Preface

Refineries that occupy large sites in heavy chemical complexes and the petrochemical industry in general, have for long years been utilizing and consuming a huge amount of fossil fuel as an energy source for operation. “Energy saving”, in the way of reduction in the use of fossil fuel, has been under active consideration for many years as this leads to the strengthening of competitiveness by saving cost in operation. Moreover the industry in general fully recognizes that public opinion is less accepting of the combustion of fossil fuel that results in the generation and release of large amounts of the greenhouse gas CO_2 in to the atmosphere. Energy saving eventually leads to a significant reduction in the emission of greenhouse gases and is one of the most important measures that can be taken to mitigate the problem of global warming.

The sites in heavy chemical complexes have two systems in general; the process system and the utility system. The history of energy saving in the process system shows that its purpose was to improve and strengthen heat recovery. Pinch technology, a methodology of heat analysis based on thermodynamic principles, was developed in 1980s and applied for the study of heat recovery. Pinch technology is used to minimize the energy consumption of chemical processes by calculating thermodynamically feasible energy targets (or minimum energy consumption) and achieving them by optimizing heat recovery systems, energy supply methods and process operating conditions. Over the past 30 years, pinch technology has been applied on thousands of processes with a large amount of energy savings having been achieved.

However the general consensus in engineers was that almost all possible methods of heat recovery had already been investigated and that a new breakthrough was needed to be any further significant improvement in energy efficiency. That breakthrough was a new approach in the development of the process system, which would replace the conventional system.

The process system, in heavy chemical complexes, has a reaction section and a distillation section. In these sections, the amount of low-grade heat discarded as waste heat is about the same amount required to be supplied for the operation of the process. Conventionally heat recovery is maximized by using pinch

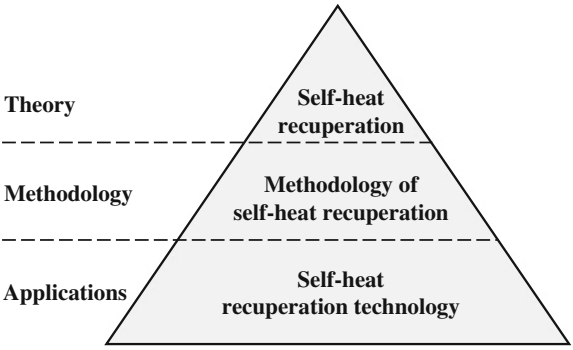

Fig. 1 From theory to applications about self-heat recuperation

technology, which means that the amount of heat input is minimized and the waste heat is reduced. It should be noted that with this methodology the process operating condition is not changed but maintained as it is.

To achieve further energy saving in the process system, "self-heat recuperation" (SHR) was developed. (see Fig. 1) SHR is able to be applied for both the reaction section and the distillation section. SHR has a novel approach in that the process operating condition is changed by using a compressor, but the process core condition, such as a reactor inlet condition, is still maintained. Self-heat recuperation technology (SHRT) was applied to the reaction section of the naphtha HDS process and the benzene distillation section in the refinery and it was found that the advanced process with SHRT was able to reduce the energy consumption significantly for both the reaction section and the distillation section. SHRT is able to be applied not only to the process systems in the heavy chemical complexes but also to the other processes which require heating and cooling, such as drying and gas separation processes. It was found that SHRT was effective to reduce energy consumption considerably in such processes.

The utility system has also been targeted to become more efficient in energy saving. Major items of equipment, such as boilers and turbines, are considered to have reached the limit for further improvement in efficiency and therefore the utility system must be optimized. However, when looking at heavy chemical complexes, it appeared that a refinery would discharge low-grade heat as waste heat whereas, at same time, an adjacent petrochemical plant could make use of such heat. There could, therefore, be a large energy saving potential by utilizing the surplus heat across the sites. The total site approach, based on pinch

technology, was applied to the heavy chemical complexes and it became apparent that there was a huge amount of energy saving potential through energy sharing among various sites in the complexes, despite the very high efficiency of the individual sites in the complex.

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