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Wear resistant process pump for metals and fertilizers applications

In the minerals and metals processing industry or in fertilizers production, ideal application conditions where a pump is operating at its best efficiency point (BEP) and the system is stable very seldom occur. Wear and corrosion are bound to a shortened lifetime of the pump in demanding applications. A deep understanding of the application, corrosive and abrasive characteristics of the fluid, flow demands, and the process itself are key to meeting the customer's requirements. Corrosion and wear rates are not summable, and that is why pumps should be tailor-made for difficult liquids that are corrosive or both corrosive and abrasive at the same time. Innovations are needed for the development of efficient pumps with low operation and maintenance costs.

Efficiency

The worldwide industrial energy consumption is expected to increase by 42% between 2007 and 2035, or at an average of 1.3% per year. Pumping systems account for more than 20% of the world's electrical energy demand, and in certain industrial plant operations they can be responsible for 25% to 90% of the energy usage. Consequently, the minerals and metals processing industry continues to make large-scale investments that contribute to energy efficiency. The task is rewarding, because with only a small reduction in energy consumption, big savings can be achieved in terms of money. The investment has a rather low risk, because cost savings will occur whenever the plant is running.

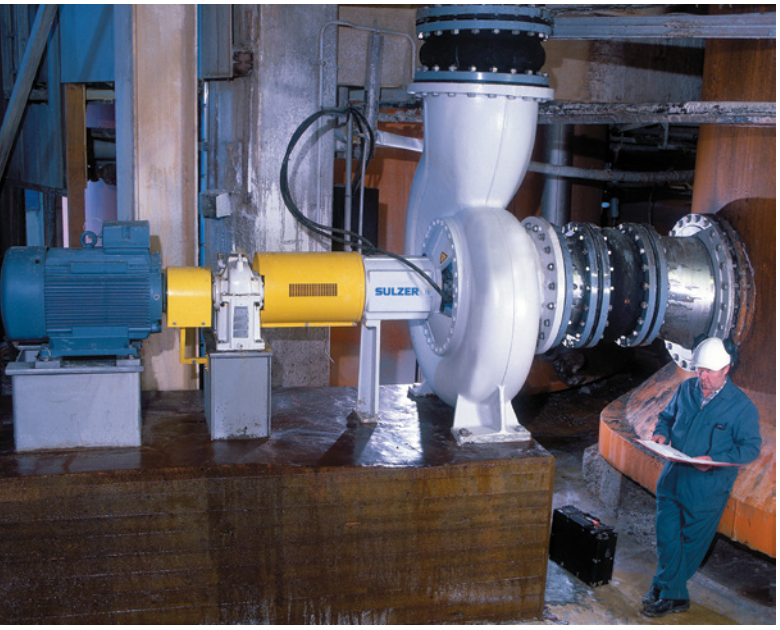

Figure 1. Ahlstar WPP design wear-resistant pump.

The Ahlstar WPP wear-resistant pump design is not a heavy-duty slurry design, figure 1. Its process pump hydraulics allows high-level efficiencies. The difference to a standard process pump is that the flow patterns of wear-resistant pumps are specially designed to prevent abrasion in the hydraulic parts. When targeting an energy-efficient pump solution, also size, speed, type of drive, pumping system lay-out as well as seal and auxiliary equipment alongside the optimal pump type must be considered for a comprehensive solution.

The best efficiency and further energy savings can be achieved by driving the wear-resistant pump with a variable speed drive (VSD) and a maximum diameter impeller. This allows the rotational speed of the pump to be adjusted to achieve the desired head and flow for the process application. The efficiency improvement compared to a constant speed driven pump can be up to 10%. A VSD can also be added to existing pumps, and once installed it can accommodate changing system demands, including potential future expansion plans without changing the pump. In addition to energy savings, this method also results in improved process control, improved system reliability, reduced maintenance costs due to reduced wear, and soft starter capability. For this reason, VSD-driven pumps are becoming more and more common in the minerals and metals processing industry.

