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COVER STORY:

PULSAFEEDER:

Practical Innovations and
Multiple Options for Industrial
Wastewater Treatment

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Special Topic: Water & Wastewater

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Pulsafeeder: Practical Innovations and Mul

Pulsafeeder patented the Hydraulically Actuated Diaphragm (H.A.D.) metering pump in 1942, and the company has continued to innovate its pumps ever since. Today, Pulsafeeder makes diaphragm pumps and rotary gear pumps for chemical feed applications, and for water & wastewater treatment applications in power plants, refineries, chemical plants and municipal treatment facilities around the globe.

By Axel Bokiba, Vice President of Product Management & Business Line Director, Pulsafeeder

Water treatment for power generation

More than 90% of electricity generated globally comes from thermoelectric (coal, nuclear or natural gas) power plants. These plants boil water by burning a fossil fuel (or through a nuclear reaction) to create steam that spins turbines. The steam has to be cooled back into water before it can be reused to produce more electricity. Colder and cleaner water cools steam more effectively and allows for more efficient electricity generation.

Legacy coal-fired plants, relying on once-through cooling processes need about 30,000 gallons of water for every megawatt of electricity produced, and nuclear plants need even more water. Modern Natural Gas Combined Cycle (NGCC) plants can produce the same megawatt of electricity with just 5% as much water (which is still about 1,500 gallons per megawatt). Regardless of plant type, a tremendous volume of water is needed to produce electricity.

Pulsafeeder's **Eclipse Rotary Gear** pumps are used by many of the world's largest power plants to treat incoming plant water, as there's a direct correlation between the quality of the water and the efficiency of the plant. The specific applications where Eclipse pumps are used in power plants include:



Eclipse Pumps can be used for transfer and metering applications.



Incoming water can vary due to storms or man-made interventions. It must be

- **Disinfection** – is accomplished by precisely dosing sodium hypochlorite (bleach). When sodium hypochlorite comes in contact with bacteria, it oxidizes molecules in the cells of the germs and kills them. Even though this simple but harsh chemical has been used for more than a hundred years, it is prone to causing problems for pumps by “off-gassing.” Rotary gear pumps are available in a “HypoPump” configuration that is specifically designed to address this issue, as it can pass the gas bubbles through the pump head, minimizing the likelihood of loss-of-prime due to off-gassing.
- **pH adjustment** – power plants operate best when the pH of the cooling water is neutral (pH-7). Specific volumes of acids and caustics are dosed to lower or raise water pH.
- **Corrosion inhibitors** – are used to avoid scaling that could damage or impede boiler performance.
- **Flocculation basins** – are used to dose chemicals that aggregate precipitated particles into larger groups that are easier to filter out.
- **Additional disinfection** – and pH adjustment processes are typically rendered by the plant's wastewater facility before water is discharged back into the environment.

Multiple Options for Industrial Water Treatment



cleaned before it can be used.

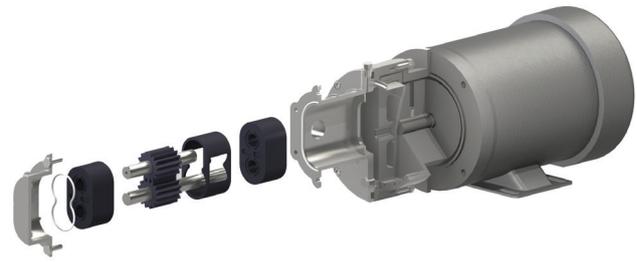
Pulsafeeder's Eclipse pumps can handle a wide range of flow rates, connection sizes, fluid viscosities and temperatures at differential pressures up to 150 PSI and a MAWP of 200 PSI. Available in PVDF or 316-SS, Eclipse pumps provide corrosion resistance against a wide range of acids, caustics, polymers, flocculants, resins and solvents & scale inhibitors that are needed for the various treatment processes in industrial plants.

The sealless, magnetically driven gear pumps are also well suited for **transfer applications**. The sealless design prevents leaks, which keeps harsh chemicals from damaging plant equipment and personnel.

Safety is always a priority for industrial plant workers, because many of the chemicals used in plants can cause respiratory issues if inhaled.

With just a few moving parts, Eclipse's patented front pull-out design is reliable and easy to maintain. Easy access to the inner workings enables maintenance in place with just one tool. This reduces downtime and eliminates the need to move the equipment to a repair shop (which in some plants can require separate personnel). Pulsafeeder's KOPkits (**K**ee**P**-**o**n-**P**ump**i**ng) provide all the spare parts required to further simplify maintenance and return the pump to as-new condition.

