



PulsaPro

Top 5 Metering Pump Applications

This white paper presents five of the most common metering applications, and identifies the pump requirements for each application:

1. Diaphragm Metering Pumps for Oil & Gas
2. Rotary Gear Pumps for Municipal Water Treatment
3. Gear Pumps for CBD Oil Extraction
4. Chemical Metering for Manufacturing
5. Metering Pumps for Industrial Water Treatment



Eclipse



ISOChem

Metering Pump 101...



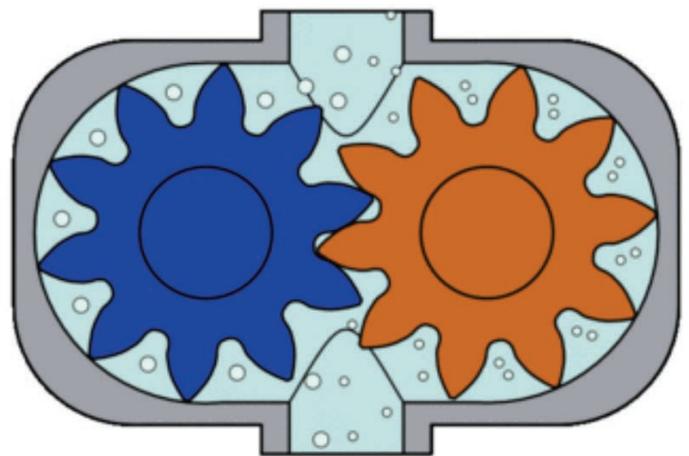
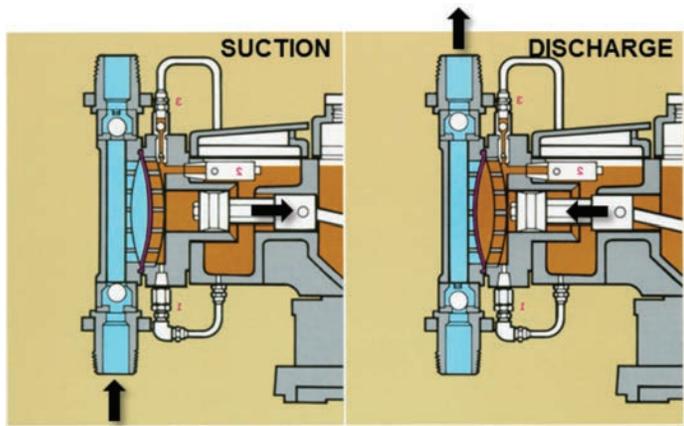
Metering pumps are positive displacement chemical dosing devices that vary capacity as needed, to within one-half of one percent accuracy. Metering pumps are engineered to handle a wide range of different chemicals – including acids, bases and corrosive or viscous liquids.

With **Diaphragm Metering Pumps**, chemicals enter the pump when the motor drives a piston to create a vacuum that sucks chemicals into the liquid end from external tanks. Alternating piston strokes create pressure that closes the inlet valve, opens the outlet valve, and forces the chemical out to the process. Within the liquid end is a diaphragm which acts as a barrier between the piston and the process fluid.

With a hydraulically-balanced diaphragm pump, the piston's pumping motion is applied to hydraulic fluid which causes the diaphragm to flex back and forth as the piston reciprocates. The movement of the piston (called deflection) flexes the diaphragm between concave and convex positions. The rate of flow can be precisely controlled by varying the speed of the motor, or

by adjusting the length of the piston stroke (either manually or remotely) ensuring that the process receives just what it needs, without over/under injecting.

The design of **Rotary Gear Metering Pumps** is well suited for certain applications. Gear pumps distribute a constant volume of fluid with each revolution – and their flow rates are easily altered by variable speed drives to match the needs of the process. The gear set draws liquid into, and through the pump. As the gears turn, liquid passes gently around the gear tips and the inner housing to the discharge side of the pump. Gear pumps can handle a wide range of volume flows, fluid viscosities, and they are well suited to handle wide temperatures ranges.



