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Editorial

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A B S T R A C T

This editorial and overview of a Special Issue dedicated to the 11th Conference *Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction – PRES 2008.* Thirteen papers have been selected and after being peer-reviewed. Nine were accepted for publication covering important subjects of energy generation and usage. They are focusing on recent development of various features of heat integration which is an important methodology for increasing energy efficiency and saving. The complementary issues covered are emissions reduction and the security of energy supply. This issue of *ENERGY* is the fourth special journal issue dedicated to selected papers from PRES conferences.

1. Introduction

One of the most established and world known conferences in the field of energy efficiency and energy saving is PRES – Conference on *Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction*. The 11th conference PRES 2008 was held in Prague in August 2008. It provided an excellent opportunity for researchers and industry for dissemination of novel ideas, processes, procedures and energy saving policies. PRES 2008 was held as already traditionally every second year in collaboration with 18th International Congress CHISA 2008 in the heart of Europe – in Prague, the capital of the Czech Republic. This Central European capital, known as a city of thousand spires and/or a golden city, welcomed so far a record number of PRES delegates from more than 55 countries. 987 authors submitted 345 contributions. They represented, beside traditional European countries, Asia, Africa, Australia and North and South America.

The series of conferences on "*Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction*" (PRES) is an important opportunity for cross-fertilisation and it is running now into its second decade. It has been established originally to address issues relevant to process energy integration in connection with the efficient heat transfer issues. The organisers of the PRES conferences are proud to continuously attract delegates from numerous countries world-wide providing a friendly and highly collaborative platform. PRES conferences have a comprehensive publication strategy. This Special Issue is already the fourth of the *Energy* dedicated to selected contributions from PRES conferences. The collaboration started in 2003 with a Special issue dedicated to PRES'03 and PRES 2004 [1] and successfully continued with PRES 2006 [2], PRES'07 [3]. Beside *Energy* some other well-known journals have been collaborating with PRES conferences – *Applied Thermal Engineering* [4], *Journal of Cleaner Production* [5] supported by related workshop Special issue [6], *Heat Transfer Engineering* [7], *Cleaner Technologies and Environmental Policy* [8], *Resources, Conservation and Recycling* [9]. All listed collaboration including this with *Energy* has been mutually greatly appreciated.

2. Selected contributions – main thematic groups

For this Special Issue of the *Energy,* nine manuscripts have been selected. They address three thematic groups: (i) Heat Integration with Total site and renewables integration; (ii) Flexibility and safety of energy supply and (iii) Energy efficiency and emissions reduction case studies. The authors came from ten countries in Asia, Australia and Europe – from India, Japan and the UK, New Zealand, Hong Kong – China, Sweden, Hungary, Spain, Greece and Switzerland.

2.1. Heat integration with total site and renewables integration

The efficient use of energy is a very important issue for the processing industry, businesses and services, the residential sector, and the agriculture. The impact of the efficiency of energy generation, transport and consumption systems on the environmental pollution have both local and global effects. Over the years they have been various powerful methodologies developed to cope with those problems. One of them is the process integration based on pinch technology. In the analysed field especially heat integration [10–12] extended into the total site [13] and integration of the renewable energy sources [14] has been one of them. The performance of the heat exchanger network in a process system is an important aspect of energy conservation. Its efficiency, flexibility, reliability and maintenance are very important issues. The ways how to deal with pollution and emissions including the CO_2 have received growing attention. Because of the increasing urgency to successfully deal with those and related problems, various

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conferences are being held to encourage closer collaboration among people of many nations.

Three papers dealing with this topic have been selected. The first paper comes from the Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Powai, Mumbai, in India and authors are Nishith B. Desai and Santanu Bandyopadhyay. It is entitled *Process Integration of Organic Rankine Cycle* [15]. They studied an organic Rankine cycle (ORC), which uses an organic fluid as a working medium for an ORC power plant. The ORC can be modified by incorporating both regeneration and turbine bleeding to improve its thermal efficiency. The authors analysed sixteen different organic fluids as a working medium for the basic and modified ORCs. They also proposed a methodology for appropriate integration and optimisation of an ORC as a cogeneration process with the background process to generate shaft-work. They illustrated that the choice of cycle configuration for appropriate application of Heat integration principles. The integration with the background process depends on the heat rejection profile of the background process - i.e., the shape of the below pinch portion of the process GCC (Grand Composite Curve). Appropriate placement of the ORC (below pinch) results in a reduction of electrical power requirement from the grid, enhancement in system energy efficiency through cogeneration, and reduction in environmental pollutants. The authors demonstrated that the extent of integration and improvement in the shaft-work output from the ORC depends on the shape of the GCC of the background process. It has also been demonstrated that multiple heat interactions between the ORC and the background process may improve the overall shaft-work production. In average 16.5% and the maximum 34.3% improvement in thermal efficiency has been obtained.

