

**ANALISIS PENGARUH VARIASI KETEBALAN *TUBE*
DALAM PERANCANGAN EVAPORATOR SISTEM INSINERATOR
LIMBAH MEDIS INFEKSIUS BERKAPASITAS 150 kg/jam**

Maria Josephine Facius
19/443629/TK/48825

Diajukan kepada Departemen Teknik Nuklir dan Teknik Fisika Fakultas Teknik
Universitas Gadjah Mada pada tanggal 21 Maret 2024
untuk memenuhi sebagian persyaratan untuk memperoleh derajat
Sarjana Program Studi Teknik Fisika

INTISARI

Insinerator limbah medis adalah teknologi yang mampu memusnahkan limbah medis melalui proses pembakaran dengan suhu melebihi 800°C. Dalam pemanfaatan kalor dari gas buang (*flue gas*) hasil proses insinerasi, diperlukan tambahan komponen *boiler*, salah satunya evaporator. Evaporator merupakan salah satu komponen penukar kalor yang dapat memanaskan air hingga mencapai titik saturasinya (*saturated water*). Melalui penelitian ini, dilakukan analisis bertujuan mengetahui hubungan ketebalan *tube* terhadap rancangan evaporator sistem insinerator untuk menentukan ketebalan *tube* yang tepat untuk sistem insinerator limbah medis infeksius.

Proses penelitian meliputi perhitungan dan perancangan yang mengacu pada metode Kern sebagai dasar perhitungan serta standar-standar perancangan yang ditetapkan TEMA dan ASME. Standar TEMA mencakup rekomendasi dimensi dan jenis alat penukar kalor sementara standar ASME mencakup prosedur serta standar bahan perancangan penukar kalor. Pertimbangan pemilihan ukuran didasari tingkat efektivitas perpindahan kalor yang baik serta *pressure drop* yang relatif rendah.

Hasil analisis menunjukkan bahwa semakin tebal *tube*, semakin besar nilai koefisien perpindahan kalor dan *pressure drop*-nya. Dari variasi ketebalan dalam rentang 8 hingga 18 BWG yang dianalisis, dipilih ketebalan 12 BWG untuk *tube* berdiameter luar 1,25 *inch* dan dihasilkan rancangan evaporator tipe *shell and tube* dengan panjang 1,25 m. Dimensi ini menghasilkan nilai koefisien perpindahan kalor 458,215 W/m²·°C, koefisien perpindahan kalor secara konveksi pada *tube* 942,08 W/m²·°C, dan *pressure drop* sistem 0,147 bar.

Kata kunci: *Evaporator, shell and tube, ketebalan tube, insinerator, pemanfaatan flue gas*

Pembimbing Utama : Dr.-Ing. Ir. Kusnanto
Pembimbing Pendamping : Dr. Ir. Andang Widi Harto, M.T., IPU., ASEAN Eng.



**ANALYSIS OF THE INFLUENCE OF TUBE THICKNESS VARIATIONS
ON EVAPORATOR DESIGN IN INFECTIOUS MEDICAL WASTE
INCINERATOR SYSTEM WITH A CAPACITY OF 150 kg/h**

Maria Josephine Facius
19/443629/TK/48825

Submitted to the Departement of Nuclear Engineering and Engineering Physics
Faculty of Engineering Universitas Gadjah Mada on March 21, 2024
in partial fulfillment of the requirement for the Degree of
Bachelor of Engineering in Engineering Physics

ABSTRACT

Medical waste technology is a technology to dispose medical waste through a combustion process with temperatures exceeding 800°C. In the flue gas utilization, the incinerator system requires additional components such as a boiler, including evaporator. Evaporator functions as a heat exchanger component to heat water to its saturation point. This study aims to analyze the relationship between tube thickness and the design of an evaporator, to determine the appropriate tube thickness for infectious medical waste incinerator system performance.

The process involves calculations and designs conducted using the kern method as the fundamental calculation basis, along with design standards established by TEMA and ASME. TEMA standards include recommendations for dimensions and types of heat exchanger, while ASME standards provide procedures and material design standards. The thickness selection is based on achieving high heat transfer effectiveness and maintaining a relatively low pressure drop.

The result reveals that thicker tube correspond to higher heat transfer coefficient and pressure drop values. Among the analyzed thickness variations within the range of 8 to 18 BWG, a thickness of 12 BWG was chosen for tubes with an outer diameter of 1.25 inches, resulting in the design of a shell and tube evaporator with a length of 1.25 m. These dimensions yield a heat transfer coefficient of 458.215 W/m²·°C, a convection heat transfer coefficient on the tube of 942.08 W/m²·°C, and a system pressure drop of 0.147 bar.

Keywords: *Evaporator, shell and tube, tube thickness, incinerator, flue gas utilization*

Supervisor : Dr.-Ing. Ir. Kusnanto

Co-supervisor : Dr. Ir. Andang Widi Harto, M.T., IPU., ASEAN Eng.

