CASE STUDY

MD for treatment and reuse of cooling tower blowdown

Introduction to the project

Power generation is a sector consuming great amounts of water. It accounts for more then 80% of industrial water use worldwide, making water a fundamental asset for electricity production.

With the increase of water scarcity, the power industry cannot afford the risk of competing with other industries and households for water resources. Hence, there is a need of implementing new technologies to reduce the water usage, mainly applied to the wet cooling towers.

Main Goal

Recovery of cooling tower blowdown water to be further reused into other power plant processes

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A 500 MWe coal fire power plants withdraws 45,000 m³/h of water, where cooling tower makeup is the largest consumer. In order to reduce the overall water footprint, membrane distillation can be powered with waste heat from the power plant.

The ENDESA-ENEL coal-fired thermal power plant was used in this project (MATChING EU Horizon 2020). It is located in the region of Galicia, in Spain. and uses water withdrawn from the Eume river.

Membrane Distillation

A demo MD setup with a total membrane area of 259m² was integrated within the thermal t treat a stream of blowdown water from one of the cooling towers. The cold and hot feed of the modules were operated by two pumps in order to increase the efficiency of the system. Furthermore, a vacuum was applied in the distillate channel to further improve the water production.

The blowdown water was used as feed and coolant water, and waste heat was available in the form of steam from the boiler blowdown (thermal energy source). Electricity was supplied to power all the electrical equipment.

The produced distillate was afterwards used as makeup water for the cooling tower.

The demo MD setup was operational for one year.

Accomplishments/Results

The project was successfully completed after parametric tests were performed to evaluate the optimal conditions, and a one-year long test to assess the long term reliability of the system.

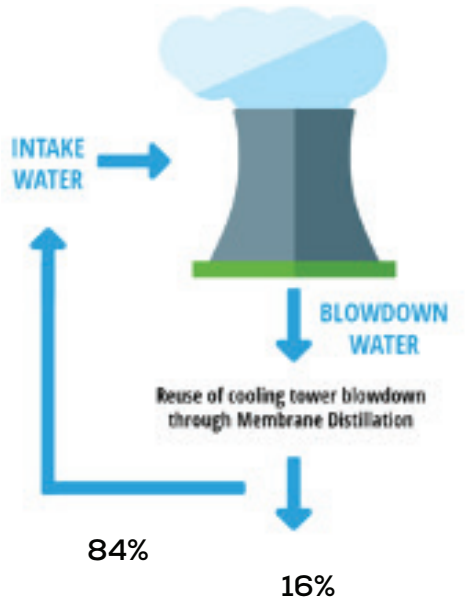
With the optimum operational conditions of 80°C as heating temperature and 12.5m³/h of circulation flow, the feed flow of 24m³/day was effectively treated, with 84% of water recovery (C.F.=6.5). The remaining 16%, the concentrate, was sent to the liquid effluent treatment plant.

On average, the specific thermal energy consumption (STEC) was 200 kWhth/m³, the specific electrical energy consumption (SEEC) was neglectable (av. 0.75kWh/m³) and the Gained Output Ration (GOR) was 3.5.

With a salt rejection of 99.7%, the produced distillate had conductivities lower then 5µS/cm. Due to its high quality, ENDESA considered other uses for the distillate, such as intake water for the demineralized water plant or in preparation of reagents like limestone slurries in DeSOx projects and/or urea solution in SNCR.

With the implementation of MD, a large amount of blowdown water can be recovered and reused, and the discharge and/or transport costs associated to the effluent streams are decreased.

The main conclusion after the closure of the project was that by using industrial waste heat, MD technology can be competitive for power plants subject to drought risk.



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