Fluid Technology Group

Watson-Marlow on handling abrasive and aggressive chemicals

Delivering operational efficiency and minimising maintenance

CONTENTS

EXECUTIVE SUMMARY

Pumping abrasive chemicals, oxidizers and strong acids poses a major challenge at industrial and utility sites throughout the world. Businesses aim to improve safety and cut costs through reduced maintenance. This report looks at the management of abrasive and aggressive processing streams and includes case studies from Europe and North America showing how companies have optimised pumping of these challenging fluids, reduced their costs and streamlined operations and maintenance schedules.

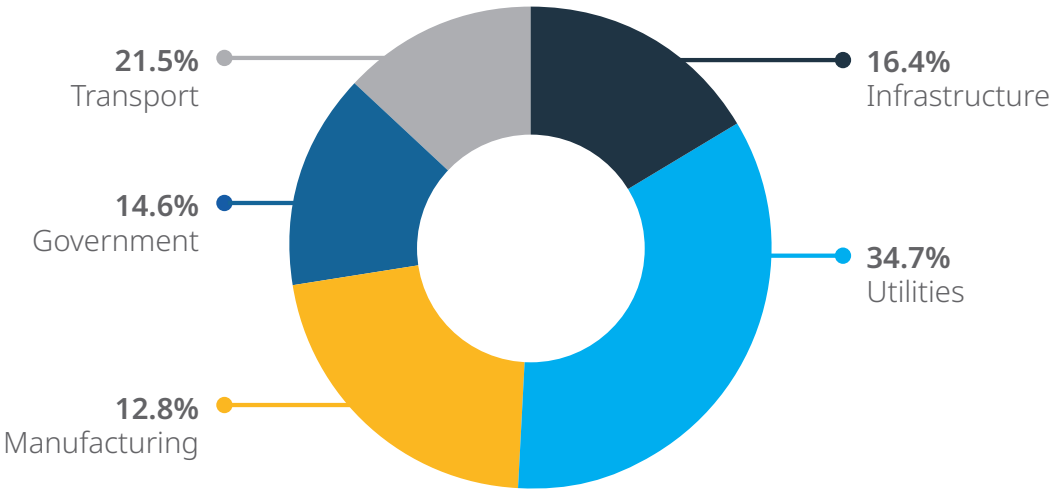
ABRASIVE AND AGGRESSIVE CHEMICALS, AND VISCOUS FLUIDS

Industrial processing can be highly complex and the fluid, water and wastewater streams that keep everything in motion are infinitely variable across different sectors and in a vast array of applications. One of the biggest challenges for all operators is pumping, dosing, metering and transferring challenging fluid streams, including aggressive chemicals and solids from treatment and processing product or contaminants. They can cause increased wear to pump components by eroding surfaces through physical force and/or by chemical reaction and corrosion.

The impact on infrastructure is significant. At national level, corrosion can represent a sizeable percentage of gross domestic product (GDP). A 2015 study[1] on behalf of the Chinese Academy of Engineering estimated that the annual cost of corrosion in China was approximately US$310 billion, representing about 3.34% of GDP.

A similar US study[2] estimated the cost to be US$276 billion—approximately 3.1% of the nation's GDP—and the water and wastewater sector accounts for 14% of that total. The consequences or impacts arising from wear and corrosion are the potential financial losses associated with risk to staff safety, environmental harm and asset integrity.

