BRINE BLOWDOWN PUMP

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1. The Duty of the Plant and its Rangeability

1.1. The Hydraulic Layout

The brine blowdown pump has the task of evacuating the concentrated brine from the desalination plant and at the same time controlling the level of the brine in the evaporator's last stage.

This control is, in general, achieved by throttling, although in some cases it is achieved by speed variation via hydraulic coupling.

Similarly to the brine re-circulation pump, the brine blowdown pump operates under severe available net positive suction head (NPSHav) conditions, because its suction side is under heavy vacuum.

It is important, therefore, to take the maximum care in the arrangement and in the computation of the velocity on the suction side of the pump in order to avoid the formation of vortexes, and to further reduce the NPSHav due to the pressure losses.

For this reason, the brine blowdown pumps are often of the vertical type, despite the less easy maintenance, or are installed together with the brine re-circulation pumps in pits in order to increase the NPSHav at impeller level.

Due to the features of the circuit downstream, the brine blowdown pump, the density loss (Δρ) in the pipework is very low, therefore, the pump head is usually very low (10-16 m). The maximum loss of the circuit is represented by the control valve, Δρ, or by the orifices that need to be installed in order to prevent vacuum from entering the circuit.

Operating experience in many plants has shown very serious problems of cavitation erosion in the pipework immediately downstream of the brine blowdown pump caused
by excessive power dissipated in the control valve.

For this reason orifices are often installed in the pump circuit in order to share the head loss at various points.

1.2. The Pump Rangeability

The brine blowdown flow rate is ruled by the overall desalination plant heat and mass balance:

\[ Q_b = \frac{(Q_m \rho_m - Q_d \rho_d)}{\rho_h} \text{ (m}^3\text{ h}^{-1}) \]  

Where \( Q \) = flow rate; subscripts m, d and b = makeup, distillate and blowdown respectively; and \( \rho \) = density of the various flow rates.

It is obvious, therefore, that the maximum brine blowdown flow rate will be achieved when the makeup flow rate is maximum, and the distillate flow rate is minimum.

This condition is achieved for the highest top brine temperature (TBT) and at the highest seawater temperature.

The part load condition, achieved at minimum TBT, indicates on the other hand, the minimum flow requirement.

1.3. The Design Criteria

The required head for the brine blowdown pump is the combination of:

1. Geodetical head
2. Pressure head
3. Friction head

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