Your essential link to the global pump industry

PUMP engineer

Cover Report:

Tycon Alloy Industries: improving on high quality, and proud of it !

In this Pump Engineer magazine:

- *Forces that drive the global pump industry*
- *Quality service in the field at Elliott Company*
- *Standards in centrifugal pumps*
- *Best practices for lubricating small rotating equipment*

Volume 5, September 2013

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PUMP engineer

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COVER PHOTO: TYCON ALLOY INDUSTRIES (HONG KONG) CO., LTD: ITS PROFESSIONAL AND DEDICATED TEAMS MAKE FOR HIGH QUALITY PRODUCTS.

Hot off the press!

As I write the introduction to this next issue of Pump Engineer, it is something like 35°C outside and sweat is trickling down my back. The Netherlands is having a heat wave, the first in six or seven years, they say. Fortunately, with the office balcony door open, a light breeze is helping me to collect my thoughts, and this time I find myself pondering the subjective experience of working as an editor of a magazine. The task brings with it the unique privilege of being able to investigate in depth the whole spectrum of pumps and pumping technology with its massive and largely unsung influence in all sectors of industry right across the world. It is precisely this quiet but universal presence of humming rotating equipment that impresses me, and the take-them-for-granted attitude that I certainly had before I began to do my research. What a wonderful thing a pump is and what a benefit it brings to all of us. We simply cannot do without them (though I do wonder how many people are actually aware of this). Why shouldn't its merits be celebrated? That is certainly what we are doing in this latest hot off the press September issue anyway. Reading the cover story feels like walking around the Tycon Alloys factory and feeling the heat of their red hot castings. Then it's out of the frying pan and into the fire on page 24, for an interview with another completely dedicated engineer in boiling Bahrain. Page 17 brings a solid technical paper on standards in centrifugal pumps and on page 33 you can learn about greasing up, not for the sun but for small rotating equipment. Pump Engineer brings you all this and more: please enjoy it while the news and information is still warm!

Andrew Peers
Editor
a.peers@kci-world.com

Contents

Projects, Products & People

PRODUCT NEWS

Parker announces syringe pump

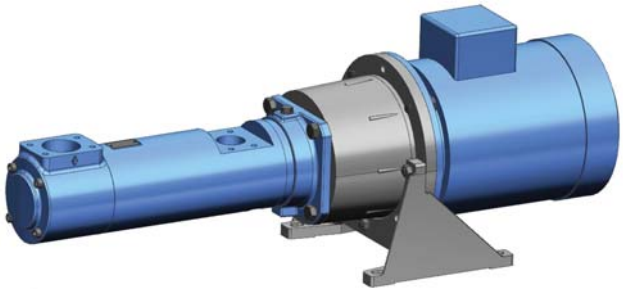
The Precision Fluidics Division of Parker Hannifin Corporation announced the Parker Smart Syringe Pump, a 30mm syringe pump that improves the performance of Clinical Diagnostic and Analytical Chemistry systems requiring precision fluid delivery. Parker designed this long life pump to a minimum of 5 million cycles, developing a lightweight and compact solution that helps reduce overall instrument costs and footprint. By directly mounting the pump on a motion system, instrument manufacturers can simplify their designs by completely removing transfer tubing between the pump and probe thereby eliminating any loss in performance associated with long transfer lines. The pump is ideal for applications such as in-vitro diagnostics, hematology, molecular diagnostics, flow cytometry, genomics, proteomics, liquid handling, sample preparation, chromatography and precision flow control. The Parker Smart Syringe Pump is CE compliant for emissions, immunity, and safety.

KNF launches smallest diaphragm pump

The new NF 2.35 from KNF Flodos is the smallest 16 bar pressure diaphragm pump on the market and fits into the palm of a hand. The new model delivers up to 100 ml/min at 16 bar and features a patented valve system and quick and reliable hydraulic connections. This pump offers an excellent size-performance ratio. Self-priming, it can run dry and is maintenance-free throughout its long lifetime. The new NF 2.35 has a head made of PEEK, which offers broad chemical resistance. The diaphragm and valves are available in EPDM and FFKM, ensuring that the pump can be used for most neutral and aggressive liquids and gases. This allows the NF 2.35 to cover a wide range of applications, including fuel cells, cleaning and disinfection devices, needle cleaning in medical devices, liquid spraying devices, degassing equipment, pressure and leak tightness control devices, and many others.

New screw pump from Colfax

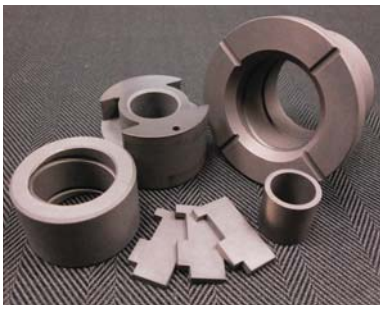
Colfax Fluid Handling begin deliveries of a new screw pump for lubricating liquids. The new series covers a wide capacity range with a variety of installation variations. The pumps are suitable even for rough operating conditions. The new “CFH M” series is suitable for pumping all types of lubricating liquids such as lubricating and hydraulic oils. Six sizes cover a capacity range from 40 to 880 l/min. (8.8 to 232.5 GPM) with a maximum discharge pressure of 100 bar (1450 psi). The temperature of the liquid may be as high as 100°C (212°F); permissible viscosity is between 3 and 760 mm²/s. Innovative materials permit usage even under rough operating conditions, such as intermittent operation. The new pumps are available in dry-mounted as well as tank-installation versions with a strainer. Preparation for installation of a suction pipe is optional.



NETZSCH pumps for food & beverage industry

The NEMO BH Hygienic Pump has a maximum capacity of is 140 m³/h for differential pressures up to 24 bar. The pump is suited to a broad range of media from shear-sensitive to abrasive or adhesive materials, including those with extremely high viscosity. For special temperature requirements, the pump housing and stator are also available in a heatable or coolable design. The pump can be installed vertically or horizontally and can transfer media even in largely airless conditions, almost up to absolute vacuum. The NEMO BH is manufactured and tested in accordance with EHEDG and QHD guidelines. All materials, particularly the elastomers used, are approved in accordance with the FDA. The hygienic pump also meets the requirements of international certificates, such as the American 3-A Sanitary Standards and the Russian GOST-R. The NEMO Beverage Pump creates conveying chambers of the same size on the suction side with each rotation, moving the sensitive medium to the discharge side in fixed volumes with almost no pulsation and without strong shear forces. No pressure reversal points in the system means no pressure fluctuation. The TORNADO (photo above) Rotary Lobe Pump was developed specifically for the food sector. The lobe rotors are attached cleanly from the outside with quick-fit taper lock ringsets, which makes replacement easier and eliminates screw fastenings in the pump chamber. No solids can be deposited on mounting parts, as all rotor surfaces are smooth. The company also supplies its barrel emptying systems in three sizes (NBE 5, 20 and 200) to empty standard containers from 1 l to 200 l and special containers up to 1,000 l at capacities from approx. 6 ml/min to 10 m³/h. Progressing cavity pump technology gives the advantage of clean emptying with residues of less than 1% without in-liner.

Metcar bushings for aircraft engine fuel pumps



Metallized Carbon Corporation announced carbon-graphite bushings for use in gear pumps that pump aviation fuel for aircraft engines. The carbon-graphite bushings are used to support both the drive gear shaft and the idler gear shaft. These carbon-graphite bushings can use aviation fuel as the bushing lubricant. Aviation fuel is a low viscosity liquid that produces only an extremely thin hydrodynamic film, too thin to provide adequate lubrication for traditional metallic bushings. Metcar's carbon-graphite material has no atomic attraction to a metallic shaft so the thin fuel film is sufficient to lubricate metallic shafts running in the carbon-graphite bushings. Carbon-graphite bushings are self-lubricating so they can run dry for short periods of time without catastrophic pump failure or significant wear. The bushings are dimensionally stable, which permits the close bushing to shaft running clearances that are required in gear pump applications. These carbon-graphite bushings also have a relatively low elastic modulus. While elastic enough to be press-fit into the metallic gear pump housing, the Metcar bushings are pre-stressed in compression. They exhibit nearly the same coefficient of thermal expansion as the metallic gear pump housing material. This assures that the running clearance between the shafts and the bushings will remain the same throughout the entire operating temperature range of the pump.

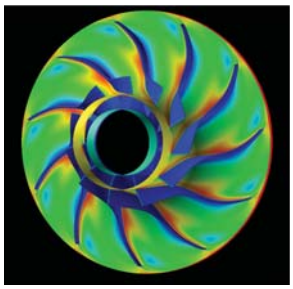
Verderflex Rapide Tube Pumps

The Verderflex Rapide has been developed to offer reliable and cost effective pumping solutions for industrial applications, including chemical, mining, printing and water treatment. These industrial tube pumps offer the customer pump choices that are compact and simple to use, requiring no tools during the tube change. They are low flow dosing peristaltic pumps which are capable of handling viscous, abrasive and chemically aggressive media with total containment and leak free pumping.

HP pump for medium-range SWRO desalination

Danfoss has added a new high-pressure pump targeting the medium-sized seawater reverse-osmosis market. The Danfoss APP 43 high-pressure pump has an output of up to 43 m³/h and is the company's largest axial piston pump to date. The pump is ideal for parallel trains that drive medium-sized SWRO plants between 500-20,000 m³/d. The APP 43 saves operators up to a full 20% in energy costs compared to centrifugal pump. In addition to the lowest energy usage in its class, the APP 43 is also the market's most compact and service-friendly pump. The APP 43 has been available worldwide from 1 July 2013.

ADT ships TURBOdesign Suite 5.2.1



Advanced Design Technology announced that TURBOdesign Suite version 5.2.1 is now available. This version of the first commercially available 3D inverse design software system for turbomachinery products introduces a new elliptically smoothed mesh generation routine in TURBOdesign CFD for computational fluid dynamics (CFD) analysis as well as a new ability to predict stage performance, including volute performance, that previously was only available for pumps. TURBOdesign CFD has an Elliptically Smoothed Mesh Generation Routine that can use different numbers of mesh sizes on the pressure and suction sides of blades coupled with elliptical smoothing to improve mesh quality near the leading and trailing edges for high stagger blades that allow users to mesh cut-off trailing edges in centrifugal pumps or compressors. The Load Distribution Section Exporting has been improved to allow users to select the number of sections when exporting load distribution of existing designs. TURBOdesign Suite 5.2.1 in now available for download and runs on Windows systems. It operates on mid-range workstations with 2.4 Ghz or better processors, 2GB RAM and 1Gb disk space.

Sulzer launches Pump Performance Expert service

Sulzer Pumps has launched a new Pump Performance Expert service for customers in the pulp and paper industry. This new global service will contribute not only to reducing customers' Total Cost of Ownership (TCO) but also to achieving significant benefits in their existing and future processes. The Pump Performance Expert Service focuses on MC (medium consistency) applications, agitation and mixing applications, tower channeling and discharge. This service is applicable for both the installed bases of Sulzer Pumps and other Original Equipment Manufacturers (OEM). The service offers a wide range of savings in pumping, mixing, agitation and tower management applications, all in one package.

Laars introduces pool heater

The Mighty Therm2 Pool Heater from Laars, designed specifically for the replacement pool heater market, is now available in seven sizes from 500 to 2000 MBH. The natural gas or LP-fired systems come standard with a built-in automatic mixing system to make sure low return water temperatures do not condense. The mixing system includes a three-way thermostatic mixing valve and a factory mounted and wired pump, allowing the Mighty Therm2 to handle return water temperatures as low as 60°F without causing internal condensation. The Mighty Therm2 Pool Heater's features also include 87% thermal efficiency, ultra low NOx (10 ppm) emissions, a wiring terminal strip for easy electrical troubleshooting, gas and water supply on right or left side, flexible Cat I or III venting and suitability for indoor or outdoor installation.

New ViscoTec RD-Easy Clean Dispenser

ViscoTec offers modifications for the cleaning and maintenance process (EasyClean) within a new generation of the RD dispenser series. These dosing pumps had been enhanced on the basis of the eccentric screw pump principle and can be used for dispensing smallest volumes of some µl up to larger ml volumes with highest accuracy. The sealing package is now completely integrated into the bearing housing. The new design means the sealing area does not need to be dismantled any longer for cleaning (e.g. during product change or regular maintenance). The life-time of the sealing parts can be extended, and overall maintenance costs are reduced in the mid-term prospective. The introduced RD-EC dispensers have interface compatibility to the previous version of the RD dispensers. Together with the combined drive and control system ViscoPro, these dosing systems provide the option of a standardized control interface without any further programming.

New pump for sterile applications

This new Tapflo pump series is certified by EHEDG, the European Hygienic Engineering Design Group and the leading organization for hygienic industry equipment certification in Europe. The aseptic pump series will come in three sizes and cover most market needs. The first to be launched is the smallest, with a maximum flow of 425 liters per minute. In order for a pump to be EHEDG certified the pump must not feature any internal horizontal surfaces. The reason for this is to prevent any liquid from remaining in the pump after it stops. The pumps are supplied on a platform that allows them to be rotated. Rotation allows the pumps to be emptied and cleaned simply, without dismantling. The new Tapflo aseptic series is made up of a minimum number of components, nor is any special training needed for installing and using the pumps. No electricity is required. The pumps are powered by compressed air or other suitable propellant. Pump capacity is adjusted by altering the air pressure, which makes it easy to adjust to the manufacturing process.