The second paper was authored by Kazuo Matsuda, Yoshiichi Hirochi, Hiroyuki Tatsumi from the Chiyoda Corporation, Yokohama and Simulation Technology Ltd., Yokohama-Kanazawa, both in Japan complemented by a co-author Tim Shire from KBC Energy Services (Formerly Linnhoff March), Northwich, Cheshire in the UK. The title is *Applying Heat Integration Total Site Based Pinch Technology to a Large Industrial Area in Japan to Further Improve Performance of Highly Efficient Process Plants* [16]. Authors implemented the Total Site integration methodology of Dhole and Linnhoff [17] and Klemeš et al. [13]. They call it "area wide pinch technology", which consists of R-curve analysis and Site Source Sink Profile (SSSP) analysis. They made a successful application to Kashima industrial area, one of the biggest heavy chemical complexes in Japan. Their case study demonstrates that despite the very high efficiency of the individual sites in the complex, there is a huge amount of energy saving potential through energy sharing among the various sites. In addition it found that appropriate use of the available Heat integration tools provides an opportunity to analyse an industrial area of enormous scale and complexity. The described work resulted in practical total site energy saving projects successful implantation. They claimed a very substantial achievement – energy saving of 24,000 kL/y (Annual Crude Oil Equivalent) that represents approximately 0.9×10^6 GJ/y.

The third paper comes from Martin J. Atkins, Michael R.W. Walmsley and Andrew S. Morrison Energy Research Group, School of Science & Engineering, University of Waikato, Hamilton in New Zealand. The title is *Integration of Solar Thermal for Improved Energy Efficiency in Low-Temperature-Pinch Industrial Processes* [18]. The authors applied another principle of Heat integration: Solar thermal systems are especially suited for low pinch temperature processes such as those in the food, beverage, and textile sectors. When correctly integrated within an industrial process, they can provide significant progress towards both increased energy efficiency and reduction in emissions. They correctly pointed out that the integration of renewable solar energy into industrial processes presents a challenge for existing process integration techniques due to the non-continuous nature of the supply. They faced a similar problem which has been tackled by Klemeš and Varbanov [19], Varbanov and Klemeš [20]. A Heat integration study of the industrial process, taking into account non-continuous operating rates, should be performed to evaluate the utility demand profile. A systematic method of combining this information leads to improved design and an optimal operating strategy. Their approach has been applied to a New Zealand milk powder plant and benefits of several integration strategies, including mass integration, were investigated. The appropriate placement of the solar heat is analogous to the placement of a hot utility source and an energy penalty will be incurred when the solar thermal system provides heat below the pinch temperature. By combining Heat integration analysis study with appropriate solar information a systematic operating strategy for the solar collector system can be developed. Their case study of a New Zealand milk powder plant demonstrated that modest hot utility savings were attainable if the solar system was integrated above the pinch temperature. If the system was incorrectly integrated (i.e. below the pinch temperature) there were no hot utility savings and a large increase in the amount of cold utility used. Solar thermal systems can be considered as a hot utility and therefore the process integration guidelines for appropriate placement are valid. The savings in both hot and cold utility are potentially much greater if there is the possibility for mass integration in addition to the integration of solar thermal. They came to several interesting observations. One of them was that for the whole year the total reduction in hot utility due to mass integration alone (825 MWh) is greater than that from the solar collectors (765 MWh).

2.2. Flexibility and safety of energy supply

This part presents again three papers. The first one is *Feasibility and Flexibility for a Trigeneration System* [21]. The authors are Sau Man Lai and Chi Wai Hui from the Department of Chemical and Biomolecular Engineering, The Hong Kong University of Science and Technology Hong Kong SAR, China. They concluded that the over-sizing, thermal storage and flexibility re-allocation can be used to improve feasibility and flexibility of a trigeneration system. A flexible design with a reasonable investment and operating costs provides additional benefits to cater demand changes in the future. They demonstrated a trigeneration system design with a predefined structure to handle the periodical utility demand deviations in a commercial building complex. They studied trigeneration system, which produces heat, cold and electricity in a combined manner. The utility demands change at different time of a year and/or different time of a day. A trigeneration system can fail to handle parameter deviations and may depreciate its profitability. The authors developed determination methods to evaluate these attributes. Operability indices were introduced in their work to provide quantitative operability information for design comparisons. One studied option is employed the thermal storage. This cuts down the peak utility production demand. This improves the system flexibility and may bring a feasible design without changing in the system production capacity. The authors focused on the trigeneration system design with periodical demand changes based on a simplified economic evaluation method. Several demonstration studies have been provided. Authors admitted that some more uncertain parameters, such as electricity tariff, can be included in the future to provide a more comprehensive operability study. They also suggested the