column 1)
C	Mines	Any person that holds a mining right or permit in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	Emission reports must be made in the format required for NAEIS.	Relevant air quality officer.
D	Facilities identified in accordance with the applicable municipal by-law.	Any person that operates facilities which generate criteria pollutants, and has been identified in accordance with the applicable municipal by-law.	Emission reports must be made in the format required for NAEIS.	Relevant air quality officer.

*National Atmospheric Emission Inventory System, NAEIS Objective, to maintain a carefully designed, developed, tested and implemented web-based atmospheric emissions monitoring and reporting system that provides accurate, current and complete information on all significant sources of identified atmospheric emissions, including greenhouse gas emissions.

The person conducting an activity listed below as Annexure 1, will be defined as a polluter and pay a carbon tax in the amount of R120 per tonne carbon dioxide equivalent of the emission.

However, in addition to the above list, Section 29(1) of the **Air Quality Act 39 of 2004** states that The Minister or MEC may:

(a) declare any substance contributing to air pollution as a priority air pollutant; and

(b) require persons to implement pollution prevention plans.

Tax base

4 (1) The carbon tax must be levied as the carbon dioxide equivalent of those greenhouse gas emissions resulting from:

a. Fossil fuels combustion determined for each type of fossil fuel.

Numbers must be determined in accordance with a formula:

E = (A x B) where A is the mass of any one type of fossil fuel and B is the greenhouse gas emission factor obtained from Table 1.

b. Fugitive emissions from which the greenhouse gas is emitted.

Numbers determined by:

F = (N x Q) where N is either tonnes of solid fuel (or m³)

other than solid, emitting the greenhouse gas. Q is the emission factor from Table 2.

The fugitive emissions will be discussed in Part 3 of the commentary.

c. Industrial process and product use with respective numbers.

P = (G x H) where G is the mass of each raw material used or product produced expressed in tonnes in respect of the greenhouse gas emitted. H is greenhouse gas emission factor from Table 3.

The industrial process and product use emissions will be discussed in Part 3 of the commentary.

(2) If there are no emission factors available for the purposes of the calculation of greenhouse gas emissions as contemplated in subsection (1), a reporting methodology as approved by the Department of Environmental Affairs must be applied for the purposes of determining those emission factors.

Rate of tax

5 The rate of the carbon tax must be an amount of R120 per tonne carbon dioxide equivalent of the (total) greenhouse gas emissions of a taxpayer.

Calculation of amount of tax payable

6 (1) Subject to subsection (2), (the generation of electricity from fossil fuels), the amount of tax payable by a taxpayer in respect of a tax period must be calculated in accordance with the formula:

$$X = \{(E - D - S) \times (1 - C) \times R\} + \{P \times (1 - J) \times R\} + \{F \times (1 - K) \times R\}$$

(a) "X" represents the amount to be determined;

(b) "E" represents the number in respect of the total fossil fuel combustion-related greenhouse gas emissions of the taxpayer in respect of that tax period expressed as a carbon dioxide equivalent determined in terms of section 4(1)(a);

(c) "D" represents the number in respect of the petrol- and diesel-related greenhouse gas emissions of that taxpayer in respect of that tax period expressed as a carbon dioxide equivalent, determined in terms of section 4(1)(a); (*not sure why D is subtracted from E? I would think it is cumulative.*)

(d) "S" represents the number in respect of greenhouse gas emissions, expressed in terms of carbon dioxide equivalent that were sequestered (captured) in respect of that tax period as verified and certified by the Department of Environmental Affairs (refer to the Carbon Offsets Paper, April 2014, issued for comment by the National Treasury Department.)