Mouvex upgrades pump line

Mouvex announced that it has upgraded its A Series Eccentric Disc Pumps for the chemical and oil and gas markets. These eccentric disc pumps have incorporated a variety of upgrades to meet growing global demand, including the implementation of ISO PN16/ANSI 150 flanges. The A Series has also doubled its maximum differential pressure from 5 bar (72 psi) to 10 bar (145 psi), enabling it to be used in the safe transfer of viscous, non-lubricating, volatile or delicate fluids in a variety of new applications. The pumps are now available in ductile iron construction—a critical upgrade as more companies in the petrochemical industry, for example, are integrating ductile iron systems into their processes. They also features the availability of both Mouvex or standardized mechanical seals, which helps expedite installations regardless of location. The mechanical seal is positioned behind the piston and provides efficient shaft sealing. The pumps enable product transfer up to 250°C (482°F) and have maximum speeds to 750 rpm, maximum flow rates to 55 m³/h (242 gpm), as well as suction and discharge ports from 1" through 4" in size. The A Series are positive displacement pumps and utilize eccentric disc technology, which enables self-priming and run-dry capabilities while maintaining constant flow rate regardless of changes in viscosity and pressure.

New pumps from Wangen

Wangen Pumps has introduced the new Wangen Twin 70 screw pump which features hygienic design and low flow rates. The compact pump is suitable for the food & beverage and cosmetics industry. It handles viscous products with flow rates in the 100 l/h - 15 m³/h range. The pump has been designed to handle medium to high viscosity or gaseous products in the 100 l/h - 15 m³/h range. Wangen Twin screw pumps have flow rates up to 40 m³/h and up to 100 m³/h respectively. The Wangen Twin series features hygienic design in compliance with EHEDG (European Hygienic Engineering and Design Group) standards, minimizing contamination during production and enhancing system cleanability. The pumps deliver reliable operation with products such as juice concentrate, yeast mixtures, yogurt, fruit preparations and bread dough. They can also handle delicate, viscous cosmetic products such as creams and ointments.

PEOPLE NEWS

Pump Solutions Group names president of PSG Europe

Pump Solutions Group announced that Ueli Thuerig has been appointed President of PSG Europe. Thuerig was formerly Chief Executive Officer of PSG operating company Maag. PSG Europe will support PSG manufacturing and facilities in Europe. In addition, the Tianjin, China facility will also be part of PSG Europe due to the engineering and technology alignment of the Maag Industrial Pumps platform and its screw pump technology offering. Thuerig had been with Maag since 1990, holding a variety of leadership positions during his tenure. He holds an MBA from the University of St. Gallen in Switzerland.

President of Wilo USA steps down

Wilo USA has announced the resignation of President and CEO Mark D'Agostino to pursue other career opportunities. Jeff Bredeson, Senior Vice President, Region Americas, who will serve as interim president and CEO, made the announcement. D'Agostino will remain at Wilo for a 30-day transition period. D'Agostino has been with Wilo for the past seven years and had previously served as vice president of sales and marketing.

Advertisers' Index

CP Pumpen appoints Jochen Schwend

CP Pumpen AG is reinforcing its management team with the appointment of Jochen Schwend (51). Assuming responsibility for global sales and business development across CP, he will use his wealth of strategic and operational experience in this role, which includes strengthening the focus of sales and distribution operations on the relevant export markets. Jochen Schwend graduated as a mechanical engineer specialized in process technology and earned an Executive MBA from the University of St. Gallen. Since 1989, he has held management positions in various companies and sectors, including the machinery and paper industries. He most recently worked for Stoll Giroflex AG, where he served as International Sales & Marketing Communication Director and Head of Business Development, also leading the "International Sales" profit centre with sales partners and licensees around the globe.

Mark Sullivan named HI Director

The Hydraulic Institute has appointed Mark J. Sullivan as its new Director of Education and Training. Mark will support Pump Systems Matter (PSM), a 501(c)3 education/training organization affiliated with the Hydraulic Institute. He will lead all strategic development, marketing and PSM educational programs as well as personnel certification initiatives. Sullivan brings a wide range of international corporate experience in electronic technologies, healthcare and the pump industry as well as a diverse training and educational background. Previously Sullivan held marketing communication management positions within technology-driven business-to-business markets and worked within many leading global corporations, including Goulds Pumps. A resident of Morristown, New Jersey, Sullivan holds a M.A. degree in Communications from the S.I. Newhouse School of Communications at Syracuse University and a Bachelor of Arts degree in Communications from State University of New York at Oswego.

Gold Fields appoints head of West Africa region

Mr. Alfred Baku, currently VP of operations for Gold Fields in the West Africa region, has recently been appointed senior VP and head of the same region. He becomes the first Ghanaian to head up the JSE- and NYSE-listed group's presence in the region. Mr. Baku has been with the group for over 19 years, having first joined the Damang gold mine in Ghana in 1997 as production engineer, becoming a member of the operation's senior management team in 2002. In 2005, he became strategic mine planner at the group's St. Ives mine and relieving mine manager at the Agnew mine, both in Australia. He was the first Ghanaian to be appointed as GM of Damang. After being appointed GM of the group's Tarkwa mine in Ghana in 2010, Baku was promoted to VP for both the Tarkwa and Damang operations. He holds an MSc degree in Mining Engineering from the University of Mines and Technology, Ghana, and a Statutory Mine Manager's certificate.

New Shell CEO

The Board of Royal Dutch Shell plc announced that Ben van Beurden will succeed Peter Voser as Chief Executive Officer, effective from 1 January 2014.Van Beurden, 55, has been Downstream Director since January 2013 and joined the Royal Dutch/Shell Group of Companies in 1983. He has held a number of technical and commercial roles in both the Upstream and Downstream businesses. Van Beurden, a Dutch national, joined Shell in 1983, after graduating with a Master's Degree in Chemical Engineering from Delft University of Technology, the Netherlands. He also has regional responsibility for Europe and Turkey.

New CEO Vivaan Consultancy & Advisory Services

Mr. Sameer Kachole, an Indian professional engineer, based in Ahmedabad, India has initiated a unique concept to harness the hidden potential of the Indian engineering industry, especially with regard to fluid handling (Valves, Pumps and Piping) He has done this under the banner of Vivaan Consultancy & Advisory Services. "India makes excellent products," says Mr. Kachole "but what the market needs today are smart products."
At Vivaan they analyze the 3P's: Product, Process, and Plant and then the 'Man & Machine' are made ready to be launched on the international market at minimum modification costs. The company further educates and advises industry on the tangible and intangible benefits of Quality Management Systems. Following these steps ensures that an organization is built on sound foundations and ethics, leading to the production of a strong product. Vivaan has twenty years of experience in the pump industry and has access to the market intelligence of more than 80+ countries. They also invite and guide overseas buyers in evaluating doing business with organizations that match global standards. Mr. Kachole concludes: "At Vivaan our mission is to match the Indian pump and engineering industry to global expectations, and offer an excellent engineered product that fully meets the requirements of the intended application." For more information please contact: vivaanconsultant@gmail.com

Parker elects CEO

Parker Hannifin Corporation announced the election of Kevin A. Lobo to its Board of Directors, effective August 1, 2013, for a term expiring in October 2013, at which time the entire Board will stand for election to a one year term at the Annual Meeting of Shareholders. Mr. Lobo is currently President and Chief Executive Officer of Stryker Corporation. Mr. Lobo joined Stryker in April 2011, and served as Group President, Orthopedics, where he had responsibility for the Reconstructive, Trauma & Extremities, Joint Preservation, Orthobiologics and Performance Solutions businesses. He became President and Chief Executive Officer in October 2012 and is also a member of the Stryker Board of Directors.Prior to joining Stryker, Mr. Lobo held several senior leadership roles at Johnson & Johnson, including Worldwide President of Ethicon Endo-Surgery. Prior to that, he served as President of J&J Medical Products Canada.

Calendar

1 - 3 October 2013: *Oil & Gas Marrakech Conference and Exhibition, Marrakech, Morocco. http://www.oilgas-marrakech.com/en/*

2 - 3 October 2013: *Pumps and Valves 2013, Ahoy, Rotterdam, The Netherlands. Dutch trade show for technology and innovations in industrial pumps, valves and seals. www.easyfairs.com*

2 - 4 October 2013: *18th Asia Upstream Conference 2013, Singapore. Discussions include Asia's emerging frontiers and upstream potential over an intensive three-day programme. For further details, contact Amanda Wellbeloved at amanda@glopac-partners.com or Naomi Tsao-Lee at naomi@glopac-partners.com. http://www.allconferences.com/c/18th-asia-upstream-conference-2013-singapore-2013-october-02*

5 - 9 October 2013: *weftec 2013, 86th Annual Water Environment Federation Technical Exhibition and Conference McCormick, Place South Chicago, IL USA. registration@wef.org*

13 - 17 October 2013: *22nd World Energy Congress, Daegu, Korea. http://daegu2013.kr/eng/index.do*

21 October 2013: *FT Global Shale Energy Summit, Milleneum Hotel, London. www.ft-live.com/renewablesummit*

29 - 31 October 2013: *OTC Brasil 2013, Rio de Janeiro, Brazil. Offshore resources in the fields of drilling, exploration, production, and environmental protection. http://otcbrasil.org/2013/*

5 - 8 November 2013: *Aquatech Amsterdam 2013, Amsterdam RAI, Amsterdam, the Netherlands. http://www.aquatechtrade.com*

For a full list of events see www.pumpengineer.net

NEWS

Saudi Aramco and the Shaybah Gas Project

Saudi Aramco received bids for the construction of a $1.07 billion plant to process non-associated gas. Companies bidding to build the plant at Shaybah in eastern Saudi Arabia include Technip SA, Parsons Corp., Foster Wheeler AG, and Samsung Engineering Co. Saudi Aramco said the planned facility will have a capacity to process 4 billion cubic feet a day of non-associated gas.

Elbow propeller pumps for major upgrade

Four large Egger elbow propeller pumps were supplied to the Christchurch City Council as part of a major upgrade project. Manufactured in Switzerland and direct coupled to 30 kW, 960 rpm TEFV electric motors, the four model RPG 503 pumps were required to transfer Return Activated Sludge (RAS) at a maximum head of 2 meters, with flow rates ranging from 175 up to 580 liters per second.

Schlumberger to supply 200 ESPs to Oman

Daleel Petroleum Co of Oman has given a US$40 million performance-based contract to Schlumberger Artificial Lift for delivery and installation of 200 electric submersible pump systems. The five-year contract includes the provision of REDA Maximus electric submersible pump technology, XT150 gauges and 18 pulse drive systems and has the option of a two-year extension.

METKA signs power deal

Greek construction company METKA, a subsidiary of the Mytilineos Group, has announced the signing of a $1.05 billion contract with Iraq's Ministry of Electricity for the construction of a combined cycle power station in Anbar. The deal involves the engineering, procurement, construction and commissioning of a natural gas-powered plant with a capacity of 1,642 megawatts and will be built over a 32-month period. The project will be carried out in collaboration with the SEPCOIII Electric Power Construction Corporation.

Amarinth molten sulphur pump

Amarinth has been awarded a £250,000 grant from the UK's Technology Strategy Board to invest in the further design and production research of a molten sulphur pump for the petro-chemical industry. Amarinth has been working on developing a cost effective and rapid process of best efficiency point (BEP) optimized impellers that can be produced quickly for acceptable cost on for use in industrial pumping applications. The centrifugal pumps used throughout industry are often a 'best fit' selection for a given application from a standard range of pumps. Most pumps in use today do not run at their BEP meaning energy inefficiencies of up to 25%. Optimized impellers will reduce annual CO_2 emissions in the company's target market by 17,000 tons by 2020 and 110,000 tons by 2050. The first application of this work will be a centrifugal pump for the sulphur production market which the company anticipates it will launch in 2014.

New waste recycling plant in Sydney

A new waste recycling plant in Sydney is using Vaughan chopper pumps for severe solids handling applications. Situated in the south of Sydney, the Macarthur Resource Recovery Park on the Jacks Gully landfill is the city's largest alternative waste technology processing plant. The plant is responsible for processing all waste from the surrounding council's, including recyclables, organics, and up to 90,000 tons per year of mixed solid waste in an effort to achieve some 70% diversion from landfill.

Torishima pumps for power station

Torishima Pump Mfg. Co., Ltd has received orders for supplementary cooling water pumps and peripheral equipment for Black Point Power Station from China Light and Power (CLP), as an E&M subcontractor. This combined cycle power station located in Hong Kong has a generation capacity of 2,500MW (8×312.5MW), and is owned by Castle Peak Power Company Limited, a joint venture of CLP and ExxonMobile Energy Limited. The water level in the pit for the main cooling water pumps is not high enough which means that all of the eight main cooling water pumps cannot be operated simultaneously at the low tidal level. The new supplementary cooling water pumps will be provided to supply water to the exiting pump pit.

German-Vietnamese water cooperation

The project IWAS (Internationale Wasserforschungs Allianz Sachsen) for water sector cooperation was started more than five years ago with the aim to support Vietnam in modernizing its water sector. IWAS was recently successfully completed with a ceremony in Hanoi. This event also marked the opening of the project DEVIWAS (German-Vietnamese Cooperation for the Competence DEvelopment of the VIetnamese WAter Sector), financed by the German Federal Ministry of Economic Development and Cooperation through Sequa, and executed by GWP and the Vietnamese partner VWSA. Its objective is to further strengthen the Vietnamese association, to create a long-term mutual exchange of experiences, and to deepen and extend the offer of capacity development measures.

WGK subsea support

Wood Group Kenny (WGK) has recently been awarded a new contract containing two Engineering Services scopes with BP Angola under the BP Global agreement awarded to WGK in 2007. The contract involves Subsea Operations Support: one for work associated with the Block 18 Greater Plutonio Operations group; the other for work associated with Block 31 PSVM (Plutao, Saturno, Venus and Marte fields) Operations Group. The $18m contract secures the provision of Wood Group Kenny's Subsea Engineering and Project Management Services (EPMS) for an initial 12 month period in one of BP's key ultra deepwater provinces.

