ABSTRACT

The Soxhlet extraction method is widely used to obtain phytochemical compounds from biomass or natural materials. Prior to the implementation of an integrated cooling system, the condensation process in Soxhlet typically relied on ice cubes as a passive coolant, which is inefficient for long-term and repetitive processes. The need for a more stable and sustainable cooling system has encouraged the design of a device capable of continuously condensing solvent vapor, with a compact design, low energy consumption, affordable cost, and ease of maintenance to meet laboratory requirements. In this final project, a cooling system based on a Heat Exchanger (HX) was designed and implemented to support the condensation of ethanol solvent in Soxhlet extraction.

System performance analysis was conducted using two approaches: pre-implementation with an electric heater element and direct implementation with Soxhlet. The test results showed that the system performed optimally at a flow rate of 2.75 LPM. In the heater test, cooling effectiveness reached 55% with a maximum Coefficient of Performance (COP) of 7.68. Meanwhile, in the Soxhlet test, effectiveness increased from 65% to 81%, and the Specific Energy Consumption (SEC) decreased from 0.131 kWh/L to 0.095 kWh/L, accompanied by a reduction in electricity cost per liter of approximately 27.5%. Therefore, from the test results that have been tested, the HX-based cooling system has proven capable of accelerating condensation time, improving energy efficiency, and serving as a feasible alternative cooling solution for Soxhlet extraction in laboratory environments.

Keyword : Soxhlet, Condensation, Cooling system, Heat Exchanger, Effectiveness, COP, SEC