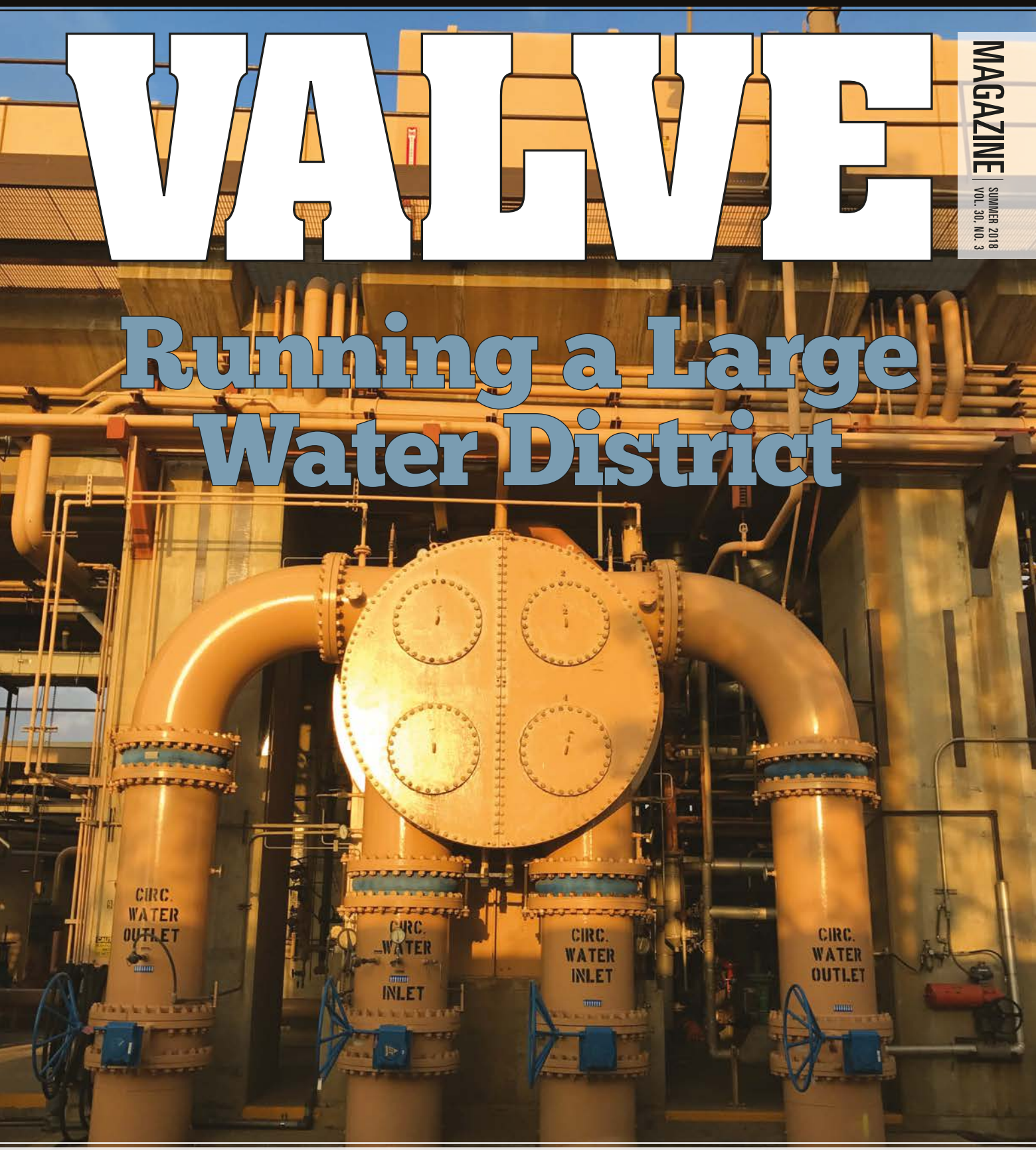
NEXT BASICS PROGRAM COMING OCT. 30 - NOV. 1

VALVE MAGAZINE

SUMMER 2018 | VOL. 30, NO. 3

Running a Large Water District



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SUMMER 2018 | VOL. 30, NO. 3

24 Manufacturing 21st Century Style

Three of the advancements that keep modern factories efficient are robotics, additive manufacturing and the ability to use data smartly.

BY MOHAMED ABUALI, JOHN TUOHY AND STEPHEN ANDERSON

14 WHERE VALVES ARE USED: THE CHALLENGES OF CHLOR-ALKALI

The valves that serve chlor-alkali plants must be made of specialized materials that stand up to tough chemical conditions and designs that enable them to control emissions.

BY PHILIP SCHULTZ

18 LACSD: AN INTERVIEW WITH THOSE WHO KEEP THE DISTRICT RUNNING

One of the nation's largest water districts faces the same issues as much of the nation's water systems: infrastructure aging, lost technical skills among workers and finding new ways to make water systems cost effective. The district's engineers explain the innovations it uses.

BY KATE KUNKEL

28 BACK TO BASICS: HEAT TREATMENT

One of the reasons today's metal is so improved over earlier times is because of the various heat treatments it receives.

BY GREG JOHNSON

PRODUCTS

46 Editor's Picks

- Resilient Wedge Gate Valve
- Rotary Electric Actuator
- Loop Monitoring Software
- Sprinkler Coupling Line
- Pressure Relief Valves
- Variable Speed Actuators
- Bellows Seal Valves

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Evolution of Control Valve Diagnostics

Analytics generated by online valve diagnostics can be easily accessed by plant maintenance or contract service personnel who can then make informed, proactive valve maintenance decisions.

- Cavitation in Globe Valves
- Advancements in Blue Laser Scanning
- Integrating LEAN Principles
- Metal Additive Manufacturing in the Valve Industry
- Integration of Automation Lifecycles
- Your Valves may be Weaponized
- Graphite for Sealing
- Workforce Training: Challenges and New Methods

COLUMNS

4 Perspectives
Education at the Forefront
BY BILL SANDLER

34 Actuators & Controls
Commissioning
BY PAUL SOUZA

38 Know Your Valves
Butterfly Valves on Aircraft Carriers
BY MARK PETERSEN-OVERTON

42 Standards
Reports on Standards
BY STAN HALE AND CARLOS DAVILA

DEPARTMENTS

Industry Capsules ... 6

VMA Calendar ... 7

VMA and VRC Member Roster ... 44

Index to Advertisers ... 48

VALVE MAGAZINE

www.VALVEmagazine.com

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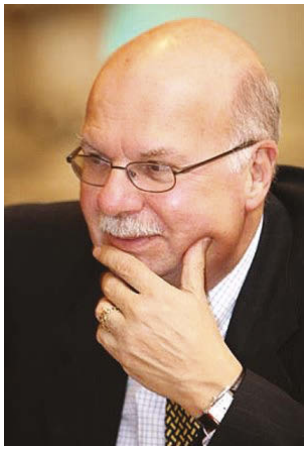
Education at the Forefront



One of our main goals for 2018 is to bring educational programs to our membership and the industry—both the meetings and workshops that have been successful in the past and some changes to our offerings.

We're already well on our way to accomplishing that mission. The new Knowledge Forum, which was held in April, was a giant step. The forum was a combination of our previous Technical, Manufacturers and Human Resources seminars. Included in the planning of this event were segments of previously separate workshops that were always a hit with attendees. The resulting conference included:

- A choice of two optional plant tours, which we offered on day one
- An exhibit program, which we presented on day two during lunch, afternoon break and a reception
- Concurrent sessions for each area of interest: technical, manufacturing and human resources, with the ability to pick and choose sessions to attend.
- Joint networking events including lunches, breaks and receptions.
- The ability to bring together both members and nonmembers across a wide spectrum of attendees ranging from end users to engineering firms, manufacturers to suppliers.

Gaining steam this year is our customized Valve Basics course, which allows companies to have VMA's popular training program at their own facilities. So far, we've had excellent programs at ExxonMobil in Louisiana and the Los Angeles County Sanitation Districts (see page 18). Designed for groups of 25-50, this program allows cost savings on transportation and housing and is designed for the specific needs of the company.

Although those two educational offerings are new, they are additions to some of our highly successful events such as our Leadership Forum, Market Outlook Workshop and this year, our 80th VMA Annual Meeting. The leadership event and the Valve Repair Meeting, Tour & Exhibits (see page 10) are behind us this year. Still on the agenda for 2018 is the outlook workshop coming in August, the annual meeting in September and the next Valve Basics Course Oct. 31–Nov. 1 at the Houston Area Safety Council in Pasadena, TX. Turn to page 7 for a complete list and visit the VMA.org website for specifics.

These meetings not only bring value to individual memberships, but to the industry in general, and we will continue to work on upgrades. We are meeting our goal of bringing education to the forefront in 2018, and we encourage you to participate.

If you are currently not a member and are a U.S. or Canadian manufacturer, supplier, distributor or repair facility that qualifies for membership, please go to our website www.vma.org to review our membership criteria as well as an online membership application.

Bill Sandler
President, Valve Manufacturers Association of America

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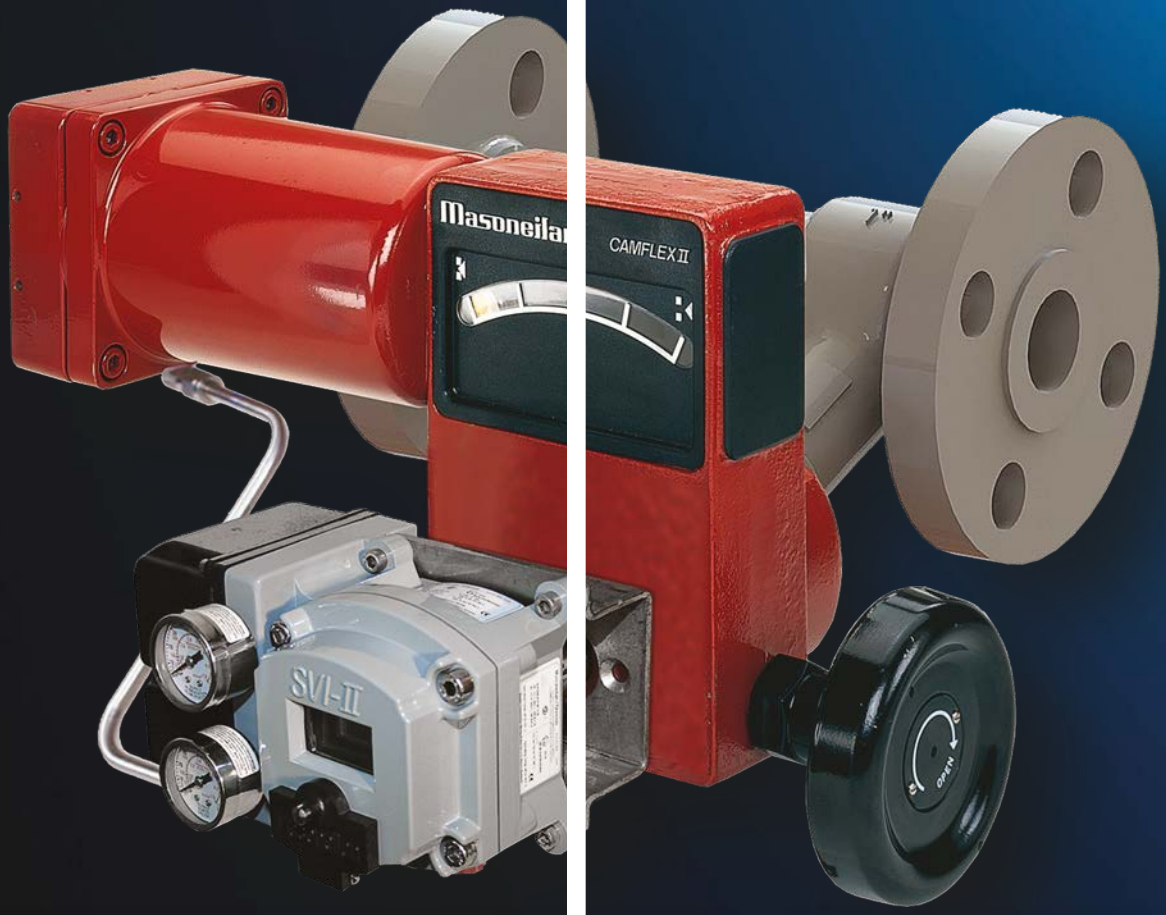

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NEW CONTRACTS

Rotork Supplying Upgrade for Irish Water Plant

As part of a major modernization program at the Kilkit Water Treatment Plant, Irish Water installed Rotork actuators at its County Monaghan, Ireland site. Rotork was chosen to automate inlet penstocks. The project is part of a contract for upgrading the Lough Egish Regional Water Supply in County Monaghan. Once completed, the upgraded treatment plant will have an increased design output of 5.5 million liters per day.

Farris Engineering Partners with EnerMech

Curtiss-Wright Industrial Division business unit Farris Engineering entered into a partnership with integrated engineering services company EnerMech for the Australian market. EnerMech will serve as a sales representative, assembler and stockist of new Farris safety relief valves and parts. The arrangement also includes sales representation for Curtiss-Wright's Solent & Pratt specialty butterfly valve range and its Phonix, Strack & Daume severe service isolation and control valves for the power and chemical industries.

Headquartered in the UK, EnerMech has over 40 facilities across the world.

Asahi/America Awards FloWorks Distributorship

Floworks International LLC via Sunbelt Supply Company was recently awarded a thermoplastic valves, valve actuation and piping components distributorship for Asahi/America Inc.

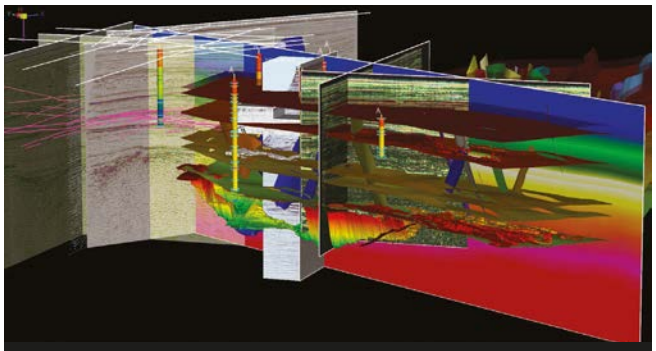
The addition of the Asahi thermoplastic product lines and service capabilities is a significant addition in thermoplastics piping products and fluid handling systems to Flowork's portfolio of brands.

Flowserve Expands Partnership with Unisys

Flowserve, a client of Unisys Corporation, will expand its use of the Unisys Stealth microsegmentation solution through a new agreement to implement that solution more broadly across the enterprise. Under the new agreement, Flowserve will increase the number of servers and endpoints protected by Stealth microsegmentation, and Unisys will manage the implementation and administration of Stealth on Flowserve's behalf.

