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External Examiner's Comments and Answers to the Comments

Overview

The thesis presents the results of a numerical and experimental study of a refrigeration ejector system using R141b as the working fluid. A parametric study has been carried out to cover a range of design parameters. There is also a reasonable agreement between the experimental and CFD results. This allows the CFD simulations to be used as a design tool for these types of ejectors. The findings of the study cover a gap in previous studies and advance knowledge in this field. Therefore, it is believed that the work undertaken is worthy of a PhD and should therefore be accepted as such. However, there are some comments below which require the attention of the candidate and I urge that the modifications are undertaken.

The external examiner's comment:

1. My major criticism of the thesis is that the experimental side of the project is downplayed. For instance, although an experiment rig has been built and some interesting experiments have been performed there is no mention of this in the title. Further, the experimental aspects and chapters can be made more prominent with more detailed explanation and discussions presented.

Reply from the author:

The thesis title has been changed to “CFD AND EXPERIMENTAL ANALYSIS OF AN R141b EJECTOR USED IN A JET REFRIGERATOR”. Details of experimental apparatus and the experimental results have been made more prominent in Chapter III and Chapter V, respectively.

The external examiner's comment:

2. The thesis requires some serious editing to ensure that the language is correct. I do appreciate that English is not the first language of the candidate; however it is essential that the language is corrected to ensure that the explanations and discussions are comprehensible. My suggestion is that a professional technical editor reviews and modifies the thesis in consultation with the candidate.

Reply from the author:

The language of the thesis has been revised according to a professional advice from a technical English reviewer.

The external examiner's comment:

3. Some work needs to be done on the style of the thesis and presentation to ensure that there is a consistent format followed throughout the thesis. For instance, the line spacing changes in a number of places. I am not sure what the University's guidelines are but they must be exactly and correctly followed.

Reply from the author:

The format of the thesis has been modified to match the University's style guideline.

The external examiner's comment:

4. The Introduction Chapter should be perhaps shortened and rearranged to clearly state the following:
 - Motivation and background of the study
 - Scopes of work
 - Organization of the thesis

Reply from the author:

In Chapter I (Introduction Chapter), the content of the chapter has been shortened and rearranged to state the following:

- Motivation and background of the study
- Objectives of the study
- Organization of the thesis

The external examiner's comment:

5. A clearer explanation and diagram on the ejector refrigeration cycle compared to the typical vapour-compression refrigeration cycle should be added.

Reply from the author:

A clearer explanation and diagram on the ejector refrigeration cycle compared to the typical vapour-compression refrigeration cycle has been added to Chapter I.

The external examiner's comment:

6. In chapter II, the literature reviews contains some detailed information on the ejector's operation and characteristics. However, there is little information provided on the CFD studies of the ejector. Further, there is little information provided on the various refrigerant used.

Reply from the author:

More information on the CFD studies of the ejector has been added in Chapter II. The information on the various refrigerant used had already provided in Chapter III.

The external examiner's comment:

7. In chapter IV, the key parameters and numerical models used in this study should be clearly summarized in a tabulated form (perhaps in the conclusion section).

Reply from the author:

According to this comment, Table 4.2 (Setup information of the CFD model.) has been added to make a summary of the numerical models used in this study.

The external examiner's comment:

8. Conclusions and recommendations (Chapter IX) should be written to summarize the overview of the whole thesis. The current text is not doing the thesis justice and does not really “sell” the outcomes.

Reply from the author:

In Chapter IX, the conclusions have been revised as suggestion.

The external examiner's comment:

9. The study is about the application and improvement in the ejector refrigeration system. Hence, the information relevant to the performance of the refrigeration system (eg. COP of the system and the cooling capacity) should be presented and discussed concurrently to the predicted CFD flow pattern results.

Reply from the author:

This study is in fact about the analysis of the flow characteristics that affected to the performance of the ejector (entrainment ratio (R_m) and critical back pressure (P_c)) in refrigeration application. Although, an ejector refrigerator had been built, the purpose was mainly to validate the CFD results. According to the above reason, the COP of the system will not be presented and discussed. However, if one wishes to determine the

COP of this ejector refrigeration system, which is relevant to the entrainment ratio of the ejector, it may be estimated as:

$$\text{COP} = \text{Rm} \frac{(h_{g,\text{evap}} - h_{f,\text{cond}})}{(h_{g,\text{generator}} - h_{f,\text{cond}})}$$

The ratio of the heat rejection at the evaporator to the heat input at the vapour-generator $\left(\frac{(h_{g,\text{evap}} - h_{f,\text{cond}})}{(h_{g,\text{generator}} - h_{f,\text{cond}})} \right)$ is almost constant for each operating condition. Thus, the performance curve of the jet refrigerator (COP) and the performance curve of the ejector (Rm) are similar.

The external examiner's comment:

10. All figure and table captions should be carefully checked and some need to be improved to be more formative but concise. For example the caption of Figure 2.1 may be written as "Configurations of typical ejectors". Also the format of the captions should be consistent with the thesis format and the University's guidelines.

Reply from the author:

All figure and table captions have been carefully checked and some of them have been improved as suggestion.

The external examiner's comment:

11. Finally, I believe that the interesting outcomes of the thesis are not presented and "sold" well. The results can be of great interest to the designers of such systems. Therefore, it is essential that some discussion on the design and operation of these systems based on the obtained results is presented. Perhaps, this can be done in a separate chapter covering the design and optimization of the ejectors using the tools developed and the findings of the study.

Reply from the author:

Some discussion on the design and operation of the system based on the obtained results has been added in Chapter IX.