Sealless magnetically driven pumps ensure no leakage and no emissions, which is important when dealing with corrosive chemicals. With no seals to replace, gear pumps are easy to maintain.

Metering Pumps for Oil & Gas Applications

» PulsaPro



More than 50 countries produce oil & gas offshore — and Metering Pumps play a critical role in offshore production.

When working in deep offshore environments, one of the biggest issues is the formation of hydrates, which form when light hydrocarbons and water mix under high pressures and low temperatures. Hydrates restrict flow and can damage equipment. Remediation is expensive and dangerous to people, equipment and the environment — so a sound strategy for managing hydrates is critical.

Flow Assurance Chemicals:

Metering pumps are used in offshore environments to deliver flow-assurance chemicals — such as methanol, monoethylene glycol and other corrosion inhibitors. These chemicals are pumped directly to the wellhead on the seabed (via an umbilical cord) to prevent hydrates from forming, which increases recovery rates and prevents the wellhead from freezing.

Separation & Pipeline Transport:

Once brought up from the wellhead, liquid hydrocarbons can become unstable as they are transported. Asphaltenes and paraffinic materials in the oil can reduce “flow-ability” and damage pipelines. A wide range of asphaltene and paraffin inhibitors must be metered in specific doses when oil & gas are separated and transported from platforms via pipelines. Accuracy matters, because these chemicals are expensive, and injecting too much upstream requires removal downstream.

Onshore/Shale Production:

Pulsafeeder pumps are widely used in the U.S. Bakken shale region and throughout the Middle East to deliver flow assurance chemicals. Pressure requirements onshore are far less than

» **KEY METERING PUMP ATTRIBUTES:**

Adherence to API-675 standards without exception.

» **KEY CUSTOMERS:**

Oil Majors in the Bakken, Permian, Gulf of Mexico, Saudi Arabia and India

offshore (where 250 Bar/3626 PSI is sufficient). In addition to metering flow assurance chemicals and scale inhibitors, metering pumps are also used in onshore environments to treat the extensive volumes of water required for shale operations.

Metering Pump Requirements for Oil & Gas Applications

- **API 675 standards** – Pulsafeeder metering pumps meet API-675 standards with no exceptions or waivers — this adherence is unrivaled in the industry.
- **Accuracy** – Plus/minus One-percent accuracy with 100-1 turndown capabilities.
- **Reliability** – The value of a day’s production exceeds the cost of the pump. Hydraulically Actuated Diaphragm pumps are the preferred choice, because they are engineered to run for decades with minimal maintenance.
- **Compact, efficient footprint** – Each ton of equipment on an offshore platform costs roughly \$30,000 per ton. Considering that hundreds of pumps are required on a platform, the weight and footprint of each pump matters.

Metering pumps are small components on an upstream platform — but the role they play is analogous to a rivet on the wing of an airplane. If that critical component fails, the entire enterprise can be compromised.

Metering Pumps for Municipal Water Treatment

» Eclipse



Only about one-percent of the water supply on the planet can be used as drinking water, so the municipalities that treat water must handle this resource with the utmost care — all while balancing the need to operate efficiently and comply with regulatory requirements.

After initial screening to remove debris from incoming water, municipal plants use metering pumps to treat water in the following ways:

Disinfection: Sodium hypochlorite, potassium permanganate or bromine are popular chemicals used to control aquatic growth and eliminate micro-organisms that could cause illness if consumed. These chemicals are prone to “off-gas” at ambient temperatures, so pumps must be designed to handle these chemicals in an efficient manner that does not bind or clog the pump.

pH Adjustment: Drinking water should have a neutral (7) pH. Acids added to alkaline water (pH > 7) lower pH, while caustics added to acidic water (pH < 7) raise alkalinity. pH adjustment is a balancing act: Injecting too much hydrochloric acid to lower pH will require additional doses of soda ash (sodium carbonate) later in the process. pH adjustment chemicals are corrosive - so pumps with PVDF composite fluoropolymer materials should be used to ensure durability and chemical resistance. Sealless magnetically driven pumps ensure no leakage and no emissions.

