University of Pannonia, Faculty of Information Technology

Doctoral School of Information Science and Technology

Veszprém

Ph.D. title submitted by Zsófia Závodi-Fodor:

INTEGRATED ENERGY MANAGEMENT FRAMEWORK IN WASTE TO ENERGY, INTEGRATION OF OTHER RENEWABLES

I would like to thank to Gábor Szederkényi, DSc, associate professor and senior researcher, for accepting my thesis review. He volunteers his time when he agreed to evaluate my thesis. I would also like to acknowledge his assistance. I am appreciating the individual comments and observation on some aspect of the work.

The reviewer had pointed out four questions.

Question about chapter 2:

What are the most important new statements and findings of the overview in chapter 2 and in the corresponding journal paper?

Chapter 2 *"Literature review and state of the art"*, is based on the 2 review papers (Fodor and Klemeš, 2012; Fodor and Klemeš, 2011). The citation numbers (cited 12 and 4 times) show that the research work is both novel and relevant. The main findings are as follows:

1. The extensive review in the two papers and the chapter was necessary because of the large number of legislation and research documents appearing in the area, which have not been systematically analyzed from the viewpoint of utilizing waste for energy efficiently.
2. The chapter discusses the applicability and limitations of the current and developing WTE technologies as well as new and emerging technologies.

3. The chapter introduces and analyzes the selected Waste to Energy technologies pros and cons approaches considering effective waste management program like economy/societal acceptance and environmental consequences also pointed out the gap of the waste to energy field for future improvement possibilities.
4. The waste composition and emission diversity by year to year and location to location makes the technology selection more complicated. This complexity is tackled by proposing a so called matrix diagram, showing how specific technologies apply to municipal (MSW), industrial (ISW), biodegradable and hazardous waste treatment, provides general assistance, making the treatment classifications more transparent.

Zsófia Fodor, Jiří Jaromír Klemeš 2012. Waste as alternative fuel – Minimizing emissions and effluents by advanced design, *Process Safety and Environmental Protection,* 90(3), Pages 263–284.

Zsófia Fodor, Jiří Jaromír Klemeš, 2011. Municipal Solid Waste as Alternative Fuel – Minimising Emissions and Effluents, *Chemical Engineering Transactions,* 25, 31-38, DOI: 10.3303/CET1125006.)

Question about chapter 3:

In section 3.5, time slicing is shown using one specific renewable source (solar collector). How is the time slicing performed when there are multiple different renewable energy sources to integrate?

The calculation procedure for incorporating other renewables is similar as in the case of solar collector. The time slices for a multitude of renewables will be determined by combining the corresponding time boundaries, which usually leads to increased number of slices. Have to define the energy content of the sources, and according to the temperature and the heat duty of the energy sources, have to plot and it will shows the external energy content for the whole unit, which can be further utilize. However, is beyond the scope of the current thesis, this extended procedure has been developed later on in detail in another work (Nemet et al., 2012. Methodology for maximizing the use of renewables with variable availability, *Energy*, 44(1), 29-37).

Question about chapter 4:

Why are the power values corresponding to Process C equal (77.4 MW) both for the traditional and for the modified procedure in Table 17?

Process C is a threshold problem as there is no cooling utility requirement both for the traditional and for the modified procedure. There is only 2 °C change in the used ΔT_{min} for Process C and this change is insufficient to alter the process utility targets.

Question about chapter 5:

It is written on page 96 that the ΔTcont values in Table 24 were defined empirically. How this empirical choice affects the quality/optimality of the final solution?

The values have been chosen based on company's experiences, the different heat exchanger model can provide different ΔT approaches, so in this way the used ΔT approaches in the different units calculation is more reliable and accurate.

Question about chapter 6:

How computationally intensive are new procedures for Total Site targeting (i.e. approximately how many integrated processes and streams can be handled on a typical PC within a reasonable time)?

Theoretically there is no limit entering the stream input parameters, although the limit is the screen as how many segments from the hot and cold streams can fit on it still in analyzed form. The running time in all the cases which was represented in this work was of the order of few seconds and also in the final test period never caused running time error such as other simulation program.

I am very grateful to the reviewer to recommend the authorities at the University of Pannonia to award Ph.D. degree after the successful defense.

Budapest, 12. 09. 2013.

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