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Design, Construction and Evaluation of a Mechanical Vapor Compression Distillation System for Wastewater Treatment in a Poultry Company

Authors : Juan S. Vera, Miguel A. Gomez, Omar Gelvez

Abstract : Water is Earth's most valuable resource, and the lack of it is currently a critical problem in today's society. Non-treated wastewaters contribute to this situation, especially those coming from industrial activities, as they reduce the quality of the water bodies, annihilating all kind of life and bringing disease to people in contact with them. An effective solution for this problem is distillation, which removes most contaminants. However, this approach must also be energetically efficient in order to appeal to the industry. In this endeavour, most water distillation treatments fail, with the exception of the Mechanical Vapor Compression (MVC) distillation system, which has a great efficiency due to energy input by a compressor and the latent heat exchange. This paper presents the process of design, construction, and evaluation of a Mechanical Vapor Compression (MVC) distillation system for the main Colombian poultry company Avidesa Macpollo SA. The system will be located in the principal slaughterhouse in the state of Santander, and it will work along with the Gas Energy Mixing system (GEM) to treat the wastewaters from the plant. The main goal of the MVC distiller, rarely used in this type of application, is to reduce the chlorides, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) levels according to the state regulations since the GEM cannot decrease them enough. The MVC distillation system works with three components, the evaporator/condenser heat exchanger where the distillation takes place, a low-pressure compressor which gives the energy to create the temperature differential between the evaporator and condenser cavities and a preheater to save the remaining energy in the distillate. The model equations used to describe how the compressor power consumption, heat exchange area and distilled water are related is based on a thermodynamic balance and heat transfer analysis, with correlations taken from the literature. Finally, the design calculations and the measurements of the installation are compared, showing accordance with the predictions in distillate production and power consumption, changing the temperature difference of the evaporator/condenser.

Keywords : mechanical vapor compression, distillation, wastewater, design, construction, evaluation
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