The selection of ORC working fluids based on Fuzzy logic

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EPSRC Engineering and Physical Sciences Research Council

1. Introduction

Recent developments in ORCs have heightened the need for choosing the optimum working fluids which are critical to the performance of Organic Rankine cycles (ORCs). Currently, the working fluid is defined as optimum if it fulfils some specific requirements, namely thermodynamic, economic, safety and environmental criteria. However, research has consistently shown that no working fluids are able to achieve all those requirements. Therefore, studies continue to find the best strategies for selecting the working fluids. So far, selection methods have been based on conventional way which are firstly to select several working fluids candidate, secondly, set the objective of the studies (net power output, thermal efficiency, irreversibility), lastly, select the working fluid based on maximising and minimising an objective function.

2. Objective

The objective of this study is to seek to remedy this trial and error method by a fuzzy logic approach which allows filtering of near optimum working fluid candidates at the first level.

4. Result

Fluid	Simulation result
isobutane	0.506
n butane	0.808
pentane	0.808
propane	0.808
R113	0.808
Cyclohexane	0.808
R407c	0.808
R32	0.808
R152a	0.589
R717	0.589
Ethanol	0.589
Methanol	0.589
R718	0.589
R134a	0.808
R12	0.808
R123	0.808
R141b	0.808
CO_2	0.808

5. Conclusion

Conclusions
Fuzzy logic approach can be used to choose the working fluid in an ORC. However, further development and validation of the membership function need to be done to achieve optimum and unique results.

Future work
The validation of the membership function will be done using a neuro fuzzy approach

Keywords
Organic Rankine cycle, working fluid, fuzzy logic

6. Acknowledgment

This work was carried out as part of the EPSRC project entitled OPTITHERM: OPTImising THermal Energy, Recovery, utilisation and Management in the process industries (project no. EP/G061467/1). The authors would like to extend their gratitude to the EPSRC for providing the funding for this project.

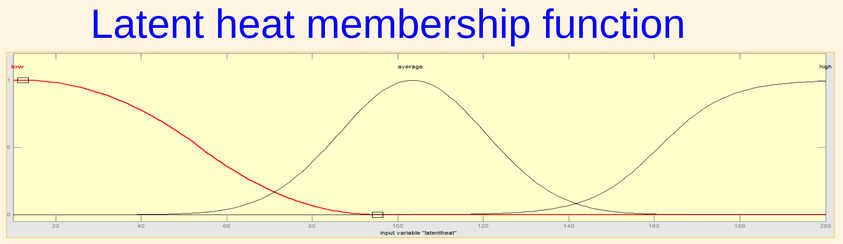
3. Methodology

1. Choose the working fluid candidates
In this study, several working fluids candidate are considered, these being Butane, ethane, isobutene, pentane, propane and trifluoromethane.

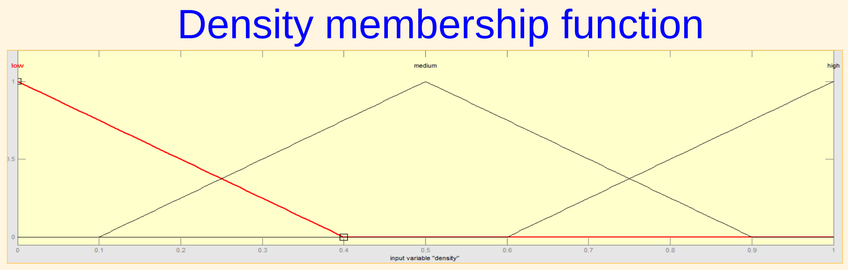
2. Decide the working fluids properties
Working fluid properties considered are:
Latent heat of vaporization, Density, Boiling point, Molecular weight, Ozone depletion potential, Price, Availability, Corrosiveness, Toxicity, Mass Flow rate, Flammability, Global warming potential, Working fluid type, Critical temperature, Volume flow rate

3. Decide the working fluid properties membership function
Each membership function of working fluid is defined. The membership function of butane is taken as example here

