BRINE RECIRCULATION PUMP

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1. The Duty of the Plant and Rangeability

1.1. Hydraulic Layout

The hydraulic recycle pump is, in general, the most energy consuming equipment of the desalination plant. It has the duty to pump the flashing i.e. the brine blended with the make up from the last stage throughout all heat recovery tube bundle up to the first stage spray nozzles. A simplified scheme of circuit of the subject pump is shown Figure 1.

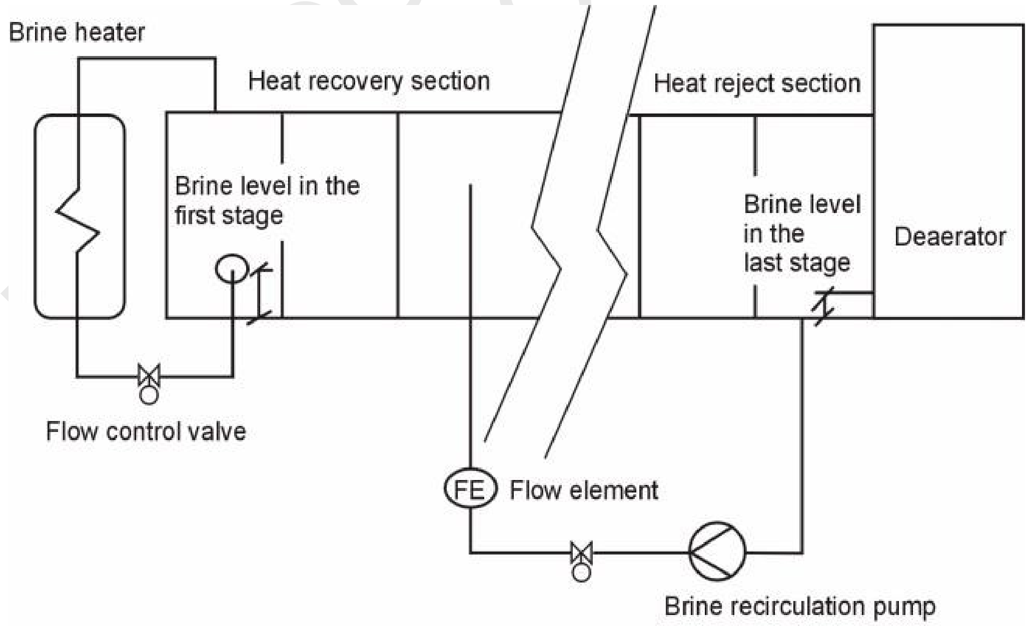

Figure 1. Brine recirculation circuit schematic diagram.

The design of the equipment is therefore extremely important and has to be carried out with great care.

The first approach to the selection of such equipment is the determination of the hydraulic layout of the circuit, and the knowledge of the circuit resistance curve.

1.2. Design Criteria

At least two points must be set in the flow rate head curve.

The first, corresponding to the maximum top brine temperature and brine circulation flow rate, represents the criteria to define the maximum head, and is strictly correlated to the power input requested by the pump.

The second, corresponding to the nominal top brine temperature (TBT) and brine recycle flow rate, represents the criteria to define the head which must be lost in the control valves of the circuit.

These two points must be specified by the designer to the manufacturer and be used to establish the pump layout curve.

Moreover, it is good practice to specify for the subject pump a 10 per cent overload capacity which allows the circuit some flexibility and some margin in order to increase the distillate production through the increase of the brine recycle flow rate.

In respect of the control head losses other points should be also considered such as the minimum load flow rate. This condition corresponds to the minimum head requested by the circuit, and therefore to the maximum pressure loss which has to be throttled by the control valves.

It is important, furthermore, to consider that the shut off head of the brine recycle pump governs the design and test pressure of all the evaporator heat recovery section tube side. Consequently, the shut off head should be specified to the manufacturer because it will directly affect the design pressure of the whole circuit by a multiplying factor (usually 1.25).

In this respect, the adoption of a mixed-flow two-stage centrifugal pump has some advantages. In fact, this kind of pump presents a typical flat curve where the shut off head increase with respect to the duty points is smoother that in a single stage.

The brine recirculation pump is operating with the suction side under a very high vacuum conditions. Particular care therefore must be adopted by the designer in the definition of the net positive suction head (NPSH) available.

Since the impeller position is decided by the pump manufacturer it is a good practice of the pump purchaser to specify the NPSH available to a fixed geodetical defined level, such as for example, the pump ground level where the pump basement will be installed.

The calculation and the verification of the NPSH available at the impeller level, will be left therefore to the pump manufacturer after reviewing the pump configuration and dimensions.

Notwithstanding that the international codes specify that at least 0.5 m of margin between the available and the required NPSH must be kept by the pump manufacturer, it is also good practice to leave a more conservative margin, if the design of the suction pipework is not completely finalized.

It has furthermore to be considered that the behavior of the NPSH required for any vertical pump presents a sharp increase toward the limit values of the continuous operating curve (minimum flow, 110 per cent overload).

Therefore the compliance of the NPSH available and that required has to be thoroughly checked throughout the operational range of the pump starting from the minimum flow.

This can cover the flexibility which must be ensured in the circuit in case the brine recycle flow rate has to be increased, or the strainer clogs in the evaporator bottom.

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