Morrison Pump Company drainage project

Morrison Pump Company of Hollywood, Florida, was awarded the order to supply four high capacity diesel-drive storm drainage pump systems for the City of Hallandale Beach s NE Quadrant Drainage Construction Project. Morrison shall provide four high-capacity Morrison Model VPS Axial Flow Pumps, each driven by Caterpillar C7 diesel engines. The Morrison Strom Drainage Pumps are 7% higher efficiency than specified, and are environmentally friendly, having no oil and no grease. The new Hallandale Drainage System was designed by Calvin Giordano & Associates and will provide critical flood control and storm drainage to the Northeast Quadrant of the city, and prevent surface water run-off by pumping the storm water back into the ground.

Environment Agency awards order

The Environment Agency (EA) has awarded Hidrostal Ltd a three year, exclusive contract worth around £3m to supply pumps and pumping equipment. Hidrostal's SuperHawk diesel pumps provide fuel efficiency, reducing environmental impact and energy use across the range of its 3" to 12" pumps. The pumps operate as quietly as 53 dB(A) – a benefit in residential areas or where wildlife may be sensitive to noise. The pumps are fitted with diesel engines from Hatz and JCB and feature Hidrostal single blade screw centrifugal impellers. Adjustment of the impeller's adjustable wear plates and liners ensures that the pump continues to operate at maximum efficiency, even when pumping high viscosity and solids-laden liquids.

CPECC wins Halfaya contract

A $548 million service contract to develop the Halfaya oilfield has been won by the China Petroleum Engineering & Construction Corporation (CPECC). The company is predicted to produce 535,000 bpd in 2017 and will handle engineering, procurement, construction and commissioning work at the oilfield. State-owned CPECC said the first phase of the Halfaya field had started operating and had a production capacity of 100,000 barrels per day.

Aker Solution and CDC working together

Aker Solutions will provide all the topside equipment in a drilling equipment package for a new rig in Azerbaijan in a contract with Caspian Drilling Company Ltd (CDC). Aker Solutions opened a new facility last year in Baku to improve its offering of services in the region. The company has previously delivered drilling equipment to eight drilling rigs operating in the Caspian Sea. The equipment for this contract will mainly be constructed and assembled at their facilities in Norway and Germany. Delivery of the equipment is scheduled for the fourth quarter of 2016.

Air Liquide and BASF

Air Liquide has signed a long-term contract with BASF to supply carbon monoxide to its MDI production unit located in Antwerp, Belgium. Air Liquide will invest in a new carbon monoxide production unit located next to its existing facilities. The unit is scheduled to be up and running in the first quarter of 2015, will double Air Liquide's carbon monoxide production capacity in this basin. The overall investment will amount to around €50 million.

Uganda awards hydro-electric project

Uganda has awarded a Chinese firm a contract to build a new dam and power plant on the Nile, the second such project to go to China in less than two months. This 188-megawatt hydro-electric project, the Isimba hydropower dam, will be developed by China International Water and Electric Corporation (CWE) and China's Export-Import Bank will give Uganda another loan worth $500 million. The memorandum of understanding (MoU) had been signed and work on the dam was expected to start in August.

BASF to build a new plant

BASF is building a new Ultramid polymerization plant with a capacity of 100,000 metric tons per year in Shanghai, China. The new plant is planned to start up in 2015. The BASF wholly-owned plant will be built at the Shanghai Chemical Industry Park in Caojing which is also home to a facility for integrated isocyanates, operated by BASF and partners. At this location, BASF also has production plants for polytetrahydrofuran (PolyTHF) and polyisocyanate (Basonat) for the coatings and furniture finishing industry and precious metalsolutions for automotive catalysts. Ultramid products are for the engineering plastics, film, fiber and monofilament industry.

Tycon Alloy Industries: improving on high quality, and proud of it!

Tycon Alloy Industries specializes in the production of metal castings for the global pump industry, and at the same time offers a wide range of related technical services. Located in Hong Kong and Shenzhen, China, Tycon Alloy covers both Eastern and Western markets, effortlessly bridging the gap between these two hemispheres with an ease its competitors can only envy. Pump Engineer recently visited the company at its headquarters in Hong Kong and spoke to Mr. Michael C.C. Lo, Senior Sales Manager, to learn more about how the company has developed and its plans for the near future.

By Andrew Peers

"Our flexibility to operate in both the East and West truly sets us apart from the competition", says Michael with conviction at the start of the interview. "Hong Kong, where Tycon's parent company, Fong's Industries Co., Ltd. is listed on the Hong Kong Stock Exchange, has traditionally been a cultural melting pot and continues to be an ideal location for setting up our headquarters." Tycon is actually a 'dual identity' enterprise with operations in both Hong Kong and Shenzhen, mainland China. "This gives us increased flexibility when trading with foreign companies, which are best serviced through our Hong Kong office, while Chinese customers can utilize Tycon Shenzhen to take advantage of local tax requirements," adds Michael. "In the end, it's all about offering the best possible service and cost efficiency for our customers."

Well-known customers

Michael goes on to explain how products are being widely supplied to the multinational pump

manufacturers, such as Sulzer, ITT and SPX etc... "For example, we have established long-term cooperation with Sulzer Ltd. The casting products that we supply directly to their plant are then made into multi-stage pumps for power plants. We have also enjoyed good collaboration with the ITT Corporation for over a decade. Our deliveries reach its manufacturing facilities all over America, Korea, China and Brazil. New long-term customers include for example SPX: we have just started to supply their plants in the Netherlands and Denmark. Another longtime customer is a marine pump producer named Wärtsilä. Recently they have been developing offshore pumps, specifically pumps for FPSO facilities, which are very demanding in terms of material and construction. We are working with them to produce their castings.

Products and materials

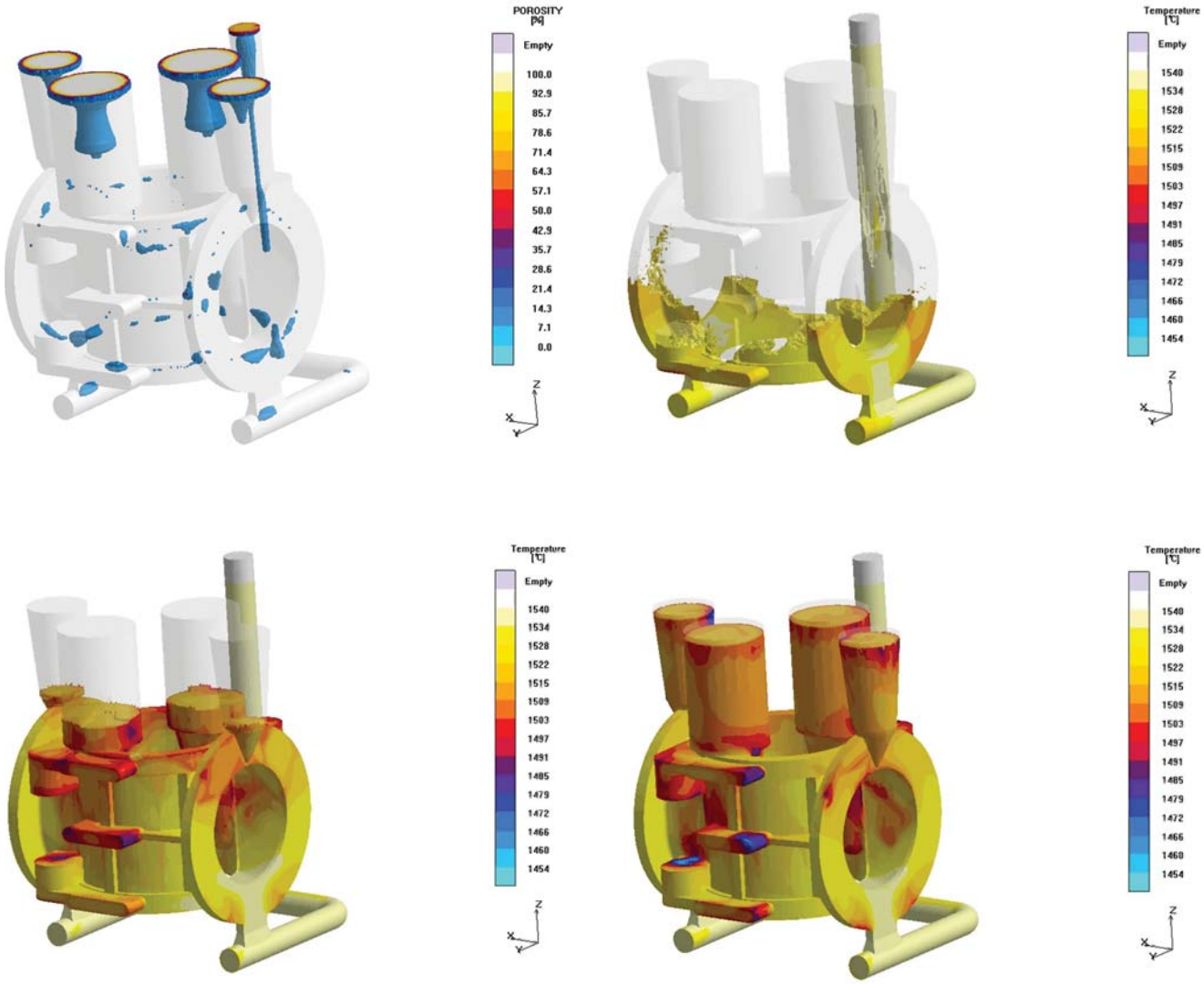
Michael says that the company is currently making casing, cover and open / close type impellers for both single-stage and multi-stage pumps - the heaviest pump casing made so far is 760 Kg in weight, with impellers

''Our sister company can provide us directly with qualified material to our group company, which acts as the raw material for the equipment we produce. So our raw material quality is assured.''

100 Kg net, OD 550 mm. "We are now studying a more advanced technique called ceramic core. Once we succeed with this, even larger size impellers will fall into our product category. The pumps made with our castings are mainly used in chemical plants and power stations. We also plan to make sand casting up to three tons in weight. After we set up larger size facilities, the size of our products will increase accordingly. We will also set up a precision casting line with a higher automation level to reduce labor costs." Tycon normally uses stainless steel for pump components e.g., martensitic stainless steel, which can be used for pumps in power stations. "We also use duplex steel and nickel-based alloys. Aluminum bronze is also an option. For example a company in Singapore uses aluminum bronze to produce marine balance pumps and we are supplying them with aluminum bronze impellers."

Quality control

Michael said that in order to supply all these companies, the company has to have the necessary ISO9001 and PED 97/23/EC certificates. Rigorous inspection procedure covers the whole cycle from raw material, production through to the finishing stage. "We have the unique advantage that our sister company can provide us directly with stainless steel. This company provides qualified material to our group company, which acts as the raw material for the equipment we produce. So our raw material quality is assured. However, part of our materials is provided by outsourcing to qualified suppliers already in a long stable relationship with us. In this way we can obtain melted materials with a very low level of foreign substance at relatively low cost. However, this never makes us compromise our



Extensive use of computer assisted design ensures an efficient and effective casting process.

inspection criteria." Michael said that a spectrum analysis is conducted on every batch of material received. "We also do penetration and hydraulic tests on each type of product that we supply to Sulzer." Tycon has been conducting internal improvements during the past five years and have specifically set up an optimization team. They perform site management with the objective of reducing costs, improving efficiency and assuring quality. "We have always invested and this year we bought nine machining centers, as well as some vertical lathes. So we've both extended our product range and further secured product quality."

New foundry under construction

"Our plan is to carry out this investment after we move to the new plant which is now under construction in Zhongshan city", said Michael. This new plant will be ready in 2014 and will be 100,000 m² with a floor area of about 85,000 m². It will be able to carry out more strategic and advanced designs there so as to optimize management and production efficiency. With regard to the production facility in the new plant, Michael said that the company had already made contact with a UK supplier who can provide automatic sand casting lines. The product range at the new plant will be same with that of the Shenzhen plant, but the largest casting will reach the weight of 3 tons. "Our plan is to raise the annual production of our precision casting and sand casting to 4600 tons and 4000 tons respectively in 2018. The geographical markets for the new plant will be mainly Europe, the Americas and Japan. There is a trend that more and more companies from those place are coming to China to build factories. We hope to supply their future plants. We have arranged that several senior engineers serve the China market in the role of sales persons and that they continue to pay careful attention to sales training, to ensure smooth communication with clients and speedy solutions." Tycon uses professional casting software to simulate production processes. This is also a precautionary measure to ensure quality control. The company also pays great attention to our service. "Our salesmen are all with engineering-related background and they often visit customers to explain difficult issues as well as to listen to their feedback as this helps us to improve too. We go abroad 4-5 times every year and visit our key accounts at least 2 or 3 times every year.

Customers often come to visit us also. Sulzer came here several times a year at the beginning of our cooperation in order to provide machine operation training."

Strength and expertise

Tycon provide services containing many engineering elements, so the company has a strong technical team. Their job is to review drawings provided by customers and generally analyze and predict any potential problems. "They then submit feedback to customers and work out solutions with them. A customer once requested us to make a product but we couldn't meet their requirements. So we communicated the fact together with an alternative solution. They agreed to our alternative and the product produced was approved. In another case, our project engineering team found that a design provided by a customer was defective. After providing our analysis and corrective measures, the customer approved our solution. With both new and regular customers, we always provide this kind of value added service. Communication is a very important factor. With products like pump components, it's necessary for us to obtain a thorough knowledge about customers' needs in order to communicate our feedback about the design and production methods. Good communication is critical."