When used as a metering pump for water treatment



Access to the pump's inner workings simplifies maintenance.

applications, Eclipse can provide +/- 2% metering accuracy, and accuracies of 1%, or better, are achievable with a closed loop control system. This level of control is within the range needed for pH and disinfection applications at power plants.

Other types of industrial plants – such as refineries – may require greater dosing accuracy for process metering or for water treatment applications. Pumping equipment for refineries and petro-chemical plants must be API-675 compliant. For these environments, Pulsafeeder's **PulsaPro** hydraulically actuated diaphragm metering pumps are the preferred choice.

Water treatment at refineries

Pulsafeeder's API-675 reciprocating metering pumps are heavily used by refineries in North America and throughout the Middle East.

Oil & gas both contain hydrocarbons that must be refined by removing hydrogen molecules to make feedstocks. The feedstock is needed for fuels, base chemicals, plastics and thousands of other chemical products used every day. The refining process is heat-intensive: 50,000 barrels of oil refined generates almost 1 trillion BTUs per hour. Most of this heat is removed



Refineries use metering pumps for process metering, and also for water treatment & recycling in cooling towers.



by water in cooling towers. As a result, refineries are amongst the biggest water users on the planet, requiring tens-of-thousands of gallons per minute to operate.

As cooling towers transfer heat from evaporating water to ambient air, dissolved solids like calcium, magnesium, chloride and silica remain in the cooling tower. Over time, the concentration of solids increases to a point where it diminishes thermal efficiency and causes corrosion. To prevent this, concentrated water is removed from the tower in what's referred to as "blowdown." Once removed, additional "make-up" water must be added to the cooling tower from the plant's incoming water source.

Effective water treatment processes enable cooling towers to reuse water (multiple times) before replacing it with fresh water. Refineries in landlocked places like Saskatchewan or Kansas have fewer choices for incoming water. As a result, they've become innovators with respect to treating, and recycling municipal wastewater.

One of the primary goals for disinfection applications in cooling towers is to prevent the growth of **legionella** – which is a ubiquitous organism that can appear in almost all sources of water. Numerous studies have found cases of legionella in up to 60% of all cooling towers around the globe. **Disinfection** is important to protect plant personnel, because the bacteria can spread via water droplets or mist, causing respiratory infections. The organism can be resistant to some chemical treatments – but "water doctor" specialists have developed chemical combinations that must be dosed in precise volumes to properly address legionella.

pH adjustment: While municipal water treatments and some industrial plants strive to bring pH levels to neutral (7), some halogens used in refineries (such as bromine) work more effectively at higher pH levels (8.5 to 9). Metering pumps, like **PulsaPro**, can dose the precise volume of caustics needed to raise alkalinity



Effective water treatment enables cooling towers to run at higher cycles of concentration, which saves water.

and create the sweet-spot where halogens work most effectively. pH control in refineries typically features multiple rounds (nested within each other) to treat water for specific processes, and then to return pH levels back to neutral prior to discharge.

Effective water treatment processes, administered by highly accurate metering pumps, enable cooling towers to run at higher cycles of concentration, which helps limit blowdown activities and save water. Plant-wide water treatments also open the door for alternative sources of water (such as process water or municipal wastewater) to be used for cooling tower make-up – which is particularly useful for plants with limited source water. The effective management of water & wastewater can save refineries one-to-two percent annually, which adds up to millions of dollars saved each year.

Requirements for metering pumps used in refineries

The flow rates for metering pumps used in refineries to treat water typically range from just a few liters per hour, up to 200 liters per hour, with pressures that range from less than 10 Bar up to approximately 40 Bar. Metering pumps sold into refineries must be API-675 compliant. They are not only used to dose water treatment chemicals – but they are also used to dose specific volumes of chemical catalysts (at higher pressures) that are required by the refining process. As such, metering pumps used in refineries should feature:

- **Corrosion resistance** – 316 stainless steel, Alloy 20, PVDF, and PTFE should be available to address chemicals needed by different processes.
- **Accuracy** – PulsaPro pumps provide 100-to-1 turndown capabilities with steady state accuracy down to +/- .5 percent. This is needed to deliver the precise pH levels needed for certain applications in a refinery. Most chemicals are procured in concentration, and they must be metered accurately – not just to save money, but to ensure that over-dosing does not occur, as acid overdoses can severely damage a cooling tower.
- **Longevity and reliability** – most refineries run continuous operations, and downtime is avoided at all costs. PulsaPro pumps feature hydraulically actuated



Launched in 2016, PulsaPro pumps are the most innovative and practical metering pumps on the market today.

double diaphragms with leak detection capabilities. Hydraulically actuated diaphragm (HAD) pumps operate with equal pressure between the hydraulic and process fluids, which eliminates diaphragm stress and provides unmatched longevity – enabling HAD pumps to operate for 20 years or more, with minimal maintenance.

