SIEMAG TECBERG

TECHNICAL INFORMATION

60 MW HIGH-CAPACITY COOLING PLANT WITH 4 P.E.S. SYSTEMS

(ANGLOGOLD ASHANTI, MOAB KHOTSONG MINE, SOUTH AFRICA)

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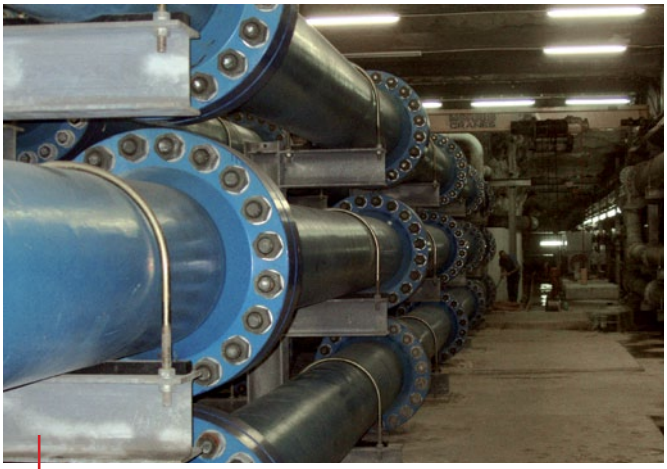
In mid 2005, SIEMAG TECBERG (Pty) Ltd. (a 100 %-owned subsidiary of the German company SIEMAG TECBERG GmbH in Haiger) in Johannesburg, South Africa, received an order for the construction and supply of 4 complete three-chamber pipe feeder systems (P.E.S.) for the central air cooling of the MOAB KHOTSONG gold mine. With an exchange capacity of 60 MW, it is the largest unit worldwide. The gold-ore mine is located around 240 km to the south of Johannesburg and is owned by AngloGold Ashanti, South Africa.

In South-African mines, gold ore is mined at depths of up to -4,000 metres and then hoisted to the surface for processing. In the so-called gold reefs, the rock temperatures may be as high as 55 °C and more. The use of machinery below ground to increase production capacity further increases these temperatures. In addition, the humidity of the air is extremely high due to the high volumes of water required for drilling work. Depending on the location of the mine, the temperature of the ventilating air above ground at the shaft entry may also reach 32 °C in the summer months.

Some of the air being drawn in is pre-cooled above ground. However, when all these factors are taken into account, it is safe to say that work at the gold reefs would be completely impossible without a cooling system. In order to cool the working areas below ground down to below 30 °C effectively, large quantities of cooling water have to be prepared by refrigerating machinery above ground and then piped below ground. The three-chamber pipe feeder systems (P.E.S.) are installed close to the main shaft at levels of -1,200 and -2,400 metres.

According to the flow plan (overall cooling concept), the cooling-water volume of 2 x 1,150 m³/h is pumped at 1.5 °C through two insulated shaft pipes DN400, PN150 in each case from above ground to the two parallel three-chamber pipe feeder systems DN300, PN150 at level -1,200 m. After pressure compensation from 125 bar to 3 bar, the cold water (2 °C) is fed into the so-called cold-water dam at -1,200 m through the cold-water outlet of the P.E.S. At the same time, the warm water (25 °C) is piped in the opposite direction from the warm-water dam (level -1,200 m) through the low-pressure warm-water inlet of the P.E.S. for pressure adjustment from 3 to 125 bar, and then into the two shaft pipes DN400 for re-cooling above ground.

High-pressure pumps with driving power of approx. 3 x 2,500 kW, level -1,200 m/level -2,400 m



Three-chamber pipe feeder system (P.E.S.), level -2,400 m

MOAB KHOTSONG Mine, 240 km south-west of Johannesburg, source: AngloGold Ashanti

Both processes are carried out at energy-saving low pumping powers according to the “communicating pipes” principle. This substantially eliminates all the lifting work of the high-pressure pumps which have drive powers of approx. 3 x 2,500 kW (see diagramme below).