Doing business in the future

Michael says that Tycon is determined to establish long-term business relationships and that the company had invested resources and energy accordingly. "We also cooperate with customers to work out technical difficulties and produce sound products. I believe that this attitude has strengthened trust in us. We study production progress in every weekly meeting. Our target is to raise the on-time delivery to achieve 100%. With products with a zero tolerance delay, we make specific arrangements to ensure their punctual delivery. The biggest challenge is costs. Both labour costs and the currency keep increasing, forming a significant challenge to export oriented enterprises like us. Our counter strike is to optimize production process and management with the aim of reducing costs. We wish to provide a more one-stop service. Besides the products that we produce, we also hope to further utilize our technical advantage and provide more professional services and value-added solutions. Our aim is to obtain more customers who pursue high value products because this enables us to make maximum use of our resources and skills. As for new products, in the future we hope to master the ceramic core technique and so produce more complicated components. We wish to become a professional supplier of stainless steel castings, especially high performance pump castings for the chemical, LNG, power generation, oil & gas, and food industries. We aim to be the preferred casting suppliers of more leading pump manufacturers. I'd like to emphasize that Tycon's clients have our commitment that they receive only qualified products, which they can deploy immediately without any worry. Customer praise is the reason behind our sense of pride."

Zhongshan – the new foundry's planned location.

Tycon Alloy: New Foundry Plan.

About Tycon Alloys

Name: Tycon Alloy Industries (Hong Kong) Co., Ltd.
Product Range: valve and pump parts, precision machine components, marine equipment & accessories, food & pharmaceutical equipment, water & wastewater equipment, oil & gas equipment and instrument etc.
Staff: 1200 staff including 200 QA/QC and technicians.
Locations: Hong Kong and Shenzhen, China
Key markets: chemical, Power Generation, oil and gas, marine, food processing, medical.
Website: www.tyconalloy.com

Column:

Subsea Focus

In his regular column, Robert Heyl, Subsea Consultant-Pumps at Chevron's headquarters in Houston, Texas talks about the challenges facing subsea pumping technology. This issue's column carries on from the May and July publications.

How do we size subsea pumping equipment properly?

As you may recall in July's publication we were working through a situation which involved a large, critical asset. Since the asset was critical, its equipment had to be quite reliable, and production had to be available day-in and day-out. The suggested solution was to have three single phase liquid-only seabed pumps installed with all three pumps of the same common size, and with two of the three pumps operating in parallel at any given time. In this proposed arrangement, one of the three pumps was operating for less time than the other two. This pump, the one with the least operating time, was to be considered an operating spare since, with less operating time, it should outlast the others. It was also suggested that all the pumps be oversized a bit, so that even if two were lost, the remaining pump would still allow marginal production. Also, if you recall, the crude was light, having an API gravity of 28.

Now let's explore what a suggested solution might look like if we change some of the asset's properties. Suppose the asset, and its crude, has the following same properties as before:

(1) Asset size: Large; (2) Value: Very significant; (3) Criticality: Uninterrupted production is critical to the operating company; (4) Sparing philosophy: Spare pumps are costly and spares must be limited; (5) Power required: 7 MWs of total power is available and step-out close enough for its delivery; (6) Reliability: Critical; (7) Weight and size: Assume no problem; (8) Condition monitoring: Still not available....yet! (9) Assume that this asset has enough reservoir pressure to get the crude to the seabed surface but no farther (that these seabed pumps are enabling the asset to be produced); and (10) Individual power umbilicals can be run, one to each pump.

But now suppose we change the following asset and crude properties: (a) API gravity: 8; (b) Gas Volume Fraction (GVF): >30.; and (c) Emulsion-forming tendency: High.

OK, so in our prior scenario, because we had a light crude with a low GVF and other benign properties and conditions, we were able to use standard subsea, single phase, centrifugal pumps. These pumps have a very high efficiency when pumping light, low GVF crudes.

Now we have a very different situation. With a gravity of 8, the efficiency of either centrifugal or helico-axial pumps is very low, so the MW consumption of each pump, for either impeller design, increases significantly. Remember that we only have 7 MW of power generation and now, to make matters worse, we have a significant amount of gas to contend with. So what shall we do? Suggestion: Install three identical multiphase, positive displacement, twin screw pumps on the seabed floor operating in parallel.

Pros and cons

Pros: Since the crude is heavy, the positive displacement twin screw pump design works more efficiently, much better than centrifugal or helico-axial pumps. This helps us keep within the available power limits. These pumps also handle low to very high GVF multiphase applications quite well. They are also relatively gentle on the flowing crude, thus keeping emulsion formation to a minimum, especially when compared to the kinetic (centrifugal or helico-axial) pump types. Twin screw pumps have been used very successfully in topside applications for years with good reliability and they have some limited experience in subsea applications. We will still use the "three-pumps-in-parallel" operating arrangement that was discussed in May's article, with all its advantages. With its exceptional efficiencies pumping heavy crudes, very high multiphase handling capabilities, and gentle pumping action, we also get a pump suited to this heavy, gassy, high-emulsion-forming crude.

Cons: Once again, in this scenario, there is the extra expense of a third installed seabed pump and its power umbilical. We also have pumps which, though they have good operating experience in topsides applications, have, as yet, limited operating experience in subsea applications.

In conclusion

We have installed equipment which has its strong points right where we need them, and a system that has minimum sparing considering we are keeping this critical asset producing. We once again have a third pump with a pump station on the seabed floor and perhaps a dry spare pump on the beach as in July's article, but, the cost of these pumps should be easily recovered by the value of the uninterrupted production.

Technical Paper

Standards in centrifugal pumps

S. L. Abhyankar

Among different types of pumps in use, horizontal, single-stage, end-suction, foot-mounted centrifugal pumps of about 16 bar rating are possibly the most common. Pumps of this description are crisply designated by code OH1 in API-610. Standards ISO-2858 and ANSI:B-73.1 deal with these OH1 pumps. These are the two major (but only two) standards followed globally for OH1 pumps. It becomes very interesting to make a comparative study of these two standards.

By S. L. Abhyankar

A comparative study would cover commonalities and differences. Commonality is summarized by the descriptive phrase "horizontal, single-stage, end-suction foot-mounted centrifugal pumps of about 16 bar rating" and in turn by the code OH1. The pressure 16 bar is not just the pressure. It connotes a range of allowable working pressure at different process-temperatures. It is a pressure-temperature (P-T) rating. ANSI:B-73.1 makes mention of Class 150 rating. P-T rating of Class 150 is quite close to that of 16 bar.

Supply frequency and nominal speeds

Considering frequency of electric power supply available in Europe and USA, it is logical that basic ratings in ANSI:B-73.1 are for 60 Hz speeds (1750 and 3500 rpm with 4-pole and 2-pole motors respectively) and in ISO-2858 are for 50 Hz nominal speeds (1450 and 2900 rpm respectively). In ANSI:B-73.1 equivalent ratings at 50 Hz speeds are also given. That facilitates this comparative study.

Bearing units and shaft diameters

Since basic ratings in ANSI:B-73.1 are for 60 Hz speeds, in turn input power required will be higher, yet shaft diameters therein are as can be seen from Table 1, smaller than those in ISO-2858 even when product Q*H is equal or more.

Table 1: Study of shaft diameters and rated duties.

Row No.	ISO-2858					ANSI:B-73.1				
	Shaft Dia	rpm	Q, m3/h	H in m	Max. Q*H	Shaft Dia	rpm	Q, m3/h	H in m	Max. Q*H
1	24	2900	50	50	2,500	22.23	3500	45.4	76.2	3,459.5
2	32	2900	160	80	12,800	22.23	2900	37.8	52.9	1999.6
3	42	2900	250	125	31,250	28.58	3500	295	106.7	31476.5
4	48	1450	400	50	200,00	28.58	2900	244.8	74.1	18139.7
5						60.33	1750	909	225	204525

This suggests less factor of safety in ANSI:B-73.1. The factor of safety will become further less when handling liquids of more density. Less shaft diameter implies bearings of smaller size and in turn less bearing life.

Distinct flanges or tapped faces?

Outline drawing in ISO-2858 shows suction and discharge flanges distinctly. In ANSI:B-73.1 foot notes (2) and (3) for Table 1 allow tapped holes in lieu of distinct flanges. With distinct flanges on pump, joint with pipe flanges become double-flange joints. One can use spanners on hex-heads on both sides of the joint and exert adequate torque. The joint on the suction side is required to be bubble-tight and the joint on the discharge side is required to be pressure-tight. Also in the event of wear-off of threads of the tapped holes, entire casing becomes unusable. This is offensive cost to the user. A 'Standard' ought to provide for and promote sound engineering practises and ISO-2858 does.

Impeller diameters and nominal head ratings

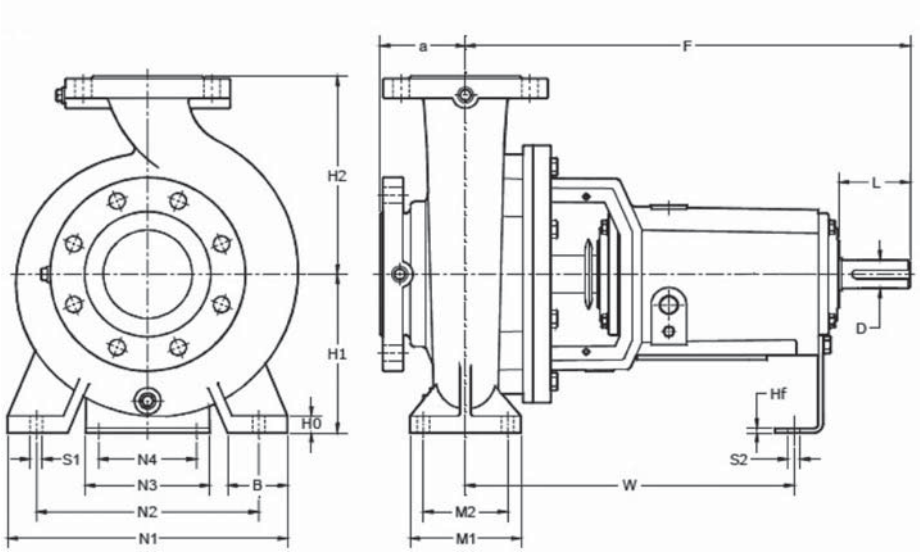
Nominal Impeller diameters in ISO-2858 (125, 160, 200, 250, 315, 400 mm) are at a ratio of geometric progression 1.25 approx. Correspondingly the Nominal Head ratings (5, 8, 12.5, 20, 32, 50 m at 1450 rpm) are at an average ratio of geometric progression 1.6. This seems to be in good tune with the Affinity Law H"/H' = (D"/D')∧2, since 1.6 is approximately equal to 1.25∧2. In ANSI:B-73.1 incremental ratios of impeller diameters and of nominal head ratings are not uniform (see Table 2). Also incremental ratios for impeller diameters and of nominal head ratings seem to be appropriate by the logic of Affinity Law only in 3 out of 8 cases.

Correlation between incremental ratios for nominal discharges and nominal heads

In ISO-2858 ratio of geometric progression for nominal discharges is 2. This, in combination with ratio of geometric progression of 1.6 for nominal heads has good linkage with the concept of design specific speeds. Since Specific speed = $n * \sqrt{Q}/H^{0.75}$ specific speed of a design for nominal rating (Q, H) and for a design of nominal rating (2Q, 1.6H) will be identical value, because $\sqrt{2}/1.6^{0.75}$ is approximately equal to 1 (actually 0.994). The concept of dimensional similarity is very much linked to specific speed of design. So in ISO-2858 geometric progression ratio as 2 for nominal discharges and as 1.6 for nominal heads reduces number of basic designs. No such mathematical discipline oriented towards less number of basic designs is evident in the nominal ratings in ANSI:B-73.1.

Nominal discharge ratings and implicit suction velocities

In both the standards, nominal suction sizes are specified for the various nominal discharge ratings. Implicit therein are the suction velocities. High suction velocities are, of course not conducive to good cavitation-free performance. In ISO-2858 the maximum suction velocity works out to be 3.537 m/s whereas in ANSI:B-73.1 the suction velocity works out to be as high as 5.217 m/s also! For discharge-ratings up to 400 m3/h, ISO-2858 has 10 nominal discharge-ratings. For almost the same range there are 17 nominal-ratings in ANSI:B-73.1. Obviously too many nominal discharge-ratings have been cramped against each suction size.



The overall dimensions as specified in ISO-2858.

Table 2: Impeller diameters and nominal head ratings in ANSI:B-73.1.

No.	Dia.	Incremental ratio of Dia.	(D"/D') ^2	Head at 1450 rpm	Incremental ratio of H
1	152.4 (6")			6.7m (22')	
2	203 (8")	1.33	1.77	13.3m (44')	2
3	254 (10")	1.25	1.56	18.6m (61')	1.386
4	330.2 (13")	1.3	1.69	31.7m (104')	1.7
4a			1.69	28.7m (94')	1.54
5	381 (15")	1.154	1.33	42.4m (139')	1.33
6	431.8 (17")	1.133	1.28	52.8m (174')	1.25
6a			1.28	47.9m (156')	1.12

Back pull-out feature and length of spacer between coupling halves

In both the standards, casings are with integral support feet. By this, pump can be disassembled for overhauling and maintenance by back pull-out, without disturbing the casing and in turn without disturbing the suction and discharge piping. A spacer coupling is implicit for best use of this feature. In both the standards, the length of the spacer is specified.

Length of spacer has to be adequate for the impeller to come out of the casing. Obviously the length has to be proportional to the width of the impeller. Width of the impeller will itself be proportional to the discharge-rating of the pump and in turn proportional to the suction size of the pump. Spacer-lengths specified in ISO-2858 seem to follow logic. In ANSI:B-73.1 length of spacer is shown in the figure of Baseplate dimensions. There again it is related to the maximum centre-height D*. The dimension centre-height is not related with the base-plate at all.

