DESALINATION AT LETHABO POWER STATION

At a thermal power station, spent steam from the last stage of the turbine, is condensed back into water as part of the generating process. This is accomplished by circulating cooling water through the turbine condensers. At most coal-fired power stations the cooling water, warmed by the heat of the steam, flows to cooling towers where the natural upward draught removes the heat from the water. During this process, evaporation takes place in which pure water leaves the towers - visible as a white cloud of water vapour at most coal fired power stations. "Make-up" water (raw water) is added to replace evaporation losses.

Lethabo Power Station uses "make-up" water for the cooling systems from three sources:

- raw water from the Vaal River,
- underground water (between 7 and 10 times more concentrated than river water) from the New Vaal Colliery
- treated sewage water.

The mine and river water introduce approximately 27 tons of salts per day into the cooling water systems. These salts must be removed on a continuous basis to prevent salts accumulating above acceptable thresholds. If these salts are not removed, some salts will cause scaling of the condensers and other salts will cause corrosion damage leading to premature failure of the condenser and associated plant. Removal of the scale forming salts is done using lime softening. The removal of salts is called desalination. In the cooling water system desalination is carried out using a process known as reverse osmosis.

Osmosis and Reverse Osmosis
When a semi-permeable membrane separates two solutions of different salinity (salt concentrations) water will flow through the membrane towards the more concentrated solution. This process is known as osmosis.

In reverse osmosis, a pump is used to force the liquid through membranes, thus leaving the salts behind. This process is the opposite of natural osmosis. In this process approximately 80% of the water is forced through the membranes, leaving behind approximately 20% of the water containing most of the salts.

The advantage of this process is that any volume of dirty, unusable water can be reduced by 80% leaving a residual volume, called brine, to be disposed of in an environmentally acceptable manner.

De-salination at Lethabo
Lethabo uses reversible osmosis units for desalination of the concentrated cooling water. The clean water, permeate from the reversible osmosis units, is of a better quality than the river water. Part of this clean water is returned to the concentrated cooling water system and part is used as feedwater for the ion exchange process - another de-salination process. The water from the ion exchange process is used as boiler make-up water, which is extremely clean and has almost no dissolved salts in it. By re-using the permeate as feed to the ion exchange process, the quantity of chemicals used to produce boiler make-up water can be reduced.

Depending on the chemical condition of the water, approximately 10% of the warmed cooling water en route to the cooling towers is periodically taken through to a clarifier. In the clarifier, suspended solids are removed before the water is fed, at a rate of 160m^3/h, into the reverse osmosis system. The three Lethabo reversible osmosis units are capable of purifying (desalinating) 480 cubic metres of water an hour, approximately 12 Ml/day. The amount of treated sewage sent to the treatment plant is ±1 Ml/day

The brine is disposed of on the dry ash dump by mixing it with ash. The brine is used to cool the coarse ash from the bottom of the boiler furnace. The coarse ash is mixed with the fine fly ash on the conveyor belts on the way to the ash dump. The cementing properties (pozzolanic properties) of the ash are used to encapsulate the salts contained in the brine. This helps to reduce dust problems and the salts are also prevented from polluting the environment.

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