Wey Valves Supplying German Biogas Plant

The BioEnergie GmbH & Co. KG biogas plant in Waldmünchen, Germany is using Wey valves. The biogas facility is operated jointly by six farmers. The plant produces 4.5 million kilowatts of electricity annually for the grid operator Bayernwerk. The plant also provides local heating for 38 buyers. About 30% of this energy is generated in Waldmünchen from slurry and manure; 20% each from grass, maize and cereals; and about 10% from wheatgrass and silphium perfoliatum, a species of plant native primarily to North America.



Emerson's E&P software showing subsurface data

Repsol Selects Emerson for Exploration Technology

Emerson has signed a multi-year contract with Repsol to provide its Paradigm Exploration & Production (E&P) software suite across all Repsol global exploration operations to identify and evaluate new and existing opportunities more accurately. Emerson acquired Paradigm in December 2017.

Powell Valves Names Newmans Valve Master Distributor

The Wm. Powell Company (Powell Valves) and Newmans Valve LLC have entered into a master stocking distributor agreement for the Powell pressure seal product. Newmans Valve is a master stocking distributor of industrial valve products based in Houston. Newmans sells through industrial pipe valve and fitting distributors in the U.S. and Canada.

Setpoint I.S. Named Gestra USA Distribution Partner

Setpoint Integrated Solutions (Setpoint I.S.) is the new, premier distribution partner of Gestra USA for Texas, Arkansas, western Tennessee, Mississippi, Alabama, Louisiana and the Florida panhandle.

The agreement augments the company's existing offering for steam and condensate management solutions throughout the Gulf South.

Velan Supplying Northern Kuwait Refinery

Velan has successfully shipped four complete control units combining the Key-C rotary control ball valve with the unique cable drive actuator. These huge, 30-inch Class 300 control valves will be part of the gas treatment process for a modernization project of a large-scale refinery in northern Kuwait.

MERGERS & ACQUISITIONS

Siemens Announces Purchase of Enlighted Inc.

Siemens Building Technologies Division is acquiring Enlighted Inc., a provider of smart Internet of Things (IoT) systems in buildings. Enlighted will be managed as an independent legal entity and wholly owned subsidiary of Siemens Industry, Inc.

Enlighted makes smart sensors, securely streaming data to the cloud. In addition, the IoT platform enables reduced energy use, improved space utilization, better environmental management and greater asset use.

Metso Acquiring Rotex Valve Automation Division

Metso has signed an agreement to acquire the valve automation division of the India-based valve technology company Rotex Manufacturers and Engineers Pvt. Ltd. The company has a market-leading position in India in the actuator business and an advanced offering of switches, process valves, and valve automation products and solutions. It has two manufacturing facilities in the Mumbai area and sales offices in Mumbai, Vadodara, Kolkata and Pune.

Emerson Agrees to Purchase Aventics

Emerson has agreed on terms to buy Aventics from Triton for a cash price of $620 million. Aventics deals in smart pneumatics technologies that power machine and factory automation applications. Aventics significantly expands Emerson's reach in a growing $13 billion market.

With central offices in Laatzen, Germany, Aventics has about 2,100 employees globally with five manufacturing locations and 2017 sales of $425 million.

AWARDS & CERTIFICATIONS

ITT to Receive Leadership Award

ITT Inc. has been selected to receive the 2018 Manufacturing Leadership Award in the Visionary Leadership category. The achievement honors ITT for its leadership and the positive impact the company has on the manufacturing industry. ITT received the award during the Manufacturing Leadership Summit, June 11-13, in Huntington Beach, CA.

The recognition comes from the Manufacturing Leadership Council and Frost & Sullivan.

To kick off the grand opening, the chief administrative officer of St. Charles Parish, Billy Raymond, performed a ribbon-cutting ceremony with the Setpoint I.S. team.

CPV Manufacturing Receives ISO 9001:2015 Certification

Admiral Valve, LLC dba CPV Manufacturing announced it received ISO 9001:2015 certification for its quality management system in the design and manufacture of high-pressure valves and fittings. The nine-month certification process involved all employees and management at all levels.

NEW FACILITIES

Crane Celebrates Opening of New Plant in India

Crane ChemPharma & Energy celebrated inauguration of its newest location, an aseptic diaphragm valve factory in Satara, India. Crane invited hundreds of customers and industry stakeholders to participate in a day-long event May 10 that included a tour of the new plant. Built within the same complex as two other Crane factories, the new facility will be solely dedicated to Saunders HC4 aseptic diaphragm valves and actuators.

Setpoint I.S. Holds Grand Opening for New Luling Facility

On April 26 Setpoint Integrated Solutions (Setpoint I.S.) hosted a grand opening for its new Luling, LA facility. Hundreds of customers as well as OEM partners attended for a crawfish boil, music and door prizes.

Victaulic Launches New Branch

Victaulic opened a new, 3,205-square-meter (more than 10,000-square-foot) branch facility in Eagle Farm, Brisbane, Australia.

The new branch, the company's third Australian site, will support continued growth within the region, servicing territories stretching from the Hunter Valley to Far North Queensland, as well as inland to Industrial & Mining Regions and the Northern Territory. The new branch will host customer care and distribution.

Metso's Valves Service Center in Turkey Relocates

Metso's valves service center in Turkey has relocated to Söke in the Aegean region to be close to important customer hubs. The new location and larger facilities strengthen Metso's presence and ensure better service availability for customers in an area lacking a service center of this volume.

CALENDAR 2018–2019

AUGUST

9-10
VMA Market Outlook Workshop*
Chicago
www.VMA.org/MarketOutlook2018

SEPTEMBER

25-27
VMA/VRC Annual Meeting*
Lake Tahoe (Truckee), CA
www.VMA.org/AnnualMeeting

29-OCT 3
WEFTEC 2018
New Orleans
www.weftec.org

OCTOBER

30-NOV 1
VMA Valve Basics Seminar & Exhibits
Pasadena, TX
www.VMA.org/ValveBasics

NOVEMBER

27-29
Valve World Expo & Conference
Düsseldorf, Germany
www.valveworldexpo.com

DECEMBER

4-6
Power-Gen International
Orlando, FL
www.power-gen.com

APRIL

9-11
VMA Valve Industry Knowledge Forum: Conference, Exhibits, Tour
Huntsville, AL (tentative)
www.vma.org/KnowledgeForum

MAY

6-9
Offshore Technology Conference (OTC) 2019
Houston
www.otcnet.org

* Open to VMA/VRC members only. Visit www.VMA.org to learn if your company qualifies for membership.

VALVE MAGAZINE

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ARTICLE SUBMISSIONS
VALVE Magazine welcomes articles, proposals, manuscripts, photographs and ideas from our readers. For a copy of the magazine's Author's Guidelines, contact Genilee Parente, managing editor, at gparente@vma.org.

DeZURIK Expanding, Opening New Facility

DeZURIK, Inc. plans to expand production at its Sartell, MN headquarters and open a new rapid fulfillment facility near Houston. The target date for completion of the transition is March 2019.

Production will gradually be phased out of the company's existing Schaumburg, IL location. VM

CORRECTION

The Spring issue of VALVE included an incorrect web address for author Timothy Gregg. The correct address for Wolseley Industrial Group is www.wolseleyindustrialgroup.com.

PEOPLE IN THE NEWS

VALVTECHNOLOGIES… appointed **Ron Anselmo** as vice president, key accounts. Anselmo started his career with Amoco Oil and held leadership roles in engineering, operations (fractionation, coking, reside hydroprocessing, reformulation), maintenance, project management and construction. His last position was with Calpine Corporation.

John Furfey will take over as industry director, oil and gas. Furfey brings more than 30 years of extensive valve industry and global sales experience to the company, most recently as director of partner accounts at Schlumberger.

METSO… appointed **Pekka Vauramo** president and CEO effective as of November 2018. CFO **Eeva Sipilä** will continue to serve as Metso's interim CEO until Vauramo begins his new role. Vauramo had served as president and CEO of Finnair since 2013, and prior to that, he held several management positions at Cargotec and Sandvik.

CONVAL… appointed **Brian E. White** refining and chemical industry manager serving the petrochemical industry in the Gulf states and elsewhere as opportunities and needs arise. White has over 20 years of experience selling instrumentation and capital equipment to the oil & gas, chemical, fluid power, shipbuilding, power, biopharmaceutical, analytical and construction industries. He has held management and sales positions at Rawson, Circor Instrumentation Technologies, Thermo Fisher Scientific, Swagelok and Illinois Tool Works.

THE CHEMOURS COMPANY… made **Jonathan Lock** vice president of corporate development and investor relations. Lock was previously at SunCoke Energy, where he led corporate strategy and investor relations.

Alisha Bellezza, Chemours current treasurer and vice president of investor relations, has been named vice president of commercial operations and supply chain for the Titanium Technologies segment.

Sameer Ralhan, vice president of finance, will assume the role of treasurer while retaining his current business finance responsibilities.

SIEMENS… named **Barbara Humpton** CEO for the U.S. as of June 1, 2018. Humpton was previously CEO of Siemens Government Technologies, Inc. (SGT).

Humpton joined SGT in 2011 as senior vice president for business development and was appointed to lead the company's approach to the federal market in 2015. Prior to joining Siemens, Humpton held senior leadership positions at Lockheed Martin and Booz Allen Hamilton, where she was a vice president at both firms.

VAL-MATIC… promoted **Andrew Brudniak** to project manager. He most recently held the position of sales engineer for the northeast territory. Brudniak also has passed the exam for the Project Management Professional (PMP) certification offered by the Project Management Institute. The PMP certification is considered the leading certification for project managers in the industry.

FLOWSERVE… has named **Elizabeth Burger** senior vice president and chief human resources (HR) officer. Burger has extensive management experience, which includes leading HR for the more than 70,000 employees at HanesBrands, Inc.


Minnix

Lanesha Minnix joined Flowserve as senior vice president and chief legal officer. Minnix comes from BMC Stock Holdings, Inc., where she served as senior vice president, general counsel and corporate secretary since 2017.

SPIRAX SARCO… added **Peter France** as an independent non-executive director to its board. France will be a member of the audit, remuneration and nomination committees. He had a career spanning 28 years with Rotork plc including CEO from 2008 to 2017, a period of significant transformation and growth.

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Trust Earned Through Performance

Repair Specialists Gather in Houston to Expand Their Knowledge

Valve repair and rebuilding professionals came from around the country to hear experts talk about everything from pressure relief device repair to bolting to use of hand-held XRF for positive material identification at the June 6-8 Valve Repair Meeting, Tour & Exhibits in Houston.

The program was designed to cover a wide range of topics; the tours were meant to expand that knowledge with real-life examples of facilities in action. An exhibit allowed attendees to see the products and services available to the industry.

Here's a sample of what attendees of this biannual meeting learned recently:

BOILER CODES

Sydney Cammeresi of the National Board of Boiler & Pressure Valve Inspectors updated attendees on the fact the 2017 National Board Inspection Code is expanded to four parts so that pressure relief information is treated as one organized subject ensuring that proper overpressure protection devices are used and that they are installed correctly.

The first section of the new part 4 is implementation of a new construction standard. Part 4 covers in-service inspection processes as well, including looking at operation of devices.

BOLTING

Several experts from U.S. Bolt Manufacturing advised attendees on ASTM International bolting specifications.

A supply chain subcommittee of the American Petroleum Institute (API) request resulted in API 20E, covering alloy and carbon steel bolting, and 20F, covering corrosion-resistant bolting.

In those specifications, heat treatment was given special attention because failures have resulted from insufficient practices or deficient testing. The standards also added controls for contractors, a new section on coating, prohibitions on zinc electroplating and on forging control.

POSITIVE MATERIAL IDENTIFICATION

Don Mears, training provider at Analytical Training Consultants stressed the importance of "trust but verify" when it comes to positive material identification (PMI).

The third edition of API RP 578 requires users to establish a written material verification program indicating the extent and type of PMI to be conducted during the construction of new assets, what will be used retroactively on existing assets, and what will be used during the maintenance, repair or alteration of existing assets.

NORM DETECTION AND PROTECTION

Justin Harris, radiation safety services manager at Quantum Technical Services, pointed out that, unless arrangements have been made beforehand, an equipment owner is responsible for ensuring equipment is free from normally occurring radioactive materials (NORM) contamination before it is shipped to a repair facility. Equipment also must be secured to prevent contamination during transport. Harris also said proactive NORM programs exist for equipment owners who keep track of baseline data, routine maintenance data and procedures and who know where their equipment will be shipped for repair.

Attendees at the recent repair meeting

OXYGEN CLEANING

Greg Johnson, CEO of United Valve, reminded attendees that sparking must be eliminated in the oxygen cleaning process because when oxygen fires happen, everyone involved in the process is sued including pipe, valve or pump manufacturers, valve repair or piping system cleaning vendors, fabricators, designers and more.

Johnson also warned that packaging is vital when oxygen valves are repaired and cleaned and advised companies to ensure their cleaning procedures are approved in advance and inspected by customers.

In addition to education sessions, attendees toured the facilities of United Valve, TEAM Industrial and A-T Controls.

Fuller coverage of the repair meeting can be found at www.valvemagazine.com/web only/technical.

NEW MEMBERS

Flo-Tite Valves & Controls, Lumberton, NC, joined VMA as a full member. The company manufactures high quality ball valves and actuation ranging from standard commercial valves to high-pressure metal-seated control valves.

Also joining as a full member is **SVF Flow Controls**, a manufacturer of ball valves, actuators, and controls for all industrial applications headquartered in La Palma, CA.

The Valve Repair Council welcomes **ECI - Equipment & Controls, Inc.**, Monessen, PA. The company provides services in Western Pennsylvania, Ohio, West Virginia and Western Maryland. Working with Emerson Automation Solutions resources, ECI offers valve, regulator and process management solutions.

EFCO USA, Inc., Charlotte, NC, is a new associate member of the Valve Repair Council. EFCO is a developer and manufacturer of repair and testing equipment offering products in 80 countries.

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Oct. 30 to Nov. 1 is Next Valve Basics Course

The Valve Basics Seminar & Exhibits will be held again at the Houston Area Safety Council in Pasadena, TX, a location chosen a year ago to accommodate the need for more space for the hands-on learning experience that attendees seek. The next course is Oct. 30 to Nov. 1.

The event has furnished a broad understanding of the valves, actuators and control industry to more than 2,000 people since it began in 2009. Along with the need for more space, the event has grown from a day-long meeting to three days as the classroom agenda has expanded.