Number of bolt-holes in foot prints

Foot prints as per ANSI:B-73.1 have two bolt holes on support feet integral with the casing and one or two holes for the support leg under the bearing housing. Comparatively, foot prints as per ISO-2858 have four bolt holes on support feet integral with the casing and two holes for the support leg under the bearing housing. In case of ANSI:B-73.1 on back pull-out disassembly, the casing and suction and discharge piping will be left standing only on two bolts of casing. Relatively ISO-2858 provides for the casing and suction and discharge piping to be standing on four bolts. This definitely makes for better structural soundness. This also provides for better assurance that alignment of the pump casing and piping will be less disturbed during disassembly. And reassembly will be faster and with better confidence. Even during running, six bolts in ISO-2858 provide better structural soundness than just 3 or 4 bolts in ANSI:B-73.1. Specifications in ANSI:B-73.1 even allow U-slots in place of bolt-holes. All this seems to be not in tune with sound engineering practise.

Across distance between bolt-holes on casing feet

From the point of structural soundness, the 'across' distance between centres of bolt holes on feet of foot-mounted casing, the distance 'n2' in ISO-2858

Table 3: Length of spacer between coupling halves.

In ISO-2858			In ANSI:B-73.1	
Length of spacer, mm	For Discharge in m3/h at 1450 rpm	Suction Size, mm	Length of spacer	Maximum centre-height, D*
100	50	Up to 100	3.5" (89mm)	10" (254mm)
140	50 to 200	100 to 150	5" (127mm)	19.25" (489mm)
180	315, 400	200		

D is the centre-height between pump centreline to bottom of support feet on casing.*

Table 4:

Cases in ISO-2858 where distance 'n2' is less than impeller diameter			Cases in ANSI:B-73.1 where distance '2E1' is less than nominal impeller diameter		
Distance 'n2'	Impeller Dia	Ratio n2/D	Distance, '2E1'	Impeller Dia	Ratio '2E1'/D
190	200	0.95	6" (152mm)	8" (200mm)	0.76
280	315	0.89	9.75" (248mm)	13" (330mm)	0.75
355	400	0.89	16" (406mm)	17" (430mm)	0.94

(Distance'2E1' in ANSI:B-73.1) is influenced by the diameter of the impeller, i.e. nominal head rating and also by the volute cross-section, i.e. the discharge-rating. In ISO-2858 'n2' is equal to or greater than nominal impeller diameter except in a few cases, shown in Table 4. Corresponding data for ANSI:B-73.1 is also compiled in the table.

Type of impeller

Although clause 4.4.1 in ANSI:B-73.1 mentions that impeller can be open, semi-open or closed, majority of population of pumps as per ANSI:B-73.1 has come to be with semi-open impellers. So, ANSI:B-73.1 pump has become synonymous with pump with semi-open impeller.

Pumps for critical services

It is the general understanding in the trade that pumps as per ANSI:B-73.1 or ISO 2858 are for non-critical services. For critical services one would opt for OH2 pumps as per API-610. Tenth edition of API-610 has also been adopted as an ISO-standard vide ISO-13709. This causes a confusion for the users for choosing between ISO-13709 and other ISO-standards providing 3-fold classification of critical services as detailed in ISO 9905:1994 (to be read with Corrigendum of 2005), ISO 5199:2002 and ISO 9908:1993. ISO-2858 is actually to be read and used either with ISO 9905 (Class 1) or with ISO 5199 (Class 2) or with ISO 9908 (Class 3).

End-notes

1. This study brings forth the mathematical disciplines and sound engineering concepts inbuilt in ISO-2858, which makes it far more appealing, compared to ANSI:B-73.1. Also values in ISO-2858 are in metric units and substantially follow the concept of preferred numbers.
2. Power required by the pump also depends on the specific density of the liquid to be pumped. With liquid such as sulphuric acid, the specific density can be as high as 1.8. It seems that the standards need to be supplemented with guidelines on the scope of use of pumps as per these standards.

About the author

Mr. S. L. Abhyankar graduated in Mechanical Engineering in 1963 and has half a century of industrial experience. He is involved in every engineering aspect of pumps and valves, including standardization, energy-conservation, environmental protection, etc. He gives training through his workshops and shares his knowledge and experience by answering queries at various forums in magazines and on the internet. (sl.abhyankar@gmail.com)

Show Preview

The CHEM SHOW 2013 New York

Held every two years, the CHEM SHOW brings process engineers, production and plant personnel, and executives from companies across the Chemical Process Industries (CPI) together to see and learn about the latest technology to increase process efficiency, solve problems, and reduce energy costs. This year the CHEM SHOW 2013 will take place from December 10th -12th in New York, U.S.A.

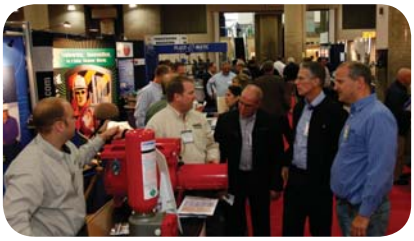
By Kiyo Ichikawa

The 55th CHEM SHOW in December is expected to attract more than 5,000 CPI professionals who will come to see all the latest products on display from over 300 companies. The mission of this year's exposition and conference, the mission of the CHEM SHOW is to bring CPI suppliers and end-users together to find solutions to their challenges. End-users of process equipment and technology, process engineers and production personnel, executives, reps, and industry professionals from up and down the buying chain will be walking the show floor. The show features new educational programs and new business opportunities for CPI professionals in 2013 and beyond. The Process Control & Automation Center is still a popular feature of the show where CPI professionals come to see the latest in wireless monitoring devices, data collection, instrumentation, sensors, transmitters, software and much more.

REE Product Presentation in the New Product Theater

It is also possible to make a 15-minute presentation of new products in the New Product Theater located on the exhibition floor. Presentations are offered to exhibitors at no charge on a first

come-first served basis, but time slots are limited and fill quickly. The CHEM SHOW mirrors a changing marketplace where chemical producers have down-sized personnel and equipment manufacturers have merged, but both exhibitors



and attendees find that there is no substitute for meeting face-to-face when it comes to doing business. On the exhibition floor, manufacturers of processing systems, equipment and plant services showcase their latest products and are met by representatives from chemical companies, pharmaceutical firms, food processors and other processing-related businesses, coming to discover solutions to current production issues as well as find resources for projects in the pipeline.

The CHEM SHOW 2013 will take place from December 10th -12th In New York, U.S.A. As an international attendee, it may be necessary to receive an official invitation to obtain your travel Visa, so advanced planning and early visa application recommended!

Deb LaVelle, WWEMA Chairman

WWEMA: the voice of the manufacturer

As the voice of technology providers in the water and wastewater industry, the Water and Wastewater Equipment Manufacturers Association (WWEMA) has as its primary objective "to advance the industry to ensure a future sustainable environment and improve its members' economic viability." WWEMA is a national, non-profit trade organization established in 1908 to represent the interests of companies that manufacture and sell technologies used in the treatment of wastewater and the purveyance of drinking water by municipalities and industries worldwide. Pump Engineer talked to WWEMA Chairman Deb LaVelle to find out more about what makes the association tick.

By Salinda Goonewardene

What are the primary aims of the association?

As a full-service trade organization with 105 years of experience, WWEMA continues its proud tradition of serving its members needs, and advancing the interests of the water and wastewater industry, through information sharing, collaboration, and advocacy. We accomplish this by working in close affiliation with legislative and regulatory bodies, as well as other industry organizations, to promote value-based procurement practices; defend fair and open trade policies; support sustainable infrastructure financing options; and develop science-based, technologically achievable environmental regulations. WWEMA's conferences and communication vehicles are regarded as among the best sources of industry intelligence regarding technology trends, customer expectations, market outlook, legislative and regulatory developments, and trade opportunities for members' products and services. Members are also able to share their experiences with their peers and learn best practices to improve their competitiveness and increase their personal effectiveness through participation in Council activities, online forums, and benchmark surveys.

What would you say are the primary issues the association has to deal with?

WWEMA is involved in a number of socioeconomic and industry-related political matters. Our current focus, as mentioned above, is on issues involving fair and open trade, sustainable funding, negotiable and equitable contract terms and conditions for all parties, value-based procurement, the removal of tariffs on environmental goods and services, and pending as well as existing regulations.

How do you seek to achieve these aims?

We are currently engaged in having our voice heard on legislation being introduced in Congress. This is about yet another onerous Buy American provision attached to water and wastewater projects receiving EPA State Revolving Fund (SRF) assistance and its effects on fair and open trade domestically and internationally. In

addition, we are supporting the removal of tariffs on environmental goods and services through member participation on the U.S. Department of Commerce's Environmental Technologies Trade Advisory Committee (ETTAC), and the White House Office of the U.S. Trade Representative's Trade and Environment Policy Advisory Committee (TEPAC). WWEMA members are strong advocates for legislation that would remove the state volume caps on tax-exempt private activity bonds for water and wastewater projects. We also continue to work diligently on advocating adoption of a uniform, national standard for ballast water discharge with the EPA and U.S. Coast Guard. In addition, we believe value-based procurement methods can play a significant role in advancing technology innovation and are working together with the U.S. Water Alliance, EPA, the American Water Works Association, and state organizations to promote improved procurement practices. A final example is our continuing efforts to promote fair contract terms and conditions through our association with the Engineers Joint Contract Documents Committee and ConsensusDocs.

How have your members been coping in the current economic climate?

This has undoubtedly been one of the most significant economic downturns our industry has witnessed in recent history. We essentially were hit with the "perfect storm," from the reduction in local public works spending, to fewer federal dollars being invested in infrastructure as a result of sequestration, to the housing market crash and capital access crunch. Our members have had to tighten their belts, scrutinize every dollar spent, and ramp up their sales efforts, aggressively putting boots on the ground to go after a smaller piece of the infrastructure pie, if you will. That being said, there are signs of hope with a recovery in the housing market expected to stimulate growth as the year progresses, and a slight pickup in activity at the local level as communities come to grips with a deteriorating water and wastewater infrastructure that can no longer be ignored.

What motivation would a company have to become a member of your organization?

Any company that wants relevant and timely information on issues affecting the sustainability of their business, has a passion for the industry, and would prefer to be a part of decisions being made at all levels of government should be a WWEMA member. The ideal prospective member knows that one voice combined with many other voices will be heard. They will choose to share and receive knowledge from their peers. The most compelling reason for a company to become a member of WWEMA is that this organization is unique in the industry in that it advocates solely for water and wastewater treatment equipment manufacturers.

During the time of your chairmanship, what changes have you seen?

During my tenure as Chair, the changes that have occurred in our industry have been at times almost overwhelming. However, with change comes opportunity for our members as well as the organization. With an experienced staff and a disciplined strategic plan that looks to the future but is capable of adapting to the current business environment and needs of its members, we have seen a number of positive changes. These changes included a review of our governance model and increasing member involvement as they prepare for future leadership of the organization. One of the most rewarding surprises for the organization has been the increased involvement by the members. Member-driven organizations rely on volunteers to work together to address many of the issues that are common to all or specific to a few companies. We can proudly say our member companies not only produce the best products in the industry but are willing to commit the resources required to make a difference. All organizations will have members with different outlooks; however it is not the differences that are significant but the manner in which they are addressed. A number of issues that have been discussed involving differing outlooks have resulted in a more fully addressed conclusion. In other instances, we have had to "agree to disagree," and respect our differences.

How do you see the association evolving in the next 5 to 10 years?

As Chair I look forward to networking with my peers, the knowledge I gain from the offerings of a 105-year-old organization, and most importantly my ability to contribute. I am proud to be associated with WWEMA, its staff, and the members. With the exponential pace of change we are experiencing as a society, it is difficult to imagine what will happen in the next 2 to 3, not to mention 5 to 10 years out. For our industry and association in particular, I think we will witness greater collaboration among the multiple organizations serving in the water sphere, viewing water more holistically and comprehensively (i.e., its relationship with energy, food, security, etc.). We will be a conduit for helping accelerate innovation and embrace new solutions to meet the complex challenges that threaten our water environment. At the same time, we must continue to help our members understand where the future demand lies for their products and services, and what impact disruptive technologies will have on their businesses, so that they may continue to be leaders in the field. Lastly, we must focus greater attention on the international arena where future growth lies for our sector, helping to bring down barriers to trade and creating an environment for fair competition where our members can flourish.

What do you do to relax in your free time?

The passion I have for the water and wastewater industry is not only my profession but one of my hobbies. I thoroughly enjoy being involved in worthwhile organizations such as WWEMA where many voices speak as one. When I am not practicing this hobby, I enjoy spending time with my grandchildren and every now and then a little golf at clubs advocating the use of reclaimed water to keep their fairways green.

Quality service in the field at Elliott Company

Mohammed Khalil

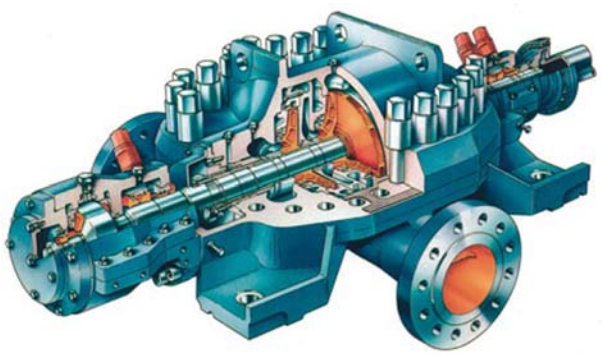
Described by colleagues as a "very dedicated and ambitious engineer who can always be counted on no matter how enormous the task", Mohammed Khalil is an experienced Field Service Engineer currently working at Elliott Company. His job is to supervise all the activities related to turbo machinery and pump installation, commissioning and maintenance in both planned and emergency shut downs. Pump Engineer magazine caught up with him in Bahrain where he is currently based.

By Andrew Peers

"On an average day you could say that my time is split between office work behind a desk and on-site work with a crew. I much prefer the latter", says Mohammed with passion. My current duties at Elliott Company include preparing Standard Work Procedure [SWP] for the maintenance of units for clients both in the field and in the factory workshop, so as to ensure completing assigned jobs satisfactorily and in compliance with the company safety and quality assurance policies. I also troubleshoot any malfunctioning units and provide a final solution to problems with the aid of Root Cause Failure Analysis techniques."

