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Multi-effect distillation: A key component for a circular economy approach in industrial waste waters – A preliminary techno-economic assessment

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Most industrial processes make use of a considerable amount of water and energy while releasing waste heat and waste water solutions (also called brines). A circular economy approach can be applied to the industrial brines to recover some of the valuable main components contained in the brines and to exploit the waste heat generated by the industrial process itself. Our work is focused on the investigation of possible combinations of waste water treatment processes, in order to maximize the purity of the recovered materials and to minimize the energy requirement as well as the eventual environmental impacts of the brines. This work reports a detailed techno-economical investigation of the Multi-Effect Distillation process and its possible employment in a waste water treatment chain. A new flexible techno-economic model for the MED process was implemented in Python, which takes into account different flow arrangements and layouts (parallel cross, forward feed, with or without the TVC). A particular attention was paid on the influence of important variable and of their estimation (such as the pressure losses and the Boiling Point Elevation) with respect to the global outputs. This analysis highlighted how the pressure losses plays a fundamental role in the definition of the heat exchanger areas and, then, of the capital costs of the plant. The influence of several input parameters, e.g. the number of effects, the composition of the brine and the distillate flow rate, was analyzed both from the technical and the economical point of view. Finally, starting from real examples of industrial brines, we were able to identify the optimum sizes and process parameters which minimize the water production costs, for a required amount of produced pure water and for a certain brine composition.

Speaker Biography

Marina Micari studied Chemical Engineering at the University of Palermo and obtained her degree (cum Laude) in 2016 with a diploma thesis titled “Closed Loop Reverse Electrodialysis: Experiments and Mathematical Modelling”. After that she worked as a researcher of the University of Palermo in the EU-funded project RED-Heat-to-Power. Her activities have been –towards development and optimization of a mathematical model, describing the Reverse Electrodialysis apparatus, as well as the analysis of the integrated system composed by Reverse Electrodialysis and Multiple Effect Distillation and the one composed by Reverse Electrodialysis and Membrane Distillation. She joined DLR, Stuttgart in June 2017 and started her PhD within the framework of the ZERO BRINE project.

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