INFLUENCE OF SUPERHEATED VAPOR IN BINARY CYCLE WITH WORKING FLUID R123 UTILIZING LOW-TEMPERATURE GEOTHERMAL RESOURCES

Mochamad Denny Surindra*, Wahyu Caesarendra, Totok Prasetyo, Teuku Meurah Indra Mahlia and Taufik

**Politeknik Negeri Semarang,*
Jln. Prof. Soedarto, Tembalang, 50275, Semarang, Jawa Tengah
Indonesia

ABSTRACT

The binary cycle on Organic Rankine Cycle (ORC) system has been appropriated technology for generating electricity in order to utilize low-temperature geothermal resources. The degree of superheated vapor attracts attention to be studied further because it is the last point to absorb heat energy from geothermal heat sources and influence the amount of expansion power produced by the expander. Therefore, achieving high ORC system efficiency requires a parameter of superheated vapor degree. This work presents an experimental study on binary cycle applying R123 as working fluid to investigate the effect a variety of superheated vapor degree on the ORC efficiency. Geothermal heat sources are simulated with lubricant oil as an external heat source to provide input heat to ORC system. Temperature High inlet (TH in) evaporator is made to remain at 120°C during the experiment, while mass flow rate is adjusted to make superheated vapor variations, namely set at 5°C, 7°C, 9°C, 11°C, and 13°C. Furthermore, the effect is observed on heat transfer inlet, pinch, heat transfer coefficient, expander work output, isentropic efficiency, expander shaft power, power generation, thermal efficiency, and ORC efficiency. The experimental results showed that mass flow rate nearly remains unchanged on variety of superheated vapor. The range of heat transfer inlet, pinch temperature and heat transfer coefficient are 27.89 kJ/kg-25.34 kJ/kg, 9.35°C-4.08°C, 200.62 $W/m^2.°K$-232.54 $W/m^2.°K$, respectively. The expander work output demonstrates a slight decrease with range 2.56 kJ/s-1.98 kJ/s, while generator produces relatively a same trend electricity with range 1.37 kW-1.37 kW. The maximum back work ratio and ORC efficiency are 0.079 at superheated of 13°C and 8.6% at superheated of 3°C, respectively. In conclusion, ORC system efficiency can be triggered by many parameters, including the amount of temperature on the exit side of evaporator. The superheated vapor of working fluid R123 to higher temperature has affected a decrease in ORC system efficiency due to the decrease in heat transfer inlets, although based on the theory reveals that the work total has increased. Further investigation have found that the magnitude of the mass flow rate affects the behavior of component ORC system.

(Total word 346)