At the Valve Basics Seminar, classroom attendees spend the first day being introduced to the industry and learning about specific valve types such as linear (multi-turn) valves, check valves, quarter-turn valves, pressure-relief valves. They also are introduced to electric actuators. The learning continues the next day as attendees go over the basics of actuators (manual and fluid-powered), control panels for fluid powered actuators, control valves and systems, and packings and fugitive emissions. On the third day, the topics get more specialized such as valve materials, solenoid valves, critical service, valve data and feedback, and valve repair.

One of the most popular features of the Basics course is the valve petting zoo.

But some of the most valuable learning comes when attendees visit a "Valve Petting Zoo" set up so they can see how what they're learning works in the field. They also get experience with the actual products that are offered in the industry through a tabletop exhibit.

The Valve Basics Seminar & Exhibits was created for both newcomers to the industry and people within the industry that need an expanded knowledge of how the equipment works and what products and technologies are currently in use.

The full program and schedule are posted online at www.VMA.org/Valve Basics. For more information on the program, contact Abby Brown at abrown@vma.org.

Largest Water Event Coming in September

WEFTEC 2018, which is generally thought to be the largest annual water quality meeting in North America is Sept. 29 to Oct. 3 at the New Orleans Morial Convention Center, New Orleans.

WEFTEC is a technical conference and product showcase put on by the Water Environment Federation, which gathers thousands of water and wastewater professionals for the event—people who attend to learn, network, find out about new products and services and earn continuing education credit and professional development hours.

The meetings and sessions at WEFTEC cover everything from water reclamation and recycling technologies to leading edge research to what's happening in Washington, D.C. and individual states.

Meanwhile, attendees also have the chance to visit an exhibit of more than 1,000 companies there to show off the latest products and services to the water

world. The exhibit hall also has an innovation center that offers more educational opportunities in the form of trends sessions and new types of operations and technology.

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WHERE VALVES ARE USED

The Challenges of Chlor-Alkali

BY PHILIP SCHULTZ

With the introduction of new materials and the evolution of valve design over the years, the days when fluid handling operators were limited by the number of valve types available to control the process are long gone. These advancements plus more stringent fugitive emissions standards, a strengthened concern for the health and safety of plant personnel and the desire of operators to achieve a lower total cost of ownership have made valve selection a science. One of the applications where this science must be put into practice is chlor-alkali plants.

The features of the valves available for chlor-alkali plants have been customized to solve some of the most plaguing issues the industry faces. Operators today must understand the strengths of each type of valve to select the right one for different parts of the process.

CHLOR-ALKALI

In a chlor-alkali plant, four major phases occur: brine preparation, chlorine processing, caustic soda and hydrogen production. Each of them presents their own challenges as does other downstream considerations with chlor-alkali, including dealing with hydrochloric acid and with sodium hypochlorite synthesis.

Each of the four phases requires specific valves and materials.

The range of valve types created for use in chlor-alkali plants is broad: diaphragm valves, sleeved plug valves, lined valves (butterfly, ball, check and plug) and bellows-sealed globe valves, to name a few.

Executive Summary

SUBJECT: Chlor-alkali plants offer some harsh processes that require specialized materials and designs.

KEY ISSUES

- The four processes involved
- What types of valves are needed
- How today's valves meet the challenges

TAKE-AWAY: The valve industry has come a long way in creating new types and technologies that can handle the processes.

All of these valves face problems with fugitive emissions, which can be caused by insufficient sealing systems, thermal cycling and corrosion of wetted valve components, especially in the case of inappropriate media/lining combinations. Downstream leakage, another common problem, can result from internal corrosion, abrasion damage of seats, scaling and seat wear over time. The valves used in chlor-alkali must have features and benefits that can handle such issues.

CHALLENGES IN THE PHASES

Brine preparation is plagued by corrosive and erosive media. Abrasion occurs from solid particles and salt buildup, and scaling can occur. The brine itself, a mixture of water and raw salt, is very corrosive and has a high ion concentration.

Because of the high sensitivity of the membranes and diaphragms in the electrolytic cells used in this process, the brine solution for those cells must be purified, a process that involves numerous steps including treatment, filtration and ion exchange. In parts of the process where solids are present, abrasion is an issue. Perfluoroalkoxy (PFA)-lined diaphragm valves with a polytetrafluoroethylene (PTFE) diaphragm are often used. PFA-lined butterfly valves are also a popular choice in the brine preparation process, and PFA-lined plug and ball valves are sometimes used, particularly after filtration when solids have been removed from the media.

Chlorine is the main product of a chlor-alkali plant. This chlorine must be cooled, dried, compressed, and either liquified for storage or transporting, or sent to downstream processes. The chlorine processing section of the operation occurs after chlorine gas is generated in the electrolyzer. The most prevalent issues encountered in chlorine processing are fugitive emissions and corrosive media. The wet chlorine that comes directly from the electrolyzer is highly corrosive and toxic. A frequent choice of valve here is a high-performance butterfly valve (Figures 1 and 4), a severe service plug valve in a material such as Monel (Figure 3) or a zero-emissions valve such as a bellows-sealed globe

☐ Figure 1. High-performance butterfly valves in the field

valve. The wet chlorine is dried using concentrated sulfuric acid (H_2SO_4). Lined ball or plug valves are often used to deal with the highly corrosive nature of the H_2SO_4.

Another major byproduct of the chlor-alkali process is caustic soda, typically sodium hydroxide. Depending on the technology in use in the electrolytic cell, the caustic soda produced is in different concentrations with different levels of salt contamination. This poses valve selection challenges because the media is corrosive, but it may also contain solids, especially after evaporation to concentrate the product. As concentration increases, salt may crash out of

THE VALVES IN CHLOR-ALKALI SERVICE

Hydrochloric Acid

Typical Valves:

- Diaphragm valves
- Lined ball, butterfly, check and plug valves
- Bellows sealed globe valves

Common Problems Solved:

- Downstream leakage
- External emissions
- Internal corrosion
- High maintenance costs

Brine Preparation

Typical Valves:

- Diaphragm valves
- Lined plug, butterfly and ball valves
- Bellows-sealed globe valves

Common Problems Solved:

- Particulate abrasion
- Valve jams
- Internal corrosion
- Scaling/downstream leakage

Chlorine Processing

Typical Valves:

- Diaphragm valves
- Lined butterfly, ball and plug valves
- Bellows-sealed globe valves
- Wet chlorine: lined

Common Problems Solved:

- External emissions
- Downstream leakage
- Lining permeation
- Maintenance difficulty
- Temperature cycling

Caustic Soda

Typical Valves:

- Stainless steel
- Lined butterfly and plug valves
- Sleeved plug valves

Common Problems Solved:

- External leakage
- Scaling/downstream leakage
- High temperature corrosion

Figure 2. Industrial diaphragm valves typical of what is used in chlor-alkali

solution (precipitate) and have scaling effects. For this reason, a sleeved plug valve in nickel alloy is often a choice (Figure 3). The absence of body cavities in this valve type prevents the accumulation of flow media, which can result in damage to the sealing surface. Valves with 360-degree port lips will protect the sleeve from any abrasion as well. In low-salt caustic applications, lined ball valves are a viable option because of their full port design and outstanding corrosion resistance.

Hydrogen gas is another byproduct produced in the chlor-alkali process. Because of unfavorable stoichiometric ratios (the exact ratio between air and flammable gas or vapor at which complete combustion takes place) and a low molecular weight, hydrogen is not produced in quantities that typically make it a commercially attractive derivative. Still, the hydrogen produced may be burned as fuel or is frequently combusted with chlorine to make hydrochloric acid for use in the plant.

The difficulties hydrogen production presents include dealing with high pressures needed for storage and the need to select a material that can avoid hydrogen embrittlement. High-performance butterfly valves (HPBVs) are a frequent choice for use in hydrogen production.

THE RIGHT VALVE

Diaphragm valves (Figure 2) are often used in chlor-alkali applications because only two parts of the valve come in contact with the line media, allowing it to resist corrosion and abrasion. The diaphragm isolates the working parts of the valve from the harmful media, further preventing corrosion of any metallic components. The linear operation of the valve assures the seal even if the diaphragm indicates signs of wear from abrasion. It also prevents break-in or break-out torque. Because of this, the rolled thread should not seize or gall, and the spindles are protected from the environment through travel, preventing valve jams. Diaphragm valves also enable a pocketless flow, which prevents buildup on sealing surfaces, facilitating complete closure.

Sleeved plug valves are another

Figure 3. Soft-seated plug valve

Figure 4. High-performance butterfly valves

prevalent valve in chlor-alkali applications. Using a sleeved plug valve with a full circumferential in-line seal design can provide both upstream and downstream (bi-directional) sealing (Figure 5). Sleeved plug valves can also minimize seat wear, as the port lips protect the seating surface in both the open or closed position. Modern valve designs feature two or even three independent sealing systems, and therefore, provide increased protection against atmospheric leakage.

HPBVs are a prime choice when it comes to ensuring bi-directional sealing, which is especially critical in any dry chlorine lines where leakage can introduce moisture and lead to rapid corrosion of piping system components. With the HPBV, leakage protection is provided regardless of flow direction.

Fully lined ball, plug and butterfly valves offer unparalleled corrosion resistance to all chemicals encountered in the chlor-alkali process.

When bellows-sealed globe valves are needed, valves with internal components made of stainless-steel or

Figure 5. Soft-seated plug valves

Hastelloy to provide sufficient protection against corrosion are used. This can also help to prevent abrasion with the multi-wall, fully-flushed stainless-steel bellows acting as a primary seal. This flushed system also can keep the bellows clean and free from any particles settling into the fins of the bellow.

Another favorable feature prevalent in bellows-sealed globe valves is tight sealing between the body and bonnet, which has the ability to further extend the valve's life. A superior safety sealing system in a bellows-sealed globe valve has multiple walls, gland packing, a metal back seat and a cover gasket for fugitive emissions protection. The bellows-sealed globe valve is also useful in the prevention of thermal cycling through the tongue and groove sealing system.

CONCLUSION

Chlor-alkali is one of the most demanding fluid handling applications. A greater understanding of the challenges that operators face allows those who select the valves to weigh the benefits and features of each valve type to match them to exact needs. It's up to the operator to ensure they partner with a valve manufacturer that has the experience and knowledge needed to supply the most appropriate valve so that the equipment can both do the job needed for smooth operation (thereby assuring best total cost of ownership), and keep personnel and the environment safe. VM

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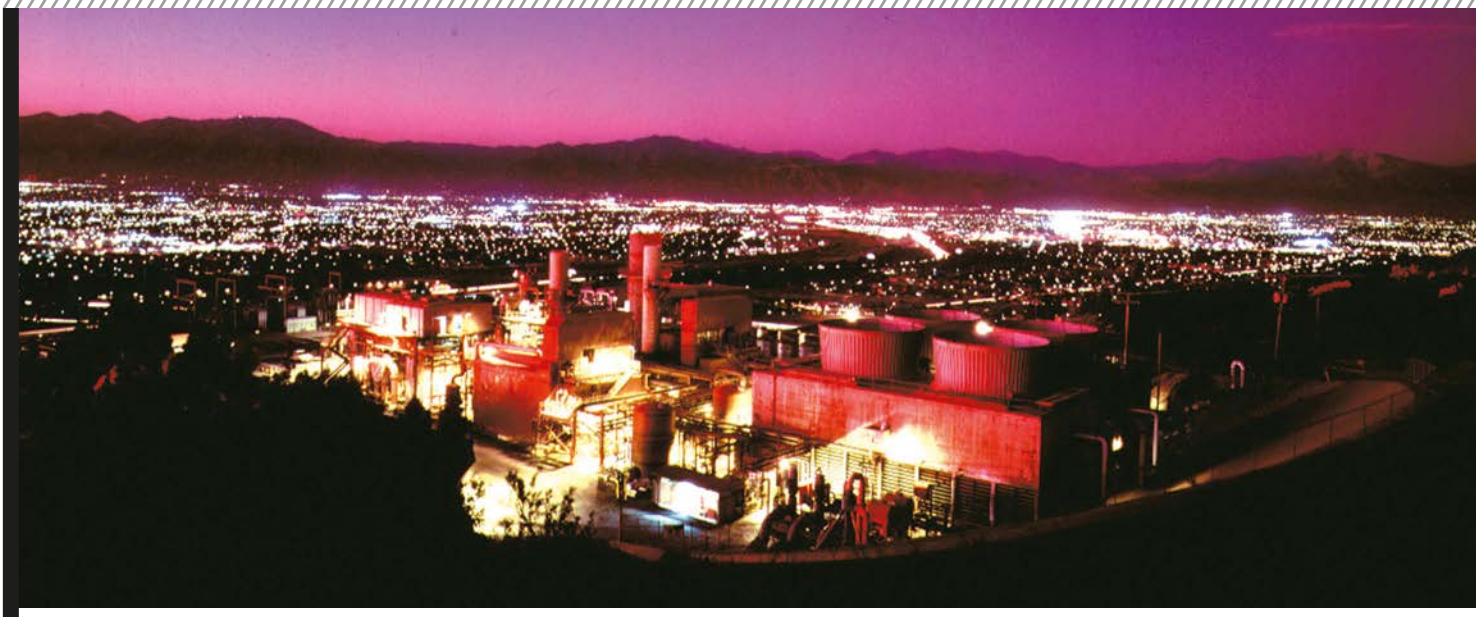

LACSD:
An Interview with Those Who Keep the Districts Running

BY KATE KUNKEL

The Los Angeles County Sanitation Districts (LACSD) are among the largest water/wastewater agencies in the country, operating 10 water reclamation plants and one ocean discharge wastewater treatment plant. The job of running them is truly a challenge.

Executive Summary

SUBJECT: What does it take to operate one of the nation's largest water districts?

KEY ISSUES:

- The challenges
- Today's innovations
- What LACSD has done

TAKE-AWAY: Valve manufacturers can be part of the process of coming up with better ways to run water and wastewater plants.

Just talk to Joe Chang, supervising engineer in the Water Reclamation Plants operations group. Chang notes that running that kind of complex system is a constant educational experience.

"I've been working in operations for 14 years, and I learn something new about one of the plants almost every day," he says.

So what challenges make the job complex?

It starts with the problem many plants have around the country: aging infrastructure.

"A lot of our plants were built in the 1960s, so we have old tanks, old piping, old buildings. Our mechanical equipment is aging," Chang says.

Much of what's in the facilities is reaching the end of its design life, so every day, decisions must be made about the best way to operate and monitor equipment, do the necessary repairs or replace parts.

"We also have to know what contingency plans there are in case of failures," Chang adds.

A second challenge is also one that faces a good portion of the country: the aging and retiring workforce. At LACSD, "We have a very experienced and knowledgeable staff," Chang says. "But many of them are closing in on retirement age, and as they retire, we lose institutional knowledge about the plants and equipment they've been operating for such a long time. How do you carry that over to younger staff?"

