

An almost everlasting evaporator circulation pump

El-Nasr Company for Intermediate Chemicals (NCIC) is the biggest fertilizer company in Egypt and a leading company in the North African market. Its Al-Fayoum fertilizer complex was started in 2011 and it includes a phosphoric acid plant (150 tons per day P_2O_5). Sulzer was the selected vendor for the supply of the axial flow pumps, among many other pumps.

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The Sulzer axial flow pump type CAHRM750K we use in the evaporator circulation loop has been running perfectly ever since the start-up and we are very satisfied. We only had to replace some parts after eight years of operation, which is remarkable.

Eng. Yasser Ahmed, Production Manager at NCIC



Evaporator circulation pump type CAHRM750K in workshop prior to packing (2010).

The challenge

The phosphoric acid is produced in a dihydrate (DH) process. The phosphate rock is attacked by phosphoric and sulfuric acid in a reactor. The 28% P_2O_5 acid produced is filtrated and then evaporated to a concentration of 54% P_2O_5 .

The constraints of the evaporator circulator are:

- 54% P_2O_5 acid with contaminants (HF , H_2SiF_6 , H_2SO_4 , $\approx 3\%$ solids)
- maximum operating temperature of $95^\circ C$
- manufacturer standard design (high flow, low head and limited NPSHa)
- no speed variation
- heavy duty and nominal bearing duration > 25'000 hours of operation

The solution

Sulzer selected the best pump size and propeller design for optimum benefits to the customer:

- propeller specifically designed for the project, with high efficiency and lasting performance in a corrosive and erosive application
- optimal selection of the operating point with regard to the BEP and inherent hydraulic constraints of axial flow pump (high NS)
- adapted mechanism for pulleys/belts assembly, guaranteeing perfect performance and long lifetime of the mechanical seals as well as trouble-free operation of the bearings

The material of construction proposed by the engineering company was SS904L, which is a common material for such applications. Its asset is a good corrosion resistance in most low-temperature P_2O_5 applications.

Customer benefit

An axial flow pump with a state-of-the-art design, adequately selected to meet exact production needs and properly serviced, proved to be highly beneficial to our customer.

The pump was operated for eight years without any repair. After that, the customer decided to replace the main wear parts: propeller, shaft, wear ring and mechanical seals. Although many of the parts could have been re-used, the customer chose to replace them with genuine new parts. Reusing worn components would not have guaranteed a similar lifetime after restart.

Despite an apparently low solids content in the fluid, the total weight of solids passing through the pump during one hour of operation can be estimated to be about 180 tons. These solids are mainly gypsum and precipitates. The traces of erosion visible on the propeller did not reveal abnormal patterns. The hydraulic design tailored for the project turned out to be successful and highly reliable.

During these eight years, the total cost of ownership (TCO) was kept to a minimum, with no added costs for commissioning, no down-time costs, no removal and disposal costs. The only costs were related to operation, i.e. energy and consumables, and routine maintenance.



Evaporator circulation pump type CAHRM750K running at site (2020).

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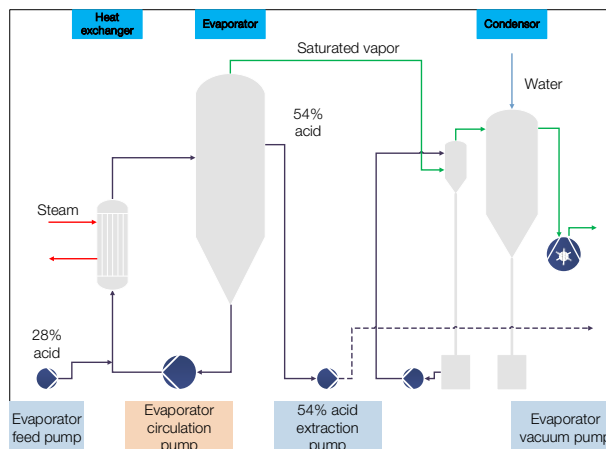
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Project data

The pump is installed in an evaporation / concentration loop. It is located between the evaporator and the heat exchanger. It takes care of the continuous circulation of the phosphoric acid through the heat exchanger and the evaporator.



Item	Description
Application	Evaporator circulation pump
Liquid	54% phosphoric acid @ 86°C
Pump type	CAHRM750K
Material of construction	Casing/wearing/shaft in WN 1.4539 Propeller in WN 1.4584
Nominal speed	520 (rpm)
Lubrication	Grease
Installation	Pump/motor side mounting on common baseplate
Motor	SIEMENS 250 kW – 3'300 V - 50 Hz
Transmission	Pulleys/belts (10 belts)
Mechanical seals	John Crane P32+FA33

For further information on the selection and operation of axial flow pumps in an evaporation loop, consult the article [Optimizing Axial Flow Pumps in Evaporator Circuit](#) written by D. Krebs (43rd Annual International Phosphate Fertilizer & Sulfuric Acid Technology Conference, AIChE, Clearwater convention 2019) or read his article [Optimizing the performance of axial flow pumps in evaporator circuits](#)