M1, M2 ,M3,M4,M5

1Student number : 40, Msc. Process Design in Chemical Engineering , Sharif university of Technology

2Student number : 40, Msc. Process Design in Chemical Engineering , Sharif university of Technology

3Student number : 40, Msc. Process Design in Chemical Engineering , Sharif university of Technology

4Student number : 40, Msc. Process Design in Chemical Engineering , Sharif university of Technology

5Student number : 40, Msc. Process Design in Chemical Engineering , Sharif university of Technology

Abstract

The Organic Rankine Cycle (ORC) offers a promising solution for converting low-grade heat into The Organic Rankine Cycle (ORC) is an effective and innovative approach for converting low-grade heat into electricity by utilizing organic fluids with suitable thermodynamic properties. This study examines how different working fluids affect the efficiency of the ORC across various configurations. Through a combination of experimental testing and simulation, the research identifies five fluids (Cyclopentane, Dichloromethane, n-Pentane, R113, and R141b) as top performers under different operating conditions. The findings clearly show that the choice of working fluid plays a vital role in improving the overall performance of the ORC system. Furthermore, this study highlights the importance of selecting the appropriate fluid to maximize energy recovery and enhance system reliability. The flexibility of ORC technology is emphasized, demonstrating its potential as an efficient and adaptable solution for reducing energy waste and optimizing resource utilization in industrial applications. Ultimately, the results underline the significant benefits of ORC in increasing energy efficiency and promoting sustainable energy practices, paving the way for broader adoption of clean and environmentally friendly power generation technologies.

*Keywords:* Rankine Cycle, GAMS, Fluid selection;

1. **Introduction**

Growing concerns over energy security and environmental sustainability underscore the need for efficient utilization of waste-heat streams in industrial processes. [1]A significant portion of the input energy in production systems is dissipated to the environment as unused thermal energy, which not only leads to substantial energy losses but also contributes to greenhouse-gas emissions. Among emerging waste-heat recovery technologies, the Organic Rankine Cycle (ORC) has attracted considerable attention due to its ability to operate with low- to medium-temperature heat sources and its flexibility in employing organic working fluids with low boiling points. These advantages enable ORCs to be deployed across a wide range of applications, including geothermal, solar, biomass, and industrial waste-heat recovery.

In recent years, research in this field has evolved from purely thermodynamic analyses toward multi-objective optimization and hybrid approaches. For instance, Palma-Flores et al. (2015; 2016) proposed …

1. **Results and discution**

نتایج قسمت A

| Spec | Hysys | GAMS | Error% | توضیح |
| --- | --- | --- | --- | --- |
| Wt | 8699.537 | 44853.5 | -415.585 | Heat Flow [kJ/s] |
| Wp | 242.70688 | 242.803 | -0.0396 | Heat Flow [kJ/s] |
| Molar Flow | 1.3898043 | 1.39 | -0.01408 | [kgmole/s] |
| H1 | -90102.27 | -90025.2 | 0.085523 | Molar Enthalpy [kJ/kmole] |
| H2 | -96361.81 | -122292 | -26.9095 | Molar Enthalpy [kJ/kmole] |
| H4 | -122262.9 | -121975 | 0.235481 | Molar Enthalpy [kJ/kmole] |
| P1 | 20.959427 | 20.985 | -0.12201 | Pressure [bar] |
| T2 | 312.40593 | 312.409 | -0.00098 | Temperature [K] |
| T4 | 313.24878 | 313.151 | 0.031215 | Temperature [K] |

Here is the data from the spreadsheet in the image (Part A candidates):

| Hysys | Name | Wp | Wt | Wnet(Kj/s) |
| --- | --- | --- | --- | --- |
| 1 | 2,2-dimethylbutane | 258.134799 | 6839.564 | 5213.5163 |
| 2 | 4-methyl-2-pentene | 219.5780021 | 6365.124 | 4872.8213 |
| 3 | Acetone | 56.07 |  |  |
| 4 | Benzene | 92.17404287 | 5588.065 | 4378.2778 |
| 5 | Cyclopentane | 221.3920083 | 7617.756 | 5872.813 |
| 6 | Dichloromethane | 242.7068797 | 8699.537 | 6716.9227 |
| 7 | Ethanol | 78.47 |  |  |
| 8 | FC72 | 65.9 |  |  |
| 9 | Isohexane | 205.8012394 | 6114.503 | 4685.8008 |
| 10 | Methanol | 108.9162242 | 6929.143 | 5434.3979 |
| 11 | n-heptane | 71.80336678 | 3557.273 | 2774.0151 |
| 12 | n-hexane | 166.2908911 | 5674.165 | 4373.0408 |
| 13 | n-pentane | 344.476657 | 7579.137 | 5718.8307 |
| 14 | R113 | 278.818838 | 7197.7 | 5479.2284 |
| 15 | R124 | 36.6 |  |  |
| 16 | R141b | 362.5213291 | 8510.272 | 6445.6959 |

نتایج: سیال انتخاب شده همان سیال HYSYS است؛ اغلب خطاها کوچک‌اند و فقط کار توربین و آنتالپی جریان ۲ انحراف دارند.

نتیجه: از بین ۵ سیال انتخابی، سیالات با جرم مولکولی بزرگ‌تر W\_net بیشتری ایجاد کرده‌اند؛ مطابق ادبیات (1,2) درباره معیار دمای بحرانی.

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نتایج کد قسمت B: جدول HYSYS قسمت 2 (از p.xlsx) ذکر شود. مدلسازی GAMS به دلیل حدس‌های اولیه و شرایط مرزی همگرا نشد.

1. **Conclusions**

References

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[1] Equations of State

[2] Peng Robinson