Coagulation and Flocculation: Billions of miniscule particles too small to be filtered (finer than 1 micrometer), remain in motion due to negative electrostatic charges that cause them to repel one another. Positively charged coagulant chemicals (like alum, ferric chloride, ferric sulfate, or polyaluminum chloride) bring tiny colloidal particles together to form flocs that are easier to filter. Reaction time varies — so accurate pumps with high turndowns can minimize coagulant chemical use and protect against wasting expensive chemicals.

Additional treatment steps include:

- **Taste & Odor Control:** chemicals like activated carbon slurries, potassium or sodium permanganate are dosed in specific quantities to control odors and improve taste.

» KEY ATTRIBUTE:



NSF-61
Certification

» KEY CUSTOMERS:

More than 100 Municipal
water treatment plants
in the U.S.

- **Fluoridation:** About two-thirds of municipal plants add fluoride in their process. Municipalities typically dose fluoride at a concentration of 1 part per million (1 ppm) or 1 milligram per liter.
- **Post Chlorination:** adds a final step to the process by dosing a minimum level of chlorine into treated water to prevent microorganism growth in distribution lines and home plumbing.

Metering Pump Requirements for Municipal Water Treatment

- **Pressure Envelope** – most water treatment applications require pressure in the 30-50 PSI range.
- **Accuracy** – pumps that can deliver within 2-percent accuracy are sufficient.
- **Flow Ranges** – Variable flow rates are required to address the volume of water to be treated in the plant. Treatment chemicals are often dosed in a range of 5-to-10 milliliters for every 20 liters of water treated. The Eclipse pump line handles flow rates from 1.7 l/m, up to 125 l/m, which is sufficient to address any municipal requirement.
- **Construction materials** – PVDF or 316-SS should be available to handle the range of chemicals used in all of the various applications.
- **Streamlined Maintenance** – With few moving parts, Eclipse’s patented front pullout design provides easy access to the pump’s inner workings – enabling the pump to be maintained in place with just a single tool. This minimizes downtime and eliminates the need to move the pump to a repair shop.
- **Reliability** – Eclipse pumps run for years before requiring maintenance. Pulsafeeder’s KOP (Keep-on-Pumping) kits provide all of parts needed to return the pump to as-new condition.

Metering with Rotary Gear Pumps for CBD Extraction

» ISOChem



The passage of the 2018 Farm Bill made the cultivation and processing of low THC industrial hemp legal at the federal level. CBD (or cannabidiol) extracted from industrial hemp is not psychoactive and it does not make users feel “high” because it contains low doses of THC. CBD interacts with the body’s natural endocannabinoid receptors to provide what many regard as health benefits without the drawbacks of marijuana. CBD products derived from hemp include oils, topical creams, lotions, breath mints and even coffee and bottle water. Available online or in retail stores, CBD products are marketed and consumed like natural alternatives to ibuprofen or commercially available nutritional supplements.

Industry analysts are forecasting that the market for CBD products will grow to an estimated \$22 billion by 2022.

How is CBD Oil Extracted?

Cannabidiol is one of approximately 100 substances that can be extracted from cannabis plants. It’s produced similar to the way essential oils (like lavender or eucalyptus) are extracted — by pressing chemical solvents through plants in order to create the reactions needed to unlock the desired molecules. This process requires that chemicals be pressed through plants at specific volumes, pressures and temperatures, using metering pumps.

Different solvents can be used, including liquid CO₂, Ethanol, Pentane and Butane — and each method has its tradeoffs: CO₂ extraction requires high pressures (up to 5000 psi) and low temperatures (down to -40°C); hydrocarbon extraction creates explosion risks, which require safety equipment and incremental safeguards for the process. Ethanol extraction is gaining traction as the preferred process that balances flammability risks, scalability, and cost effectiveness.