LACSD has a mentoring program, and experienced staff works closely with newer employees, but Chang admitted it is tricky to find ways to convey the knowledge that's been accumulated. The districts use manuals and more experienced staff to conduct training for newer operators and are trying to capture legacy information by taking actions such as studying criticality of equipment and working through different scenarios to see what would happen if systems fail. These facts are recorded so new operators understand what steps to take if problems arise.

Derek Zondervan, supervising engineer in the Field Engineering Section,

added that LACSD is also trying to put a focus on professional development. "The custom VMA training we just had was great [The group held a VMA Basics Program in February 2018]. It's very valuable to have industry experts bring staff up to speed, so that they are all on the same page regarding specifying, installing and operating valves," he said. "Otherwise some fine points can become an afterthought."

Through the Basics Program, "Joe and his staff members in operations, field engineering and design were all getting the same training at the same time," he adds.

Basil Hewitt, supervising engineer in the Public Information Office at LACSD, also refers to retirement as a problem, specifically, the exodus of baby boomers. He says LACSD is handling it better than many similar organizations.

"We're working hard to ensure there is continuity of knowledge," he says.

Aging infrastructure presents a more troubling challenge, he says.

"Some of our infrastructure has been in use for almost 90 years," he points out. "Joe and Derek do a great job of rehabbing and fixing, but we need to make sure we have funding to address the infrastructure issue."

Derek Zondervan helped put together the customized basics education program VMA presented at LACSD.

California is well known for strictness in environmental matters, but LACSD says the agency is also dealing well with those issues.

"Our mission is to protect public health and the environment. So the bottom line is that whatever is good for the people we serve, we do, provided it's cost-effective," says Basil.

Still, "our agency has operated differently than many sanitation districts from the beginning. We took wastewater off the shoreline using ocean outfalls, while others were discharging directly at the beach," Basil says.

Chang also notes that LACSD facilities are designed with a good amount of redundancy, which helps with both infrastructure challenges and environmental concerns.

"Even though we have aging infrastructure, we have enough redundancy that if a pump or valve or air compressor or aeration tank went offline, we would still meet our environmental requirements," he says.

Like many water districts, LACSD also faces challenges created by the new "flushable" wipes being pushed on the market. Chang says that in the wastewater collection portion of the districts, there is a critical need to de-rag equipment because many of those wipes clog up the pumps and screens at the districts' pump stations.

Hewitt stresses that the public

should be told that most of the wipes do not flush harmlessly away.

"We see it in our pumps, and we're looking into how we can spread the word that these wipes are not flushable.

WATER RECLAMATION

LACSD's long history includes an early foray into recycling.

The districts started as a wastewater agency in 1923. In the 1940s, the second chief engineer for the agency recognized the value of recycled water and started planning water reclamation plants.

The districts' first tertiary effluent plant was constructed in the 1960s. Since 1962, the organization has reused over a trillion gallons of water.

"Every year, we generate about 130 million gallons of tertiary effluent (a.k.a., recycled or reclaimed water)," says Hewitt. The water "is indistinguishable from bottled water, and there are more than 850 sites throughout L.A. county that use the recycled water," he adds.

The districts' largest treatment plant, the Joint Water Pollution Control Plant, is in Carson. Hewitt notes water from that plant has been too salty for reuse because much of the wastewater comes from industry.

However, "we're exploring how to cost-effectively recycle this wastewater and use it to recharge groundwater aquifers," he says.

To do so, the organization is partnering with the Metropolitan Water District of Southern California, which is building a demonstration facility that would further purify the effluent produced at the Carson plant. If the project runs smoothly, "we could potentially get 150 million more gallons per day going back into the water supply," he says. This is significant since currently half of the water used in L.A. County is imported from the Sacramento Bay Delta or the Colorado River.

Also, since Los Angeles is in a semi-arid region, many issues arise regarding water supply. A severe drought between 2012 and 2017, for example, brought the importance of conservation to the forefront, and while there has been a slight uptick in rain the last year, the districts are working diligently to make the water supply more resilient.

☐ The LACSD basics class is one way the districts have found to expand skill levels among employees.

"The reservoirs throughout the state are not at comfort level," Hewitt says. Because of this, "We have to ensure that the water keeps flowing. If there is another drought or if something happens to an aqueduct, we could have a problem. So, we're moving ahead with more water recycling."

Chang addresses the issue of water conservation's effects on equipment. Because with reclamation, "There is less flow, but it is more concentrated, we considered whether that would create problems with more odor or corrosion," he explains.

The agency has always been aware of this issue, but staying ahead of it is a constant process.

"Fortunately, we haven't experienced any issues associated with the reduced flow, even though the waste is more concentrated. That's because we've been pro-active all along," he says.

Zondervan points out the advantage of that reality. Drought is more the norm than the exception now, so conservation measures will continue to keep flow rates down, even when there isn't a drought.

Still, the pursuit of better and better ways to reclaim water isn't going away anytime soon.

"As long as you flush the toilet and use the shower, you need water." Reclamation is "an important, reliable source of water for our region," he says.

MEETING TODAY'S CHALLENGES

Zondervan has worked in wastewater and solid waste design for the last few years, just recently moving to field engineering. He says that while no recent major changes have been made in the districts' system design process, it's a constant process finding innovative and cost-effective ways to keep operations up and running smoothly.

For example, "We're always looking for better materials and designs. We look back at the way we did things before and see how they've held up. Then we can decide if that was the best way and make changes accordingly," he says.

One challenge today comes from the variations in flow coming into the treatment plants, he says. For example, a huge wash of wastewater hits the sewer system shortly after people get up in the morning. That slows down during the day but then there is another, somewhat smaller upswing after people return home from work. Flows then drop to very low levels during the night. This creates a challenge for operators who must keep the chemicals at the right levels, and it also causes spikes in energy use.

Because of this, the districts have a flow-equalization tank at the Valencia Water Reclamation Plant and are

currently building a second such tank at the San Jose Creek Water Reclamation Plant. These tools will capture those peak flows in the morning, store them until the night and then send them back into the system, thereby enabling stabilization of electricity needs and chemical additions, and optimizing treatment.

Chang says this will help spread out the load from higher concentrations of wastewater over the day and make more recycled water available for the overnight hours when irrigators use the water for parks, golf courses and other tasks.

ENERGY RECOVERY

Hewitt notes that the LACSD operates two landfill sites and has a power plant at the Puente Hills landfill that closed in 2013. A network of pipes collects landfill gas, which is about 40% methane. However, it's burned to produce nearly 50 megawatts of electricity to power the districts' San Jose Creek plant, administration offices and homes.

Another power generation system is in place at the plant in Carson, Hewitt says.

"All the biosolids that settle out from six of our upstream water reclamation plants are sent to the plant in Carson. Once the solids are removed there, they go into anaerobic digesters where microorganisms break down solids, generating methane to power the treatment plant," he says.

"This 20-megawatt power plant saves about $9 million a year," which makes the plant energy self-sufficient, he says.

State regulations about pulling organics out of landfills created another special program for the districts, Zondervan says.

Because flow rates are down from conservation, the digesters at the plant in Carson don't produce as much gas. As a result, the agency is embarking on a project to turn collected food waste into a slurry and putting it into the Carson plant's anaerobic digesters to generate more biogas and power.

The demonstration phase of this program was just completed, and the districts are working to bring it to full scale to generate more power from food waste.

"This is an example of being innovative and cost-effective. The state comes up with a new regulation, but we had to figure out a way to get it out of landfills and into the digesters and have that food waste become a resource rather than a burden," Zondervan says.

HELP FROM MANUFACTURERS

The districts say that manufacturers can help in the constant effort to keep up with better ways of doing things.

Chang recounts a project where several valves were installed simultaneously years ago that are now all coming to the end of their life at the same time.

"This goes towards overall maintenance strategy of infrastructure," he says. "We need something in place where we can track cycle times on valves, especially critical valves."

This might be a tool that allows tracking what a valve can do when it has cycled many times.

"That would help us figure out if maybe we need to stagger how we're using the valves so they don't get burned out all at the same time," he says.

Such ideas go along with the idea of remaining proactive, Zondervan says. "One thing we have appreciated is the support from manufacturers on the design side with specifying." But it also includes tools such a lunch-and-learns and educational material.

The lessons are "a big help to us. There are so many different valves and applications so it's helpful to get input," he says.

Hewitt adds that a new, 18-foot (5.5-meter) diameter, 7-mile-long (11 kilometers) tunnel is being built from the Carson plant as part of a redundancy plan to support the tunnels originally built in 1937 and 1958.

"There is always flow going through these tunnels," he said, "so we can't take them out of the service for inspection."

Because of that, "we're going to need some very large, 144-inch valves," he says. VM

Kate Kunkel is senior editor of VALVE Magazine. Reach her at kkunkel@vma.org.

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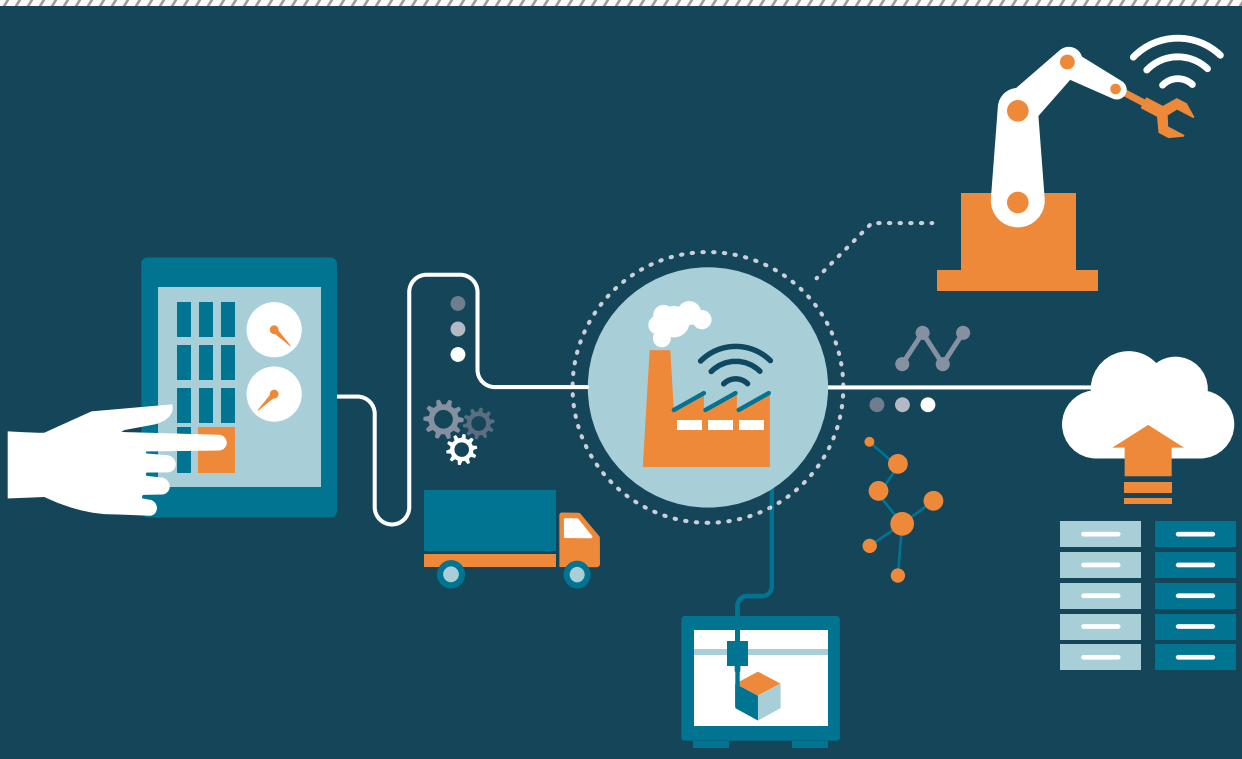

Manufacturing 21st Century Style:
Smart, Data-Driven and Agile

BY MOHAMED ABUALI, JOHN TUOHY AND STEPHEN ANDERSON

The Fourth Industrial Revolution has had a tremendous impact on business. While fears exist that this revolution could exacerbate the segregation of the job market, thus increasing wealth and income inequality, what's to come is also seen as the solution to the skilled trades shortage made critical because of the retirement of the baby boomer generation. Meanwhile, the interconnectedness of processes and businesses are raising serious concerns about cybersecurity.

While the debate about the pros and cons could go on until the next industrial revolution, one factor is generally accepted: Amazing advancements are making manufacturing plants more efficient and agile.

Three of these advancements were discussed at VMA's 2018 Valve Industry Knowledge Forum in April: robotics, additive manufacturing and the power of data to drive it all.

The following articles came from three presenters at the forum who gave VALVE Magazine their thoughts on the power of Industry 4.0.

Executive Summary

SUBJECT: As the industrial world works to develop the Internet of Things, tools such as cyber-physical systems, cloud computing, machine learning, robotics and additive manufacturing are changing the way we think about efficiency, customer service and even the very structure of business.

KEY ISSUES:

- Transforming to smart
- Robotics on the plant floor
- Additive manufacturing

TAKE-AWAY: The newer tools may well be able to help industry solve one of its most pressing needs: finding ways to replace lost skills and talent.

The Transformation to Smart

BY MOHAMED ABUALI

Across the world, manufacturing is regarded as an essential and uniquely powerful economic force. The unprecedented ability to connect, capture and analyze plant floor data drives the engine that is the Industrial Internet of Things (IIoT), which offers a new way of thinking.

Data-driven shop floor management is already creating greater efficiencies in every corner of the manufacturing ecosystem. It produces better supply chain management at the front door, more precise and prescient maintenance practices on the line and greater control over all the raw materials that go into the finished product—including energy and personnel.

Today's modern manufacturers are more efficient and effective than ever. As the demands on manufacturing change to single-lot orders and new business models emerge, even more efficiencies are required to make good on promises. What smart data and better analytics provide to this picture is more effective use of resources without spending any more money on either people or materials.

Yet it is worth noting that "big data" in manufacturing is not really about size. While the idea of better data management on the floor is part of the "big," the data has been there all along. Thanks to the advent of great data analytics tools and less expensive sensors, what has changed most recently is that more data is available easier to more people in exactly the way they need it for better decision-making.

Data analytics gets the entire manufacturing plant—from the corner office to the front line—up to speed in a hurry. The information reaches workers with the speed they need to make not just fast decisions, but the right decisions quickly. Big data, then, is really about smart data. It begins with information that is delivered to the people who have the skill to make better choices about how to turn that data into action and bottom-line results.

IIoT's primary selling point is more connectivity, interoperability and intelligent analytics of data to drive actionable metrics such as "overall equipment effectiveness" (OEE). This supports the probability that throwing more money at a problem might not be as effective as analyzing what information is needed to get a true idea of the current state of affairs. Such level of insight through connectivity to the shop floor not only makes the business more transparent and minimizes costly impact, it also allows for modeling of data so that manufacturing leaders can predict the cost and the operational results of a decision before putting it on the plant floor.