Hands-on skills

"In my eyes, experience is the fruit of accumulated hands-on skills and knowledge, shared in discussion with people in the same career. I often used to have discussions with work colleagues when I worked as a maintenance engineer at oil & gas facilities. Discussions with professionals on web forums are also sometimes a very useful opportunity to share experience and gain more knowledge or to solve issues related to pumps and other rotating equipment. For OEM specialists, the main concerns have to do with performance improvement, mechanical design or environmental issues, which are mainly the responsibility of either the R&D department or technical support. Meanwhile the field service and workshop teams are in direct contact with the customer during installation, commissioning and after-sales services and this will sometimes include other types of challenges which often need an innovative solution. Most of the problems concern mechanical issues (high vibrations or premature failures) and these make up an average of almost 50% of the request calls that come in. Seal performance improvement takes up another 25% and is considered as an environmental issue when hydrocarbon and toxics are involved. From my point of view, the biggest challenge facing the pump industry at the moment is the increased demand for a hyper-frame pumps with a high standards performance and less

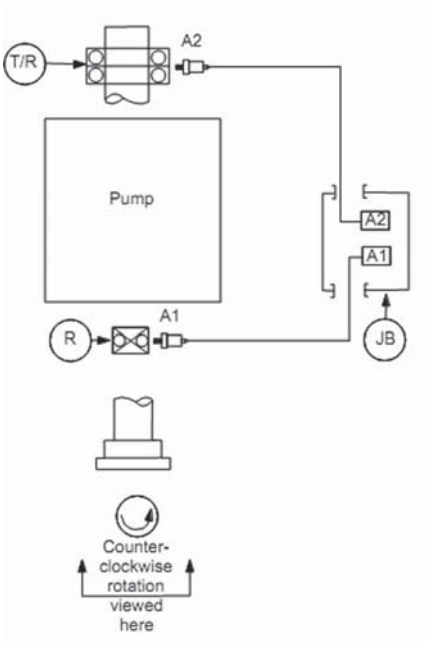


Typical process pump. Courtesy of SULZER Co.

required maintenance and reliability, so as to increase the MTBF and reduce the MTFR. Another important factor is the satisfactory and punctual fulfillment of customer requirements in after-sales services. This requires a combination of using state of the art design software and manufacturing techniques, deploying qualified crews and repair facilities all around the globe. There is a felt need to optimize the whole process of delivering equipment and services at a competitive price on order to maximize the market share. This is all the more necessary because the number of competitors has increased in the last two decades, notably in the emerging economies such as India, China, and Far East markets."

Asset management

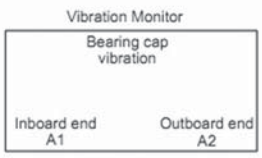
"In the past, everyone seemed to be concerned about data such as MTBF (Mean Time Between Failures), but it is possible that the emphasis has shifted slightly now. Every individual plant has its own management philosophy regarding asset maintenance. Modern plants which are more dependent on automation - sometimes described as total management philosophy - generally prefer an unmanned, long term and uninterrupted operation. Dependence on modern machinery, health monitoring techniques and statistics analysis (such as MTBF, MTFR, Availability & Reliability records) in fault



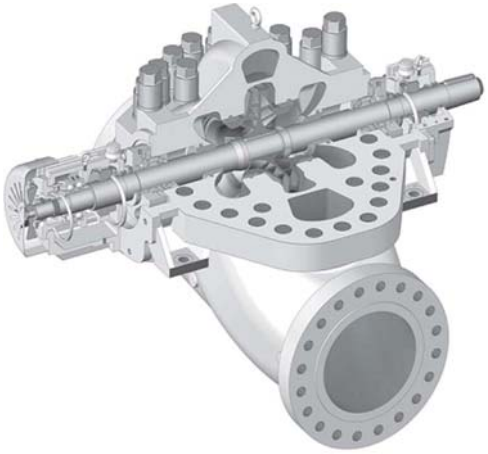
Item	Description
A1	Inboard end radial horizontal accelerometer, 90° off TDC (instrument manufacturer ID data)
A2	Outboard end radial horizontal accelerometer, 90° off TDC (instrument manufacturer ID data)
R	Radial bearing (description)
T/R	Thrust/Radial bearing (description)
JB	Junction box (description)

Notes:

1. TDC = top dead center.
2. The same arrangement would be used for a motor with rolling element bearings but would be viewed from the outboard end.



Typical System arrangement to a pump or Motor with rolling element bearings. Courtesy of API.



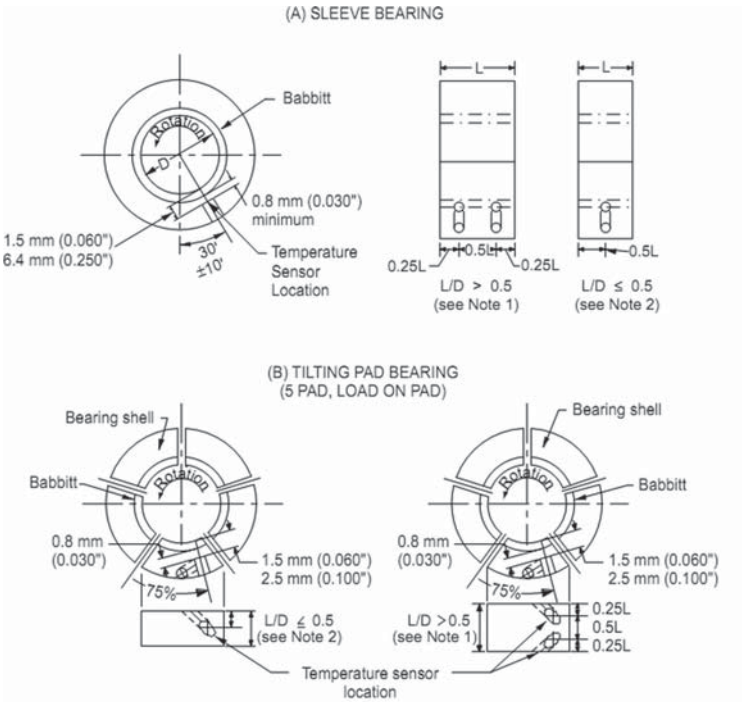
Typical transferring pump.
Courtesy of SULZER Co.

detection is high when compared to conventional plants which still follow more traditional ways in performing the required maintenance e. g., hiring in personnel crews. Time remains the most cost-effective variable but the maintenance crew has an accumulated experience so they can usually detect the problem quickly. Each approach has its own benefits and disadvantages. The first benefits from low overhead and running costs compared to conventional ones, but on other hand, the capital cost in modern plants is higher if compared to the old ones."
Mohammed gave some common tips for running your machine safely in both cases:

- Maintain a precision level of balancing and alignment for your pump to reduce its power use and also increase the life-time for seals and bearings which could be affected by over stressing.
- Maintain a proper record of pump health conditions such as lubricant analysis or noise and vibration level measurements, to assure early detection of any signs of faults before severe damage occurs.
- Maintain a proper log for the pump after every maintenance performed as a history record for your machine, which helps to set your requirements for spares or future repairs especially where existing problems could not be solved in time.

Monitoring techniques

"The more critical the pump is to the process, the more monitoring techniques should be deployed to the pump. This is applicable even for modern plants where it is unwise, very costly and consumes many working hours to apply all of these techniques to the whole machine fleet in the plant. The common on-line monitoring techniques being applied are vibration and temperature monitoring, used for almost all critical and mega-frame pumps (i.e., feed pumps for boilers and furnaces, critical transfer pumps or product pumps such as in ethylene and ammonia plants). Portable vibration analysis techniques are more common to process pumps where it is not economical to provide on-line monitoring instruments for such pumps. Another common technique is the thermal imaging technique which is also a very helpful diagnostic tool for evaluating the condition of the pump. Power consumption analysis is more common in turbo machinery applications (i.e., centrifugal compressors in gas or petrochemicals plants) than in process pump applications, but for large pumping stations (either water or transferring applications) it is being applied for mega-frame pumps using turbo drive pri-movers (steam/gas turbines), gas engines or high voltage electric motors. Lubricant analysis (such as oil and particle analysis) is also applicable for critical applications with large amounts of lubrication. For other applications such as common process pumps, it is more economical just to keep replacing the lubricant at frequent intervals and to keep records of the visual condition of the lubricant upon replacement as an indicator of any existing problems within the pump. Improving pump performance is a



Typical Installations of Radial Bearing Temperature Sensors.
Courtesy of API.

matter of maintaining or restoring the profile of internal pump components (i.e., impellers, volute or diffusers) and strictly maintaining the internal clearances of the original condition or the common established standards (i.e., API, ASME or ANSI). Commonly for large projects involving either train or multiple trains extensions or revamping, an end user will go to the EPC provider to do all the sizing, bedding and procurement. The information then goes to the manufacturer. For other cases such as simple train or individual machine revamping or replacement, the end user's engineering department will take responsibility for setting the specifications and contract terms with the vendor."

Experience counts

"My work experience started as a Rotating Equipment Maintenance Engineer for two different oil refineries (one was more old fashioned and the other was considered as modern) and also one modern polyethylene plant. I spent two years as Pump Assembly Shop Engineer and this was followed by a change to the Elliott Company." Mohammed considers training important and EBARA Corporation (holding company for the Elliott Group, of which Elliott Company forms a unit) affords apprenticeship programs for individuals at manufacturing plants. "Training programs are also offered to customers on request, either in situ or at the vendor's facility. It would be good to improve general maintenance quality by providing high standard tools and proper training for individuals performing maintenance, and to upgrade monitoring systems with the current state of art systems available.

From my prospective, I feel great satisfaction when I go home after a working day, having taken part in solving a problem or developing a solution that was successful in terms of saving money for my employer, whilst maintaining the asset in proper condition for production. Basically, I just feel joy in being helpful to others."

About Elliott Company

Elliott supplies and services turbo machinery for the full spectrum of oil and gas, refining, LNG, petrochemical and other process and power applications. Their global service network routinely installs, overhauls, repairs, upgrades and re-rates machines from any manufacturer. Field services include:

- *Assistance to analyze and diagnose problems and take corrective action.*
- *Technical direction of routine maintenance to keep turbo machinery running more efficiently and for longer periods.*
- *Technical opinions and repair recommendations*
- *Technical direction and assistance for new installations and startups.*
- *Project manager services to coordinate all phases of outage service work including major overhaul, inspection, outage and maintenance support and relocation and installation services.*

Innovation

Containment shells for magnetic coupled units

Andreas Russ

Jürgen Konrad

The containment shell on a pump is an important piece of equipment as it forms a closed system with hermetically sealed liquid end. It is designed as a pressure vessel to separate the pumpage from the atmosphere only. The containment shell is not used as an additional bearing holder. No dynamic stress occurs. The containment shell is bolted to the bearing housing in a manner that allows removal of the bearing bracket including outer magnets and ball bearings without exposing the pumped liquid to the atmosphere.

By Dipl. Ing. (FH) Jürgen Konrad, Andreas Russ, Dickow Pumpen KG

One of the most important components in magnetic coupled units is the containment shell. It provides a safe barrier between liquid and atmosphere. However compared to units with mechanical seals, a significant disadvantage arises in the high performance range regarding energy efficiency. The induction of an electric voltage through the rotating magnetic field generates eddy current losses in the containment shell which is normally made of metallic materials. The total efficiency of magnetic coupled pumps decreases, especially for high transmission powers. Losses above 20 kW are not uncommon but avoidable as

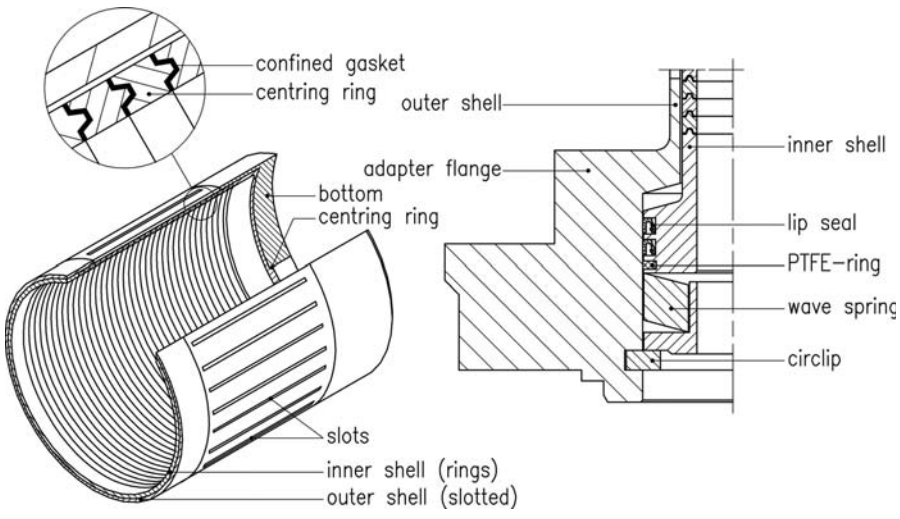


Figure 1: A schematic of sandwich containment shell.

Figure 2: New segment containment shell.

this article shows. The use of non-metallic materials for these applications has failed so far not only because of the universal applicability and interchangeability, but unfortunately also due to higher costs. Not only higher material costs must be considered, also the required special tooling before manufacturing is quite expensive.
An energy-efficient option for high transmission capacities was so far the so-called sandwich containment shell according to Figure 1.
With this design a reduction of more than 50% compared to normal metallic containment shells could be obtained. However, problems appeared occasionally in the past with pump units in operated with variable frequency drive. These have been solved meanwhile through design changes. The aim was now to combine proven technology with the current possibilities of modern materials and more than 25 years of experience in magnet coupling design. In order to maintain safety and operating limits the advantages of different containment shell designs had to be combined and weak points needed to be eliminated. The result is a new segment containment shell of different designs according to Figure 2. The single segment rings assembled together with a retainer and a cover form the shell. Electric isolation of the single segment rings is done by gaskets. Centering of retainer, cover and segment rings is guaranteed.
An internal pressure-resistant and liquid-tight connection is obtained with tension rings and their frictional connection through high-strength studs and nuts. The internal components are additionally held by a threaded ring and sealed by a grooved ring.