In addition to the chemical metering process, pumps are also used move solvents through various stages of the process, including: plant preparation, extraction, winterization, filtration/dewaxing, solvent recovery, purification, fractional distillation and transfer to storage.

» **KEY METERING PUMP ATTRIBUTES:**

Sanitary Connections

» **KEY CUSTOMERS:**

Small/medium sized Extractors

The Right Pump for the Job:

Ethanol extraction is typically accomplished at less than 100 psig and at temperatures ranges of -40°F to 250°F — a zone where ISOChem excels. ISOChem pumps are compact, magnetically-driven, sealless gear pumps designed to handle hazardous and expensive chemicals. ISOChem offers the flow and pressure envelop needed to address any ethanol extraction process. Its sealless design ensures no leaks, no downtime and minimal maintenance. Its compact footprint fits on any skid, and Pulsafeeder distributors prefer ISOChem because of its price point, and the fact that it can be provisioned within hours, and shipped to the customer in a matter of days.

Metering Pump Requirements for CBD Extraction

- **Pressures** – up to 150 psig
- **Flow** – from .75 gpm (2.8 lpm) up to 55 gpm (206 lpm)
- **Accuracy** – the right mix of solvents enhances yield and product quality
- **Temperatures** – between -40°F (-40°C) to 250°F (121°C)
- **Sanitary Connections** – similar to requirements for food & beverage applications
- **Reliability** – ISOChem has a 30 year track record in the field
- **Streamlined Maintenance** – Sealless mag drive means no leaks and minimal maintenance
- **Price** – significantly less expensive than diaphragm or peristaltic pumps
- **Availability** – ISOChem can be provisioned and delivered in a matter of days.

When it comes to CBD extraction, no single pump feature dominates. It’s the combination of capabilities that have enabled ISOChem to carve its niche in the rapidly-growing CBD Extraction market.

Metering Chemicals in Manufacturing Processes

» PulsaPro



Chemicals are a Top-3 expense for any Plant, but they cannot add value without Metering Pumps

Modern society exists because of the products and the conveniences made available by different chemical compounds. Chemicals are the life-blood of manufacturing plants. But many chemicals are toxic and dangerous to people and the environment – so great care must be taken to ensure that chemicals are handled and dispersed properly in any manufacturing process.

The metering pump plays a critical role in making many of the products we use every day – from the floors we walk on, to the cars we drive, to the plastics we need for so many aspects of our lives. None of these products can be made without chemical catalysts, which create the reactions needed to manufacture products. These catalysts are injected at precise volumes, temperatures and pressures via Metering Pumps.

Consider cooking a gourmet meal, or baking a cake. These processes follow recipes requiring specific ingredients, in precise amounts, in the right sequence, and prepared at specific temperatures. Adding too much or too little of a certain ingredient can change (or ruin) the end result. Manufacturing plastics, aluminum or vinyl products is similar – in that proprietary formulas require the addition of chemical catalysts in the right amounts, at specific temperatures and under specific pressures.

Here are just a few examples of the most common chemicals that are metered via manufacturing processes:

- Sodium Silicate – for pulp & paper production
- Ethylene Glycols – for plastics, latex paints and adhesives
- Nitrate, Ammonium, Urea, Phosphate and Potassium – for fertilizers
- Methanol – for petroleum refining and solvent production
- Hydrochloric Acid – for hundreds of uses including metal refining

» **KEY METERING PUMP ATTRIBUTE:**

Precision & Accuracy

» **KEY CUSTOMERS:**

The world's
largest chemical
manufacturers

- Caustic Soda (Sodium Hydroxide) – for aluminum, automobiles, textiles, soap/detergent, and more than 12,000 commercial compounds. Caustic Soda is the second most metered chemical in the world.
- Chlorine – for bleach, plastics, automobiles, pharmaceuticals, vinyl products, and more than 15,000 commercial compounds. Chlorine is the #1 most commonly metered chemical in the world.