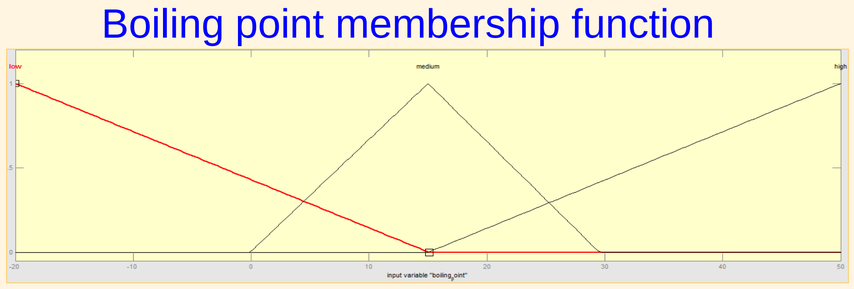
Latent heat membership function



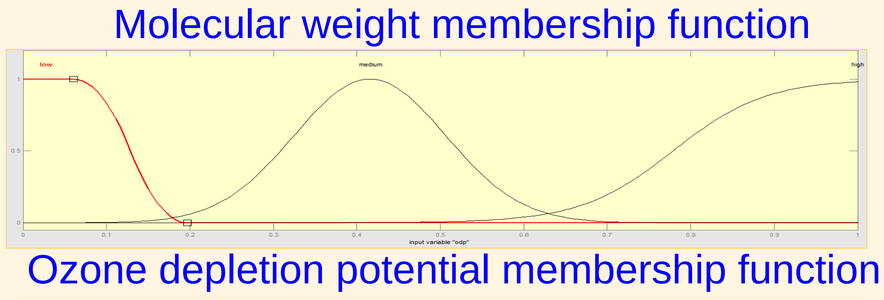
Density membership function



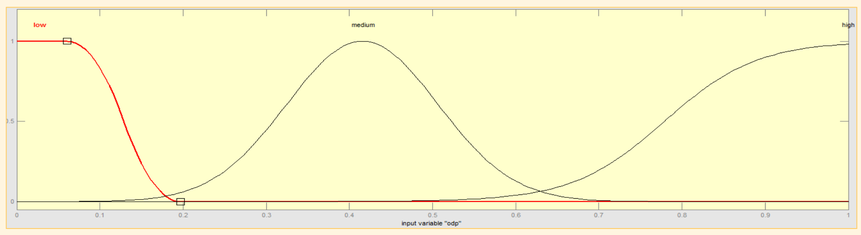
Boiling point membership function



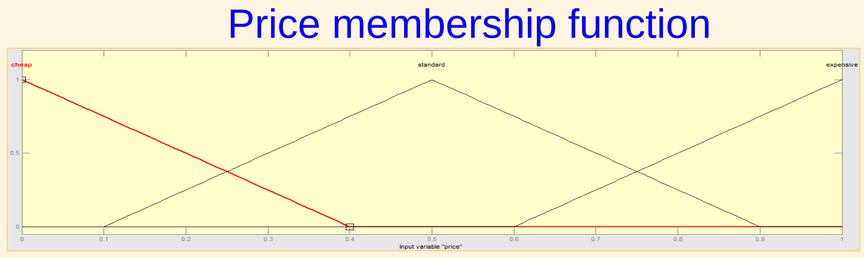
Molecular weight membership function



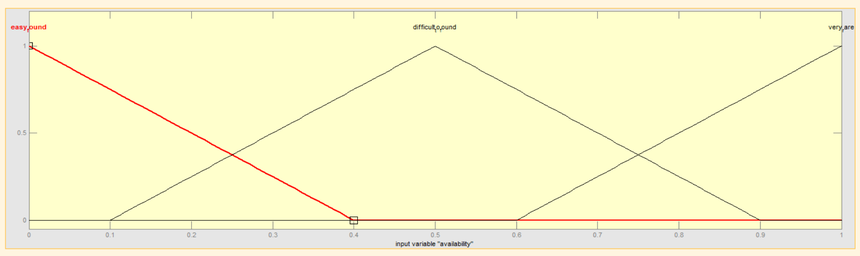
Ozone depletion potential membership function



Price membership function



Availability membership function



Corrosiveness membership function