(e) "C" represents the sum of percentages of allowances determined in terms of sections 7, 10, 11, 12, and 13 (Part 2 of this commentary) in respect of that tax period subject to section 14;

(f) "R" represents the rate of tax prescribed under section 5;

(g) "P" represents the number in respect of the total industrial process and product use-related greenhouse gas emissions of the taxpayer in respect of that tax period expressed as a carbon dioxide equivalent determined in terms of section 4(1)(c);

(h) "J" represents the sum of the percentages of the allowances determined in terms of sections 8, 10, 11, 12 and 13 in respect of that tax period, subject to section 14;

(i) "F" represents the number in respect of the total fugitive greenhouse gas emissions of the taxpayer in respect of that tax period expressed as a carbon dioxide equivalent determined in terms of section 4(1)(b); and

(j) "K" represents the sum of the percentages of the allowances determined in terms of sections 7, 9, 10, 11, 12 and 13 in respect of that tax period, subject to section 14:

If "(E - D - S)" in the formula is less than zero, then it is used in the calculation as zero.

(2) The amount of tax payable by a taxpayer in respect of the generation of electricity from fossil fuels in respect of a tax period must be calculated in accordance with the formula: $X = A - B$

Example 1

An entity burning solid fuel (a Stationary Source), say coal:

From Section 6 the formula is:

$$X = \{(E - D - S) \times (1 - C) \times R\} + \{P \times (1 - J) \times R\} + \{F \times (1 - K) \times R\}$$

Where: $E = (A \times B)$ where A is the mass of any one type of fossil fuel and B is the greenhouse gas emission factor obtained from Table 1.

Table 1: Energy Combustion Emission Factors (some types omitted for brevity) Stationary Source category

FUEL TYPE	GHG EMISSION FACTOR (CO ₂ e) PER TONNE
Anthracite	2,6371
Aviation gasoline	2,4095
Biodiesel	1,9183
Biogasoline	1,9183
Coking coal	2,0915
Crude oil	3,2214
Diesel	2,8326
Naphtha	3,2906
Natural Gas	2,4233
Natural gas liquids	2,6423
Other bituminous coal	1,8253
Petrol	2,3785
Sub-bituminous coal	1,8541
Sulphite lyes (black liquor)	1,1323
Waste oils	3,0220
White spirit and sbp	2,9566
Wood/wood waste	1,7764

It is estimated that a modern coal-fired power station requires around 8,3 tonnes of coal per day per MW. It will operate 365 days per year for its 4 800 MW maximum capacity. This equation is shown below:

$$8,3 \times 4\,800 \times 365 = 14\,600\,000 \text{ tonnes of coal per annum}$$

$$14\,600\,000 \text{ tonnes} \times 1,8541 \text{ (sub bituminous coal, GHG emission factor CO}_2\text{e per tonne)} = 27\,069\,860 \text{ t CO}_2\text{e}$$

Annual carbon tax liability will be:

$$27\,069\,860 \text{ CO}_2\text{e} \times R120 = R3\,248\,383\,200$$

Part 2 of this commentary will discuss allowances and rebates to the tax imposed.

Example 2

An entity burning a Non-Stationary / Mobile Source, say diesel:

A mobile source in air quality terminology is a non-stationary source of air pollutants, such as motor vehicles, buses, trucks, ships, trains, aircraft and various other vehicles.

A fleet owner is responsible for accounting for emissions resulting from the burning of fuel from the fleet, but not for the emissions associated with producing the fuel.

Most calculation tools address only CO₂ emissions from mobile sources due to the small contribution of non-CO₂ gases, which is consistent with the recommendations of the WRI/WBCSD GHG Protocol [4].



**Table 2: Energy Combustion Emission Factors
(Non-Stationary Source/ Mobile Source category)**

FUEL TYPE	GHG EMISSION FACTOR (CO ₂) PER TONNE
Aviation Gasoline	2,3977
Diesel	2,8706
Liquefied Natural Gases	N/A
Liquefied Petroleum Gases	1,7244
Lubricants	2,9566
Natural Gas	2,4233
Refinery Gas	2,8538

Ignoring small quantities of fuel used for two-stroke engines and equipment, a company's diesel records indicate that its fleet of trucks uses 200 000 litres in a year. At 0,832 kg/l this equates to 166 400 kg. The CHG emission factor from Table 1 is 2,8706. So the t CO₂e is 166 400/ 1 000 x 2,8706 = 477,7 t CO₂e.

Annual carbon tax liability will be:

$$477,7 \text{ t CO}_2\text{e} \times R120 = R57\ 320$$

Part 2 of this commentary will discuss allowances and rebates to the tax imposed.

