A Framework for Total Site Heat Recovery Systems Retrofit

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Heat Pinch Analysis retrofit projects are typically performed by evaluating and maximising the heat recovery potentials of the individual process units. Once the potential improvements from the individual units have been assessed the Total Site (TS) Heat Integration analysis is performed. Such approach may steer designers away from the promising retrofit opportunities and lead to suboptimal heat exchanger networks. This paper presents an effective retrofit framework for a total site system to determine the most cost-effective retrofit options and maximise the potential saving.
The framework consists of five stages:
Stage 1: Perform a baseline analysis of the TS centralised steam system
Stage 2: Determine the benchmark theoretical utility targets for the TS steam system
Stage 3: Specify the retrofit objectives based on the Plus-Minus Principle
Stage 4: Propose potential retrofit options
Stage 5: Analyse the overall savings and economics of the various scenarios
This framework has been tested on a case study involving a petrochemical plant comprising of multiple process sections. The results of the analysis shows that the strategy to approach the heat recovery network retrofit from the individual process sections (unit-wise) can result in very limited energy savings in comparison to approaching retrofit from the TS context. On the other hand, significant energy savings can be realised when both direct and indirect heat recovery retrofit options are evaluated based on the proposed TS retrofit framework. Further energy savings can be achieved via the Plus-Minus Principle that helps pinpoint the correct locations of heat and deficits and lead to the appropriate TS retrofit strategy. As a conclusion, energy retrofit projects should be approached from the total site context, followed by the retrofit of the individual process sections.
This proposed comprehensive framework has considered both individual process (IP) and TS heat integration to improve HEN configuration of an existing TS system. The TS Plus-Minus Principle is used in this framework to screen the retrofit options prior to the detailed analysis. The targets determined in Stage 2 shows that the Case Study is a threshold problem that requires 0 MW of hot utility and 335.4 MW of cold utility. The existing HEN, however, required 104.8 MW of hot utility and 9.1 MW of cold utility. The existing HEN configuration has increased the hot utility requirement for 100% and 97% of cold utility requirement reduction. The IP and TS retrofit options found using the proposed framework has reduced the hot utility to 75.1 MW (28% of the current consumption) and the system only required 7.0 MW of cold utility (23% of current consumption, 98% of theoretical consumption). In addition, the possible annual savings from the retrofit options for the TS has increased significantly from USD 69,000 for considering IP Heat Integration only to USD 2,911,000 by considering both the IP and TS Heat Integration.