**Simulis Pinch: quick and efficient process energy integration in Microsoft® Excel**

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**Highlights**

* Process energy integration;
* Pinch technology;
* Microsoft Excel.

Industrial sectors account for one third of global energy consumption. A common feature of industrial processes is reliance on fossil fuels as the primary source of energy, where a large part of the energy consumption is spent on production of utilities. Due to the huge negative impacts of fossil fuel combustion on the environment, the scientific world makes a significant effort to find alternative sources of energy. However, even by the most optimistic assessments, these alternatives are long-term solutions and many projections show that in the near future, fossil fuels will remain the primary sources of energy, in particular for the process industries.

Pinch analysis [1] is a well-known methodology to optimize process energy consumption. It allows the determination of the minimum required process utilities consumption. Simulis Pinch [2], software used directly in Excel, has been developed to perform energy integration calculations with the pinch method, while also systematically considering real-world engineering constraints. Based on a chosen pinch that is acceptable for the whole process, Simulis Pinch calculates the minimum utility requirements and the maximum heat that can be recovered through energy integration. The software also plots the hot and cold composite curves, as well as the grand composite curve. The energy integration concept is used by the software to reach the optimal synthesis of a heat exchanger network that achieves the maximum energy recovery. In Pinch theory, the synthesis of the optimal heat exchanger network is subject to construction rules (for example, the division of the problem into two sub-problems, one below and the other above the pinch temperature). However, the ideal point may not be simple to reach (due to partial exchanges on streams, stream divisions…), and the number of heat exchangers needed may be significant. While optimisation tools can help to determine the optimal structure of the heat exchanger networks using MINLP-type algorithms, these tools often have calculation times that are very long, and their convergence on an industrial scale is not guaranteed. The approach of Simulis Pinch is more pragmatic: the aim is to quickly propose some good solutions with a limited number of heat exchangers. The method is not an “optimal” method in the mathematical sense of the term, as it systematically aims to exchange the maximum power between two streams. If a hot stream and a cold stream can exchange heat, the algorithm searches for the possible couplings that allow the exchange of the maximal thermal power under certain limitations or “boundary conditions”. The automatic synthesis of a ‘good’ heat exchanger network takes into account the specific constraints on particular exchanges (fluids incompatibility, different units, distance, difficulties…). Between two streams that can exchange heat, the combination of the possible exchanges is limited to a maximum of 3 possible couplings between these streams.

An application example, from an industrial case of an existing bio-refinery, will be presented to illustrate the use of Simulis Pinch. Two heat exchanger networks are proposed, which take into account the on-site constraints. The heat recovered corresponds to more than 80% of the MER (Maximum Energy Recovery).

**References**

[1] Bodo Linnhoff, PhD thesis “Thermodynamic Analysis in the Design of Process Networks”, Leeds University, 1979

[2] <http://www.prosim.net/en/index.php>