PERANCANGAN *HEAT EXCHANGER* PADA STUDI AWAL INSTALASI PEMBANGKIT LISTRIK TENAGA PANAS BUMI SIKLUS RANKINE ORGANIK DI LAHENDONG

Oleh

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INTISARI

Salah satu area panas bumi di Indonesia yang telah beroperasi secara komersial ialah pembangkit listrik tenaga panas bumi (PLTP) Lahendong yang berlokasi di Tomohon, Sulawesi Utara. Lapangan panas bumi Lahendong memiliki karakteristik sumur produksi dominasi air. Air panas (*brine*) hasil pemisahan air dan uap fluida panas bumi akan diinjeksikan kembali dengan laju alir massa 624,82 ton/jam, temperatur 180^{o}C dan kondisi tekanan *separator* sebesar 10,23 bar.

Salah satu metode untuk memanfaatkan energi panas dari *brine* adalah pembangkit siklus Rankine organik (ORC). Perancangan pembangkit ORC akan disimulasikan menggunakan perangkat lunak Cycle Tempo 5.1. Sedangkan perancangan komponen *heat exchanger* pembangkit ORC yang meliputi *heat exchanger thermal oil, preheater* dan *vaporizer* akan menggunakan metode Kern. Analisis *effectiveness* metode NTU dan perhitungan efisiensi eksergi menjadi metode dalam menganalisis kinerja *heat exchanger*.

Pada hasil simulasi didapatkan daya bersih pembangkit ORC sebesar 2,46 MW dengan efisiensi termal sebesar 11% dan efisiensi eksergi sistem 34%. Hasil perancangan pada komponen *heat exchanger thermal oil* didapatkan 2 buah *heat exchanger* dengan luas area perpindahan panas masing-masing 359,4 m^2 dan 237,5 m^2 serta didapatkan nilai *effectiveness* dan efisiensi eksergi sebesar 0,49 dan 0,41 serta 81% dan 69,4%. Hasil perancangan pada *preheater* didapatkan luas area perpindahan panas sebesar 590,9 m^2 dengan nilai *effectiveness* 0,58 dan efisiensi eksergi 70%. Sedangkan Hasil perancangan pada *exchanger vaporizer* didapatkan luas area perpindahan panas sebesar 984,1 m^2 dengan nilai *effectiveness* 0,75 dan efisiensi eksergi 74%. Geometri hasil perancangan akan disajikan pada penelitian ini.

Kata Kunci : PLTP, Siklus Rankine Organik, Penukar Kalor, Perancangan

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THE DESIGN OF *HEAT EXCHANGER* ON PRELIMINARY STUDY OF ORGANIC RANKINE CYCLE GEOTHERMAL POWER PLANT INSTALLATION IN LAHENDONG

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ABSTRACT

One of commercially operated geothermal area in Indonesia is Lahendong geothermal power plant (GPP) which located in Tomohon, North Sulawesi. Lahendong geothermal field has the characteristic of water dominated production well. Brine as a result of separation process between water and steam will be re-injected with mass flow rate of 624.82 ton/h, temperature 180^{o}C and separator's pressure as high as 10.23 bars.

One of the methods for utilizing the heat energy from the brine is an Organic Rankine Cycle (ORC) power plant. ORC plant design will be simulated using the software Cycle Tempo 5.1. While in the designs of heat exchanger in ORC power plant which includes heat exchanger thermal oil, pre-heater and vaporizer will use Kern method. Analysis of the effectiveness in NTU method and the calculation of exergy efficiency will be the methods in analyzing the performance of the heat exchanger.

Result from simulation showing the net power of ORC Power plant is 2.46 MW with a net thermal efficiency 11% and system exergy efficiency 34%. The result on the design of heat exchanger thermal oil component obtained 2 heat exchanger with the heat transfer area 359.4 m^2 and 237.5 m^2 respectively, also obtained the value of effectiveness and exergy efficiency are 0.49 and 0.41 also 81% and 69.4%. Preheater component shows result of heat transfer area 590.9 m^2 with the value of effectiveness 0.58 and exergy efficiency 70%. While the result from heat exchanger vaporizer obtained the value of heat transfer area is 984.1 m^2 with the effectiveness value 0.75 and exergy efficiency 74%. Geometry of heat exchanger is also presented in this research.

Keywords: *Geothermal Power Plant, Organic Rankine Cycle, Heat exchanger, Design*

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