ABSTRAK

Pemanfaatan kembali *waste heat* dan *low grade thermal energy* telah menjadi topik penelitian sejak energi jenis tersebut dapat diperoleh dari sisa proses – proses industri, kolektor surya, dan gas buang kendaraan. Sistem refrijerasi ejektor uap merupakan suatu perangkat yang ekonomis dan ramah lingkungan dimana sistem ini dapat beroperasi dari panas sisa dan refrijeran yang fenomena pencampuran aliran serta performa dari ejektor uap. Dengan memperbesar ruang pencampuran melalui *throat* yang dapat diubah – ubah, nilai optimum rasio luas penampang *throat* pada ruang pencampuran akan diteliti secara eksperimen.

Sebuah sistem refrijerasi ejektor uap berskala kecil telah dirancang dan difabrikasi. Ejektor dirancang dalam suatu sistem terbuka dan boiler beroperasi pada tekanan 100 – 400 kPa. Fluida didalam sebuah evaporator bertemperatur antara 50 - 80°C, sedangkan temperatur kondenser dikondisikan pada 27°C. Ruang pencampuran dengan diameter 8 mm dan 3 konfigurasi panjang (50 mm, 100 mm, 150 mm) diuji pada kondisi posisi NXP 0 mm dan diameter nosel 2 mm.

Dengan memvariasikan rasio luas *throat* pada ruang pencampuran, hasil percobaan menunjukkan nilai optimum dari *entrainment ratio* didapatkan dengan rasio luas *throat* 18.75 pada tekanan boiler 100 kPa dan temperatur evaporator 80°C dengan nilai $\omega = 1$. Sedangkan, nilai rasio ekspansi optimum adalah 2.1 dan koefisien performa dari sistem refrijerasi ejektor uap adalah 0.98.

Kata kunci: *Waste heat*, sistem refrijerasi ejektor uap, rasio luas penampang *throat*, *entrainment ratio*.

ABSTRACT

The utilization of waste and low-grade thermal energy has been of interest to reaserchers ever since this type of energy is available from sources such as industrial process waste, solar collectors, and automobile exhaust. Steam ejector refrigeration system is an application, which is economically feasible and environment-friendly as it can operates with waste heat and a harmless refrigerant such as water. The aim of this paper is to investigate the entrainment behavior and performance of steam ejector. Through enlarging the designed mixing chamber by replaceable throats, optimum area ratio throat of mixing chamber is studied experimentally.

A small scale steam ejector refrigeration system was designed and manufactured. This ejector setup consist of an open loop configuration and the boiler operated in the pressure range of Pp = 100 – 400 kPa. The typical evaporator liquid temperatures range from Ts = 50 - 80°C while the condenser temperature fixed at Tc = 27°C. The mixing chamber with 8 mm diameter and three length configurations (50 mm, 100 mm, 150 mm) were tested while the nozzle exit position remained unchanged at 0 mm and used 2 mm nozzle's diameter.

With variable area ratio throat of mixing chamber, experiments showed that the optimum entrainment ratio was obtained by throat area ratio 18.75 at 100 kPa primary pressure and 80°C secondary temperature with $\omega = 1$. Meanwhile, the optimum expansion ratio was 2.1 and optimum coefficient of performance of steam ejector refrigeration system was 0.98.

Keywords: waste heat, steam ejector refrigeration system, area ratio throat, entrainment ratio