When humans make a connection, they use a straight-line process—a handshake, a phone call, an email. Usually, this is easily understood and provides immediate feedback. Connectivity in manufacturing is similar in outcome in that information is exchanged about how the plant is operating based on the communication received from the assets. To get to that point of truth, however, requires many other smaller moments of connectivity, all happening in fractions of seconds. For connectivity to work on the plant floor, an agreement needs to be in place at each point of communication.

In today's manufacturing, such communications don't take place in a straight line, but in an intricate matrix. Data analytics have made gathering and contextualizing those communications possible in real time. Moreover, that matrix is getting larger, involving more parts of the organization, more technology, and more room for interpretation. It's called interoperability, and to be a truly interoperable ecosystem in a plant involves three parts: humans, machines and processes.

Creating a truly interoperable system requires a referee of sorts—a way to tie all of these disparate parts together into a network. That's how IIoT really works: It begins with a straight-line communications process, but the power of real connectivity in manufacturing has the potential to do much more.

The success of this effort will require better training, better equipment, better software and a more progressive view of how a plant should operate. When completed, the process can produce more satisfied workers, better morale, lower costs, reduced downtime and higher profits. Nothing has changed in the process except the way data is managed. Yet at the same time, IIoT can change everything.

One example of a company using smart data is valve manufacturer Richards Industries. Using shop-floor management software, Richards achieved a 40% increase in productivity improvements in less than six months, and it continues to create opportunities for radical optimization for more overall global competitiveness. Shop floor workers detect errors during production, and any deviation from the target is corrected to ensure a more efficient and leaner production process.

The interactions of the real and virtual worlds represent a critical aspect of the manufacturing and production process. Whether you call it Industry 4.0, the Fourth Industrial Revolution or the Industrial Internet of Things, technology advances have paved the way for machines not just to produce, but to communicate with other machines. Virtual technology is the backbone of such flexible production founded on the principles of lean management and the interconnection of 'things.' This leads the way to a truly transparent manufacturing environment—in other words, the smart factory.

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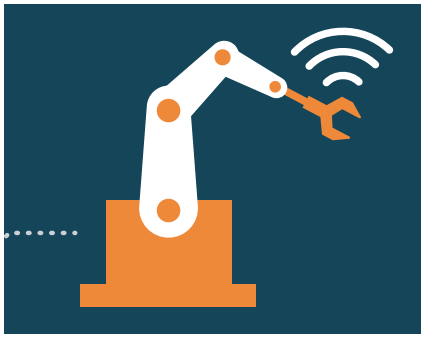

One of the technologies integral to many smart factories is robotics. While people think of industrial robots simply as equipment that accomplishes repetitive tasks, robotics today can do much more than this.

Robots as Solutions to Manufacturing Challenges

BY JOHN TUOHY

Plant managers and CEOs wake up every day facing critical challenges posed by today's manufacturing climate. The modernization of the plant floor combined with continuous efforts to improve efficiencies and control costs is a heavy burden that every industrial business faces. Everyone is wondering who has the answers and what solutions are available to both improve quality and strengthen the bottom line.

In a recent survey of CEOs from top advanced manufacturing companies, the number one concern respondents shared was finding qualified workers who have the required skill sets or experience. The aging workforce is an ongoing concern, and as baby boomers retire, the millennials are not back-filling the technical positions, which has created a serious skills gap that continues to widen. By 2025, there will be an estimated requirement for 3.5 million manufacturing jobs, which is about 2 million short of what labor will be available. Most companies agree the talent shortage influences daily businesses, and we're all asking ourselves: How can we overcome this skills gap?

Meanwhile, other challenges manufacturers face are the rising costs of labor, raw materials, work in progress, how we can better control inventory and how we can assure continuous improvement in our methods. Already facing labor shortages, we must now overpay just to retain employees that may not even be the right fit. Some people believe we are stuck with workers who may lack proper training or don't have their heads in the game. I believe the best way to get unstuck and to overcome labor shortages and meet production goals is to automate.

The standard productivity/efficiency of manually loaded machine tools is 60% or less. With robots, the same machine can achieve efficiency rates that reach 80-95%.

Robotic cells are designed to run continuously. They can perform value-added functions such as pre- and post-process operations including deburring, inspections, marking parts, assembling or packaging. This affords a plant the ability to shift employees from basic, mundane or dangerous tasks to the more engaging tasks within process management. A robot will always load faster for better "chip to chip" time (the period between when a part is finished being machined and the spindle is idle to when the next part is loaded and the spindle is cutting, also known as spindle utilization optimization).

The following examples emphasize these benefits:

A plant manager was recently asked by his executive team to explain the company's production efficiencies and what percentage of that efficiency machine tools provided. The manager, who was an educated, experienced individual with a deep knowledge of his product and how it's made, responded that his machines on the shop floor were 70-90% efficient.

Without any way to verify the response, management was left scratching their heads. They didn't want to invest in more buildings, people or machines without verification. Management decided to collect and evaluate data from their machine tools using machine monitoring software. The eventual goal was to be able to make more chips. The types of information the software could collect and they could evaluate were limitless: They could study torque and harmonics to extend tool life, amperage draw for motor life and temperatures to assure accuracy. To focus on increasing operational efficiency, they concentrated on actual cutting time, loading and unloading time, and secondary processes performed on a part. The results of the investigation were shocking to the whole team.

The plant manager had based his original estimates on machine availability. However, while machines may have been available, when they were loaded up or set up for the next part, the operation was manual. In reality, when the data collected by the software took that into account, it found the machines were operating at only 40-50% and as low as 15% in some cases.

The plant manager was surprised his efficiency numbers were so low and contacted a consulting firm to review his processes. Having zero experience with robots, the plant manager felt disconnected with what should happen in a connected world. He learned that not only could he mine data from his machine tool but robots as well. As he began to realize how much data will drive a business, he implemented robots for machine tending combined with monitoring software for his machine tool. After implementing all this, the company achieved machine utilization of 80-90%, a 40% increase in efficiency.

In another case, a manufacturer was at capacity with an expensive machine tool and needed additional throughput. Management initially considered buying a second machine, but the cost was prohibitive. To free up existing machine time, a robot was added to perform the gauging between loading and unloading cycles. By adding the robot, the manufacturer reduced cycle time from 16 to 12 minutes, opening up 25% more machine tool capacity and allowing more parts to be produced.

These two examples show that, when faced with manufacturing hurdles, analyzing the right data and evaluating it in the right way can lead to options that may not seem obvious at first, including robotics.

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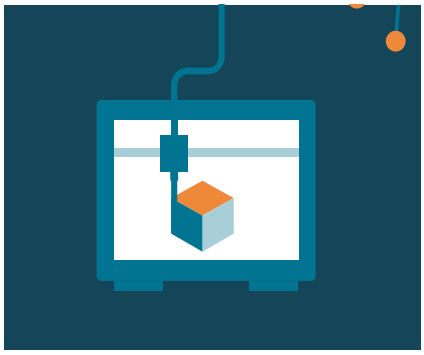
The most important potential advantage of using AM in valve manufacturing is design freedom; it is possible to print any flow path through a valve that an end-user wants. That user can specify the upper and lower limits, which are fed into the software. What's needed is then printed with those specs without having to have new equipment for just that one model or product. What's more, it's possible to do that for every single customer with basically any degree of variation.

One example is a product produced at Bray. (See more about this project at www.valvemagazine.com>web only>"Metal Additive Manufacturing in the Valve Industry.")

In the case referenced, the ball valve had a hole with a shape that had a certain flow rate. However, Bray's customer wanted to know if a different flow rate could be achieved. Rather than creating entirely new tooling and machinery that met the requested flow rate, the specifications were fed into AM to print just that valve with a different shaped hole.

This process is so versatile, it is possible to create 500 or more models or products with just slight variations. The design changes are made with a CAD design tool, then sent to the software, then on to the printer. This capability opens up the potential for manufacturers to do many more bespoke applications for different customer requirements without adding manufacturing costs to the process.

Another benefit of AM is that legacy parts can be reverse-engineered when no drawings or models are available. Also, in the case of a breakdown of a piece of expensive equipment, when the end user needs that equipment quickly, the user does not necessarily need to break into the production line. Just the required part can be printed, then shipped within hours, even to remote locations.



While 3D printing or additive manufacturing (AM), as it is generally known in industrial applications, has been around for 30 years, its value for manufacturing valves and components was not fully explored until recently. While AM has its challenges, its value is quickly becoming obvious to those who are beginning to see the many ways AM can be incorporated into the industry.

Design Freedom through Additive Manufacturing

BY STEPHEN ANDERSON

Collaboration between humans and robots can substantially increase machine time and productivity. Photo: Fanuc

Still, there are drawbacks to AM. The cost of materials plays a role in the process as does the need to allow a cool-down period before removing a part from the printer. The part also has to be removed before the unused powder in the machines can be accessed, which can add time to the process.

One of the most significant drawbacks, though, is that finishing a part that has been 3D-printed can be time-consuming. In this case, robotics may play a significant part in the AM process. The factories of the future, then, should be envisioned with both AM machines and integrated robots.

Still, the vision is exciting. Imagine a situation in which parts would be recovered from the printer automatically by robotic centers that measure the parts. If those measurements turn out to be not quite right, the parts could be passed on by the robot to another robot or directly put into the machine tool where they could be finished with subtractive processing.

These robots would be passing the component from machining station to inspection station to machining station automatically. What's more, all that data coming off the machine tool or the measuring machine or the robot itself would be aggregated into the product management system. There, smart software can make decisions about quality based on gathered data.

This makes it possible to have a full manufacturing line with massive efficiency of scale. We could effectively remove some uncertainty from the equation because humans bring individual variation to processes. Robots can be more consistent, which could translate into better quality.

It certainly won't replace our workforce, but the possibilities for efficiency are far-reaching.

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Conclusion: As valve manufacturing embraces Industry 4.0, it seems inevitable that robotics, additive manufacturing and intelligent use of data will become the norm rather than the exception in the process. Concerns about cybersecurity and potential job losses will have to be addressed, but successful implementation of this new industrial revolution has the potential to exponentially advance the quality of the products and the profitability of manufacturers and end users alike.

Welding is a thermal operation that can induce stresses into components, which then must be relieved by a post-weld heat treatment.

The Magic Behind the Metal

BY GREG JOHNSON

Like the superhero that can leap tall buildings, the valve industry is made of steel.

Actually, while the industry is certainly formidable, its products are made of steel, iron and a host of other metals and alloys, all of which are used to construct valves, actuators, flanges, fittings and pipes used in commercial and industrial piping systems. These materials and parts also get a little help—the components would not be able to do their job of controlling pressure, resisting temperature and fighting corrosion if the metals they are made of weren't made even better by being properly processed to meet the challenges. This is where heat treatment comes in—it's the sidekick that makes our superhero materials more effective.

Aside from some "as-cast" cast irons, the vast majority of metallic valve materials require some form of heat treatment to attain the properties needed to meet their purposes.

Executive Summary

SUBJECT: The metals used in valves and related equipment often are given the properties needed to handle their application challenges through heat treatment.

KEY ISSUES:

- What treatment entails
- What it addresses
- Standards and specifications

TAKE-AWAY: Heat treatment today is a science that has created many advantages for the industrial world.

WHAT IT IS

The process of creating valve castings, forgings and wrought components begins with molten metal. Various compounds and alloys are mixed in a high-temperature vessel and melted, then poured in molds or formed into forging bars and billets and allowed to cool. In the case of carbon steels, scrap steel is usually the base ingredient.

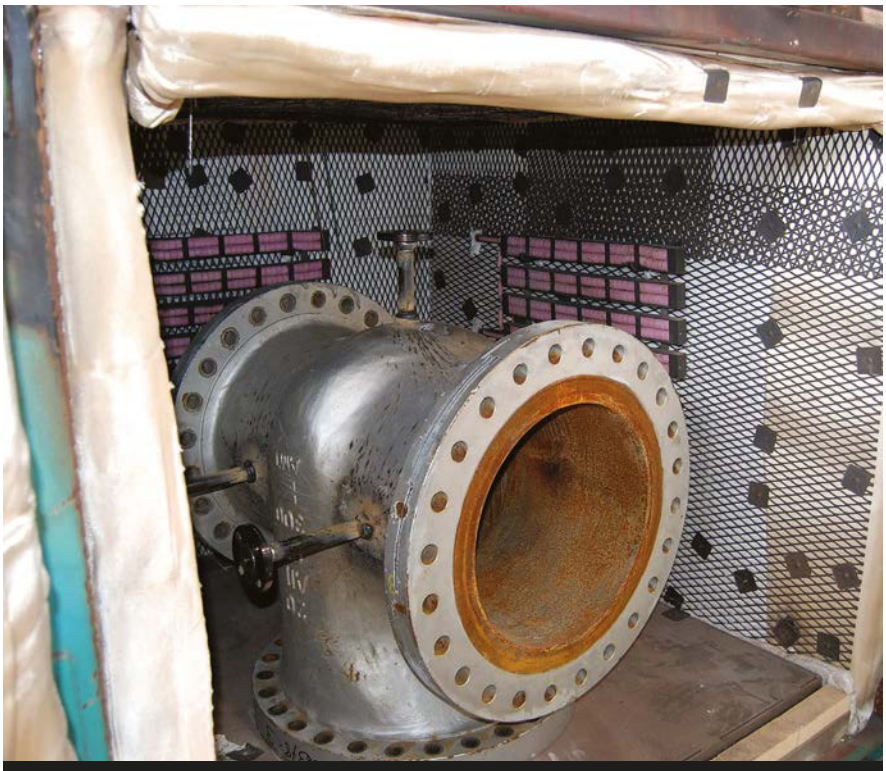
This initial process of thermal creation normally does not yield metals with the most desired mechanical properties. After the initial cooling phase, these metals are "put back in the oven," for a little more cooking to refine their properties. This secondary thermal processing is referred to as heat treatment.

The general definition is: "the controlled heating and/or cooling which is intended to improve certain properties of metals." Some of these treatments will harden and strengthen metals, while others will soften or make metals easier to machine or shape. Still other heat treatments will reduce the residual stresses caused by welding or forming. While most heat treatments are performed at elevated temperatures, some specialized heat treatments are performed at cryogenic temperatures.

A hardness test is performed on a valve body following a heat-treating operation.

The primary mechanical properties affected by heat treatment include hardness, ductility, strength and toughness. These are:

- **Hardness:** A measure of the resistance of a metal to scratching or



A small, electrically powered batch furnace is often used for performing heat treat operations.

indentation. A variety of hardness tests are used to measure this property.