While the Carbon Tax Bill uses CHG emission factors as listed in Table 1, calculating the tax liability using emission factors based on heat content of diesel and the kg CO₂ equivalent per Tj as listed in Table 2.2 of the IPCC 2006 guideline, the following is evident:

$$200\ 000 \text{ l/y of diesel with heat content of } 0,039 \text{ GJ LHV/l} \\ = 7\ 800 \text{ GJ LHV/y} = 7,8 \text{ Tj LHV/y.}$$

For diesel the LHV is 0,95 times the HHV so = 7,8/0,95 = 8,21 Tj HHV/y

From the IPCC table, diesel oil is 74 100 kg CO₂/Tj

Hence emission is 608 400 kg CO₂e/y = 608,4 tonne CO₂e/y

Annual carbon tax liability will be:

608,4 t CO₂e x R120 = R73 008 which is higher than using the Carbon Tax Bill table for emission factors for Non-stationary/Mobile source categories. However if all tax payers are taxed according to the same tables, any difference is equitable to all parties.

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- 4 Prepared by: National Council for Air and Stream Improvement, Inc (NCASI), Research Triangle Park, NC, USA

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Seaweed-based flocculent technology to recover water from oil waste

A pilot project has started up in the Middle East that aims to use a biodegradable flocculent made from seaweed to help recover water from oil waste.

Norway-based Sorbwater Technology AS has started a trial with the aim to achieve zero liquid discharge (ZLD) and recover fresh water for reuse.

Produced water is being cleaned using Sorbwater's technology from an oil-in-water content of about 100 ppm down to 1 ppm oil in water. The trial is in the range of 400 bbl/day.

The idea is that a desalination process can then follow to remove salt from the water so it can be reused as process or wash water.

The pilot commenced in January 2016 and if successful, the Sorbwater system will be deployed in several plants, with each installation treating between 200 000 – 300 000 bbl/day of produced water.

Approved by the Norwegian Institute of Public Health for use in drinking water treatment, the supplied Sorbfloc® flocculent

technology is extracted from seaweed and is from the hydrocolloid family, able to attach to even the smallest particles or oil droplets in water, the company said.

It is characterised by cross linking capabilities that, when activated according to Sorbwater's process, "instantly and irreversibly flocculate pollution in water to large, easy separable super-strong flocks", according to Sorbwater.

Sorbfloc® is characterized by excellent cross linking capabilities. These capabilities, when activated according to the Sorbwater Process, instantly and irreversibly flocculate pollution in water to large, easy separable super strong flocks. Sorbwater Technology AS has developed IPR and utilisation of the product in water

treatment processes which until now has been considered impossible to treat with such cross linking hydrocolloids. The brand is also licensed to Sorbwater's production and development partner, FMC



Corporation, PH, USA.

Sources: <http://www.waterworld.com/water-and-wastewater-international.html>
<http://www.sorbwater.com/>

The changing face of waste management



Waste management in South Africa is changing. With the growing need for organisations to be more sustainable and incorporate responsible waste management practices, the Institute of Waste Management of Southern Africa (IWMSA) will yet again be at the forefront of helping organisations incorporate these practices with their flagship conference,

WasteCon. The WasteCon 2016 conference and exhibition will take place from 17–21 October 2016 at Emperors Palace in Gauteng.

This year's conference and exhibition marks the 23rd biennial WasteCon event and is the largest of its kind in Africa. "The IWMSA's Central Branch is hosting the conference with the theme 'The Changing Face of Waste Management'," says Prof Suzan Oelofse, President of the IWMSA.

By working towards more sustainable waste management practices, South Africa will see a reduction in greenhouse gas emissions, extended lifespan of landfill sites and useful recycling and compost products that ultimately safeguards natural resources.

WasteCon 2016 will be a premier showcase of sustainable waste management solutions with topics such as: alternative waste treatment technologies; community-based

waste collection; diversion versus minimisation; integrated waste facilities; the circular economy; and waste-to-energy; innovation in waste collection and transport systems; Municipality experiences implementing recycling initiatives; awareness campaigns on waste; and state of the art landfill design, construction and rehabilitation, to name but a few.