What makes PulsaPro pumps different?

For many operators in refineries, power plants and chemical plants, this question can be difficult to answer. Although Pulsafeeder patented the HAD metering pump principle in 1942 - that patent (and almost all of the patents for reciprocating, centrifugal, and other pump types) expired many decades ago. As a result, it can be somewhat difficult to differentiate between pump manufacturers today.

In refineries and across oil & gas operations in general, the adage “if it’s not broke, don’t fix it” applies nicely. Proven reliability will always outweigh new innovation, which may or may not be needed. Pulsafeeder has hundreds of Pulsa-series (the predecessor to PulsaPro) pumps deployed in plants around the globe, which were installed more than 20 years ago, that are still functioning precisely as needed today.

On one hand: a stable of happy customers is great news. But on the other hand, a content and conservative customer base does not mean that pump manufacturers shouldn’t continue to innovate.

With this balance in mind, in 2016, Pulsafeeder conducted the largest voice-of-the-customer campaign in the company’s history. This effort resulted in a series of innovations for the new PulsaPro metering pump family. The new enhancements are designed to:

- Simplify commissioning and start up;
- Enhance the pump’s ability to survive upset conditions;
- Reduce the pump’s footprint;
- Provide remote monitoring, and remote control, via the new XAE Actuator.

The majority of these innovations are practical and simple. A “Push-to-Purge” valve maintains hydraulic balance and automatically removes air entrained in the hydraulics, while also purging excess oil. A mechanical refill hydraulic system replenishes hydraulic oil on suction strokes and eliminates the need for an adjustable oil make-up valve. An externally adjustable internal relief valve protects the pump from over-pressurization and eliminates the need to open the gearbox. A new 4-bolt tie bar adds stabilization to the valve assembly, which further reduces potential for leaks. And Pulsafeeder’s 3-component check valve enables quick disassembly and removal without disturbing connections to the piping infrastructure (which comes

in handy if pipe debris enters the line, or any other obstruction that can’t get past the check valves).

These improvements simplify operation, minimize maintenance, and enhance the pump’s ability to survive upset conditions – all of which help to minimize plant downtime.

Looking ahead

The growth of upstream activities in North America and throughout the Middle East has increased the volume of feedstocks funneling into refineries and petro-chemical plants around the globe.

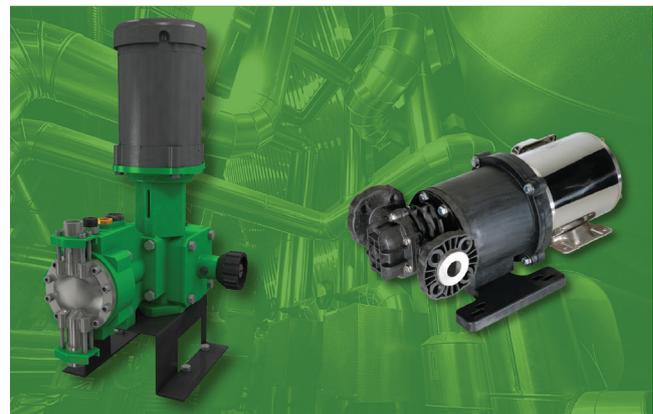
This uptick in activity increases the demands for water – which is a finite resource – prompting a simple question: has the time come for industrial plants to re-evaluate their water acquisition strategies, and increase their investments in chemical treatment & water reuse?

Pulsafeeder believes the answer to this question is “yes.” Pulsafeeder also believes in a spirit of continuous innovation - not just to further improve a pump’s efficiency or ability to survive upset conditions – but also a look ahead to innovation that can usher in a new generation of metering pumps.

These innovations will require new materials; higher power density; energy efficient micro-controlled drives; closed loop electronic controls; enhanced diagnostics & automation; wireless communications; IIoT, digital transformation, metal 3D-printing, and other enhancements that we haven’t even thought of yet.

This spirit of innovation guides everything Pulsafeeder does. It is this type of thinking that delivers the pumping infrastructure that operators at refineries, chemical plants and power gen utilities need to achieve more predictable, and sustainable operations – and to become better environmental stewards in the process.

For more information on the reciprocating diaphragm and rotary gear pumps used to treat industrial water in refineries, chemical plants and power gen utilities, please visit: www.pulsa.com



Multiple options for process metering and industrial water treatment applications.

