ABSTRACT

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Cooling towers are a widely used equipment in oil refineries, power plants and large commercial buildings. The role of cooling tower is to recover the heat rejected by the equipments responsible for the refrigeration of the environment and/or processes. In this dissertation, cooling towers are used in conjunction with compression chillers. The growing environmental concerns and the current scenario of scarce water and energy resources have lead to the adoption of actions to obtain the maximum energy efficiency in industrial processes and equipments, which justifies the application of computational intelligence techniques to determine the best operating conditions of such processes and equipments. In this context, this work proposes the utilization of multi-objective optimization algorithms to determine the optimum operational setpoints of the cooling system, which is based on cooling tower and compression chillers. The multi-objective optimization proposed here provides the best trade-offs between two conflicting objectives: maximizing the effectiveness of heat exchange performed in the cooling tower and minimizing the overall energy consumption of the cooling system considered. The obtained solutions take into account the operational constraints of the equipments in order to ensure the safe operation of the cooling system. In this are applied the NSGA-II, SPEA2, Micro-GA, MOPSO and MO-TRIBES algorithms. The first three algorithms use evolutionary techniques, while the other two use techniques based on swarm intelligence. The results obtained by the algorithms are compared under different scenarios and models of the cooling system equipments, allowing for the selection of the best algorithm for the proposed application.

Keywords: Cooling towers; Compression chillers; Multi-objective optimization; Evolutionary algorithms; Swarm intelligence.