"National and international specialists will be present to share best practices and showcase innovation in the industry – making it a must for all individuals and organisations operating in the waste management field," mentions Oelofse.

For more information on WasteCon 2016, please visit www.wastecon.co.za. For more information on the IWMSA visit www.iwmsa.co.za.



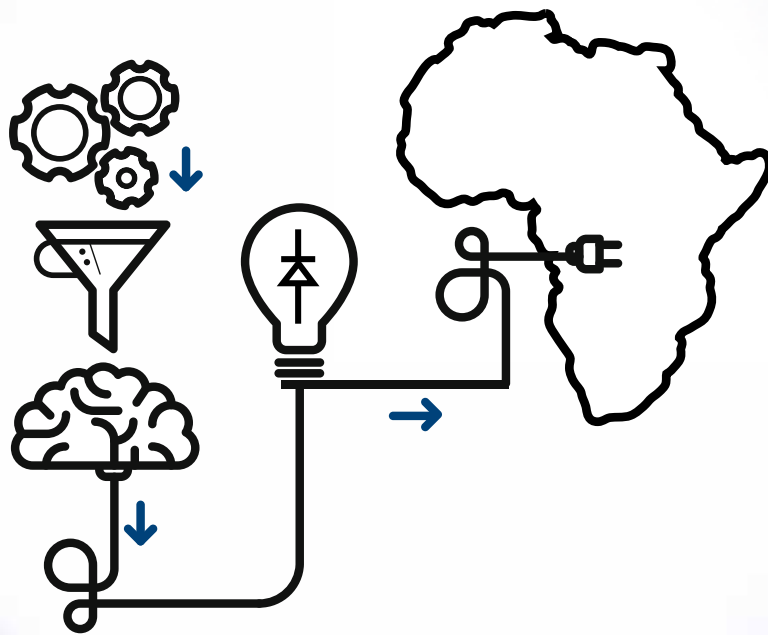
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SAIChE-IChemE Western Cape Student Chapter Launch - 1 October 2015

Written by Nkululeko Mbonane
 on behalf of the Western Cape
 Student Chapter

On October 1, 2015 Stellenbosch University Process Engineering Department successfully hosted the launch of the Western Cape Student Chapter of the South African Institute of Chemical Engineers (SAIChE) and the Institution of Chemical Engineers (IChemE).

The launch gave students the opportunity to network with their peers as well as to attend thought-provoking speeches by Mr Mazema (Chairperson of the Western Cape SAIChE-IChemE), Professor Cairncross (Guest Speaker from Cape Peninsula University of Technology) and Professor Pillay (Stellenbosch University).

Topics covered included the role of professional bodies, the struggle against climate



change, and how the chemical engineering profession can rise to the challenge by facilitating a greener economy and supply chain.

The event was well attended, with over 50 undergraduate and postgraduate students from the Stellenbosch University, University of Cape Town and Cape Peninsula University of Technology.

Where to find chemical engineering educational programs around South Africa

Educational Institute	Website
University of South Africa (Unisa)	http://www.unisa.ac.za/
Western Cape:	
Cape Peninsula University of Technology (CPUT)	www.cput.ac.za
University of Cape Town (UCT)	www.uct.ac.za
University of Stellenbosch (SUN)	www.sun.ac.za
Gauteng:	
University of Pretoria (UP)	www.up.ac.za
University of the Witwatersrand (Wits)	www.wits.ac.za
Northwest University (NWU)	www.nwu.ac.za
University of Johannesburg (UJ)	www.uj.ac.za
Tshwane University of Technology (TUT)	www.tut.ac.za
Vaal University of Technology (VUT)	www.vut.ac.za
KwaZulu-Natal	
University of KwaZulu-Natal (UKZN)	www.ukzn.ac.za
Durban University of Technology (DUT)	www.dut.ac.za
Mangosuthu University of Technology (MUT)	www.mut.ac.za

Want to be interviewed or nominate someone for in the Spotlight? Contact Michelle at Michelle.Low.za@gmail.com.