In the South-African gold-mining industry, the high-pressure pumps are part of a mine’s standard safety equipment. The three high-pressure pumps remain switched off during P.E.S. cooling operations.

At the next state, the same process as described above takes place between the levels of -1,200 and -2,400 metres. For this project, SIEMAG TECBERG switched two P.E.S. systems in series for the first time in order to achieve a cooling capacity of 60 MW down to depths of -2,400 m while saving a high degree of energy.

In order to reach the -3,200 metre zone, two further P.E.S. systems are currently being planned for MOAB KHOTSONG.

IMPROVEMENT OF THE THERMAL-ENERGY BALANCE

During P.E.S. operation, the thermal-energy balance is improved with reference to a pump/throttle system by 2 x approx. 1.5 °C = 3.0 °C. For a total volume of cooling water of 2,300 m³/h, this gives a thermal surplus of around 8,000 kW equivalent to an electrical surplus of 1,600 kW.

The reason for this is that water is heated by pump and throttle operations, i.e. for 120 bar, the thermal loss is around 1.7 °C. In addition, the heat generated by the 2,500 kW motors causes further worsening of the overall climate in the mine.

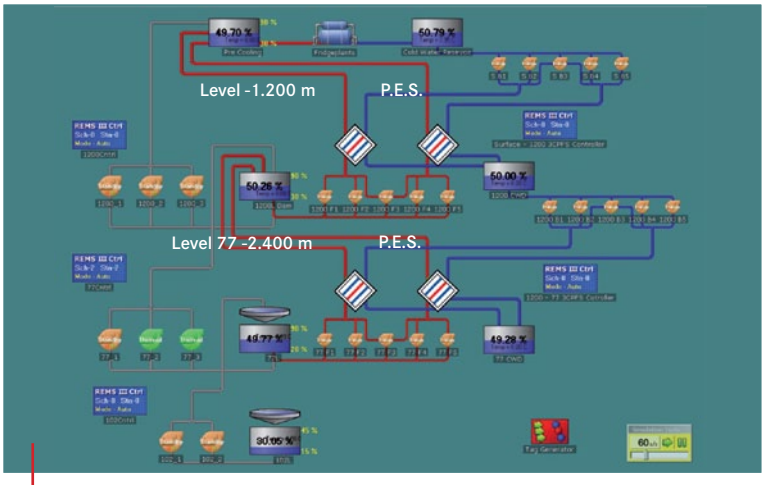
PLANNING FOR THE FUTURE

A new development patented by SIEMAG TECBERG makes it possible to couple two P.E.S. systems (without dams at level -1,200 m) in series. This makes it possible to provide temperatures of approx. 3 °C for the air coolers at level -2,400 m for the first time.

IMPROVEMENTS IN POTENTIAL ENERGY EFFICIENCY

Improvements in energy efficiency were achieved by the following means:

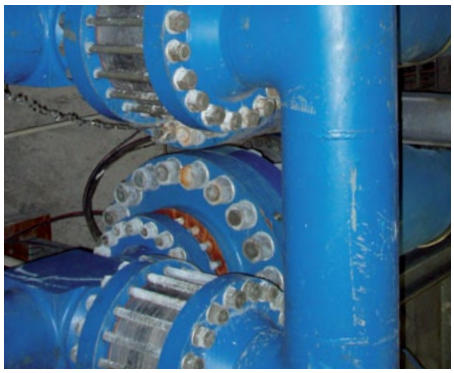
The three-chamber pipe feeder system in the MOAB KHOTSONG Mine utilises the potential energy of the cold water (2 °C) flowing downwards through the shaft pipes for transporting the warm water generated by the operations below ground (25 °C) back to the surface. On an average, this system reduces the energy consumption by around 70 % compared to conventional systems. Only the pressure losses in the shaft pipes are added to operate the primary side of the cooling circuit.

