Site report

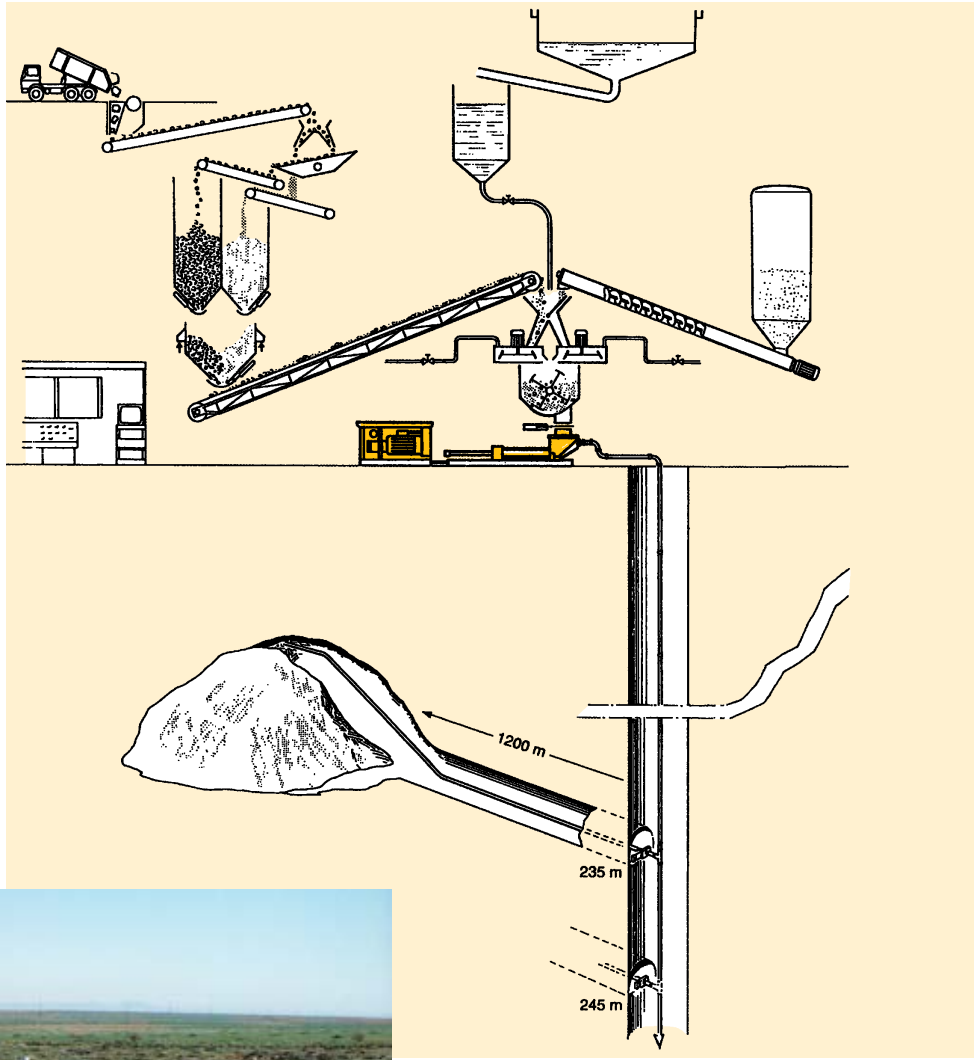
Backfilling in mines and draining pools with KOS solids handling pumps

Not only in the European mining industry are high production costs forcing those running mines to take extensively mechanized measures. The following report from Morocco describes the use of double piston high density solids pumps for back-filling waste and waste sludges as well as for conveying highly abrasive pit sludges.

A. Backfilling mine residue below ground

Preparation of waste residue

In the Moroccan mine of Hajar, 40 km south of Marrakech, 2,000 tonnes of waste arrive daily as a result of the lead, zinc and copper production. For reasons involving environmentally protection and to stabilize the pit building for further excavation work, the waste is mixed with cement and waste sludges from thickeners, and then brought back under ground again. The waste is crushed in a crushing plant in the immediate proximity of the shaft, then classified and delivered by a conveyor belt to a mixer. The waste sludge which arises from the ore separation is de-watered, collected in a silo and then also delivered to the positive-action mixer.



Above: Systematic representation of the mine backfilling with KOS solids handling pumps

Left: The classified waste is first weighed and then passed into the mixer via a conveyor belt

Putzmeister

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A delivery auger draws off the precisely metered amount of cement needed from a third silo, and this is mixed in the mixer with the crushed waste and waste sludges.

The backfilling material when ready mixed is passed into a 12 m^3 capacity supply container equipped with agitator which is positioned directly above the material hopper of the Putzmeister solids handling pump KOS 2180. The electrohydraulically-driven piston pump consists essentially of the actual pumping unit with material hopper, S transfer tube, two delivery cylinders, two delivery pistons and hydraulic drive cylinders.