Atlas Copco's Water for All project changes lives



Through the Water for All project, Atlas Copco, a leading provider of sustainable industrial productivity solutions, sets out to make clean, potable water a possibility for all and the latest beneficiaries of this remarkable initiative are learners from the Mhlazane Primary School in Rorke's Drift, Kwa-Zulu Natal.

The Water for All project finances the installation of infrastructure and facilities that promote accessibility to clean water for disadvantaged communities in the rural areas. The project was first introduced to the Rorke's Drift area in 2011 and commenced with the drilling of three boreholes by Atlas Copco, in association with local NGO, the David Rattray Foundation. "Mhlazane Primary school was one of the beneficiaries of the project which was completed in late 2012," explains Kgothatso Ntsie, Atlas Copco South Africa's Corporate Communications Manager, South and sub-Saharan Africa.

Prior to the introduction of the boreholes, the school of over 465 learners, collected water from the river or depended on rainwater

harvested in Jojo tanks. However this has now all changed thanks to the Water for All initiative which has made a huge and positive impact on the school. Easier access to water is facilitating some of the primary school's projects including the vegetable garden which is used in their learner feeding scheme.

On 13 November 2015, a delegation of eight Atlas Copco board members visited Mhlazane Primary School to witness the project's efforts and growth in South Africa.

"Atlas Copco South Africa was host to the very first visit by board members to a Water for All project site," says a very proud Ntsie.

The delegation included Atlas Copco's Senior Vice President of Corporate Communications and Corporate Governance as well as Peter Wallenberg Jr, whose father helped start the initiative back in 1984. Peter Wallenberg Jr gave a moving speech on the history of the Water for All initiative where Atlas Copco is one of the larger contributors.

"This is an exceptional experience which has opened the eyes of the board members

to a region that has not has any rainfall since April and to see the good effect this project is having on the school!" remarks Peter. Commenting on the good work being done by the David Rattray Foundation helping some 19 schools in the area, Peter highlights the fact that such a small foundation can do so much. "We must see to it that we continue doing these projects."

Atlas Copco donated ten soccer balls to the learners and the cheerful atmosphere became even more festive when the learners entertained the delegation with singing and dancing. School Principal, Mrs Ndlovu, was thrilled to have international guests at her school and expressed her gratitude stating that the project had changed their lives for the better and has alleviated some of the many problems

they were experiencing in the area. Grade 7 learner, Amanda Ndebele, says that they are so grateful for this project because it is very important to drink water especially during this drought when temperatures are extremely high.

"Given the protracted drought that is gripping large regions of southern Africa, the importance of this project cannot be overstated," notes Kgothatso. "Water gives life and the Water for All project is making a difference in the lives of many people and is also in line with Atlas Copco's commitment to sustainable productivity through standing by our responsibilities towards our customers, our environment and the people around us. The school visit was a huge success; the board members were most impressed with the efforts and left feeling proud of their association with Atlas Copco."

To learn more about Water for All and the Peter Wallenberg Water for All Fund, please visit

<http://www.water4all.org/us/>.

VEGA Controls SA holds a winning event at fun Golf Day 2016



Günter Kech with his small radar

VEGA's annual golf day has become a calendar event not to be missed. This year was no exception.

In his opening introduction, John Groom stated that VEGA "does not do recession". This people-oriented company instead focuses on what they can do best for their customers.

Invited guests also heard from Natalie Barnes, Director of VEGA Controls SA, the sole authorised distributor of VEGA products for the South African market from 1 January, 2016. She was followed by five heads of department who each introduced a VEGA product and spoke briefly about their personal growth within the VEGA family.

The main product presentation was given by Mr Günter Kech, Managing Director of par-

ent company VEGA. He had the attention of the audience as he took them through the history of VEGA's development of the first 4-wire radar sensor in 1996 up until 2014 when VEGA produced the 80 GHz radar, optimised for solids measurement.

Finally, Frikkie Strikker, Head of External Sales, gave a practical demonstration on how easy it is to install and set-up any VEGA instrument using the low energy Bluetooth PLICSCOM application using a smartphone or tablet PC.

For more information contact Chantal Groom on +27 11 795 3249 or email chantal.groom@vega.com.