Cost of corrosion breakdown by sector



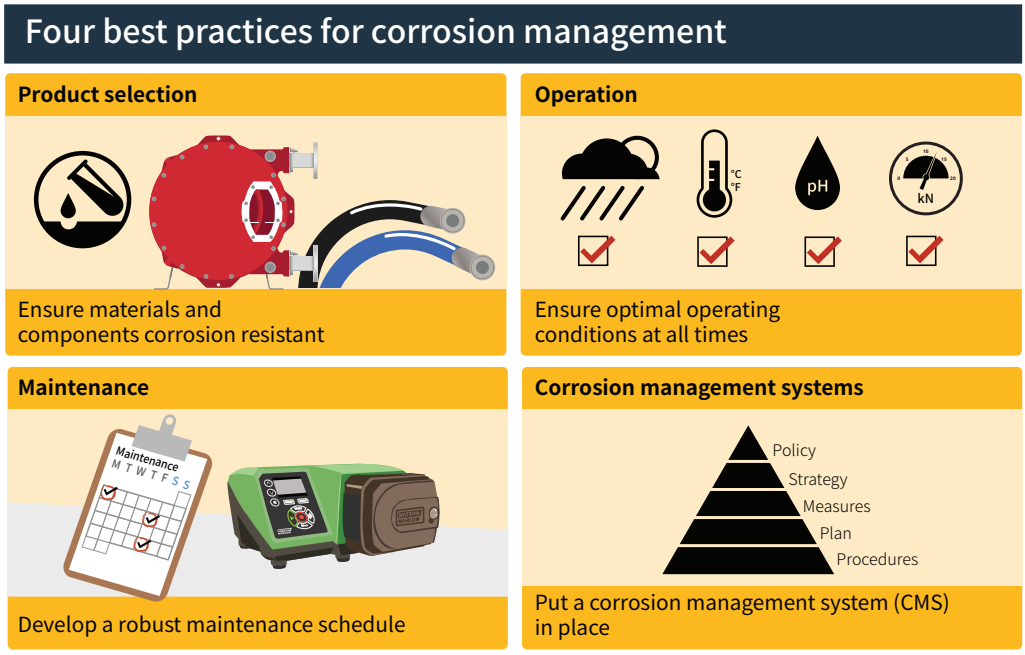
ABRASIVE AND AGGRESSIVE CHEMICALS, AND VISCOUS FLUIDS

Companies can take a range of measures to reduce corrosion and a milestone study[3] from NACE International, a global authority, insists that organisations must implement corrosion management systems (CMS). The document says that while precise savings are difficult to measure, corrosion control can reduce costs on multiple fronts including:

- Maintenance and inspections
- Equipment failures and lost production time and product
- Extending asset life and postponing capital expenditure
- Industrial injuries and damage to facilities
- Environmental impact and reputational risk

The report also says that one way to monetise corrosion maintenance decisions is through risk assessment - combining the probability of failure and its consequences.

As a contributor to the financial toll of corrosion, every measure that can reduce the impact of abrasive fluids on industrial processes and infrastructure should be embraced, including care around the selection, operation and maintenance of one of the most important components - pumps. The consideration of installing peristaltic pump technology to handle challenging chemicals also presents opportunities for more precise dosing within a smaller footprint and with lower whole lifecycle costs.



OPERATION AND MAINTENANCE

The main concern regarding pump selection is identifying a system suitable for transporting streams efficiently, while minimising pump wear and avoiding costs and delays incurred through maintenance and downtime. Ensuring optimal operating conditions for pumps moving abrasive and corrosive liquids can have a significant impact on whole lifecycle service and costs.

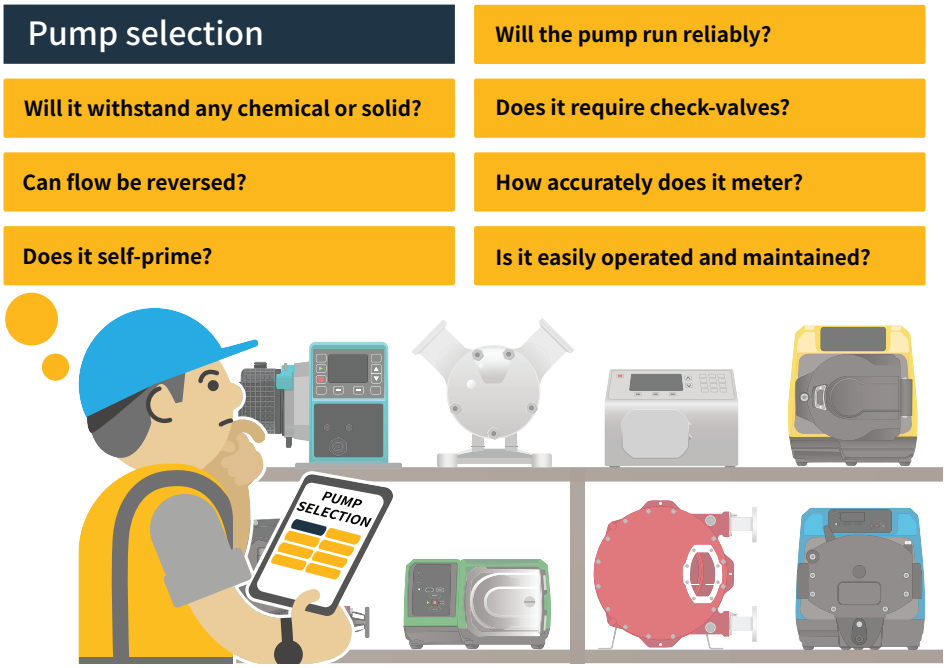
When faced with the challenge of installing a mechanical pump in the heart of their process to dose, meter or transport challenging fluids, engineers need to find a pump that can:

- Run reliably
- Withstand any chemicals or solids
- Meter accurately
- Be easily operated and maintained

Peristaltic dosing pumps are valve-free and operate without seals; they also have no mechanical parts immersed in the product stream. This minimises the risk of damage to pump components as fluid only comes into contact with the inside of a hose or tube, which is a low-cost, easily serviceable component.

In addition, their design prevents flow-drop or erosion from backflow and eliminates the need for check-valves, which are a primary source of inaccuracy in other pump types because they can clog and may be affected by corrosion.

Peristaltic pumps also have the ability to self-prime which improves employee safety by reducing handling of hazardous chemicals. They are also completely reversible, so a simple change in direction can be used to drain lines or dislodge blockages.



CASE STUDY 1: HANDLING HIGH TEMPERATURES AND DRY SOLIDS IN WET-SCRUBBING PROCESS

During a site inspection at a major energy-from-waste (EfW) plant in Europe, it was noted that centrifugal pumps supporting a 15-hour wet-scrubbing operation were experiencing frequent failure. The pumps were struggling to manage the high temperature and 25% dry solids content of the abrasive limestone slurry reagent entering the scrubbers; an additional challenge was crystallisation of the slurry on cooling.

Air emissions from incinerators are under scrutiny by regulatory authorities and flue gas desulphurisation (FGD) needs to take place without unscheduled downtime. Recognising the need to upgrade the legacy centrifugal pumps deployed in the wet-scrubbing process to meet stringent industry requirements, the plant trialled Bredel peristaltic hose pumps. Unlike centrifugal pumps, hose pumps are virtually maintenance-free, leading to a much more controlled process and lower OPEX costs.

Such was their success in performing lime slurry transfer operations across a five-day duty cycle that the plant now employs eight Bredel pumps. The pumps are helping the facility gain greater control over its processes and have reduced operational expenditure (OPEX).

DOSING BEST PRACTICE

Hydrochloric acid, sodium hydroxide, sodium hypochlorite and sulphuric acid are just a few of the corrosive, but widely applied, chemicals used at industrial and utility sites throughout the world. Where they are handled inappropriately, they also risk shutting down processes and breaching compliance through pump failure and health and safety incidents.

Process engineers need equipment that can deliver flow rates that remain consistent throughout the required operating window, up to the highest anticipated pressure level. A high degree of accuracy minimises the risk of process disruption and compliance breaches; it can also reduce the quantity - and cost - of chemicals required. Watson-Marlow's Qdos and Bredel pumps eliminate the need for ancillary equipment while ensuring accurate, linear and repeatable metering across all process conditions.

HEALTH AND SAFETY

The risks of exposure to corrosive chemicals cannot be overstated, handled incorrectly they can destroy body tissue, cause severe burns, blindness and even death. Breathing in corrosive vapours will burn the lining of the nose, throat, and lungs and prolonged exposure can result in a fatal build-up of fluid in the lungs.

