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AHLSTAR™ Process Pumps for Metal Refining Applications

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Research and development have always played a significant role at Sulzer Pumps. Our main target is to always meet the customer's requirements. Therefore, we aim at bringing a new pump into operation at the same time as a new process is developed. This continuous development process has been highly successful. Our quality standards and new innovations result in highly efficient pumps with low operation and maintenance costs. We take pride in Sulzer's ability to custom "fit" process pumps to metal refining applications for zinc, copper, nickel, steel, alumina and aluminum.

AHLSTAR™ Process Pumps are designed for continuous operation in industrial processes, and the pumps can be used for pumping various kinds of liquids and slurries. AHLSTAR™ pumps are horizontally mounted with the following characteristics: single stage, end suction, back pull-out, ROTOKEY impeller mounting, simplified heavy-duty bearing unit etc. The AHLSTAR™ Process Pump series has a standard (A), wear resistant (W), non-clogging (N) and hot liquid (E) hydraulic design. The series has two solutions for gas handling: an air separating (R) design and a self-priming gas removal (S) design. The gas handling options can be integrated with standard (A), wear resistant (W) and non-clogging (N) hydraulic designs.

Pumping of slurries, selection of pump type against erosion

When selecting a slurry pump, the most important thing is to classify the type of the pumped liquid or slurry. The rough selection of whether to use a wear resistant (W design) pump or an ordinary process pump can be made according to figure 1 below. The table is then used to define the range of recommended operating conditions.

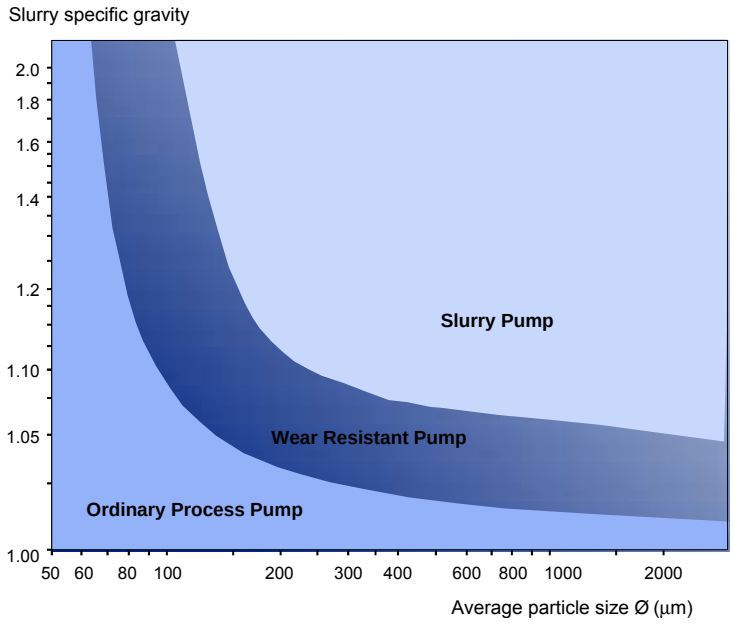


Figure 1. Pump types according to average particle size and specific gravity.

Ordin P Pump	ary rocess	Wear Resistant Pump	Slurry Pump
Maximum discharge velocity	12 m/s	8 m/s	6 m/s
Maximum impeller peripheral speed	43 m/s	36 m/s	28 m/s
Range of capacity Q/Q BEP	30–130 %	40–120 %	50–110 %

The above values may vary, depending on how erosive the particles in the slurry are and how corrosive the liquid is. The maximum lifetime can be reached by selecting a pump with the biggest impeller diameter (lower running speed) and the duty point as close as possible to the best efficiency point (BEP).

There are some applications in metal refining processes, like in the leaching step in zinc and nickel refining, where the solids can damage the volute casing very severely in a short period of time. The pump can be lost in a couple of weeks if the pump type and material selection is not the right one. If only abrasion damages the material of the pump, a hard material should be selected. One possible solution is to select hard chromium iron whose hardness is 600 HB. This material, A532 Class IIIA, contains about 23 – 30 % of chromium that gives high hardness. Chromium iron can manage very well solids whose hardness is less than 600 HB. We have installed the AHLSTAR™ WPP wear resistant pump with chromium iron material in several applications that are not acidic. We have found that their lifetime can be about three times longer than that of a normal process pump with CD4MCu material.

