MAIN DEWATERING OF MINES
NEW COST SAVING TECHNIQUES

B. Andén, MSc Min. and Met. Eng.
Marketing Manager, Flygt AB
Solna, Sweden

ABSTRACT

Together with a large, extremely wear resistant high head submersible mine pump, a new concept of water removal is introduced offering considerable savings in installation and operation.

INTRODUCTION

The most common conventional method used today for the removal of mine waters is first to separate solids particles from the water in large sedimentation basins before pumping the clearified water out.

Multistage clean water pumps are used for this operation.

In addition to the high costs for the construction of the basins and pump foundations, operational costs are also high.

The basins must be regularly emptied of settled sludge and the drainage pumps frequently repaired or replaced due to excessive wear by abrasive particles remaining in the water.

DESCRIPTION OF THE DESIGN

General

With a new submersible pump now available, one can avoid investing in sedimentation basins. A simple water collection sump, is all that is required. The new pump can be sunk at almost any suitable angle. The water, including the sludge and particles, will be pumped out directly.

The pump is 2.7 meters long, weighs 2.5 tons and contains two main sections: the motor and the pump. They are joined with a flexible gear type coupling with axial movement possibilities. Any small angular difference between the pump and motor is automatically taken-up in the coupling and thus avoiding time-consuming adjustments and control of linear connections in the axis.

In practice, this results in a simple procedure regarding service. Disconnecting the two sections and mounting a replaced pump section is rapid, thus providing a minimum of down-time. The exchanged pump section is supplied with a shielded entrance cover to protect against bumps and dirt and then transported for servicing in the service shop.

The handling at service is quite easy as the pump is divided into two secitons; halving the weight for transportation and preventing any risk for electrical coupling problems as the power cable does not need to be disconnected from the motor.

The pump section

The pump-section has four stages and the impellers are, on both sides, sealed-off from the housing by self-adjusting long life silicon carbide sealrings which prevents capacity losses. The pump stages are also sealed-off from each other to eliminate pressure loss.

Most important is the quality of the seals, which determines the overall quality of the mine pump. Certainly good seals are critical, yet at the same time one must avoid overpressurization on the seals and also make them resistant against abrasive particles, shock and impact from by-passing heavier particles.

An advanced material and an unconventional fortified method has been chosen in order to reach increased sealing capacity and such a high wear resistance that the normal service intervals are 4.000 hours, corresponding to two service occasions per year.

Both the seals in the pump-housing and the seals between pump-stages are made of smoothly wrapped sealrings of silicon carbide, a material with a hardness equal to the upper value of normal rock. The design is made balanced resuling in a low axial force thereby diminishing the wear on the seals.

To avoid stress due to different expansion coefficients of silicon carbide and steel castings in the pump, the rings are not soldered but instead mounted with o-rings. This also offers a simplified exchange when the rings are worn down to about 25% of the material thickness. The fortification is spring-loaded and the rings thereby self-adjusting, keeping the seal tightness at a constant level as they gradually wear.

Parts subject to wear in the pump-section are either coated in high-alloy chromium steel or with a abrasive resistant polymer material so that the pump will remain as resistant as possible to the effect from the abrasive particles in the mine water.

The impellers are manufactured in high-test chromium steel and shaped as totally covered axial balanced impellers. Three of the impellers have a return-flow canal, which reduces pressure and lessens the load on the shaft bearings without appreciable loss of capacity.

The shape of the impeller was made to fit the operational range by the help of computer simulation. The goal was to create an undisturbed flow to further minimize wear on the vanes.

The impellers and the sleeves for the sealrings form, together with the pump shaft, a strengthened thicker shaft with a critical rotation speed that safely exceed the normal operational rotation speed.

At the discharge the shaft is supported in a spherical roller bearing in combination with a single row deep-groove ball-bearing which is lubricated by oil from the integrated oil chamber/cooler. The oil is circulated by movement of the roller bearing via a filter. The oil chamber is pressurized through four membranes which transmit the ambient water pressure to the oil maintaining equal pressure on both sides of the seals thereby prevent the water to impeade into the oil chamber.

The motor section

The hermetically sealed motor section is equipped with a two pole, three-phase squirrel-care motor of 200 kW at 50 Hz or 220 kW at 60 Hz. The motor, which is directly cooled by the ambient water is, among other things, equipped with thermo-switches, which prevent overheating.

Performance

The pump lifts 20 liters of liquid per second to 350 meters height (50 Hz) or 20 l/s to 380 (60 Hz). See figure 1. The pump is designed to work in liquids with a pH between 6 and 11 and at temperatures up to +40°C. The motor is completely sealed so that it can be submerged down to a depth of 100 m below the liquid surface. The largest pumpable particle size is 10 x 10 mm.

For easy handling of the pump, it is normally placed on a skid. (See figure 2).

APPLICATIONS

A first series of pumps is now being tested in four different underground mines around the world.

One pump is tested as the main dewatering pump in Bolidens' Stekenjokk Mine, a copper/zink mine in the arctic region of northern Sweden.

In May 1985 the total operating time on this unit was 4300 hours. The feed to the pump contains in average 1 gram/liter of fine solids.

Further testing has also been carried out in Canada, Poland and Hungary.

In Canada the pump has been applied in one of the settling basins in the Mt Pleasant Tungsten Mine. The operating time in May 85 was 2300 hours with feed containing up to 6 gram/liter of suspended solids.

In Poland in the Lubin Copper Mine a pump is installed on the lowest mine level were it is discharging water with the very high solids content of up to 70 gram/liter. The operating time here in May 85 was 1000 hours.

In the Tatabanya Coal Mine in Hungary the pump is applied on the main dewatering level.

SUMMARY

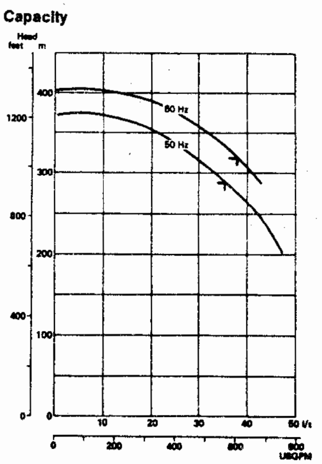
The simple installation and the low investment and maintenance costs make this pump an interesting alternative for the main dewatering in newly opened mines and on new levels in existing mines.

The test results and calculations of the total annual costs for this new pumping concept can offer more than a 30% savings compared to conventional techniques.

Fig. 1. PERFORMANCE DATA FOR THE NEW HEAVY DUTY HIGH HEAD SUBMERSIBLE PUMP

2540 180 KW 50 HZ - 200 KW 60 HZ
2950 RPM 3550 RPM
CONNECTION: 100 MM

WEIGHT: PUMP INCL. FRAME 2900 KG



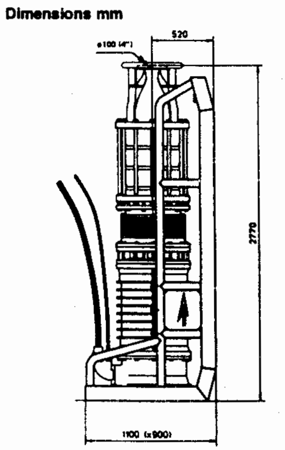


Fig. 2. HEAVY DUTY HIGH HEAD SUBMERSIBLE MAIN DEWATERING PUMP PLACED ON A SKID.