Advantages of this design:

- Reduced manufacturing and assembly costs
- High-strength, removable and non-wetted stud bolts
- Internal pressure-compensated connection
- Non-wetted spring loaded bottom cover
- High-strength stud bolt material with high electrical resistance
- Standard material Duplex. Other high-strength materials are available on request

With this design the magnetic losses could be reduced by 20% compared with the sandwich containment shell. An exterior rubber tape prevents that the stud bolts are vibrating. With this measure unlimited application of frequency converter is possible.
The design was also checked with a numeric stress-analysis - e.g. for the critical area of the tension ring – it shows a 60 percent utilization of the yield strength of the selected material, at a test pressure of 60 bar (Figure 3). The FEM-analysis proofs further that the stress on the sealing elements which is important for a liquid-tight execution, is within an uncritical range. The highlight of this segment-containment shell is the possibility to replace the single segments by a compact intermediate pipe of ceramic, e.g. zirconium oxide (Figure 2), or fiber-reinforced composites. Sections to bottom- and flange area, which are critical for these materials, do not apply. The simple form of a pipe can be manufactured easily and is optimal concerning stability and compressive strength.

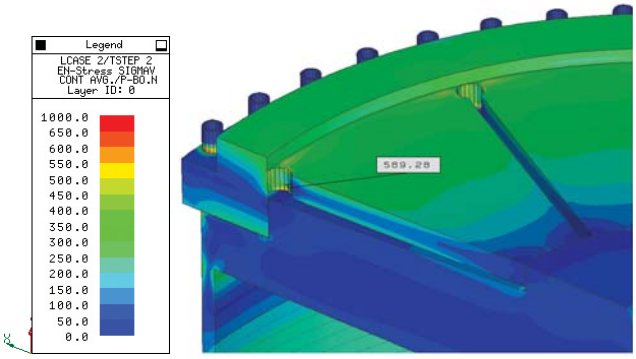


Figure 3: Numeric stress-analysis of the tension ring at a pressure of 60 bar.

Yet, the biggest benefit is the repeated reduction of the power loss which reduces 40% compared to the sandwich-containment shell. 90% of the power loss come from friction losses through the rotating internal magnet rotor and the liquid around it. The eddy current losses contribute only about 10% to the power loss.
The result of this is, apart from the reduced production- and assembly costs, further energy savings through higher efficiency as shown in the following example: the sandwich-containment shell, installed in a pump unit operating at a speed of 2900 rpm, is replaced by a segment containment shell with zirconium oxide tube. Due to the reduced power loss, the power consumption after one year of continuous operation is about 28000 kWH less. Based on an industrial electricity rate of 10 cents/kWh, cost savings are 2800 euro per year.
A patent application has been filed for this energy-efficient segment containment shell which can not only be applied in magnetic coupled pumps, but also in agitators or dry-running compressors.

***DICKOW PUMPEN** was established in 1910 and is based in Waldkreiburg, Germany. The company specializes in the production of centrifugal pumps for industrial applications - casing pumps, side channel pumps and multistage centrifugal pumps.*

Column:

The Pump Surgeons

George J. Maddox

Ian James

In their regular column, pump surgeons Ian James and George J. Maddox eagerly tackle a variety of important pump topics. This article forms the second of a two-part feature entitled 'Understanding Cavitation – Beyond the Basic', the first part having been published in the July issue of this year.

In the last issue of Pump Engineer, we learned what is meant by cavitation, how to avoid it, why it is so damaging, and finally how the thermal characteristics of the pumped liquid will affect the damage caused by cavitation. In Part 2 of this article we see examples of where and why cavitation can occur in different areas of a centrifugal pump, discuss various cavitation facts, and understand how different materials will resist cavitation and erosion damage. The four of the most common types of cavitation are:

1. Suction cavitation:
Where the pressure drop as the fluid accelerates into the impeller eye is low enough (Bernoulli's theory) to cause pockets of the liquid to vaporize. This is caused by insufficient NPSHA. So the system pressure at the pump is too close to the liquid vapor pressure, so the NPSH margin is too low. (NPSH margin= NPSHA - NPSHR).

2. Recirculation cavitation:
This is caused by low flow rate through the pump. There are two types which may occur together or separately: Suction Recirculation and Discharge Recirculation. Both types of recirculation work by the same phenomena of reverse fluid flows in close proximity to each other. When two flow paths within a fluid are moving in opposing directions and in close proximity to each other, vortices form between the two directions of flow, causing high fluid velocities and turbulence, resulting in localized pockets of low pressure where cavitation can occur.

3. Incipient cavitation:
In order to understand incipient cavitation one must know the definition of NPSHi (Net Positive Suction Head Inception), and NPSHR. Differential Pressure (dP or Delta P) = The pressure differential produced across a pump, as measured at the suction and discharge nozzles.
NPSHi - That fluid pressure, as measured at the pump suction nozzle, at which all cavitation inside the pump is suppressed.
NPSHR - The fluid pressure, as measured at the pump suction nozzle, at which a 3% drop in Differential HEAD occurs, as a result of the cavitation bubbles restricting the liquid flow through the impeller. As the liquid in the impeller eye is heavier than the vapor bubbles, the liquid is centrifuged to the outer diameter of the eye, so pushing the bubbles into the centre. Incipient cavitation is then described as the point at which cavitation first starts to form.

4. Vane passing cavitation:
Cavitation resulting from the gap between the impeller vane tip and the cut-water being too small. This results in high turbulence (particularly in high energy pumps) each time a vane passes the cut-water, resulting in cavitation and also pressure pulsations. (API 610-11th Edition (Para 6.1.15) defines high energy pumps as those pumps with more than 650 Ft And more than 300 HP, Per Stage.) The location of cavitation damage will vary as follows. Typical cavitation type damage may be observed on the center of the cut-water, impeller vane tips, discharge edge of the impeller shroud, and possibly to the pump casing downstream and directly behind the cutwater. The following photos show examples of different types of cavitation, and how to detect them.

Discharge recirculation cavitation damage

The photograph shown in Figure 1 is an example of extreme discharge recirculation damage. The fact that

Figure #1: Courtesy of www.irrigationcraft.com/diagnosing_cavitation.htm. An example of extreme discharge recirculation damage.

this was so intense so as to cause holes to be eroded through both impeller shrouds, just behind the impeller vanes, seems counter-intuitive. But let's remember the effect of Bernoulli's Laws: the pressure is lowest in the high velocity areas. So the pressure side of the vane (shown to the right of the vane in the photo above) is higher than the underside of the vane. Remember our earlier effect: pressure difference drives flow. So this pressure difference causes a horizontal vortex to form across and just beneath the vane width. This vortex can be likened to a tornado, whose highest speed, and so lowest pressures, are in the central part of the vortex. In fact, in order to cause cavitation, the vortex was so intense that it reduced the impeller discharge pressure to below the vapor pressure of the liquid. Then as the bubbles imploded or collapsed, the cavitation damage against the sides walls of the impeller shrouds was intense enough to erode holes through them.

Suction cavitation damage

Suction cavitation has damaged the leading edge and suction side of the vane, and also damaged the "corner" surfaces leading into the vane. The suction side of the vane is the side facing the viewer. Suction cavitation on this pump was severe enough that cavities formed in the fluid before the fluid reached the impeller. When the fluid reached the leading edge of the vanes and surrounding areas, the cavities collapsed onto the vane and surrounding areas eroding the impeller material. If the pressure side of the vanes were damaged, (back side of the vane that can only be seen with a mirror), then suction recirculation cavitation would have been the cause.

Various cavitation facts

1. Cavitation causes erosion.
2. Cavitation causes corrosion.
3. Low Flow Rates can result in cavitation.
4. High Flow Rates can also result in cavitation, depending on the NPSH margin.
5. Low NPSHA can reduce the NPSH margin to the point where cavitation occurs in the impeller eye.
6. Higher density liquids such as cold water, will cause more damage if cavitation occurs.
7. Some materials are more resistant than others to the effects of short term cavitation, see next page.

Figure #2: Courtesy of www.irrigationcraft.com/images/impeller_suction_cavitation_1b.jpg. This photo shows how suction cavitation has damaged the vane.

The effect of cavitation on a variety of pump metallurgies

Cavitation can cause both erosion and corrosion damage, as explained below.

1. **Erosive damage:**

This is a physical attack phenomenon, where cavitation and the resulting shock waves will erode the area in which it is taking place. For example in the impeller eye, behind the vanes.

2. **Corrosive damage:**

This is a chemical attack phenomenon. Corrosion resistant metals usually develop a protective passive oxide layer. This is particularly true for Stainless Steels and those containing large %'s of Chromium. Cavitation will erode this oxide layer on a continual basis, leading to a corrosion/erosion regime which will result in metal loss from the casing and impeller.

Metallurgy resistance

The following materials are progressively more resistant to erosion and cavitation damage, with cast iron as the least resistant. So from least to most resistant:

1. Cast Iron.
2. Leaded Bronze.
3. Cast Carbon Steel.
4. Manganese Bronze.
5. Monel.
6. Chrome and Stainless Steels:- CA15 & CA6NM (Martensitic) & CF8M (Austenitic).
7. Cast Duplex Stainless Steels.
8. Cast Nickel Aluminum Bronze.
9. Alloyed Titanium.
10. Cast Carburized 12% Chromium Stainless and Chrome Manganese Austenitic Steels.
11. Stellite coating.

The effect of this extremely short term, high energy cavitation shockwave is to remove particles of material. We have previously identified that the degree of particle removal depends on a variety of factors. Such as the intensity of the cavitation, the characteristics of the liquid and vapor phases, the metallurgy being impacted by the cavitation. There are also other physical factors that affect the degree of particle removal rate, as shown below.

The erosion or particle removal rate is proportional to:

1. Increases with increasing implosions powers. Erosion intensity is proportional to $NPSHR^3$ or RPM^6.
2. Reduces in ratio with the material UTS^2 or BHN^2.
3. Increases with increasing volumes of vapor, if the pressure continues to drop locally within the pump.
4. Increases with higher liquid densities, as the higher density increases the kinetic energy of the cavitation implosion micro-jet, and so increases the resulting damage.
5. Decreases with increasing water temperature, due to lower liquid densities (lower jet kinetic energy) and due to the thermodynamic effects described.
6. Decreases when the liquid contains dissolved gasses, as these reduce the energy of the implosions, and act as 'shock absorbers'.
7. Increases when pumping a corrosive liquid, as the shockwave can set up an erosion/corrosion regime, as already described. This causes the protective oxide layer that forms on chrome containing stainless steels, to be removed.
8. Increases at lower flows, further away from BEP, compared with the erosion at BEP.

As can be seen, cavitation is detrimental to pumps, and is preventable. A thorough understanding of the factors involved and their interaction, will ensure cavitation does not occur, resulting in a long pump life, trouble free from this damaging phenomenon.

References:

1. Figure #1: From www.irrigationcraft.com/diagnosing_cavitation.htm.
2. Figure #2: From http://www.irrigationcraft.com/images/impeller_suction_cavitation_1b.jpg.

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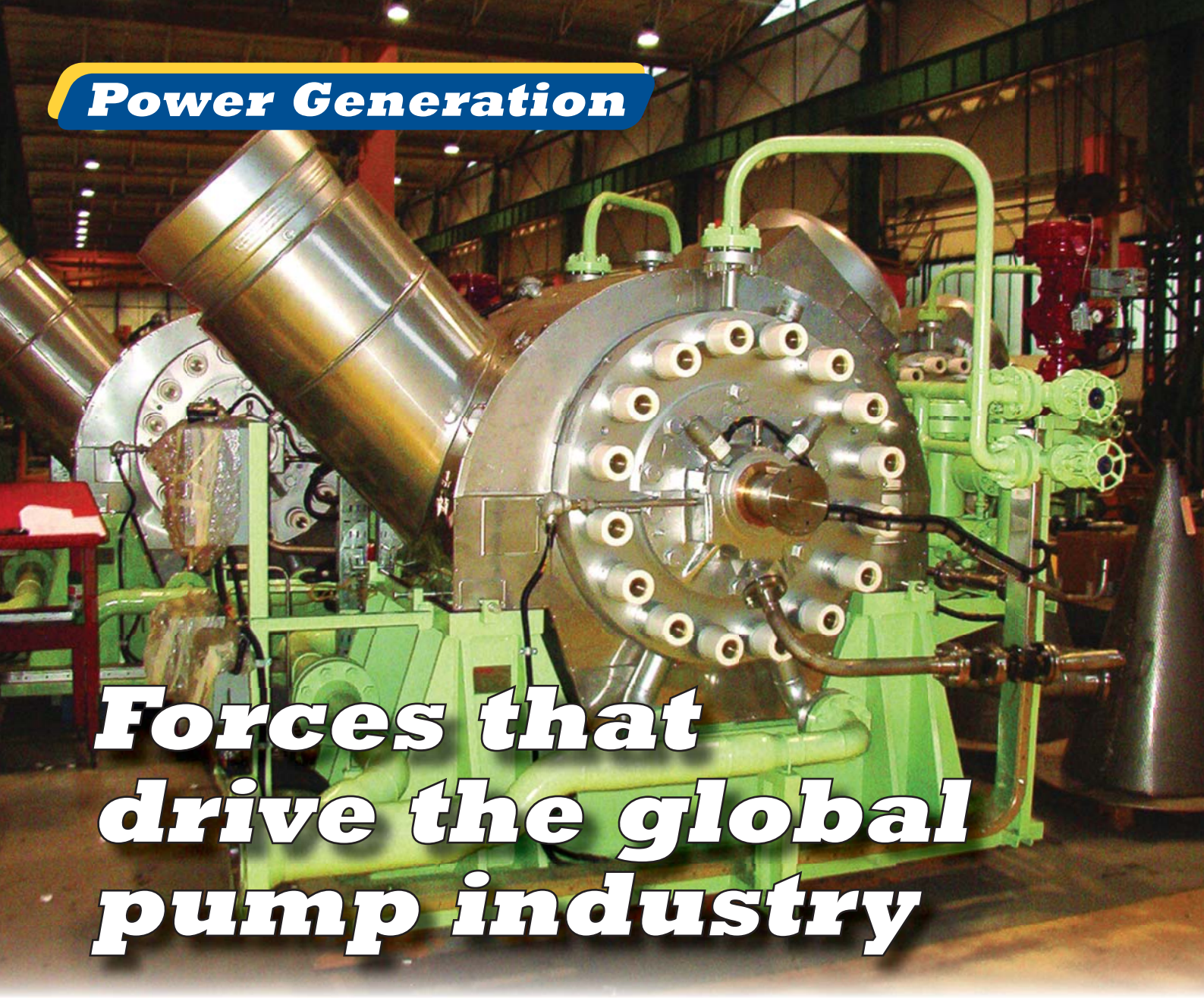

Forces that drive the global pump industry

Flowserve model CN reactor feed pump.