- **Ductility:** The ability of a metal to deform permanently prior to fracture or failure. The elongation or reduction-of-area, tensile-pull-test of a round sample is used to quantify this property.
- **Strength:** When considering most valve components, two essential measures of strength are used: The first is yield strength (YS), which is the measure of strength before a metal permanently deforms. The second is tensile strength or "ultimate tensile strength" (UTS), which is the maximum strength a metal exhibits before failure or permanent deformation.
- **Toughness:** This is a less scientific term, but it combines strength and toughness. Toughness is an extremely important property for metals used at low temperatures. The Charpy Impact Test is one of the methods used to measure a metal's toughness at various temperatures.

CARBON STEELS

Forgings, castings and welding are all processes used to make valves and valve components. Nearly all these processes require some form of heat treatment. Since low-carbon steels (steels with a carbon content of about 0.030% or less, such as WCB and A105) constitute much of total valve population, the correct heat treatment for this material is worth discussion.

Carbon steels are a mixture of iron and carbon. This mixture exists as a microscopic structure of grains visible only under a high-powered microscope. These grains align themselves in different configurations known as "grain structures," such as austenite, ferrite, martensite and bainite. The presence and percentage of each of the grain structures help determine the mechanical properties of steels and their alloys.

These valve bodies have been removed from the furnace following a post-weld heat treatment.

These grain structures can be altered through heat treatment. This means that a steel of a specific chemistry can be heat-treated to yield grades of steel with various levels of strength, ductility or hardness. To alter the grain structure, the steel must be heated to within a very specific temperature range, called the "transformation range," for grain structure changes to occur. Some heat treatment temperatures even exceed the transformation range.

Let's consider the most common valve cast steel in use today, ASTM A216 grade WCB. As cast, even with the correct chemistry, the microstructure of the steel would be so poor that the casting is useless for pressure-containing applications. However, the A216 specification requires the castings be delivered in one of the following heat-treated conditions: 1) annealed, 2) normalized, 3) normalized and tempered, or 4) quench and tempered. Proper heat treatment will convert the as-cast material into a highly useful valve component.

HEAT TREATMENT PROCESSES

Some of the more important heat treatment processes used in valves and the valve industry are annealing, quenching, tempering, normalizing and stress relief. Definitions of some of the different heat treatment processes as given in ASTM A961, Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications are:

- **Annealing:** Material shall be uniformly reheated to a temperature above the transformation range and, after holding for a sufficient time at this temperature, cooled slowly to a temperature below the transformation range.
- **Normalizing:** Material shall be uniformly reheated to a temperature above the transformation range, and subsequently cooled in air, at room temperature. (This is a faster cooling rate than that of annealing.)

- **Quenching and Tempering:** Material shall be fully austenitized and quenched immediately in a suitable liquid medium. The components are then reheated to a minimum temperature of 1100°F (593°C) and allowed to cool in still air.
- **Post-Weld Heat Treatment and Thermal Stress Relief:** Material shall be reheated to the prescribed temperature below the transformation range, held at temperature for at least one hour per inch of thickness and allowed to cool in still air. (The exact time and temperature requirements are listed in various piping standards and construction codes.)
- **Solution Annealing:** Material shall be heated up to a temperature that causes chrome carbides to go into solution and then quenched in water or rapidly cooled by other means to prevent precipitation. (This process is often used with austenitic stainless steels such as 316ss to help maintain the corrosion resistance of the component.)

The austenitic stainless steels, especially the 300 series, usually receive a solution-annealed heat treatment at between 1900°F (1038°C) and 1950°F (1067°C), depending upon the specific alloy. High nickel alloys and "superalloys" also receive a variety of heat treatments with names such as age-hardening, precipitation hardening and others, specific to their chemistry and desired mechanical properties.

410SS AND HEAT TREATMENT

When it comes to valve components, the combination of martensitic stainless steels (410ss) and heat treatment has been and still is, an all-around winner. The air-hardenable, 13% chrome (Cr), 400 series martensitic stainless steels have been the material of choice for linear valve trim for nearly 75 years. The magic of the martensitic stainless steels comes from the heat-treating process, which can provide components harder than cobalt-based Stellite or as soft as plain carbon steel, depending on the chosen heat treatment.

Martensitic stainless-steel stems with a hardness range of 200 to 275 Brinell Hardness Number (BHN) are in more valves in refinery service than any other material. Seat rings or discs of 400 series stainless steel are extremely popular as well. As an aside: Most of the cutlery in your kitchen drawer is probably manufactured out of heat-treated 400 series stainless steel.

HEAT TREATMENT FURNACES

Heat treatment of castings, forgings and many weldments is usually accomplished in ovens or furnaces. These vessels are designed for batch processing and can hold loads ranging from a few pounds to many tons. Heat treatment furnaces must be calibrated to ensure the prescribed hot air temperature is evenly distributed throughout the furnace. The calibrations are called furnace surveys and are a quality requirement of any organization performing heat treatment operations. Modern furnaces may be powered by either electricity or gas, while in the old days, coal or coke-heated furnaces were used.

If a furnace has improper heat distribution from poor heated air-flow design or leaky walls and doors, the

This batch of valve bodies has been heat-treated at the foundry.

heat treatment may not be performed uniformly on all pieces in the furnaces. Also, the parts put into the furnace must be laid out in such a way as to allow free air flow around all the pieces. Failure to meet either of these requirements can yield parts without the proper mechanical properties. To ensure the heat treatment was correctly performed, test bars are usually heat treated with the actual parts batch and then subjected to various non-destructive or destructive testing techniques.

Improper heat treatment of castings has been an issue with some foundries in low-cost manufacturing countries. These improper heat treatments have resulted in a host of metal failures and components with incorrect mechanical properties over the last 25 years. Still, the heat treatment process in these locations has improved significantly in the last several years.

WELDING AND POST-WELD TREATMENT

Welding is a thermal process similar to casting in which metal is melted and deposited on or attached to another workpiece. This melting process, in the best case, can induce great stresses within the microstructure of the weld and heat-affected zone (HAZ—the area adjacent to the weld deposit). At worst, the process changes the microstructure of the HAZ. To alleviate this unwanted stress or change the microstructure of the HAZ back to what it should be, a heat treatment called post-weld heat treatment (PWHT) is performed.

PWHT is important in the valve industry because parts are often welded in the process of valve construction and because some valves are welded to other piping components. The plain low-carbon steels such as A105 and WCB usually do not require PWHT when welding to them, depending upon the thickness of the pieces to be welded.

A common operation in linear valve construction is the welding of seat rings into valve bodies. Depending upon the seat ring base material and valve body thickness, there may be no need for PWHT. However, in some cases, such as welding solid 400 series (martensitic) seat rings into valve bodies, a PWHT is recommended.

Another common operation is the welding of pipe "pups" onto the ends of valves. Pipe pups are short sections of pipe attached to the butt-weld or socket-weld ends of valves to allow them to be welded onto the pipeline itself without the risk of field welding directly onto the valve. Depending upon the pipe and valve material, thickness of the pipe and specific customer requirements, these welds may require a PWHT.

Generally, welds on low-carbon steel, non-pressure containing parts (such as brackets, yokes or actuator attachments) of a valve do not warrant any PWHT.

PWHT AND SOUR GAS

One situation in which PWHT is strongly recommended is when hydrogen sulfide (H_2S) is present in the fluid stream. Although plain low-carbon steels can work fine in this service, large thickness welds should receive a PWHT, depending upon the degree of H_2S exposure. Guidance for the PWHT of welds is contained in National Association of Corrosion Engineers (NACE) international documents MR01-75 and MR01-03. These documents are both now jointly administered and updated by NACE and the International Organization for Standardization (ISO).

For valves in H_2S refinery service that contain 410ss components, added PWHT in the form of an additional tempering heat treatment is required to avoid the creation of hard areas in the weld deposit and HAZ. The requirements for these heat treatments are detailed in NACE MR01-03. The requirements for valves in upstream and midstream H_2S are detailed in NACE MR01-75. They are similar to those in MR01-03.

The default for many valve manufacturers and valve service companies providing valves for H_2S service is to be conservative and PWHT all welds attached to pressure-containing components or in the flow stream on carbon steels. Additionally, 400 series stainless-steel stems should receive an additional tempering heat treatment.

PWHT AND CHROME/MOLY ALLOYS

Chrome/molybdenum (Cr/Mo) alloys are steels designed for use at temperatures and pressures higher than what low carbon steels (such as WCB and A105) are designed to be used. The additions of chrome and molybdenum to the steel improve some of the properties of the steel. If thermal processes such as welding or forming are performed during or after initial manufacturing, additional heat treatment may be required. In general, the higher the chrome content of the low-alloy steel, the more intense of a post-weld heat treatment or stress relief is required.

LOCALIZED PWHT

In addition to furnaces, some heat treatments are performed using localized heat treatment methods. These processes typically use flexible ceramic blankets held together with high-temperature, heat-conducting wire. The blankets can be positioned around local areas requiring PWHT in the field without overheating other areas of the valve or piping.

When properly insulated, these blankets can produce temperatures required to easily PWHT carbon steel, martensitic stainless steel and Cr/Mo weldments. The ability to perform field heat treatment is a boon and a time-saver during processes and power-plant-welded piping fabrication.

STANDARDS AND SPECIFICATIONS

Heat treatment must be performed correctly to achieve desired mechanical properties. To this end, standards and specifications must be followed. For valve and piping parts and components, specific heat treatments are referenced in the base material specification, such as ASTM A216 or A217. However, the exact heat treatment procedure is often left up to the foundry or sub-contracted heat treatment vendor.

When it comes to welding PWHT, several standards can be referenced. For piping in the power industry, the requirements are listed in the American Society of Mechanical Engineers (ASME) B31.1, Power Piping design code. For refinery or chemical plant piping, the requirements are listed in ASME B31.3, Process Piping. The ASME Boiler and Pressure Vessel Code, Section VIII, also lists PWHT requirements that may be applied to valves.

American Petroleum Institute (API) has created a new standard in its Quality Committee 20 for manufacturers that are performing or subcontracting heat-treating services. The document, API 20H, Heat Treatment Services–Batch Type for Equipment Used in the Petroleum and Natural Gas Industry, has extensive quality and procedural requirements for companies performing heat treatment. The 20H document has four heat treatment specification levels that are used to qualify heat treatment operations.

In the 19th century, heat treatment was referred to as an art, with the heat treater or foundryman relying on his experience to add a bit of this and a bit of that to "magically" create the proper metal with the desired properties. Today, heat treatment is a repeatable scientific operation, one that is of critical importance in creating metallic valve components with the proper mechanical properties. Although there is no magic wand or even a red cape involved, the process of heat treatment and the way it works is still pretty amazing. VM

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Electric Actuator Commissioning

BY PAUL SOUZA

Typically, electric actuator commissioning is performed when the actuator is installed at site. This is because, except for basic settings, the OEM cannot perform commissioning nor can it be done at the place of automation. Proper commissioning should include the operating controls so that the entire system is included in the process and of course, the valve manufacturer or automation center typically doesn't have the control system.

Because the installation contractor is the party that often performs the actual commissioning, however, actuator product knowledge is sometimes insufficient, which means the commission is too often performed improperly.

Also, even before the process begins, specification discrepancies, missing components or interfaces, and sometimes poor handling or storage conditions often present problems. Below are some of the installation issues:

- **Mechanical:** The wrong actuator is sometimes installed. For example, the actuator may be open/close when it needs to be modulating or the actuator could be too small with not enough torque. The orientation, footprint or sizing could be wrong. Fasteners could be loose, or brackets could be damaged or incorrect.

  When actuators are not stored correctly, the equipment can be damaged before commissioning even begins.
- **Electrical:** The wrong wiring diagram could have been used, or not enough wires were pulled. Wiring could also be terminated on incorrect terminals. Additional issues can occur onsite from loose or broken electrical connections. Conduit or cable connections could become loose or damaged.

Another consideration in the commissioning process is:

Commissioning is often performed by the company that installs the equipment.

- **Device torques:** It's important to be aware of the torques required to operate the device because torque impacts proper commissioning. Also, when process media is influencing the driven device, the unseating or seating torque and the dynamic torque can change during actual operation in the field.

WHERE TO BEGIN

Typically, the sequence for commissioning is:

1. Set or verify mechanical stops. Note that varying valve types may require different starting positions. For example, butterfly and ball valves will have different critical end positions.
2. Set position switches.
3. Calibrate additional items such as the feedback loop, positioner, auxiliary position switches or fieldbus address, if included in the actuator.

End position settings for mechanical purposes

On part-turn/quarter-turn valves, the mechanical stops are usually set by the valve manufacturer. This is easy because the moving device is visible. Usually, some type of closure or leak test is performed.

In the field, setting the stops is generally not needed. However, if the valve is installed and a leak is verified, the mechanical stops may need adjusting:

First, the valve is checked to see if the hand wheel will close it. If it does, the stops are most likely set correctly. Simply resetting the limit switches should take care of any issue. If a fully closed valve cannot be achieved through the handwheel, adjusting the mechanical stop is usually required.

Typically, two types of mechanical stops are addressed: stop bolts in the gearbox housing, which can be one or two bolts, and traveling stops on the worm shaft of the gearbox.

Depending upon the manufacturer, setting the mechanical stops with external stop bolts is done by loosening the lock nut on the side requiring adjustment; turning the stop adjustment screw, and turning that screw in or out for more or less travel (the swing angle).

Be aware that, if the stop bolt has been turned out beyond the settable position and the valve still can't be placed into the required position, it may be necessary to lift the gear up to allow repositioning of the gear box on the valve. Open and closed settings are similar so be aware the segment should not be forced into the gear box housing because damage can occur

(Figure 1).

Setting the closed mechanical stops when dealing with traveling-nut-style stops also depends on the manufacturer. Generally, fasteners are loosened on the stop housing, the valve is moved to the closed position, and the stop housing is rotated clockwise until it stops. Then, fasteners on the stop housing are reinstalled and tightened.

For mechanical end position settings on part-turn butterfly valves, the closed position may be influenced by the seat material or design. The types involved include:

- Rubber, polymer or other "soft" material seats
- Hard metallic seats

For the softer seats, the actuator will put the valve disk into the seat for tight shutoff, stopping on the position (the limit). Butterfly valves with metal seats are typically driven into the sealed position at a specific torque value or torque seating. Regardless of type, the mechanical stop must allow the actuator to drive the disc to the closed position.

☐ Figure 1. Stop travel is okay (left); no further adjustment is possible (right).

For butterfly valves, the open position is usually set at 90 degrees from the closed position. The mechanical stop must allow the actuator to drive the disc to the full open, 90-degree position.

For ball valves, the open position is generally more critical so the ball must be positioned as close to "full open" as possible.

