Reliable Pumps for Abrasive Material

By Sergio Avila

Solid-body plastic AODD pumps deliver the operational ability required for challenging abrasive-handling applications.

The originator of the epigram, "Laws are like sausages; it's better not to see them being made," is unknown although it is generally attributed to the 19th century German statesman Otto von Bismarck. The sentiment that it portrays, however, is easy to grasp: While we may like and respect the outcome, sometimes it is best not to know how it was reached.

This can also apply to the manufacturing industry. The shine on the chrome of an automobile or a mirror-like reflection on the surface of a highly glazed piece of pottery may dazzle, but most consumers really have no idea just how harsh the manufacturing conditions are to produce the desired end result. Innumerable objects that we see and use in our daily lives only achieved their final form after a harsh production process that may have included the use of any number of abrasive media to create the finished product.

This article examines several manufacturing applications or components in which abrasive chemicals are used and the best type pump technology to incorporate in those processes. Choosing the right pump will not only ensure that the desired final product is produced, but that the entire manufacturing process will be completed efficiently and effectively at a cost-conscious rate and with a minimum of pump maintenance and downtime.

Abrasive Material Challenges

While consumers may be blissfully unaware of the trying conditions required to produce their favorite piece of jewelry or the ink that is used to print the words on their daily newspaper, the manufacturers of those, and thousands of other products, are not. The conditions in which their products are created must be a front-of-mind concern for manufacturers, as are the specific pieces of equipment that are used to complete the process.

Examples of the types of manufacturing processes or components that can require abrasive chemical compounds are discussed in this section.

Pickling Baths

When metal is "pickled," in a process that is also known as tarnision, a surface treatment is used to remove any impurities, such as inorganic contaminants, stains, rust or scale that can discolor the steel. The pickling bath, or tarnision liquor, that is used to facilitate this treatment primarily consists of hydrochloric acid, although steels with an alloy content greater than 6 percent must be pickled in two stages—the initial hydrochloric acid stage, followed by submersion in another strong acid, such as nitric, phosphoric or hydrofluoric.

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An AODD pump in a slurry transfer application in Korea

In jewelry-making, pickling is used to remove the oxidation layer from copper, which occurs after heating. The waste product from steel pickling, known as pickling sludge, includes:

- Acidic rinse waters
- Metallic salts
- Waste acid

All the components that make up this pickling sludge make it a hazardous waste that needs to be neutralized with lime before it can be disposed of in a landfill.

Silicon Carbide Slurry

Slurry is a generic term for any thick suspension of solids in a liquid. Silicon carbide slurry is used in a variety of applications in the construction, ceramics, paper and explosives industries, among many others. It is made from a mixture of powdered silicon carbide that is suspended in polyethylene, diethylene glycol or an oil-based fluid. Silicon carbide is an extremely hard, durable, heat-resistant compound.

Grains of silicon carbide can be sintered together to help form hard ceramics that can be used in the manufacture of such diverse products as:

- Solar cells
- Car brakes
- Bulletproof vests

Because of its degree of hardness, silicon carbide is often used as a cutting liquid, or slurry, in the manufacture of solar cells and wafers.

Most silicon carbide slurries are mixed by the manufacturer, who purchases the silicon carbide powder by the size of the "grit" needed and then mixes it with the preferred liquid. Once the slurry is created, it is pumped to storage tanks until needed.

Electroplating

Electrodeposition is the name of the process used in electroplating. In the electrodeposition process, metal ions in a solution are transferred via an electric field

to coat an electrode. It is primarily used to deposit a layer of material, such as a metal, on an object in an attempt to give it a preferred property—such as wear resistance, lubricity or corrosion protection.

The electrodeposition process occurs when the components are introduced to an electrolyte solution that contains one or more dissolved metal salt(s) and other ions that enable the flow of electricity. Depending on the object to be plated, the electrolyte solution can be extremely abrasive.

Printing Inks

Printing inks are divided into two categories: writing inks and printing inks. They are further divided into two distinct subcategories—ink for conventional printing (where an image is transferred to the paper or object to be printed via mechanical plate) and ink for digital, non-impact printing (electrophotographic and ink-jet technologies).