Global Solar PV pipeline surpasses 200 GW, IHS says

With the United States in the lead, due in large part to the recent extension in the country's solar investment tax credit (ITC) late last year, the global solar photovoltaic pipeline now exceeds 200 gigawatts (GW). At a combined capacity of 110 GW, projects in the US, China and Brazil make up half of the current PV pipeline, according to IHS Inc, the leading global source of critical information and insight.

"A large share of the planned projects is still immature, with developers scouting for tenders and other opportunities to sign power-purchase agreements," said Josefin Berg, senior analyst for IHS Technology. "The previous panic to complete project phases ahead of schedule has reverted to a development pipeline responding to demand and contract fulfilment."

The biggest growth of the global solar pipeline has been in the United States, where 16 GW of new projects entered the pipeline in 2015; at the same time, 10 GW of tracked projects were installed or entered construction. As a result of the ITC extension announced in December 2015, the US pipeline is now changing shape, according to the latest IHS Solar Deal Tracker.

Early-stage projects that faced the challenge to complete development and break ground, in order to reach completion prior to the previous deadline at the end of 2016, are now relaxing their schedules, as they do not need to enter construction before 2019 to benefit from the 30 % credit.

On the opposite end of the global spectrum is the United Kingdom, where the PV pipeline of pre-construction projects decreased by more than 4 GW in 2015. Projects continue to be built; however, few new projects have started development, because of the looming expiration of the Renewable Obligation Certificates (ROC) scheme in April 2016.

Economies of scale, and an inclination for oversized projects, are expected to increase

system sizes. Two thirds of the global PV pipeline capacity are projects larger than 50 MW. Developers in both the United States and China target economies of scale by implementing large projects in areas with abundant land. The oversizing of module capacity in relation to the output inverter capacity also raises total system sizes. In the United States, IHS tracks projects where the module capacity is up to 40 % higher than the inverters.

"Among the markets with the largest pipelines, only Brazil prefers the more modest system size of 30 MW, as a result of regulation; however, Brazilian developers are bundling projects to reduce costs," Berg said.

Research that generates energy by mixing water receives European Federal Chem Eng award

Generating electricity can be as simple as mixing salt water and fresh water. The European Federation of Chemical Engineering (EFCE) has recognised a postdoctoral researcher at TU Delft whose PhD thesis detailed such a process with its Excellence Award in Membrane Engineering.

Dr David Vermaas' PhD entitled 'Energy generation from mixing salt water and fresh water: smart flow strategies for reverse electrodialysis' focused on using ion exchange membranes to harvest renewable energy from mixing water streams with different salinities. The difference in salinity between salt and fresh water streams, when separated by an ion exchange membrane, induces a potential difference. The redox reaction that occurs then converts ionic current into an electrical current.

Vermaas' research has been scientifically published in highly ranked journals within the field of membrane engineering, and in addition, his research has resulted in two patent applications. EFCE recognised Vermaas, who completed his PhD within



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the Membrane Science and Technology research group at the University of Twente, the Netherlands, for his strong personal contribution to the field of membrane engineering.



Dr David Vermaas

On receiving the award, Vermaas said: "I was extremely happy to receive this award, and it is such a great honour to be recognised by the Federation. Moving forward, this award will really motivate me to continue my research in transport through ion exchange membranes as I find this a really exciting field to be working in."

Vermaas was presented with the Excellence Award in Membrane Engineering at the Euromembrane 2015 conference, which was held in Aachen, Germany in September 2015.

Sea water samples found to be contaminated aboard the SA AGULHAS II

Scientists aboard the SA Agulhas II discovered recently that their sea water samples were contaminated. The engineer's investigation determined that a 50 mm diameter stainless steel pipes circulating through five levels of the ship which supplied seawater from the hull to the laboratories had become compromised and threatened the scientists' research expedition.

To make matters worse, the vessel was due to leave port within a week. Even if a dry dock was available, the time it would take for conventional repairs would jeopardise their mission.

Engineers commissioned a technology which has never been used on a research vessel of this magnitude in South Africa. Water Damage Services (pipe relining division) used compressed air to shoot epoxy into the piping system. This caused a 'Venturi effect'

which created a barrier coating which in turn rehabilitated the inside diameter of the pipes. Chemical engineers predict this rehabilitation technique to have a 50-year lifespan in standard applications.