Usually, a mark is placed on the valve by the valve manufacturer showing the centered position for the ball.

The ball valve is usually operated as a stop-on position (the limit). Regardless of gear type, the mechanical stop must allow the actuator to also drive the ball to the closed position so travel may be greater than 90 degrees from the full-open to closed position.

For end position mechanical settings for most linear valves, the "mechanical stop" for the closed position is the actual seat of the valve. As with butterfly valves, this may be soft or hard. The valve manufacturer can verify the type of seating, position or torque.

The mechanical stop for the open position of a linear valve could be the end of thread on the valve stem or the back seat of the valve. Note that this may actually be beyond the actual open position.

For example, a 12-inch gate valve may have 14 inches of stem travel. This extra travel could come into play during calibration or linearity of feedback devices.

End position settings for electrical

Typically, the most critical position is the first to be set. For butterfly valves, this might be the closed position. For ball valves, it might be the open position.

When setting the end positions, the actuator should be placed in manual handwheel mode. The new setting position should be approached as the motor is approached so the position allows for possible mechanical backlash.

The manufacturer's recommended setting procedure should be followed for the type of actuator involved. The setting can be made by a screwdriver or similar tool or via a non-intrusive method.

OTHER ISSUES

Issues that may influence the end-position settings include:

- **Seating:** Is the valve to be torque or position seated? Even if the valve is torque seated, the end position limit may still need to be set.

  Setting the end position limit prior to the torque trip position has several purposes: 1) It indicates to the controls that the valve is in the closed position area and a torque trip can be expected, and 2) it may be used for remote light indication for the closed position.
- **Coasting:** This is the time from which the reversing device (motor starters) drops out (disconnects power to the motor) to the time the motor/gearing physically stops rotating from the inertia of the motor rotor. It may be necessary to set the limit ahead of the actual end position to allow for the coast.
- **Excessive torque:** Sometimes the actuator torque might not be sufficient to get to the end position because of an unknown valve or installation issue. In this case, suppliers should be consulted.

TORQUE SETTING

The electrical torque switch settings typically can be set at any time.

A caution is needed here: The torque switches should not be set without the consent of the valve manufacturer or the automation center that mounted the actuator to the valve.

Note that changing the actuator output torque setting can damage the mounting assembly between the actuator and the valve or the valve itself.

CONTROLS SETTING

When the actuator manufacturer supplies the controls, those controls can vary from very basic push buttons and starters to fieldbus-enabled, microprocessor-based motor controls. Some of the settings most often requiring calibration, regardless of type, are:

- Torque seating or position seating and whether they are in the open or closed position
- Push-to-run or maintained control in both local and remote cases (open plus closed)
- Position feedback of 4-20mA (output)
- 4-20mA remote positioner operation (input)
- Intermediate position switch or relay

With microprocessor-based motor controls, many of the "calibration" steps required by conventional controls are performed automatically depending on end-position settings. This makes commissioning easier but also introduces many new items that may need attention, such as the actuator or valve's identification tag, digital relay output programming, digital input programming, local light programming (on or off in mid-travel; green or red for closed or open position), intermediate positions, timer functions and torque warnings.

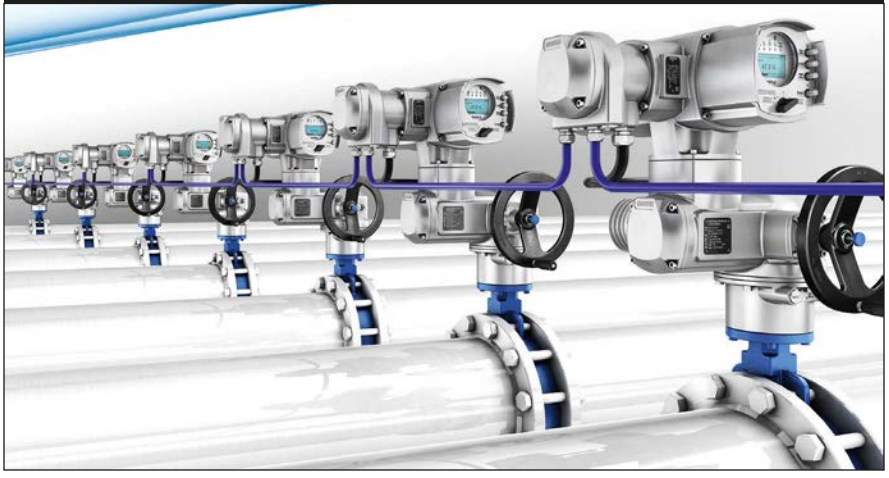
Microprocessor-based motor controls introduce a time stamp data log. This extremely useful tool can be used for reviewing many of the issues within the actuator and often the remote interface. Unfortunately, an often-overlooked setting is the internal clock of the microprocessor-based actuator. This should be set for the local time at the place of installation.

CONCLUSION

Commissioning required at the site can be done by most technicians familiar with the site requirements, and the actuators involved. Reading the actuator manufacturer's operating instructions and programming manual is always recommended and often required.

Unless specifically called for in the engineering specification, commissioning is not typically in the scope of what an actuator manufacturer supplies. However, most actuator manufacturers and their regional distributors or representatives offer some commissioning services, and there is also phone or web-based help available from major actuator manufacturers. VM

☐ Actuator device addresses, data transfer bits, etc., are typically set by the systems integrator.



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Evolution of Butterfly Valves on Aircraft Carriers

BY MARK PETERSEN-OVERTON

Butterfly valves are an integral part of keeping an aircraft carrier's firemain system operating smoothly. But they've been modified and improved greatly from the early days of their use.

THE FIREMAIN SYSTEM

The firemain systems aboard carriers distribute pressurized seawater for firefighting, cooling and washdown services. The firefighting services aboard these ships include fire hose stations, foam stations and fire protection service for compartments that store flammable material. Foam stations inject a mixture of foam and seawater, which is distributed to areas where risk of flammable liquid spills or fire exists such as the hangar bay, flight deck, machinery room and aviation fuel pump room bilges.

The firemain is one of the most mission-critical fluid distribution systems aboard any naval combatant. It provides a cooling medium for key equipment including jet blast deflectors—the safety devices on jet planes that redirect the high energy exhaust. The main also provides chemical, biological and radiological washdown countermeasures as well as water for cooling down auxiliary machinery, eductors (pumps), ship stabilization equipment and flushing for urinals and commodes.

Because it is so critical to the entire ship's water flow, the isolation valves in firemains are designed not only to enable routine maintenance, but more importantly, to continue support for the ship and its crew after a system incurs battle damage.

I remember in the early 1990s when I was serving as the chief engineer of the USS Nimitz (CVN-68), my team pointed out an old-style butterfly valve that would not cycle. After many attempts, it was leaking saltwater in one of the main passageways on the carrier. When I visited the location of the valve, I saw the handle broken off completely. My guess is that my team had used a "cheater bar" to maximize torque on the valve in a vain attempt to cycle it. Because of the potential impact to operations from this one, non-functioning valve, we had to attempt maintenance action only while the ship was berthed in port. Our team made plans to tag out additional butterfly valves up- and downstream to isolate, then remove and replace the bad valve.

The ship eventually moored in Bremerton, WA, where the team attempted the repair. Hours passed, and the supervisor of the repair effort reported they had already closed and tagged out three or four valves up- and downstream of the broken

Figure 1. Rubber-seated butterfly valve

Figure 2. High-performance double-offset butterfly valve

PHOTOS: EMERSON

Figure 3. Navy-qualified triple offset valve

valve without a decrease in pressure. I received the ship captain's permission to shut down shore-supplied firemain water. Once the system was drained (several hours later), the repair could be completed. We found out the valve would not cycle because it was packed with mussels, barnacles and other debris as well as pieces of seat material from other butterfly valves.

At the time, I wondered why we had such ineffective valves on such a critical system—the firemain's job is to launch the aircraft.

The type of butterfly valve aboard the Nimitz at the time was a rubber-seated butterfly valve (Figure 1). As the valve was cycled, the valve disc was always in contact with the seating surface, an action described as a "zero offset butterfly valve." Since the seating material was always rubbing against the disc with each cycle, erosion of the seating surface was common. Combine that with the high density of calcareous sea life resisting the valve's movement and damaging the seat and it's easy to see why these valves failed often. Considering the fact the double offset valve military specification for shipboard butterfly valves was issued in 1983, it's surprising the Nimitz still had these older valves aboard. New construction carriers most probably were already being outfitted with improved butterfly valves and in-service carriers were scheduled to be upgraded going forward.

The Navy's 1983 defined military specification (MIL-V-24624) for shipboard butterfly valves represented a major improvement over the zero offset butterfly valve. The specification required the double offset feature (Figure 2). Generally, the first offset is achieved by locating the shafts downstream of the centerline of the seat. This allows a totally unobstructed 360-degree sealing surface. The second offset locates the shafts off-center of the vertical axis of the seat. The combination of these two offsets creates a camming effect as the disc swings into and out of the seat.

The disc lifts quickly out of the seat in the first few degrees of travel and does not contact the seat again until it is nearly closed. No wear points exist between the seat and disc.

The double offset valve enjoys reduced operating torques and a substantially extended seat life. This valve has become widely known as

a high-performance butterfly valve and is in great demand even today on almost all surface combatants, including aircraft carriers. However, despite its benefits, this valve often requires piping modifications because it uses gasket material on both sides, and it sometimes does not fit into the space remaining when a resilient or rubber-seated butterfly valve is being replaced. Industry stepped up to address that issue with the next upgrade of this valve.

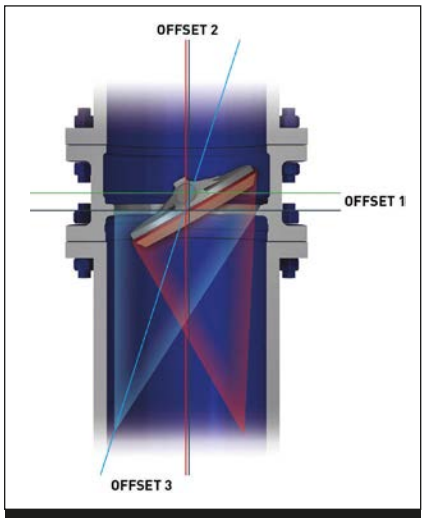

Figure 4. Design concept for a triple-offset valve


Figure 5. Erosion/corrosion of the seat

This next improvement was the triple offset torque-seated valve (TOTS), which has a metal-to-metal seat and a quarter-turn, non-rubbing rotation (Figures 3 and 4).

Torque seating means that the seating force is generated by externally applied torque rather than by mechanical interference. Cone-to-cone sealing occurs by contact pressure and not by friction generated by the rubbing between the valve disc and seat.

The TOTS valve also has the double offset features of the MIL-V-24624 valve, but a third offset was created. This third offset is where the seat and seal cone centerlines are inclined with respect to the pipe/valve centerline. This offset eliminates rubbing completely, yet still results in zero leakage. These features result in longer life expectancy, minimum maintenance requirements, and a lower cost of ownership compared to traditional gate, butterfly and other valve designs. In addition, because there is no requirement for gaskets, the TOTS will usually fit perfectly into the space vacated by an older-style butterfly valve.

In 2003, the aircraft carrier program manager approved a ship alteration and specifically declared that the purpose of that alteration was to replace 20 existing butterfly valves with TOTS butterfly valves in key locations throughout the firemain system. These valves were intended to replace major isolation branches *only* (not this author's emphasis). TOTS valves are generally more expensive to manufacture so it made sense to ensure the most important points of isolation for a firemain system, which has miles of piping across the ship, should have the most efficient and functional isolation valves. TOTS valves are the "Cadillac" of butterfly valves, and they function extremely well in the harshest of environments. Still, industry continued to improve on this Cadillac.

The most modern and even-more resilient butterfly valve is an interesting and unique version that addresses one of the slight weaknesses in nickel-aluminum-bronze valves—the erosion/corrosion of the seat. (Figure 5 shows evidence of this on a TOTS seat).

The next generation of TOTS has a reinforced or hardened seat. This is accomplished by using cold spray technology, which takes small particles in the solid state of Inconel 624 and accelerates them to over 3,000 feet per second. The result is a coating on the base material. This generation of TOTS has a half-millimeter thickness of material that provides a substantial increase in hardness and is more than a 2000% improvement in resistance to erosion/corrosion. At this rate, it would take hundreds of years to wear away the cold spray covering (excluding foreign object seat damage).

CONCLUSION

Every U.S. Navy combatant ship depends on a good system of isolation for both maintenance and casualty control. Imagine if that bad valve on the Nimitz had failed catastrophically. With an inability to isolate that system (since several valves both upstream and downstream were not holding), it would have been challenging to stop the flooding. The only way may have been to eliminate firemain pressure almost completely for most, if not all the ship. If that had happened while our ship was deployed, the impact would have been extensive: flooded spaces, loss of use of a few catapults, loss of cooling for nearly all auxiliary systems. The list could go on and on. It probably would not have been a mission kill because the depth of talent and training of the crew in casualty control would have enabled them to correct the problem and restore the firemain. However, for a brief time, it would have degraded the readiness of one of the nation's most important assets.

Because of how critical butterfly valve performance is to the fleet, the U.S. Navy has pushed industry to continue to improve on these valves. Thankfully, industry has responded, with today's top performer the triple offset torque-seated (hardened seat) variant—the finest high-performance butterfly valve in the world. VM

Mark Petersen-Overton is a retired captain from the U.S. Navy, who is currently vice president of operations for ESI Acquisition Corp. doing business as JA Moody. Reach him at MPetersen-Overton@jamoody.com.

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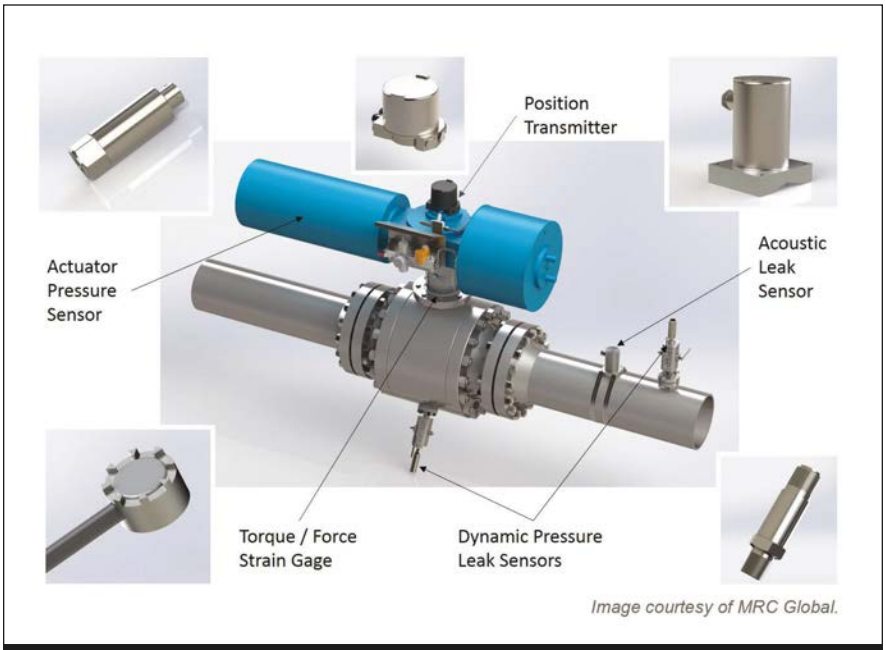
The Latest from ISA, ASME, API and MSS

At the recent Valve Industry Knowledge Forum, Stan Hale, senior director of Supply Chain, MRC Global, reported on the status of International Society of Automation's (ISA) TR96.05.01, and Carlos Davila, PE, product manager—Americas for Crane ChemPharma & Energy, gave updates on several standards from the American Society of Mechanical Engineers (ASME), American Petroleum Institute (API) and Manufacturer Standardization Society (MSS). Here are condensed reports based on their presentations.