Corrosion

Corrosion is a reaction of the material with its environment. The basic reason for corrosion is that the material aims to come back to a lower energy level. Chemical corrosion is a reaction of the material with a contacting liquid, gas, material-, etc. where the result is a new chemical compound. The most important reaction is oxidation that results in an oxide layer on the surface of the material. Electrochemical corrosion is affected by acid, alkali or dissolved salts in a water solution. It is usual that different metals have different dissolving pressures, and the electrical potentials of materials have different values in different solutions. Electrochemical corrosion always takes place within electrochemical corrosion pairs.

If the pumped liquid comes out of the pump to the atmospheric side, there is usually corrosion, especially when there is sulphuric acid in the liquid. The material comes loose by corrosion on the atmospheric side when different kinds of holes have been made in the volute casing. This is why holes e.g. for the draining of the pump are not accepted in the volute casing.
When corrosion and wear take place at the same time in the pump, a metallic material is usually selected. The metallic parts can resist the solids that attack the surface because their hardness is quite high. Austenitic cast steels can manage both simultaneous corrosion and abrasion very well. A very good example of a successful trial was an AHLSTAR™ WPP wear resistant pump made from Avesta 654SMO (Avesta 654SMO is a trade mark owned by Avesta Sheffield which has granted Sulzer Pumps Finland Oy license to produce this material) that replaced a rubber-lined pump in a zinc leaching process. The pumped liquid contained 300 g/l of solids and the pH was close to 0. The maximum lifetime of the rubber-lined pump was two months, but the WPP wear resistant pump operated without any problems for a similar period of time. The pump was opened for inspection of wear, and the result was excellent: there was no apparent wear in the pump.

Figure 2. WPP32-80 made from Avesta 654SMO.

Electrochemical corrosion always takes place within electrochemical corrosion pairs as stated above. A potential difference between the process equipment is not accepted. The key word is isolation from the ground. This is very important in the electrolysis process step, especially in the electrowinning process where the dissolved product is supposed to precipitate on the cathodes. Electrochemical corrosion can destroy the pump in a short period of time if the pump has not been installed properly.

If corrosion happens within electrochemical corrosion pairs, all the hydraulic parts of the pump should be the same. This means that those parts, which are in contact with the pumped liquid, must be made of the same material. This is important with bolts and nuts.

The other parts of the pump, which are not in contact with the pumped liquid all the time, should have corrosion resistance, especially when leakage from other process equipment takes place due to operational failures. The baseplate, bearing unit or other parts will be lost in a very short time if they are made from cast iron. We have recommended that they should be made from stainless steel also for severe service.

It is always very important to know what kind of a liquid is pumped. If it is not certain what the application is and if there is a clear possibility of chemical corrosion, the loss of material will happen in a very short period of time. The customer always has to give the information about the liquids that are in contact with the pump. The question list can be for instance as follows: Density, temperature, pH, chemicals content, contaminants, solids, solids content and size.

Nowadays, a totally stainless steel pump is possible. The stainless steel pump certainly gives a longer lifetime for the pump and thus offers more reliable pumping solutions.

Shaft sealing

The shaft seal is one of the most important factors when attempting to minimize the lifetime costs of a pump: capital, operating, maintenance and downtime costs. Experience shows that at least 60 % of all troubles with centrifugal pumps have been caused by the shaft seal.