The entire project was completed within 48 hours whilst the vessel was afloat in the harbour. The vessel went to sea within a few days of the procedure. When the success of the procedure was confirmed by the scientists, Water Damage Services was commissioned to carry out additional rehabilitation in March 2016 when the vessel returns to SA.

For further information contact Jerome Gray on tel 0860 105 314 or email info@waterdamageservices.co.za. In the event of an emergency, please call the 24 hour number: 082 461 1345.

Highlights from the International Council for Science (ICSU)

ICSU participated in the first meeting of Science International, which was held from 7-9 December 2015 in Pretoria, South Africa, on the topic of 'Big Data/Open Data'. At the meeting, ICSU, together with the Global Network of Science Academies (IAP), the International Social Science Council (ISSC) and the World Academy of Sciences for the Advancement of Science in Developing Countries (TWAS) agreed a new accord, 'Open Data in a Big Data World', which details principles and practices to support open access to 'big data' used in publically funded research. The ICSU will soon be reaching out to its members and the wider scientific community to seek further endorsement of this accord and its principles.

During the Science Forum South Africa (SFSa), which was also held in Pretoria

(from 8-9 December), ICSU was awarded the SFSa Science Diplomacy Award, recognising ICSU's work on science for policy, especially within the context of ensuring that science is integrated into international policy development.

In January 2016, ICSU Executive Director, Heide Hackmann, was appointed by UN Secretary General, Ban Ki-Moon, to serve on a special advisory group on the Sustainable Development Goals. The group consists of members of civil society, the private sector and the scientific community. They will support the Technology Facilitation Mechanism, a key part of the post-2015 architecture for the implementation of the Sustainable Development Goals.

At the end of January this year, ICSU co-organised the UNISDR Science &



Technology (S&T) conference which was held in Geneva on 27-29 January and attended by some 750 delegates. At the conference, hundreds of scientists and policymakers pledged to step up action on the Sendai Framework for Disaster Risk Reduction, a 15-year global agreement that aims to curb deaths and economic losses from natural and man-made hazards. ICSU took part in the organisation of the conference alongside other partners.

At the conference, a new Science and Technology Partnership in support of disaster risk reduction was launched. The partnership comprises over 65 agencies, science networks and organisation.

'Fundamentals of Process Safety Management' course 2016

The Institution of Chemical Engineers (IChemE) "Fundamentals of Process Safety Management" course, (PSM), is being held at the Birchwood Hotel & OR Tambo conference Centre, Boksburg, from the 9-13th May 2015. The proceedings will cover the entire five-day UK IChemE course and is approved by IChemE

Course leaders are Rod Prior, a chemical engineer with over 30 years of experience in process industries, including production, commissioning and health and safety management; and Nigel Coni, who has over 40 years' experience in the

chemical industry, in design, project, production and consulting positions.

The course is aimed at process plant management, supervisors, engineers, designers and safety experts. The course will cover, *inter alia*, a model for PSM and basic hazard science, performance measurement and learning from accidents, design safety, legal framework, management of change, mitigation and emergency responses and much more. A comprehensive course manual will be provided.

Please contact Rod Prior for details. Cell: 082 554 0010.

More news from ICSU's Regional Office for Africa

- *Global Climate Observation - the Road to the Future*. Amsterdam, 2-4 March 2016.
- *23rd ISPRS Congress*. Prague, 12-19 July 2016.
- *41st COSPAR Scientific Assembly*. Istanbul, 30 July - 7 August 2016.
- *IUFoST 18th World Congress of Food Science and Technology (World Food Congress)*. Dublin, 21-25 August 2016.
- *SciDataCon 2016*. Denver, Colorado, 11-13 September 2016.
- *3rd Global Land Project Open Science Meeting*. Beijing, 24-27 October 2016.