Eric van Gemeren began his career as a marine systems engineer in the Canadian navy, then transitioned into Aerospace, and later into the Power Generation business. He is currently vice president of Research and Development (R&D) for Flowserve Corporation, a leading supplier of fluid motion control products. With experience in engineering, operations, supply chain, marketing and channel development work, he has had opportunities to view the business from a variety of different angles. *Pump Engineer* spoke to van Gemeren about some of the main forces currently driving developments in the global pump industry and power generation in particular.

By Joanne McIntyre

"For pump suppliers globally, the biggest single shift in our business today is our role in taking cost out of our end users' business," van Gemeren began. "We are expected to help them be more profitable by changing from a strict focus on original equipment (OE) supply to a more expansive partnership role. There have been a lot of evolutions in our business that make it possible to deliver significant cost reductions by bundling value-added packages of services. These now cover the whole spectrum from the engineering design of a project to servicing, overhauls, decommissioning and all points in between. There are some subtly different trends among the oil and gas, power generation, and petrochemical industries, but clearly the vast majority of demand is coming from outside traditional OECD economies in countries like China, Brazil and Middle East with developing economies."

Eric van Gemeren:"Suppliers can deliver significant cost reductions by bundling value-added packages of services".

Powergen driving intelligent designs

The increase in the size of both nuclear and conventional power plants demanded in today's market is creating some significant driving factors for design evolution, explained van Gemeren. "Plants are not only much larger than we have seen before; they must also have greater operating efficiencies, more uptime and better reliability. EPCs around the world are focusing on much larger equipment with greater capacity and output than we have designed in the past. EPCs and end users try to get every ounce of thermodynamic efficiency out of a power plant, and this is driving some real materials challenges for equipment providers. It is essential that we work to supply equipment for plants in those types of operating conditions."

It's not just the increasing demands on operating conditions that are placing pressure on equipment design. "Some regions of the world are also facing critical shortfalls in experienced engineers, not just to get the plants commissioned but to actually operate and maintain the plants. These pressures translate into choices for plant designs that can be operated with far fewer people than in previous generations. Furthermore, they are looking for equipment that has a much larger mean time between failures, thereby reducing the maintenance requirements," he said. Van Gemeren continued, "Another important factor is also greater demand for data at the point of use. This is specifically in support of the fewer skilled resources available but also in response to new environmental and safety regulations that place greater demands on the plant to be able to track critical safety events or near-misses. That drives the demand for more data throughout the plant down to the equipment providers. A lot of end users and EPCs require that instrumentation be provided by the Original Equipment Manufacturer (OEM), so the intelligence has to reside on the pump itself. The manufacturer of the pump understands its failure modes better than anyone else. They will know what to look for and be able to translate patterns of instrumentation readings to foresee impending failures, and recommend corrective actions, maintenance procedures, special tooling, and replacement parts.

"Being able to provide an intelligent system helps the owner-operator understand when an aberration or performance anomaly is serious enough to shut it down or let it limp along until the next planned shut-down, and what kind[s] of spare parts, special tools and maintenance procedures are needed for shut-down maintenance work. It's now possible to provide a system that can support the pump with constant monitoring, minimizing unplanned down-time."

Pressures on the pump industry

The general trend towards higher pump unit efficiencies, decreasing natural resources and investigation of new, leading-edge technologies for the exploration of alternative energies have caused a considerable focus on metallic and non-metallic materials and their combination. In the power industries, higher pressures and temperatures required by ultra-supercritical applications can only be realized with the help of highly advanced alloys, including sophisticated methods in post heat treatment and surface refinement of parts and components. In subsea pumping applications, multi MW submerged pump and motor units today are required to run maintenance free for more than three years at 4000m sea depth in an extremely harsh environment and varying operating conditions. Down-hole well water pumps today reach into the 2 MW range and installation depths up to 800 m below ground, challenging the dynamic behavior, cooling system and thrust force management of the units.

"The other really big impact on the industry has come from the boom of the fracking industry, not only in North America but also hydraulic fracturing in Eastern Europe. Fracking has increased demand for high-pressure, high-reliability pumps to support the rigors of that business," he pointed out.

Striving for energy efficiency

"In an industrial plant, the largest single component of cost related to a pump is the energy that it takes to actually run it," van Gemeren expounded. "Therefore, the degree to which we can introduce new technologies and new suites of services to reduce energy consumption can have a significant influence on overall profitability."

"Computational fluid dynamics and finite element analysis modeling provide the next generation of tools to better simulate what goes on inside a pump and shaft seal. These tools help us design products that have a much higher hydraulic efficiency. The same flow rates and pressure outputs in a smaller package consume a lot less energy. Motor designs are much more efficient in terms of their ability to convert the potential energy from an electrical power source into kinetic energy that drives a pump. Motor technology continues to be a hot topic of research and exploration in the pump industry. The industry as a whole is getting a lot smarter and needs to look for innovations that really increase up-time, allowing the same output from much less energy input and significantly reducing the need for skilled engineers to operate and maintain that equipment. I think, in the near future, we will see a lot of great new innovations being accepted by end users and actually commercialized in the field," van Gemeren concluded.

Martin Williamson

What kind of grease is in each gun and which one to use from the rack? Colour coding will prevent mistakes and allow quick identification.

Best practices for lubricating small rotating equipment

Machinery lubrication is at the heart of almost all equipment and is therefore critical to the reliability and profitability of a company. Contamination of the lubrication has frequently been identified as one of the major causes of premature wear on rotating machines. If all other root causes such as the alignment, balance and the mounting integrity have been checked, then the other major influence is solid particulate and moisture. In pumping systems, the pumped product itself may be the cause, but solids of less than 10µm are generally deemed the most destructive. Other root causes of premature wear also come into play such as topping up with the wrong lubricant or using inadequately specified oils and greases.

By Martin Williamson B.Sc. MLE, KEW Engineering Ltd

Editor's log

In the November issue of Pump Engineer, you can read an interview with Jay Zaffino (photo right), Principal Rotating Equipment Engineer with Burns & McDonnell Engineering Company.

It is part of his job to make sure that equipment is specified and selected with long-term reliability in mind.

If you have any news or views you would like to share with our readers, then the address, as always, is: a.peers@kci-world.com

Surveying and inspecting for improvement to enhance the contamination control on a chemical injection pump.

The biggest hurdle to improving systems is one of basic attitude, and to try to change the culture with regard to maintenance. An active discipline of good house-keeping goes a long way towards this, but ultimately all maintenance and operations personnel need to understand why contamination control is critical. Below are some suggestions as to how to identify the sources of contamination:

Create a colour coded tagging system - Create a colour and shape coded chart to identify each lubricant. Ensure that all the units are tagged with the appropriate colour code for the oil or grease in use, along with the frequency and number of shots applied on greased systems. Apply the colour coding to the new lubricant packaging when it arrives on site as well as the funnels and tools used for dispensing.

New equipment commissioning - The cleanliness of units at the commissioning stage is crucial to ensuring infant reliability and increased operating life. It is common to find manufacturing debris present in a new unit. Ensure that when specifying new units, choose the best quality breather and seals as standard. Any openings in the castings etc. should be plugged and the shafts and gears covered with a protective film of grease or oil whilst in storage, to be thoroughly removed before use. Make use of the portable filter cart to flush the unit through before it is turned. The best way is to use a low viscosity fluid that can splash through the box ensuring that all the dead zones are cleaned and any debris dislodged and trapped by the filter cart. If you are requesting the OEM to do this before delivery, ensure that they flush in accordance with the appropriate standards and show proof of achieving your required levels.

Storage and handling - Ensure a clean, dry environment for the storage of the oils. Pre-filter drums of new oil before use to bring them to a standard of cleanliness suitable for the machine. Use colour coded, seal-able containers to dispense the oil. Avoid leaving open containers and funnels lying by the machinery, but do make provision for storing the seal-able top-up containers in a cupboard nearby and ensure these are taken away when empty to be cleaned and refilled. For constant level oiler bottles, use a small dispensing bottle to minimise waste and spills and ensure this is also sealed when not in use. For grease guns, use a dedicated gun for each grease type and use the cartridges to minimise contamination where possible. Only use the larger 20/25kg pails of grease with a proper dispensing pump and keep the unit sealed at all times. Identify the grease guns and pumps using colour electrical cable ties in line with the grease colour coding structure.

Set-up for dispensing - Try to avoid the use of funnels and instead use hand pumps and snap-on connectors to ensure the oil is not contaminated during the dispensing. Ensure the fill ports and grease fittings are clean prior to use and use colour coded dust caps on these.

Set-up for inspection - A number of units will have simple check plugs, port-hole level gauges or simply a dipstick. This can be improved on by fitting a combination sight glass and drain that will allow inspection of the oil right down to the lower level where water may be sitting. If using an external sight tube gauge, ensure this is vented to the breather via a tee-piece to minimise contaminant ingression. Alternatively, bottom sediment and water inspection bowls can be fitted at the base of the unit to check for water, sludge or sediment levels. Combine these fittings with oil sampling ports that have an internal extended tube arrangement to avoid drawing sediments and sludge from the base. This will allow sampling on the run rather than stopping and inserting a tube into the unit.

Seals - Standard lip seals are a low cost item, but require frequent replacement and their performance deteriorates over time as they cause wear on the shaft where they

How not to store the funnel next to the pump! The funnel's spout is sitting in dirt and this will transfer along with the oil the next time the funnel is used.

How the set-up should be for dispensing oil from drums into sealable containers, with colour-coding used to indicate products in the storage area.

rub. Although mechanical and magnetic type seals are a greater cost initially, their superior performance will ensure minimal risk from water or dirt ingress, as well as minimising shaft wear and lubricant loss and potential process/environmental problems. Training the cleaning staff to avoid the use of high-pressure wash-down sprays directly on the seals is a must, although in food and drug related environments this cannot always be avoided. In this instance, a seal guard can prove beneficial.

Breathers - Vent plugs serve their purpose, but will not stop destructive 10µm particles. The upgrade to the breather should minimise the ingestion of hard particulate and moisture. A good quality breather, such as a 1µm rated spin-on filter canister will remove as much of the airborne particulate as possible. If in a moist environment, then the use of desiccating breathers is advisable. However, on pumps, there is little actual need for breathers, generally, they are there to allow for changes in volume as a result of top-ups, leakages and temperature related air pressure changes. For applications where volume changes are minimal, the ideal form of breather is a bladder type sealed unit. This effectively seals the internal of the unit from the atmosphere, but a small bladder allows for expansion and contraction of the air within as a result of temperature changes. These are especially ideal where high levels of particulate or moisture occur in the environment.

Portable off-line filtration - Generally, oil lubricated pumps can benefit from the use of a filter cart. Filter carts can usually be applied by permanently replacing the fill and drain plugs with Snap-On quick connectors. The use of the periodic portable filtration will then deal more effectively with contaminant ingression minimising the need for frequent oil changes, assuming the oil is not being contaminated by the pumped fluid. The filter carts should be selected for easy manoeuvrability and allow for a selection of filter ratings (including small amounts of water removal) within the design constraints of the pump on the cart. If you are operating a sampling and analysis programme, be sure to collect the samples prior to filtering. Remember that these filter carts are non-intrusive and are best used whilst the unit is operating at higher temperatures, although be sure to check that there is not too much loss of level when engaging the cart that may be detrimental to the asset. At least five to seven times the volume of the oil in the system should be passed through the filter cart to ensure adequate clean up.

Mist lubrication - That is mist, not missed, lubrication. In pure mist designs, the bearings are lubricated by a 'total loss' mist of oil droplets. This eliminates the potential for damage from oils with moisture and solids, as well as the risk of bearing damage from oil contaminated by the pumped fluids leaking into the housing. The mist also generates a positive pressure within the bearing housing reducing the risk of moisture and solid ingestion from the atmosphere.

Benefiting from the changes

The above changes are not onerous and are easily adapted to the pumps if spread over a period of three years. Those companies that have made the changes often state that the lubrication technician's job is now easier and safer. They also have a better control on the lubrication tasks, and keep better records of how much oil is being used, whilst wastage from leakages and spillages is minimised.

KEW Engineering provides independent support to the industrial lubrication industry, offering consultancy and training worldwide. Fields of expertise are the oil and gas, mining, marine and power generation including wind turbines and many other industries.

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