Integrated low-grade energy recovery in process sites and local energy systems

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The efficient use of energy at process sites is a top priority for the chemical industry due to rising energy costs. In particular this is important because the appropriate use of energy can make the difference between profit and loss for an industrial plant. At a typical process site significant quantities of heat are currently wasted because its temperature is too low for it to be used in normal process heating. Hence, there is urgent demand for technology and equipment which can be used to recover this waste heat.

In this work we consider applications using this waste heat on the site and also at local energy systems or district heating systems near to the site. Four different heat recovery technologies are evaluated using techno-economic analysis including: Organic Rankine Cycles, Heat pumps, boiler feed water heating and absorption refrigeration. In a previous study comparing these technologies, Kapil et al. (2012) integrated these options assuming that the waste heat is available at a fixed temperature and also that the internal parameters inside the recovery equipment are fixed. Here we extend the work of Kapil et al. (2012) by optimizing these internal parameters and by considering waste heat available at a range of temperatures to give a more accurate analysis of plant integrated heat recovery. To evaluate these heat recovery options, they are integrated with an example reference site of Aguilar (2005) and compared in terms of the resulting energy and cost savings.

In addition to on-site energy re-use we also consider integration of heat from process sites with local energy systems. We use multi-period analysis of the local energy system requirements to give accurate heat-integratio modelling of their requirements. These requirements are met by either heat from the process site or from locally generated heat, which is systematically minimized through a developed targeting method. Storage of waste heat is considered as well, which is strategically utilized in later time periods. To test the feasibility of linking site waste heat with local energy systems we consider a case study involving a hospital energy system (Kemp, 2007) and calculate the potential energy savings and determine the most appropriate energy recovery for local energy systems with/without integration of waste heat from the industrial site.

Acknowledgement

This research was supported by the International Research & Development Program of the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (No. 2011-0031290).

The authors would also like to acknowledge the support provided by the EC project EFENIS, Efficient Energy Integrated Solutions for Manufacturing Industries (EFENIS) – ENER/FP7/296003/EFENIS.

References

Aguilar O., 2005, Design and optimisation of flexible utility systems, PhD thesis, UMIST, Manchester, United Kingdom.

Kapil A., Bulatov I., Simth R., Kim J., 2012, Site-wide low-grade heat recovery with a new cogeneration targeting method. Chem. Eng. Res. and Des. 90(5), 677-689.

Kemp I., 2007, Pinch analysis and process integration, 2nd edition, Elsevier, Oxford, United Kingdom.