

Stepping outside the standards for higher corrosion resistance

Corrosion resistant pumps are critical to many industrial processes. While some duties may use plastics for pump construction, the mechanical limitations of this material mean that for most applications, cast metals are used. Traditionally, high-alloy steels have been widely used with limited success in more severe duties. Around thirty years ago, when austenitic-ferritic steels (duplex) became available, Sulzer Pumps was the first company in the world to use the material in seawater injection pumps. The following examines the latest high alloy cast steel used by Sulzer Pumps for demanding industrial processes that deliver improved performance over duplex types.

Extended pump life:

Pump manufacturers experience continuous pressure from users to extend the life of process pumps in order to benefit customers by reducing parts and labour costs and reducing the number of unplanned shut-downs. The key to life extension is to produce pump parts from erosion and corrosion resistant materials that nevertheless retain the properties essential for manufacturing the component. This balance is often a compromise between providing good corrosion resistance and adequate strength and hardness for the component.

Cast high-alloy steels:

The production of steels used in pumps has traditionally have been on the American Society for Testing and Materials (ASTM) Standard, which is widely accepted throughout the industry. The more recent European Standard, EN 10283, also details steel grades intended for general applications. The European and ASTM Standards contain many equivalent or nearly equivalent steel types. Typically, pump manufacturers use these standard grades for components because they source from commercial foundries.

Sulzer Pumps is dedicated to continuous research on how to improve the performance of the materials it uses. In addition to these internationally recognized standard materials, it also examines materials outside the industry standards. A good example of this is the completely austenitic, highly nitrogen alloyed and extremely corrosion resistant Avesta 654MO™ steel. This patented material is not included in either the American or European cast steel standards, so is not readily available from commercial foundries.

Benefits in the foundry process:

In the past, the duplex-alloyed steels were usually easier to make than the completely austenitic corrosion resistant grades. Production of the latter grades requires an argon oxygen decarburisation (AOD) converter or, when method in an induction furnace, raw material that has been pretreated in an AOD converter. Highly chromium and molybdenum alloyed steels must have both a low carbon content and increased nitrogen content, these conflicting needs are readily achieved using AOD technology. The low sulphur content achieved through the method lends additional corrosion resistance to the material. Because of its modern foundry production facilities (Fig. 1 and 2), Sulzer Pumps Finland Oy has become one of only a limited number of licensed producers of 654SMO.

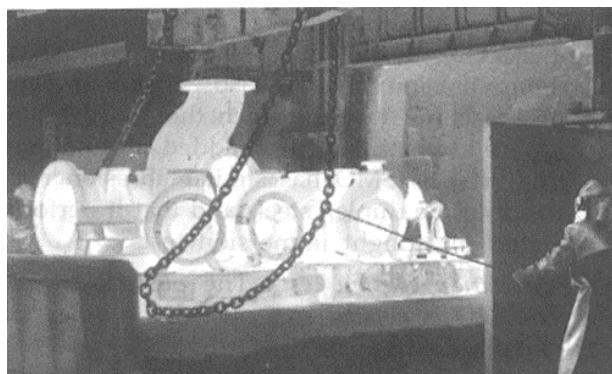


Fig. 1

Stainless steel pump casings are heat treated to optimize corrosion resistance.

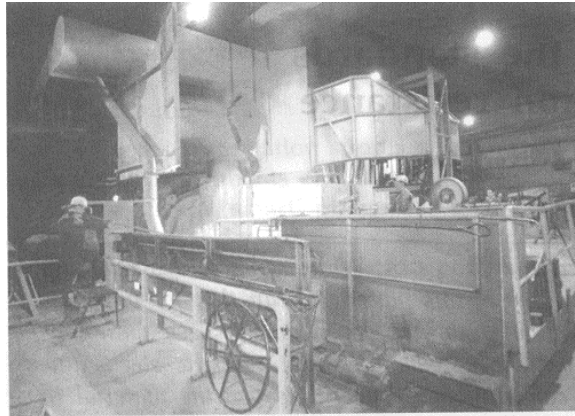


Fig. 2

Sulzer Pumps Finland Oy has state-of-the-art foundry facilities, including an argon-oxygen decarburisation converter.

654MO excels in tests:

Before committing to production of 654MO, it was important to establish its superiority to most of the common alternative materials used in pumps. The material was, therefore, subjected to the following rigorous tests with positive results.

- Critical pitting temperature: Results prove that 654MO withstands pitting corrosion well. It shows a critical pitting temperature almost 40°C higher than for duplex steels.
- Corrosion test: Samples were tested in an operational phosphoric acid reaction tank for a period of eleven days. In addition, a short-term abrasion test was also performed. Using the reaction fluid to which the abrasive substance alumina had been added. Results indicate that 654MO has similar abrasion resistance to the duplex steels and that it performs better in straight immersion tests.
- Cavitation erosion test: The performance of 654MO is clearly superior to the other materials (Fig.3)

654MO excels in live applications:

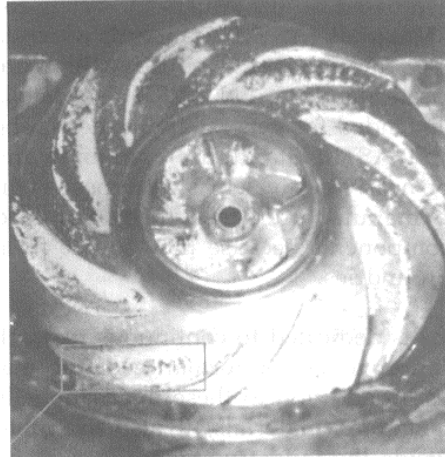
Phosphoric acid is made by a 'wet' process where natural phosphate rocks are immersed in sulphuric acid. Serious corrosion problems occur because of the aggressiveness of the industrial phosphoric acid and abrasive nature of the raw pumped solution.



In a cavitation erosion test, 654MO performed better than most standard materials commonly used for abrasive pumping applications, such as grades 3A and 5A in ASTM A890.

The Kemira plant located at Siilinjärvi (Finland) produces phosphoric acid. It chose Sulzer Ahlstar WPP process pumps manufactured from 654SMO for its production process. After three years operation, a pump was inspected internally and proved to have withstood wear so well that the text '654SMO' was still clearly visible on the impeller casting (Fig 4.)

A major manufacturers in Morocco put a Sulzer Ahlstar WPP61-600 pump (Fig.5) manufactured in 654SMO in its flash cooler circulation duty (after the reactor) on an experimental basis. After the completion of the six month test period in this extremely corrosive applications, the customer was so impressed by how well the pump had resisted corrosion damage that he immediately had three further units installed.



A pump impeller made of 654SMO stainless steel shows good wear resistance. The text '654SMO' is still clearly visible after three years of operation

State-of-the-art pumps:

Sulzer process pumps manufactured from 654SMO have class-leading resistance to erosion and corrosion attack. Sulzer Pumps can control the entire manufacturing process—from production of the initial melt and casting parts to selection of the most appropriate design features for a particular application. This ability enables it to provide exceptionally reliable pumping solutions with extended operational life that stand up to even the most arduous applications.

Reference book:

Indian Pumps
Vol. XXXVII, March 2005