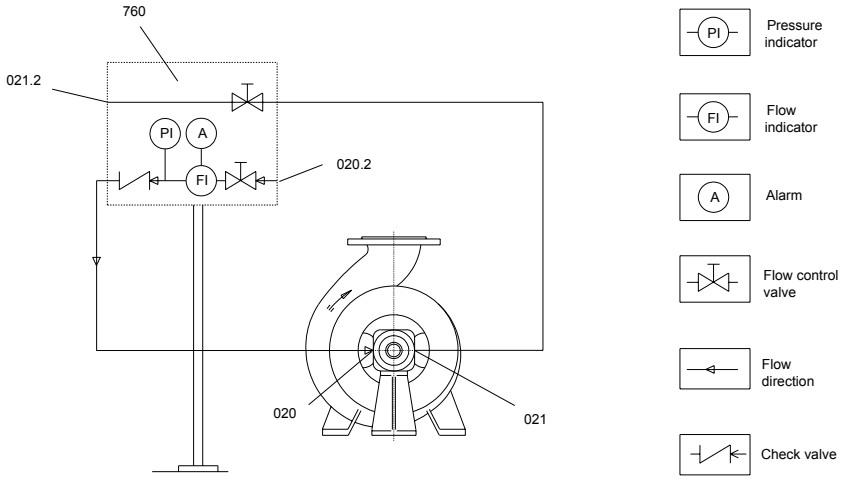
There are several reasons to use mechanical seals. One of the most usual reasons for the use of mechanical seal is the leakage, which is not permitted in any case. Another major reason is interrupted service with a high frequency of stops and starts.

The use of mechanical seals gives several advantages. The general advantages are low maintenance costs, no visible leakage, low friction losses, no wearing of the shaft or the shaft sleeve, no service during operation, no running-in needed, requires less sealing water than gland packings, and longer lifetime.

The usual mechanical seal types are Cartridge (fitting MC), Element (fittings ME) and Ready-fitted (fittings MR). The best one among these seal types is surely the ready-fitted seal. Why? Ready-fitted seals are available for applications with both easy and difficult liquids. The design is robust and simple to assemble and it is also a part of the pump. This means that the seal can be made of the same material as the hydraulic parts of the pump. The ready-fitted mechanical seal also protects the shaft of the pump because the pumped liquid is not in contact with the shaft at all.

Then there is the question of whether to select a single or double mechanical seal. Whenever possible, select a double mechanical seal because then there are two pairs of seal faces. This gives more reliable operation: it is better to have leakage to the outside because the seal face on the side of the pumped usually gets broken first. It is possible to transmit the sealing water pressure in the seal in some versions of double mechanical seals. When there is a leakage, the pressure transmission device gives information about a failure.

When a double mechanical seal is selected, the seal has two pairs of seal faces and always external sealing water. The most reliable sealing water system in metal refining applications has proved to be external pressurized non-flowing sealing liquid. This sealing liquid system is used in very demanding applications such as with wearing, impure liquids, crystallizing liquids, corroding liquids, slurries, liquor, kaoline and lime sludge. The sealing liquid first flushes impurities such as dust off the seal and then a valve located after the seal is closed. The sealing water network still feeds the seal, but the sealing liquid does not go out of the seal. The friction heat of the seal will be transferred to the sealing liquid and the temperature of the sealing liquid rises. The sealing liquid will not vaporize because there is an overpressure inside the seal. The sealing liquid circulates inside the seal through the seal faces on the side of the pumped liquid and then on the atmospheric side. The temperature of the seal faces on the atmospheric side is warmer than on the side of the pumped liquid, so the sealing water is cooled on the side of the pumped liquid. The circulation of the sealing water is possible because of the rotation of the pump shaft.



CAD drawing 910322

Figure 3. Pressurized non-flowing sealing water (non-flowing barrier) into the seal.

A pressurized non-flowing ready-fitted double mechanical seal (called dead-end) has been used in the copper electrolysis process where air bubbles are not accepted in the electrolyte. The dead-end seal doesn't let air come from the atmospheric side into the seal and into the pumped liquid because the seal is pressurized. The overpressure is achieved by a closed valve after the seal and by the supply of the sealing water network.

The dead-end seal also prevents crystallization on the seal faces on the side of the pumped liquid because the temperature of the seal face is higher than that of the pumped liquid. The higher temperature of buffer water has been obtained from the internal circulation.

The double mechanical dead-end seal is a reliable solution as a shaft seal for pumps when the pumped liquid involves crystallization, solids and especially a high corrosion. The body material of a dead-end seal is the same as the material of the volute casing. The sealing water consumption is usually about 5 liters per month.

Figure 4. AHLSTAR™ APP Process Pump with ready-fitted double mechanical seal (dead-end).

For more information please contact
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