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Ultra-High recovery Multi-Effect Distillation for nearly-liquid discharge desalination

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The availability of water is still one of the most important factors for the growth and sustainability of a country. Although many countries have free access to an inexhaustible source of water, the sea, this source cannot, as it is, be used for human purposes. To face this problem, desalination has been proposed for fresh water production, though the limitation in recovery of conventional RO plants and the generation of a waste brine effluent pose some issues of actual sustainability. Multiple Effect Distillation (MED) has been proposed in this work to be coupled with a NanoFiltration unit in order to dramatically enhance the conversion ratio of the process, thus reducing the brine volume produced.

A 2-effects MED pilot plant, with a capacity of about 1.5 m³/d, has been installed as part of the treatment chain of the Watermining project, within the premises of the power station of the island of Lampedusa (Sicily, Italy) and is fully powered by waste heat at 70-80°C from the diesel engines of the power station.

Several operating conditions were investigated using real saline stream produced as a permeate of the NF unit. A recovery ratio above 80% has been achieved and an effluent brine conductivity between 250 and 300 mS/cm was produced, which is close to the saturation in NaCl, thus being excellent for being sent into evaporative ponds. A temperature between 40°C and 55°C has been maintained in the evaporator, suitable for integration with very low temperature waste heat sources. In all cases the distillate productivity and the conductivity of the produced water were maintained close the nominal values, with the latter typically ranging between 10 and 20 µs/cm.

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