Level 4 valve performance instrumentation

PARTIAL STROKE TESTING

By Stan Hale

ISA's working group responsible for ISA Technical Report (TR) 96.05.01, Partial Stroke Testing of Automated Valves, completed an update to the technical guidance provided in the original TR issued in 2008. The 2017 update is the result of a lengthy process that included industry-balanced input from end users, valve and actuator OEMs, process safety engineers, valve maintenance providers, engineering service companies and several consultants.

Much of the 2008 discussion of methods used to move or control a valve during a partial stroke test (PST) remains intact, and the industry has seen many products emerge since 2008 that ensure automated valves can be safely controlled as needed to facilitate a PST. The 2017 update introduces new PST concepts related to collection and analysis of data not included in the original 2008 version.

The most important new addition is the concept of margin. Margin is the difference between the torque or force required to move a valve to its intended position and the torque or force available from the actuator to make that happen. As long as actuator output capability remains greater than the torque or force required to operate the valve, the actuator will move the valve to its intended position. OEMs and automation suppliers ensure adequate margin is designed into new valves by applying safety factors during the automation engineering process.

However, practically all valve and automation OEMs list disclaimers at the end of their sizing worksheets that warn end users the calculated results are for new valves in clean service and the end user is responsible for specifying safety factors or adjustments needed to account for application specific margin degradation that occurs over time. Consistent with that valve OEM guidance and the margin discussion, the working group recognized "loss of margin" is a common failure mode that remains hidden during any testing process that does not employ measurements capable of indicating margin status.

After considerable debate, it became obvious the various PST implementations are not equal. Many end users do not make physical measurements during a PST, while others have implemented increasing levels of monitoring and analysis. This led to identification of four basic implementation levels or approaches to PST as defined below:

- **Level 1**–Partial stroke test without instrumentation
- **Level 2**–Partial stroke test with event timing
- **Level 3**–Partial stroke test with actuator-based instrumentation (e.g., control signal, pressure and position feedback)
- **Level 4**–Partial stroke test with external condition monitoring system that includes Level 3 parameters and incorporates process system and valve-based measurements (e.g., torque/thrust and acoustic leak detection)

The analyses conducted as the 2017 update was developed revealed proof test coverage increases significantly with each increasing level of implementation. During a Level 1 test, the valve is simply moved to an intermediate position and returned. Level 2 is often a feature of plant systems designed to automate the PST process that enables the user to trend the time required for the valve to travel between two known posi-

tions and detect changes that may indicate margin degradation.

A Level 3 approach is a built-in feature of certain valve controllers (e.g., position transmitters and positioners). The user looks for changes in the relationship between pressure and position supplied by the actuator instrumentation to assess changes in performance that indicate margin degradation.

Level 4 includes sensors and data acquisition devices installed on the valve and actuator but kept separate from the control system. This often includes torque or thrust gauges, pressure transducers, position transmitters and acoustic devices to detect leakage or flow when the valve is closed.

The working group also identified 48 different categories of failure causes and ranked them to understand which ones occur most often and which implementation level will be effective at detecting each. Guidance contained in the new technical report recommends end users perform a similar analysis and use either statistical data or a similar expert panel process to identify and rank the causes of failure for valves at their facilities.

After lengthy deliberation and analysis, the working group participants concluded performance measurements must be made during execution of the PST to make the process meaningful and provide the information on valve operability needed to properly support safety objectives. The working group remains active and plans to continue improving PST guidance as new data, experience or know-how emerges.

ISA-TR96.05.01-2017 is currently available online at www.isa.org/findstandards. Readers interested in participating in the current or future work of ISA's valve and actuator standards committees and working groups should contact Eliana Brazda (ebrazda@isa.org) or the chairman of S96, Vince Mezzano, Fluor Fellow and control systems engineering lead at Marathon Petroleum Company Program (vince.mezzano@fluor.com).

Stan Hale can be reached at stan.hale@mrcglobal.com.

UPDATE ON ASME, API AND MSS STANDARDS

By Carlos Davila

ASME Standards B16.34 is the main standard for valves. A new edition was published in 2017 that has a three-year revision cycle in conjunction with ASME B16.5 and B16.47 (which cover flanges).

In the last revision, Paragraph 6.1.2 was approved. The proposal was to revise 6.1.2c and delete sub clause (1) and (2), which were revised in 2009. This caused some manufacturers of three-piece ball valves to substantially increase the wall thickness of the center body, resulting in additional weight for larger valves. After extensive discussion, a compromise was reached to approve both options.

The revisions also extended the scope of flanged and weld-end valve sizes from NPS 24 to NPS 60 to match B16.47 flanges.

A major review of needed material and pressure/temperature ratings corrections was conducted and included in the new edition.

The 2017 edition also allows use of ASTM International Editions other than those referenced in the standard (and with stated guidance and conformance). International Organization for Standards and MSS documents are referenced as guidance for construction of cryogenic bonnet valve extensions.

As far as B16 cases under B16.34, a case to use increased ceiling pressures for materials with high creep strength, F91, F92 and C12A, has been approved. Also, a B16 case, which adds unlisted materials not currently in B16.34, was approved by the board. This is more of an approval procedure than a case; it must be supplemented with actual material strength data and requires approval by B16 SC-N.

API

Several API standards are being revised or have just been issued recently including:

API 599, Metal Plug Valves–2013 (7th Edition)

A task force has been formed and is working to update to the next edition. The expiration was extended to 2020.

Proposed changes include increasing the size range from NPS 24 to NPS 36 and incorporating lift plug valves into the scope. The task force is also adding a requirement to comply with API 641, Fugitive Emission Testing. The first ballot for the next edition has been sent to the committee, and many comments were received. The task force will review the comments and prepare the next draft for balloting.

API 608, Ball Valves–2012 (5th Edition)

The task force is working to update the next edition. The expiration has been extended to 2019.

A section is being added to note double piston effect seats are outside the scope. An option for parallel threads for plugs is being added, and the task force also aims to address direct mounting of actuators.

A revision is being made to specify API-qualified packing must be used, and compliance with API 641 is under consideration.

API 621, Valve Reconditioning–2010 (3rd edition)

This standard was set to expire in 2017 so the current edition was reaffirmed, but the task force continues to work through the many issues and will prepare a draft for balloting. The main point is whether the standard requires a refurbished valve to be better than the original valve for fugitive emissions.

API 622, Type Testing Valve Packings–2011 (2nd Edition)

The last draft received no negative comments and has now moved to publication. The one-eighth packing test is included: The leak rate was 500 ppm and now is 100 ppm. The revision also changed the high-temperature corrosion test; no packing adjustments are allowed during the test.

API 623, Globe Valves–2013 (1st Edition)

The task force is working through

CONTINUED ON PAGE 48

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For information on joining the Valve Manufacturers Association, contact Bill Sandler at 202.331.8105 (wsandler@vma.org).

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For more information on joining the Valve Repair Council, contact Marc Pasternak at 202.331.0104 (mpasternak@vma.org).

Mueller Water Products expanded the 350psi, American Waterworks UL/FM-rated resilient wedge gate valve product line with new end design that conforms to the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) dimensional requirements for Class 250/300 valves. Specifically, the flange and lay length (end-to-end) of the new product line complies with ASME/ANSI B16.1, B16.42, B16.10 and PN25 drilling standards.

Typical applications include mechanical rooms of high-rise buildings, pump stations, reservoirs and water processing facilities that operate at higher pressures.

Harold Beck & Sons will release the Group 57 quarter-turn rotary electric valve actuator this summer. The Group 57 maintains all traditional Beck actuator features, but adds new ones often required in hazardous environments and remote locations typical of oil and gas wellhead and pipeline valves.

Features of the Group 57 include no burn-out motor; positioning accuracy to 0.1 degree; the ability to run on 12-48 Vdc or 120 Vac power; Class I, Division 1, Groups B, C & D hazardous location ratings; built-in electric fail-safe capability; and more.

Metso announced a new version of its Expertune PlantTriage control loop monitoring software. The newest version improves process plant operational efficiency, reduces cybersecurity risks and helps to improve profitability.

This version provides a clearer view of proportional-integral-derivative tuning benefits via a new performance evaluation dashboard and a performance summary panel. These features show the effect new tuning parameters will have on valve duty, relative response time, robustness and performance.

The latest version also includes advances in cybersecurity: Users can now encrypt communications with PlantTriage servers.

Victaulic's FireLock IGS Style V9 Sprinkler Coupling and line of FireLock IGS grooved sprinklers provide the fire industry's first installation-ready sprinkler that is UL-listed and FM-approved. Created to replace threads on both outlets and sprinklers, this mechanical connection redefines sprinkler system design and installation in exposed applications, particularly the storage and warehouse market. The coupling has one-bolt, is captured onto sprinklers with a connection size of half-inch, three-quarter-inch or 1-inch, and transitions to 1-inch allowing for the standardization of 1-inch IGS outlets.

Curtiss-Wright announced its Farris Engineering business unit has received ASME Code Section VIII certification for the 3800L series pilot-operated pressure relief valves with modulating pilot controls (PCM) for use in air, gas and vapor service. Previously, the 3800L was only certified for liquid service.

The addition of air, gas and vapor certification allows PCM control to be ASME Code-stamped for use in both compressible and non-compressible services. This provides an attractive option in applications that can experience two-phase flow.

AUMA launched explosion-proof variable speed valve actuators for use in potentially hazardous environments. The new SAVEx actuators for open-close duty and SARVEx multi-turn actuators for modulating duty, combined with intelligent ACVEx actuator controls, provide full control of the motor speed at any time.

In oil and gas applications, variable speed offers significant advantages for challenging valve control tasks, since it allows the optimum operating speed to be selected for each change of valve position.

Conval is offering lower-pressure Clampseal N- and NPT-stamp bellows seal valves for demanding toxic, corrosive, caustic applications and regulations of severe service process control where leakage to the environment is not an option.

The new Clampseal bellows seal valves feature low weight and seismic profile; leak-proof integrity; in-line servicing; high-cycle bellows; high-flow capacity; and no fugitive emissions. The valves are available in half-inch through 4-inch sizes, for ASME Class 150-900 pressure classes, with socket weld, butt weld, flange and threaded end connections. VM

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Questions about VMA? Contact VMA President Bill Sandler (wsandler@vma.org).
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STANDARDS CONTINUED FROM P. 43

issues for the next edition. Among them is a question of whether disc guiding is required for all globe valves with no valve to be stem-guided only. Also, glands and gland flanges must be at least as corrosion resistant as the body. Wall thickness is to follow B16.34, Table 3 for Group 3 alloy valves.

A ballot was issued to the committee. Many comments were received, and the task force is working on developing the next draft for balloting.

API 624, Type Testing Rising Stem Valves for Fugitive Emissions

The task force is working toward the next edition. The scope of the standard is to increase to 42 inches. Additional valve sizes will require testing.

Leakage from the body joint will be considered a failure and full retesting is being considered for valve design changes when packing is changed from a previous qualified type, when spacers are added, or when material is changed in the packing chamber or the number of sealing rings changes.

MSS

Among standards under development are:

SP-44, Steel Pipeline Flanges was published in 2016. However, dimensional errors were discovered and an errata sheet published. The standard was reissued in 2017.

SP-155, 2018. A new SP was developed and published covering plastic-lined, ferrous metal valves.

SP-55, 2011. Visual Qualification for Steel Castings is being expanded to include iron castings.

A new SP for Large Diameter Slip-On and Lap-Joint Flanges is being evaluated.

Additionally, SP-134, Valves for Cryogenic Service and SP-144, Pressure Seal Bonnet Valves are under revision for their next editions.

In August 2017, Carlos Davila wrote an article for VALVE Magazine called "An Update on U.S. Valve-Related Standards" that gave a fuller version of standards changes made up to that point. Go to www.valvemagazine.com.

Carlos Davila can be reached at CDavila@CraneCPE.com.

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37	ASCO	www.asco.com/spoolvalves
11	AUMA	www.auma-usa.com
15	Babbitt Chainwheels	www.babbitt.com
19	Champion Valves	www.wafercheck.com
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5	GE Baker Hughes	www.geoilandgas.com/distributed-gas/production/rotary-control-valves
17	Highland Foundry	www.highlandfoundry.com
29	Manufacturers Standardization Society	www.msshq.org
13	Metso	www.metso.com/valves
C2	Powell Valves	www.powellvalves.com
35	PowerGen	www.power-gen.com
1	Rotork Controls	www.rotork.com
39	Scientific Linings & Coatings	www.weathercap.com
21	Solon Manufacturing Company	www.solonmfg.com
C3	United Valve	www.unitedvalve.com
31	Valve Accessories & Controls	www.vacaccessories.com
22	Valve Basics Seminars & Exhibits	www.vma.org/ValveBasics
41	Valve Ed Custom Training	www.vma.org/CustomTraining
33	Valve World	www.valveworldexpo.com
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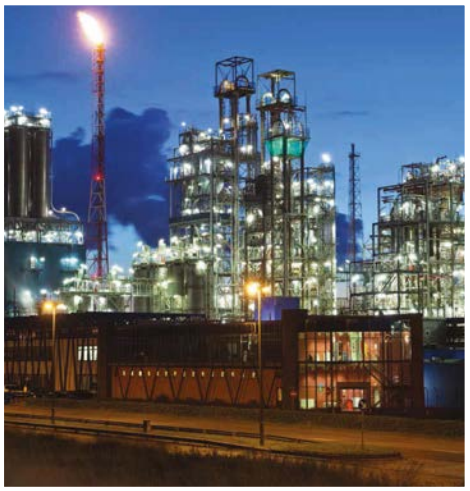

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