The wear of the impeller and volute case drop the head and efficiency of the pump, with an increase in the energy consumption as a result. Unnecessary machine downtime can be minimized by monitoring the condition of the volute case, impeller and other components of a wear-resistant pump, by identifying pump defects at an early stage, and by planning preventive maintenance effectively.

Pumping of slurries, selection of pump against wear and corrosion

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 (WPP design) pump, an ordinary process pump, or a heavier design can be made according to figure 2.

The values may vary depending on how abrasive 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 with the duty point as close as possible to the best efficiency point (BEP).

There are many applications where suspended solids can severely damage the pump in a short period of time. The pump can be lost in a matter of weeks if the design and material selection are not optimized. If only abrasion needs to be considered (non-corrosive liquid), a hard material should be selected. One possible solution is chromium iron with a hardness of 600 HB. This material, A532 Class IIIA, contains about 23 – 30% of chromium to provide high levels of hardness.

If the pumped liquid comes out of the pump to the atmospheric side, there is usually corrosion, especially when the liquid contains sulfuric acid. The material comes off by corrosion on the atmospheric side when holes have been made in the volute case. This is the reason why holes for example for draining the pump are not accepted in the volute case. Corrosion is a complicated phenomenon and the result of electric and chemical effects. Corrosion is commonly divided into the following categories:

- general
- galvanic
- crevice
- pitting
- stress
- abrasion

The general rule to increase corrosion resistance is to use higher-alloyed stainless steels. Pitting and crevice corrosion resistance in particular can be improved by adding molybdenum and chromium. Duplex stainless steels are also resistant to stress corrosion.

Abrasion corrosion typically appears when pumping liquids that contain corrosive solid particles. It also occurs when pumping clean but corrosive liquids without solids when the velocity of the flow within the pump is high enough. High velocity occurs in the impeller and volute case when a pump operates at a high rotational speed.

When corrosion and abrasion take place at the same time in the pump, a metallic material is usually selected. We offer a wide range of metallic materials for wear-resistance pump designs, such as duplex, super duplex, and austenitic cast steels. Austenitic cast steels like 654 SMO®* can manage simultaneous corrosion and abrasion very well due to their tough features. Also, their corrosion resistance is good when chlorides are present in liquids that contain acidic solid particles, for example in metals leaching plants.

*Trademark by Outokumpu Oyj

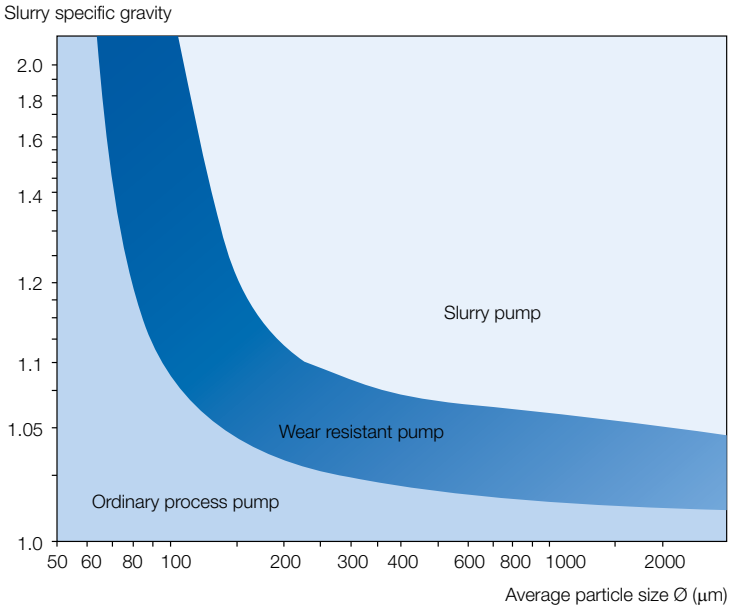

Figure 2. Pump types according to average particle size and specific gravity.

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