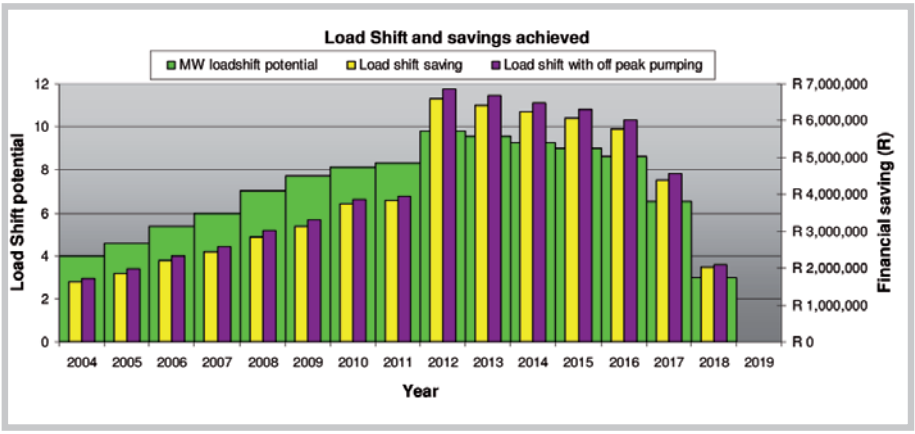


Flow diagramme of overall cooling concept
MOAB KHOTSONG MINE

TECHNICAL DATA

Number of three-chamber pipe feeder systems (P.E.S.)	4
Location 1	Level -1,200 m
Location 2	Level 77 -2,400 m
Volume flow per P.E.S.	1,150 m³/h
Total volume flow with 2 P.E.S. systems	2,300 m³/h
Main valves / pipe chambers	DN300, PN150/DN600, PN150
Electrical control system	stored programme with touch panel
Shaft pipes (insulated) for cold water	2 x DN400
Shaft pipes for warm water	2 x DN400
Cold-water temperature Warm-water temperature	approx. 2.2 °C (-1,200 m level) approx. 25 °C (-2,400 m level)
Rated pressure, primary circuit (1 + 2) Rated pressure, secondary circuit	125 bar 16 bar
Refrigerating capacity Total length of each three-chamber pipe feeder system (P.E.S.)	max. 60 MW 37 m



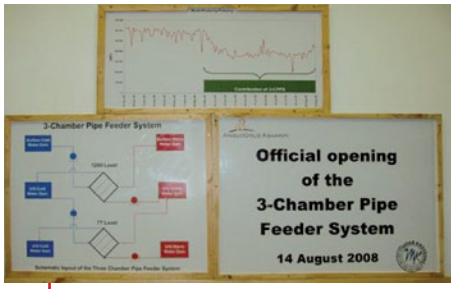


LOAD SHIFT POTENTIAL WITH PROJECTED ANNUAL ENERGY SAVINGS

Planning has shown that feeding cold water into MOAB/Great Noligwa affects the performance (cooling capacity) of the three-chamber pipe feeder system at level 77 (-2,400 m). If the water supply to Great Noligwa was stopped, this would almost double the annual savings potential. The financial savings calculated for the period 2008 to 2019 (when the load shifts in the freshwater pumping system combined with the three-chamber pipe feeder system are finally realised) would be around 51 million Rand (Source: customer information).

The refrigerating capacity of up to 60 MW generated above ground is supplied to the air coolers of the secondary circuit via the 4 P.E.S. systems with an excellent degree of efficiency. Compared with other systems, the three-chamber pipe feeder systems (P.E.S.) are capable of achieving very high savings in energy while retaining a high degree of availability for the plant as a whole.

The flow diagramme shows the overall concept of the cooling system at the MOAB KHOTSONG mine during the opening on August 14, 2008.



Flow diagramme of the overall cooling concept MOAB KHOTSONG MINE, opening MOAB

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