COMPARATIVE STUDY OF ORGANIC RANKINE CYCLE(ORC) FOR LOW GRADE ENERGY IN TURBINE AND *PAT* METHOD WITH FLUID

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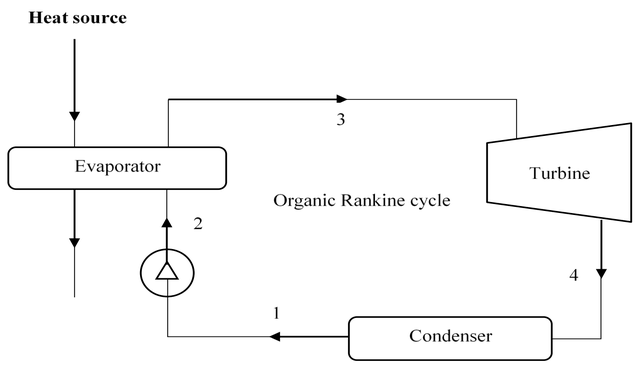
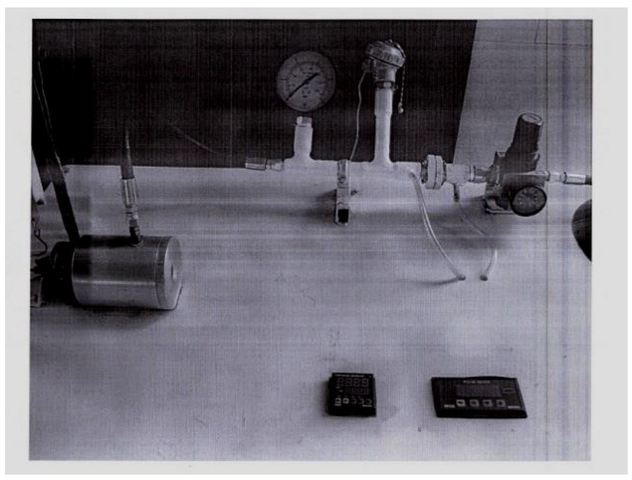
Preface:

Organic Rankine Cycle is a well-known and widely spread form of energy production, mostly in biomass and geothermal applications, but great rises in solar and heat recovery applications are also expected. Environmental concern over climate change and rising oil prices are powerful reasons supporting the explosive growth of this efficient, clean and reliable way of producing electricity.
In this paper, the organic fluid open Rankine cycle is analyzed when the variable expander is common assumption. The cycle arrangement in this plan is semi-open that is the layout is as a semi-cycle and the exhaust gas is directed to a drain tank. The effect of various parameters such as the inlet pressure on the expander, inlet temperature, pressure limit, injection rate on the thermal efficiency, the second law efficiency is measured and energy conversion to work is done with laboratory fixed effects . The highlighted characteristic in this study is the source serviceability capability in low-temperature and introduction of different blades as expander and its using to determine different organic fluids serviceability.

Feature extraction:



Schematic diagram of basic organic Rankine cycle



Experimental setup for measuring data.

Main equipment:

- **Boiler**
- **Pressure Regulator**
- **Flow meter**
- **Thermometer**
- **Manometer**
- **Expansion Chamber**
- **Dynamometer**

Pump instead of Turbine

In this system, we focus on pump system instead of turbine system.

Expansion chamber: is a cylindrical steel chamber with two nozzles that depending on the injection direction has the capability of conversion from expander to pump system instead of turbine.

For flow rate measurement in the main path, aluminum plate with ratio of hole diameter to path diameter is set after regulator and two holes are set before and after the plate to attach to the U shape path of manometer tube to determine the height difference.

Experimental Facility:

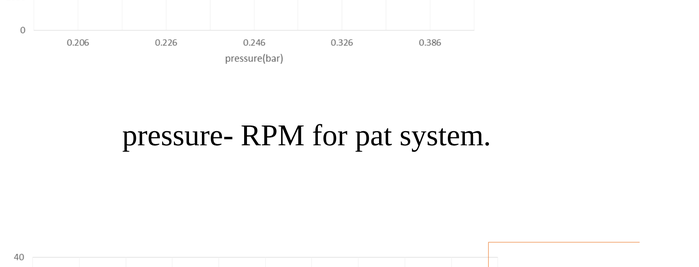
- **Flow rate calculations**
- **Force calculation principles**

  For dynamometer, a base attached to the pulley with the lubricant bearing is used in that a belt with proper width in one hand is attached to the base of dynamometer and is attached to pulley base from below and is attached to pulley in back and is attached to weight plate on the other hand and work and power are calculated as below:

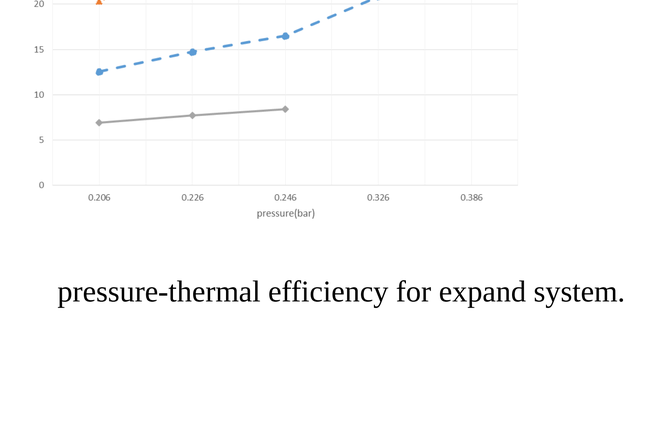
$$W = \frac{\pi}{30} . (RPM) . (F - m . g) . R$$

- **Expansion chamber**

Results:

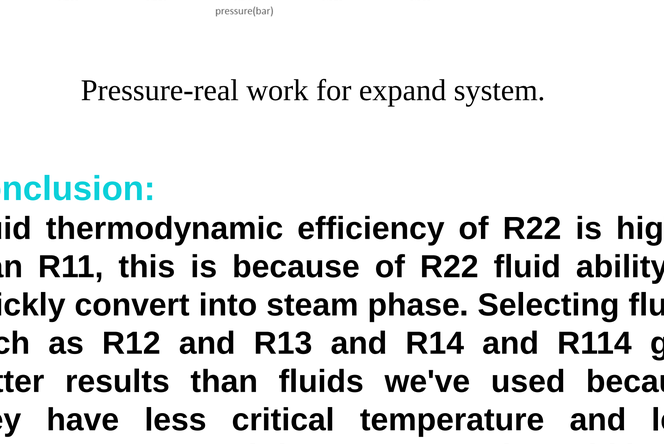


pressure- RPM for expand system.

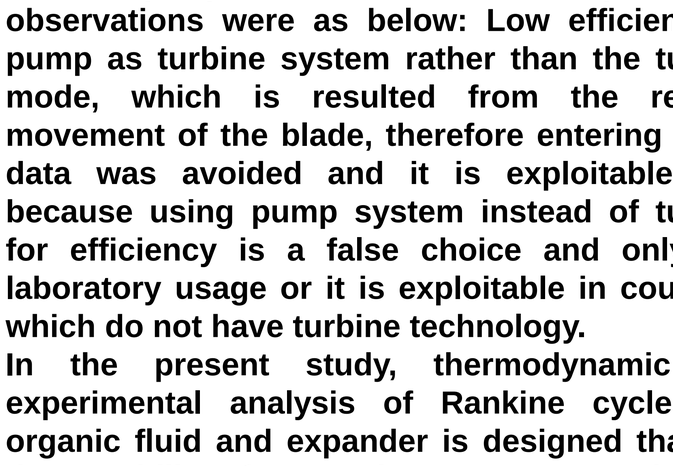


pressure- RPM for pat system.

pressure-thermal efficiency for expand system.



pressure-thermal efficiency for pat system.



Pressure-real work for expand system.

Conclusion:

Fluid thermodynamic efficiency of R22 is higher than R11, this is because of R22 fluid ability to quickly convert into steam phase. Selecting fluids such as R12 and R13 and R14 and R114 give better results than fluids we've used because they have less critical temperature and less entropy range and better converting ability to steam vapor phase. What is done in experimental observations were as below: Low efficiency of pump as turbine system rather than the turbine mode, which is resulted from the reverse movement of the blade, therefore entering minor data was avoided and it is exploitable only because using pump system instead of turbine for efficiency is a false choice and only has laboratory usage or it is exploitable in countries which do not have turbine technology.
In the present study, thermodynamic and experimental analysis of Rankine cycle with organic fluid and expander is designed that has the capability of converting pump system instead of the turbine, and is presented based on first law of thermodynamic. The main conclusion can be summarized as follow:

1)Rankine cycle has clear exit power and different fluids can flow in it. The effects of selecting various fluids and parameters such as temperature into expander, inlet pressure and injections flow rate have been studied in ORC and results are announced.

2)The study was done with Hyundai vehicle supercharger blade and has the ability to pump liquidity system instead of turbine but the important point in the design is lubrication process and moving with low friction that using lubricant bearings is recommended.

For measuring flow rate in designed path, pressure must not exceed a limit because it mix tube path water with factor fluid of main path and this factor is more effective in data measuring and should be followed.

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