Chemicals make up a “top-3” expense for any plant, but these expensive chemicals (which are procured and stored in high concentrations) can't add value to the process without metering pumps delivering them in the precise fashion. By evaluating pump criteria and pairing it with operational requirements, plants can be sure that they are following the recipe needed to keep their plants running at optimal efficiency.

Metering Pump requirements for Chemical manufacturing:

- **Flow Rates & Pressure** – as required by the process
- **Corrosion resistance** – to the chemical being pumped
- **Accuracy** – to within +/- one half of one percent, with 1,000-1 turndown
- **Reliability** – to ensure sustained and predictable operation
- **Simplified maintenance** – to minimize costs and maximize plant uptime
- **Safety** – to protect plant employees, and the surrounding environment

Industrial Water Treatment Applications

» Eclipse and PulsaPro



Nuclear Plants generate power with less carbon dioxide emissions than coal or gas fired plants. But nuclear plants consume tremendous volumes of water (up to 500,000 gpm) in the heat exchangers needed to cool their turbines. Clean heat transfer surfaces have a direct impact on a plant's operating efficiency – so cooling water must be treated to manage micro-bio organisms, prevent scaling and corrosion, and prohibit foulants from lowering the plant's efficiency. Typical water treatments involve pH control (with sulfuric acid) and disinfection (via sodium hypochlorite solutions). These chemicals are metered at exceedingly high dosing rates and at relatively low pressures. For these reasons (and the fact that non-API-675 pumps are acceptable for water treatment in these plants) Eclipse Rotary Gear Pumps are a practical solution.

Refineries also use tremendous volumes of water: Every 50,000 barrels of oil refined generates one-trillion BTUs per hour, which is removed by water evaporating in cooling towers. Large refineries can use more than 10,000 gpm. As cooling towers eliminate heat from evaporating water, dissolved solids like calcium and magnesium remain in the tower. Over time, these solids diminish thermal efficiency and cause corrosion. To prevent this, API-675 compliant diaphragm metering pumps are used to dose specific volumes of acids, caustics, scale inhibitors and disinfectants. These water treatment applications enable cooling towers to run at higher cycles-of-concentration, which enables refineries to save money by reusing water and limiting blowdown activities.

Boiler-feed Water Treatment Applications: Almost every plant (in every industry) has boilers – which are used to create steam by applying heat energy to water. When water turns into steam, its volume expands more than 1,000 times – and it can traverse steam pipes at more than 25 m/s. The biggest issue associated with boilers is the fact that water's life-giving properties also encourage

» KEY ATTRIBUTE:

Reliability

» KEY CUSTOMERS:

Dozens of Refineries
and Power Plants

bacterial growth, which fouls boiler surfaces. Water also dissolves gases (like oxygen and carbon dioxide) which can corrode metals. If left untreated, scale deposits and fouling diminish a boiler's efficiency, and can lead to unplanned downtime. The feed water used for boilers must be as pure as possible – so metering pumps are used to treat boiler feed water in a variety of ways, including: disinfection applications, pH control and the rendering of scale inhibitors. Both diaphragm metering pumps and rotary gear pumps are used for boiler feed water applications.

Metering Pump Requirements for Industrial Water Treatment:

- **Reliability** – Power plants and refineries run continuous operations, and they cannot function without water. The pumps that treat a plant's water must be designed for reliability because downtime must be avoided at all costs.
- **Streamlined Maintenance** – Eclipse's front pullout design enables the pump to be maintained in place with just a single tool, while PulsaPro diaphragm pumps are engineered to run for decades with minimal maintenance.
- **Small/Efficient Footprint** – Space in any plant is valuable and operators today prefer small, vertical configurations that are spatially available, less susceptible to flooding, and easier to work on.
- **Flexibility** – to accommodate flow and pressure requirements for the various applications, and also a mix of construction materials to handle a wide variety of harsh chemicals.



PulsaPro

*For more information
on the Pumps referenced
in this white paper:*

Find your local representative at: pulsa.com/find-a-rep
Or visit www.pulsa.com for more details



Eclipse



ISOChem