

Referee's Report on Doctoral Thesis

Title: INTEGRATED APPROACH OF INTELLIGENT ASSET MAINTENANCE AND RESOURCE CONSERVATION FOR CIRCULAR ECONOMY

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1) Subject and Significance

The submitted dissertation deals with the study of a very topical issue, the elaboration of which is essential for the design and operation of industrial production facilities. The thesis presents an extended analysis of a manufacturing facility based on the Pinch method. This extended analysis includes material headers, and maintenance planning and organization, while taking into the account ecological approaches.

I believe that these issues, albeit in a simpler form, should not be absent from the curriculum of any technical university educating chemical and process engineers.

2) Scientific Content and the objectives

The thesis is prepared at a high theoretical, conceptual and creative level. The thesis is clearly divided into eight chapters, the content of which is clearly explained in the thesis. Therefore, I will omit this descriptive part of the review.

The author illustrates creative chapters 3 to 7 with fourteen publications that have been peer-reviewed in archival journals. The list of publications of accomplished tasks of the doctoral thesis in national and mainly international scientific media and archive journals. Impressive is very high Impact factor of almost all publications.

The work corresponds to the requirements of TU Brno and the Sustainable Process Integration Laboratory – SPIL, in the frame of it, the Thesis has been conducted, on a doctoral thesis concerning the scientific aspects.

3) Substantial Aspects

The literature search of detail global literature was done thoroughly. Objectives of his Thesis are clearly formulated the in the introductory section.

The novelty of the thesis consists:

- (i) The extension of the Pinch-based framework to material conservation networks multiple qualities as well as headers targeting and synthesis for both process and site level.
- (ii) (ii) The investigation of the resources allocation and operational management in the Game Theory. The approach provides a guideline to formulate a balanced economic policy between stakeholders and the government or authorities, through fair subsidies and tax implementation to facilitate the Circular Economy system
- (iii) Utilizing Pinch approach in planning maintenance inspection and tasks scheduling enables simple saving of the resources (time, cost, work force).

The author presents new scientific findings in a comprehensible manner

4) Structure, Presentation and Language

The structure of the thesis is very logical, clear and understandable. I very much appreciate the form and the way of presenting rather complex ideas. Tables and figures are presented acceptably. The thesis meets the requirements for a doctoral thesis in technical sciences for linguistic correctness and stylistic expression, it is prepared clearly and with a minimum of errors. I have no serious comments on the thesis. The questions for discussion in the appendix rather concern further possibilities of application and development of the methodology.

5) Overall Assessment

In conclusion, Mr. Hon Loong Chin, MEng. has demonstrated the ability to solve complex scientific problems. His dissertation contains valuable, formally published results. The thesis ranks in the top 10% of doctoral dissertations I have reviewed. I have no major reservations about the scientific content and am happy to support the award of the PhD to this candidate. There is no doubt about his potential for independent creative scientific work. I recommend that this dissertation be accepted by the committee, and I believe that after a successful defense, Mr. Hon Loong Chin, MEng. will be awarded the degree of Ph.D.

Prague, October 11, 2021



Attachement:**Comments and remarks on the thesis:**

1. How do accounting and tax laws affect maintenance strategy and planning? (Useful life-time and depreciation periods vary considerably).
2. How do you respect the uncertainties in maintenance and resource conservation planning and analysis caused by rapid changes in energy, raw material and construction material prices (e.g. currently) and changes in environmental regulations and limits?
3. Is your methodology also applicable in the case of zero-waste technologies? (E.g. when waste from one technology is a raw material for another production.)
4. Does your methodology allow you to decide whether or not is advantageous to double the apparatus (often pumps and heat exchangers)?
5. What percentage range of the acquisition cost, according to your analysis, should be put into maintenance in the chemical industry?
6. Can your methodology be used to inform decisions on when to perform maintenance in-house and when to outsource?