Keeping operatives safe on industrial sites where chemicals are stored, pumped and deployed and where contaminants require careful management is a top priority for most companies. As well as the risk to life and limb, there is also a significant reputational risk at stake where organisations do not take their responsibilities seriously.

Selecting equipment that minimises contact with corrosive fluids is yet another way to mitigate risk. Peristaltic pumps like Watson-Marlow's Qdos models keep fluids sealed within the pumphead in event of a failure. The system can then be emptied and the pumphead replaced quickly and easily, eliminating the risk of a technician coming into direct contact with hazardous substances or breathing in potentially toxic vapours.

Integral leak detection means that the operator never comes into contact with the chemicals, ensuring complete safety. Not only is the operative kept safe, the personal protective equipment (PPE) requirement is reduced, making further time and cost-savings over the contingencies required when more traditional equipment is being maintained.

Keeping operatives safe where chemicals are stored, pumped and deployed is a top priority

ASSESSING LIFECYCLE COST

Assessing whole-life cost can deliver major savings over costing only for upfront outlay and even where cost is not so sensitive, smooth plant operation and minimisation of hazards and risks should be a key business objectives.

While the initial capital cost of a peristaltic pump may appear to be higher than other positive displacement (PD) pumps, assessing the cost of ancillary equipment, installation, maintenance downtime and spare parts quickly tips total expenditure in favour of the peristaltic pump. Further considerations are the savings from optimisation of chemical consumption.

Many PD pumps require a separate control panel or variable frequency drive for achieving variable flow metering, with incremental cost and complexity if a high turndown ratio is required. With peristaltic pumps high turndown, closed-loop speed control and connectivity for a range of control systems are built in, simplifying instrumentation integration and significantly reducing whole-life costs.

CASE STUDY 2: ELIMINATING OFF-GASSING IN SODIUM HYPOCHLORITE METERING

The water treatment facility in the US city of Victoria, Minnesota, serves a population of 8,800 and uses several chemicals in the water filtration, clarification and distribution process. The diaphragm pump used to meter sodium hypochlorite at the post-chlorination stage was experiencing severe issues related to off-gassing, which is a common problem in such applications.

The pump was losing prime and had stopped working due to bubbles entering and vapour-locking the diaphragm. There were very few options available to the operator when it came to sourcing a replacement pump because of the relatively low flows (9 - 13.5 l/h) and high pressures - up to 7 bar on discharge.

Since replacing the diaphragm pump with a Qdos 20 peristaltic pump from WMFTG, the facility has significantly reduced downtime and maintenance. In an initial trial, the plant ran for over a year with just one replacement of the ReNu pumphead and the pump's fluid recovery features mean chemical spills are avoided when replacing the line.

SUMMING UP

One of the biggest challenges in industrial processing is handling abrasive and corrosive fluids, understanding their viscosity and managing the risk of off-gassing. The impact of corrosion and wear on equipment exposed to these streams can be costly and requires mitigation, making careful pump selection an important consideration.

Pumps capable of managing harsh acidic or alkaline chemical profiles or high solids content are required by operators, equipment manufacturers and installers. They need to be reliable and accurate to minimise chemical consumption and optimise product yield. Handling onsite chemicals also poses a risk to health & safety and environmental stewardship. Selecting equipment liked Watson-Marlow's Qdos and Bredel pump models eliminates contact with corrosive fluids.

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The critical nature of industrial processing pumps means they will provide months of reliable service without interruption and when the time comes to maintenance, the procedure can be carried out in a matter of minutes. Peristaltic pumps are valve-free and operate without seals. They offer a major reduction in the risk of damage and maintenance downtime as the only surface in contact with the fluid is the inner bore of the tube or hose.

Calculating whole lifecycle cost is a critical consideration, especially where profit margins are slim. The anticipated outlay on ancillary equipment, installation, maintenance and spare parts should all be factored in as early as possible, along with energy savings and reduced chemical consumption from precision dosing.

Whether the application is in pulp & paper, drinking water treatment, mining, energy, dairy or automotive, a best practice approach to handling abrasive fluids is central to mitigating risks, whether from equipment damage, production downtime or breaches in health and safety and environmental compliance.

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