The mix – one batch corresponds to 1.25 m^3 – has the following composition:

Gravel 5 - 10 mm	850 kg
Gravel 0 - 5 mm	950 kg
Water	120 l
Cement	110 kg
Sludge from the thickener (Density 1.9 - 2 kg/l)	240 kg

Directly above the solids handling pump KOS 2180 is the 12 m^3 capacity supply container. The hydraulic unit of the solids handling pump is in the foreground.

The KOS solids handling pump

Due to the orbicular cross-section of the total conveying system, KOS double piston pumps are successfully used for conveying high density solids under extreme conditions, e.g. when:

- Pumping high density solids with extremely high dry solids content
- Conveying sludges over great distances
- Pumping abrasive, resp. aggressive media with enclosed foreign bodies, the size of which can be 2/3rd of the diameter of the S transfer tube and the delivery line

The main feature of the pump is the S transfer tube. This swings in the supply hopper alternatively in front of the two delivery cylinder openings. The delivery pistons move equably with 'push-pull' action in the cylinders, suction and pressure stroke alternate: Due to the one free cylinder opening, one piston sucks the material to be conveyed out of the hopper into the delivery cylinder. At the same time, the piston running parallely pushes the material out of the second delivery cylinder via the S transfer tube into the delivery line. When the respective end position is reached, the piston changes direction and the transfer tube swings over in front of the other cylinder opening.
The S transfer tube forms the connection between the respective delivery cylinder and the connected-up delivery line.

An automatic ring reliably seals the only point of separation between the delivery cylinder and the transfer tube. The automatic ring is borne loosely. The sealing effect

From a depth of 435 m a solids handling pump KOS 1040 conveys the abrasive sludges above ground and safely masters conveying pressures up to 130 bar

arises due to the contact force on the sliding surface of the spectacle plate. The contact pressure is dependent upon the built-up conveying pressure; the higher the pump pressure, the more leakproof the whole delivery system is. The hydraulic unit for the pump drive and the switchbox for the electric control and monitoring are set up separately. The whole installation for the waste backfilling is controlled by a separate central control.
In keeping with the requirements of the Hajar mine, Putzmeister has designed the two cylinder piston pump KOS 2180 with a specially large volume and long stroke; it has a stroke of over 2,100 mm, and a cylinder diameter of 280 mm; this is the equivalent of a cylinder volume of 129 l. This thus guarantees that the number of transfer tube switchovers is kept as low as possible and that pump conveying is especially quiet and uniform.
The Putzmeister solids handling pump with this design obtains an output of 120 m^3/h and 60 bar pressure in the medium.

Backfilling the excavation

A delivery line with a diameter of 125 mm is connected to the transfer tube outlet of the backfilling pump. This is first laid 10 m horizontally and then led vertically underground. From the 235 metre floor, the delivery line is laid downwards to backfill the mine working horizontally in several galleries. These reach up to 1,200 m horizontally into the pit building and are backfilled in stages with the prepared mix from the waste and cement.
The high density solids pump conveys on average approximately 65 m^3/h.
After setting, further excavation work can be carried out on the approx. 10 m thick layer.

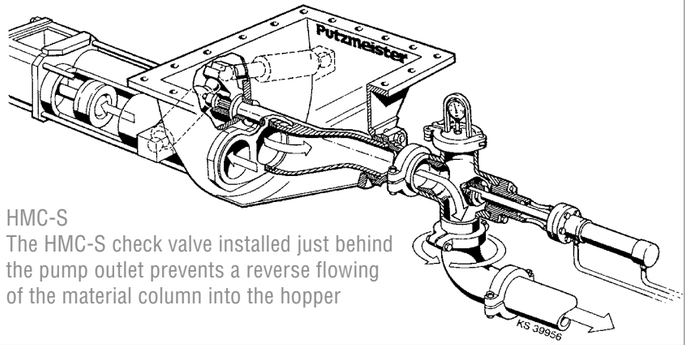
B. Conveying abrasive pit sludges above ground

Great wear on centrifugal pumps makes the use of a piston pump compulsory

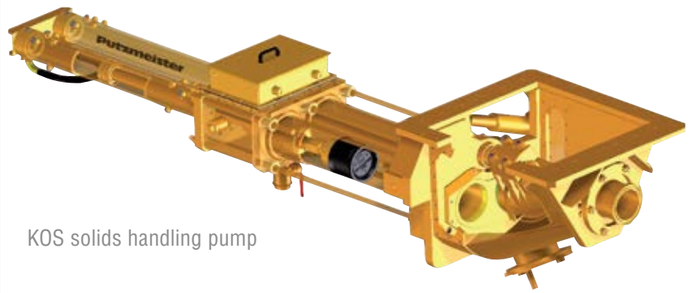
270 m away, another shaft is faced with the problem of conveying the pit water that arises with a high share of finest grain and abrasive sand out of the central pools.
Earlier experience has shown that centrifugal pumps wear within the shortest of time when conveying this extremely abrasive water.