Chemical Technology is the only publication in Africa for chemical engineers focusing on all unit operations in a comprehensive way



SUDOKU NO. 112

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>

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

Solution
for SUDOKU
111

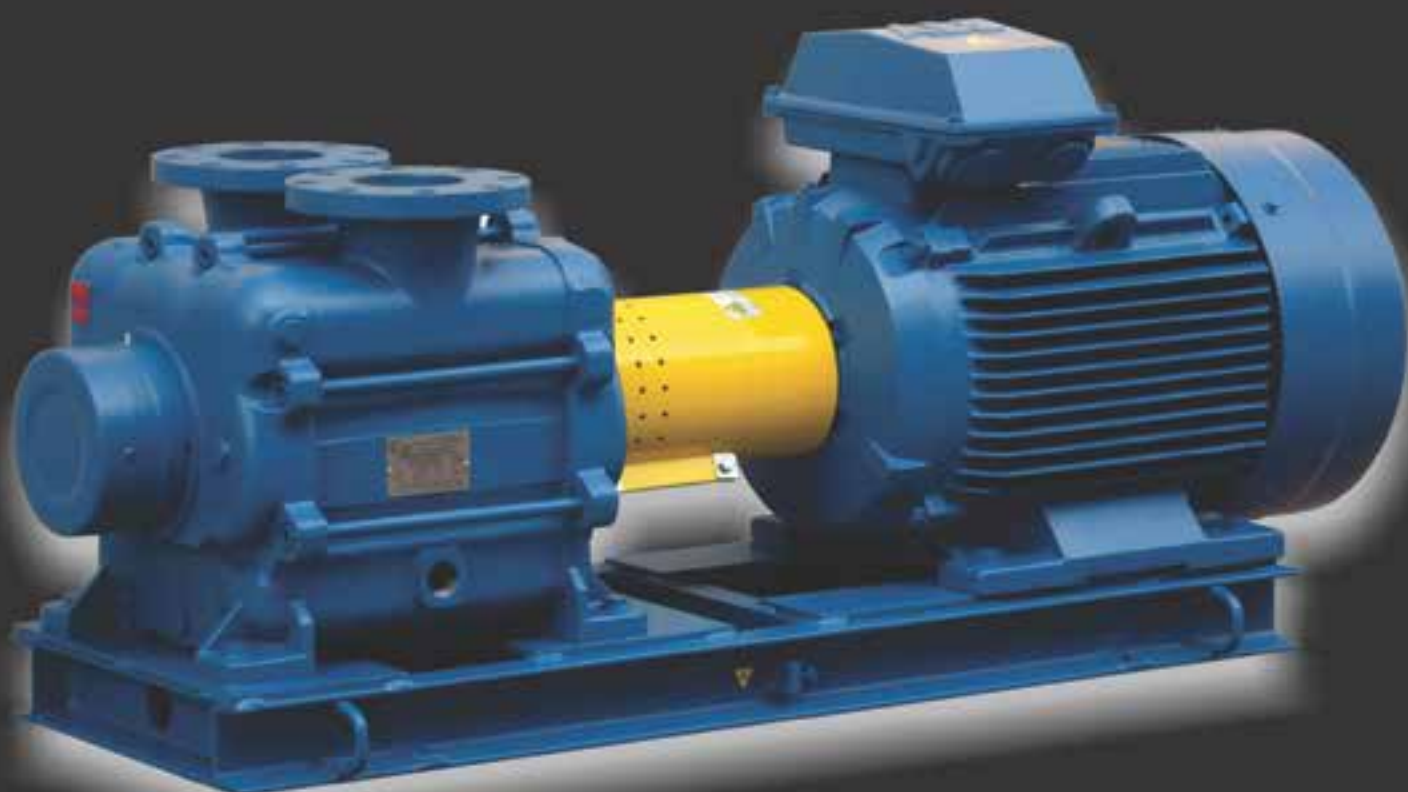
3	4	6	2	5	7	8	1	9
8	1	2	4	9	6	5	7	3
9	5	7	1	3	8	2	4	6
7	6	5	9	8	2	1	3	4
2	9	3	5	4	1	6	8	7
1	8	4	7	6	3	9	2	5
5	7	9	8	1	4	3	6	2
4	3	8	6	2	5	7	9	1
6	2	1	3	7	9	4	5	8

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