

Total Site methodology – a way to reduce the use of primary energy sources and contribute to global CO₂ mitigation.

Dr. Sc. Stanislav Boldyryev

During last 2 years' (2015-2016) researcher has worked on the project CARBEN (NEWFELPRO Grant Agreement No. 39) financed Ministry of Science, Education and Sports of the Republic of Croatia and EC Marie Curie action.

The main goal of CARBEN project is to optimise simultaneously the use of heat recovery, cogeneration of heat and power, renewables and fossil fuels, minimising the carbon footprint and catering for the varying energy demands and renewables availability. The current project develops an extension of the Total Site methodology covering various customers and incorporating renewable energy sources, accounting for the variability on the supply and demand sides. Project deals with selection of optimum amount heat to be recovered during Total Site integration and utility targets for external heating, cooling, refrigerating etc. The methodology provides the calculation of minimum capital investment during heat integration of industrial site. It uses heat transfer area targets, utility distribution with overall cost of retrofit.

Several case studies were analysed during project implementation. First one deals with analysis of energy consumption of cement production. The improvement can be achieved by heat recovery of existing process and utility consumption can be reduced on 30 % and 29 % for external heating and cooling. These results are achieved by improved methodology for heat integration accounting process limitations. The use of excess heat can provide a way to reduce the use of primary energy sources and to contribute to global CO₂ mitigation. The results of can be used for energy analysis of cement factories and provide the recommendation for decision for efficient retrofit, new concept design, energy planning and strategy.

Second one analyses the energy efficiency of bromine production site and pathways for heating and cooling demands reduction are proposed. The PA (Pinch Analysis) and TSA (Total Site Assessment) were used for estimation of energy saving potential and design of retrofit project. It is shown that the process with improved heat integration consumes 57% of hot and 97% of cold utilities required by existing production site. Third one is connected with methodology of an appropriate integration of geothermal energy within residential, commercial and industrial systems. Pinch Point Analysis was used to find the best ways to fulfil the energy system requirements in an efficient, clean and cost-effective way. The used approach gives a good overall picture of energy targets for process, site and utility levels.

The results of the project were published in 8 peer reviewed scientific paper, 2 book chapters and 11 conference proceedings and presentations. Pinch Analysis was added as obligatory measure for guidance of energy audit for big companies in Republic of Croatia ("Narodne novine", No 127/2014). 3 lectures were delivered for Croatian Ministry courses of energy auditors: "Optimisation of heat exchangers network", "Process Integration". 4 lectures and 2 working session have been provided for FSB students and academic staff. 1 BSc diploma was supervised at University of Zagreb, FSB, student Kudeljan Valentino, topic is "Maximising of waste heat recovery of industrial regions using Total Site approach". Special Session at 11th SDEWES conference was organised.

The researcher is gratefully acknowledged scientist in charge Goran Krajacic, Holcim Croatia d.o.o. and Zoran Mohorovic, staff of Power Engineering and Energy Management Chair, administration of Faculty of Mechanical Engineering and Naval Architecture and colleagues from Power Lab for help during project implementation.