Those responsible at the Hajar mine therefore decided to first collect the pit water in three settling basins and to purify it.
The sewage water thus purified can then be conveyed by centrifugal pumps above ground as was planned and with justifiable wear costs. After just a few weeks the sand and the sediment content in the pit water have settled as fine sludge in the range. Also here the density amounts to 1.9 to 2 kg/l.

At the front of the pit basins there is a Putzmeister solids handling pump, type KOS 1040. This can be driven on rails in front of each of the sludge basins.



HMC-S
The HMC-S check valve installed just behind the pump outlet prevents a reverse flowing of the material column into the hopper

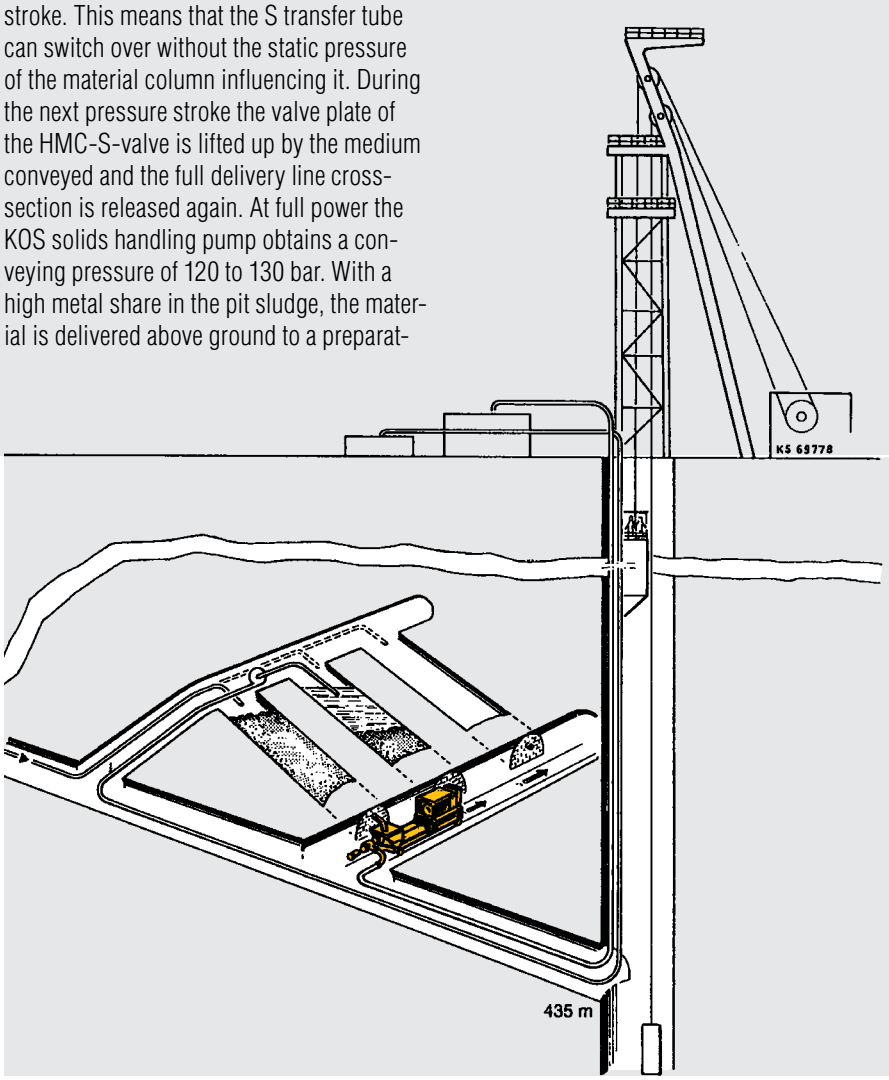


KOS solids handling pump

A pipeline which can be easily interrupted at any time with the help of a shut-off valve - forms the connection between the pool outlet and the material hopper of the KOS solids handling pump.

435 m conveying height without a relay pump

Due to the high degree of abrasive medium, wear parts of the KOS solids handling pump which come into contact with the sludges such as spectacle plate and automatic ring, have been equipped with ceramic layers by Putzmeister.
An hydraulically controlled Putzmeister HMC-S-check valve has been installed in the delivery line to prevent the 435 m high vertical material column flowing back into the high density solids pump when the transfer tube switches over. This valve closes the delivery line to the pump for a short point of time after every pressure stroke. This means that the S transfer tube can switch over without the static pressure of the material column influencing it. During the next pressure stroke the valve plate of the HMC-S-valve is lifted up by the medium conveyed and the full delivery line cross-section is released again. At full power the KOS solids handling pump obtains a conveying pressure of 120 to 130 bar. With a high metal share in the pit sludge, the material is delivered above ground to a preparation plant, – or taken to the waste ground. The mining association thus succeeds in the sensible closing and economic operation of the cycle – excavation, ore separation, preparation of the residue and backfilling.



Winding tower of the Hajar mine

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