

INTISARI

Kettle reboiler merupakan alat penukar kalor jenis *shell and tube* yang digunakan untuk menghasilkan uap pada *shell side*. Fluida dingin ammonia pada sisi *shell* diuapkan oleh fluida panas *steam* pada sisi *tube*. Fluida pada *shell side* dan *tube side* mengalami perubahan fasa sehingga diperlukan analisis aliran dua fasa untuk perhitungan *pressure drop* dan *heat transfer coefficient*. Fluida pemanas yang terdapat pada *tube side* terendam oleh fluida dingin sehingga pertukaran kalor terjadi secara *pool boiling*. Karakteristik *pool boiling* berlangsung pada *nucleate boiling regime* agar diperoleh nilai *heat flux* yang optimal.

Tugas akhir ini bertujuan untuk menghasilkan rancangan *kettle reboiler* yang mengakomodir sejumlah *heat exchanged duty* dan mengetahui unjuk kerja *kettle reboiler* dengan variasi laju aliran massa pada sistem *Gas Treatment Unit*. Perancangan *kettle reboiler* mengacu pada *Tubular Exchanger Manufacturers Association (TEMA) Standard* dan *American Association of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII Division 1*. *Kettle reboiler data sheet* yang mencakup data termal dan mekanikal digunakan untuk menentukan berbagai variabel seperti *spesifikasi tube*, *kettle reboiler dimension*, *mean temperature*, *overall coefficient heat transfer*, *thickness*, dan *flange class*.

Hasil perancangan diperoleh *kettle reboiler* memerlukan *heat exchanged duty* 12.855,6 kW, spesifikasi *tube* jenis *u-tube*, BWG 16, panjang 6.096 mm, *tube pitch* 25,4 mm dengan *square layout pattern*, dan material 316 *stainless steel* (17 Cr, 12 Ni), dibutuhkan sebanyak 2.108 *tube*, 1.371,6 mm untuk *shell inside diameter*, *kettle inside diameter* sebesar 2.455,34 mm, dan *overall coefficient heat transfer* sebesar 1.406,34 W/m²·K. *Kettle reboiler* bekerja pada *internal design pressure* 10.600 kPa dan *design temperature* 185 °C. Material SA-516-70, *joint efficiency* bernilai 1, dan 3,175 mm untuk *corrosion allowance* dipilih untuk perancangan *shell* dan *head* lalu diperoleh *nominal thickness* 127 mm. Perancangan *nozzle* didapatkan size 10" Sch 120 untuk *shell inlet* dan *liquid outlet nozzle*, 14" Sch 120 untuk *shell outlet* dan *tube inlet nozzle*, dan 3" Sch 160 untuk *tube outlet nozzle*. Material A 105 ditentukan sebagai material *flange* dan diperoleh *flange class* 900.

Kata kunci: *kettle reboiler*, *shell and tube heat exchanger*, *pool boiling*, perancangan, TEMA.

ABSTRACT

Kettle reboiler is a shell and tube type heat exchanger used to produce steam on the shell side. The cold fluid ammonia on the side of the shell is evaporated by the steam hot fluid on the side of the tube. The fluid on the shell side and tube side undergoes phase changes so that a two-phase flow analysis is needed for the calculation of pressure drop and heat transfer coefficient. The heating fluid contained on the tube side is submerged by cold fluid so that heat exchange occurs in pool boiling. The characteristics of pool boiling take place in the nucleate boiling regime in order to obtain an optimal heat flux value.

This final project aims to produce a reboiler kettle design that accommodates a number of heat exchanged duties and knows the performance of the kettle reboiler with variations in mass flow rates in Gas Treatment Unit system. The design of the kettle reboiler refers to the Tubular Exchanger Manufacturers Association (TEMA) Standard and the American Association of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section VIII Division 1. Kettle reboiler data sheets include thermal and mechanical data are used to determine various variables such as tube specifications, kettle reboiler dimension, mean temperature, overall coefficient heat transfer, thickness, and flange classes.

The design results obtained by the kettle reboiler requires a heat exchanged duty of 12.855,6 kW, u-tube type tube specifications, BWG 16, length 6.096 mm, tube pitch 25,4 mm with square layout pattern, and material 316 stainless steel (17 Cr, 12 Ni), it takes 2.108 tubes, 1.371,6 mm for shell inside diameter, kettle inside diameter of 2.455,34 mm, and overall coefficient heat transfer of 1.406,34 W/m²·K. The kettle reboiler works on an internal design pressure of 10.600 kPa and a design temperature of 185 °C. SA-516-70 material, joint efficiency value of 1, and 3,175 mm for corrosion allowance were selected for the design of the shell and head and then obtained a nominal thickness of 127 mm. Nozzle design obtained size 10" Sch 120 for shell inlet and liquid outlet nozzle, 14" Sch 120 for shell outlet and tube inlet nozzle, and 3" Sch 160 for tube outlet nozzle. Material A 105 was specified as flange material and obtained flange class 900.

Keywords: kettle reboiler, shell and tube heat exchanger, pool boiling, design, TEMA.