Many components that make up inks can be abrasive. Color inks, for example, are made with a solvent that is generally produced from petroleum distillates, linseed oil or soybean oil, while the pigments are made of dyes. Titanium dioxide can be used to adjust the color characteristics of color inks. All inks may also contain additives such as:

- Lubricants
- Waxes
- Surfactants
- Drying agents

Lime Slurry

By definition, lime slurry is an alkali that is a suspension of calcium hydroxide in water. It has many uses in industrial, municipal and environmental applications—such as metals precipitation, odor control, sludge stabilization, lime softening and pH adjustment.

While easy to pump by itself, when lime slurry reacts with water, a condition known as "plating out" may occur. When this does occur, all surfaces that come in contact with the lime slurry are in danger of being caked with lime, including the pumps that transfer it, which can cause some pumps to malfunction. Lime slurries can also contain additional abrasive solids, such as grit and pebbles, that can wear a pump's internal components and lessen its efficiency and reliability.

Ceramic Mass/Glaze

Mass finishing is a common method of finishing metals that cleans, deburrs and polishes the surface. An abrasive ceramic media is used to facilitate the finishing process. Glaze is defined as a layer or coating of a vitreous substance that has been fused to a ceramic object through firing.

Before application, ceramic glazes can be abrasive, because

they consist of miniscule shards of glass-forming silica in combination with a metal-oxide mixture, which consists of:

- Sodium, potassium and calcium, which allow the glaze to melt
- Alumina, which stiffens the glaze and prevents it from running
- Colorants—such as iron oxide, copper carbonate or cobalt carbonate
- Opacifiers—such as zirconium oxide and tin oxide

Reliable Pumps

While many types of pumping technologies have been tried and found wanting in these (and other) harsh manufacturing applications, one has proven to be a reliable performer where a wide range of abrasive components need to be handled safely, efficiently and reliably: solid-body, plastic air-operated double-diaphragm (AODD) pumps.

Solid-body, plastic AODD pumps have many beneficial features when handling abrasives. To begin with, they do not require electricity. They are self-priming and can pump a wide range of abrasive media, from slurries to liquids with suspended solids. Plastic AODD pumps are positive-displacement pumps that have a diaphragm in each of their two pumping chambers.

These diaphragms are connected by a shaft so that when the compression stroke takes place in one chamber during the pumping process, the suction stroke takes place simultaneously in the other chamber. This results in efficient, reliable, cost-effective, repeatable operation when handling any number of abrasive liquids or compounds.

Some AODD pumps offer the user a solid design, constructed of polyethylene (PE), which offers excellent abrasion-resistance when used with slurries and other abrasive media. Thanks to their PE construction, these pumps have been shown to last seven times longer than pumps that are made with polypropylene—while having similar chemical-resistance characteristics—and be 1.6 times more durable than stainless-steel pumps.

Solid PE also delivers better sealing, higher static weight, smoother operation and better torque retention than other materials of construction. For specific applications, the pumps can also be constructed of PE conductive, PTFE and PTFE conductive. All the pump's cylinder valves are constructed with PTFE with the diaphragms (EPDM, PTFE/EPDM and NBR) and ball valves (EPDM, PTFE, NBR and stainless steel) available in a range of materials.

All the housing parts are tightened to each other via housing bolts. However, instead of single bolts that press punctually against the housing, the bolts are tightened against a diaphragm-sized ring on each side of the pump. This results in a

more even spreading of the housing-bolt force and an increase in permissible bolt torque, both of which enhance safety and reliability.

An optimized flow pattern reduces the pump's flow resistance, which results in increased efficiency and lower air consumption. Other standout features of some AODD pumps include:

- A maintenance- and lubrication-free air-control system, which ensures accurate reversal of the main piston
- Internal piston diaphragm (IPD) technology
- Integral dampeners for constant flow with no need for additional piping
- ATEX conformity
- Variable port configurations
- No drives, rotating parts or shaft seals
- Easy startup
- Options include: a barrier chamber for leak prevention, drain system, stroke counting, diaphragm-monitoring system and transport cart

Safe and Efficient Abrasive Pumping

Abrasive liquids and compounds play a huge role in the creation of some of the world's most recognizable products—this is a manufacturing fact.

These products are only made, however, if the equipment used to produce them can meet the challenges of handling and transferring a wide range of harsh and abrasive chemicals. Solid-body, plastic AODD pumping technology is well suited for use in these demanding manufacturing environments.

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