Energy conservation by installation of Advanced Process Control (APC) Technology

Advanced Process Control (APC) is an IT system (software) incorporating statistical analysis, decision theory, engineering, signal processing and artificial intelligence. APC analyzes individual process data obtained through Distributed Control System (DCS), and provides instructions which optimize the overall production process, resulting in less energy to meet a production target.

1. Application of APC in hydrocracking units (HCU)

A. Reduction in heater fuel

In hydrocracking units (HCU), hydrogen is reacted with feed (heavy gas oil) to produce various petrochemical products. Amount of hydrogen required to meet the demand fluctuates due to factors such as chemical composition of feed and component. Since it is not possible to maintain the hydrogen supply exactly at the required values due to such fluctuation, hydrogen is fed at excessive levels to minimize the risk of not meeting the required level, resulting in increased fuel consumption at the heater. APC reduces the fluctuation by inferring feed component, which results in reduction of total hydrogen demand. Reduction of hydrogen demand results in increased temperature of the reactor column, which can be used to preheat the feed, thereby reducing the fuel consumption at the heater.

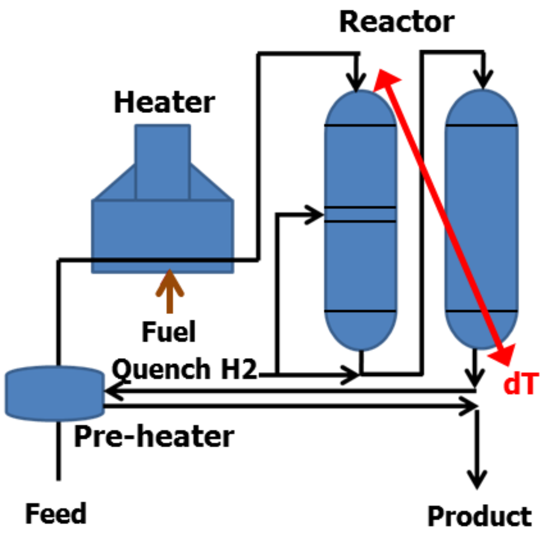

Figure 1. Schematic diagram of reactor in HCU.

B. Reduction of debutanizer reboiler fuel

In debutanizer in hydrocracking units (HCU), the temperature and pressure of debutanizer column must be maintained at or above a certain level. Since it is not possible to maintain the temperature and pressure exactly at the required values due to fluctuation in feed component, fuel is fed at excessive levels to the reboiler in order to minimize the risk of column top pressure dropping below the required values. Introduction of APC reduces the fluctuation of column top pressure and lowers the pressure by inferring (*)feed component, which reduces the need to consume excessive fuel to the reboiler. (*:Estimate calculation by the relating process data available on DCS)

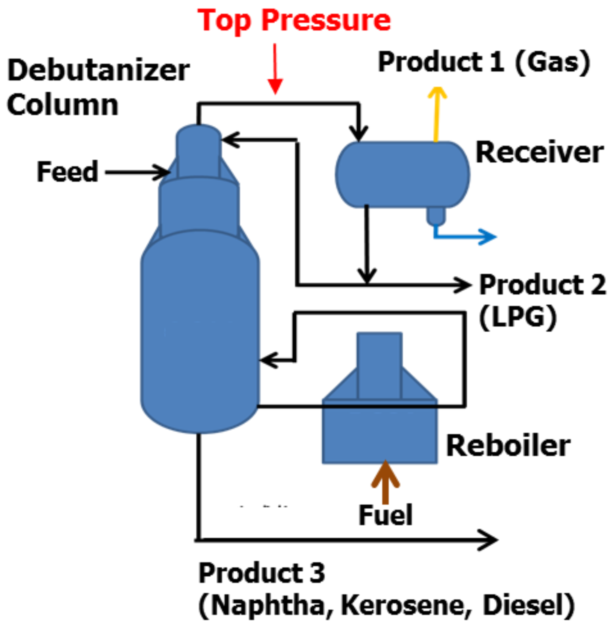

Figure 2. Schematic diagram of HCU debutanizer in HCU.

C. Emission reduction in HPU due to reduction in hydrogen demand in HCU

When APC is introduced in HCU, hydrogen demand is decreased, leading to energy conservation in HCU, as shown above. In addition, such reduction of hydrogen demand results in reduced hydrogen production in the hydrogen production unit (HPU) where hydrogen is produced by reforming methane with steam under high temperature. Therefore, application of APC in HCU results in reduction of energy consumption in HPU.

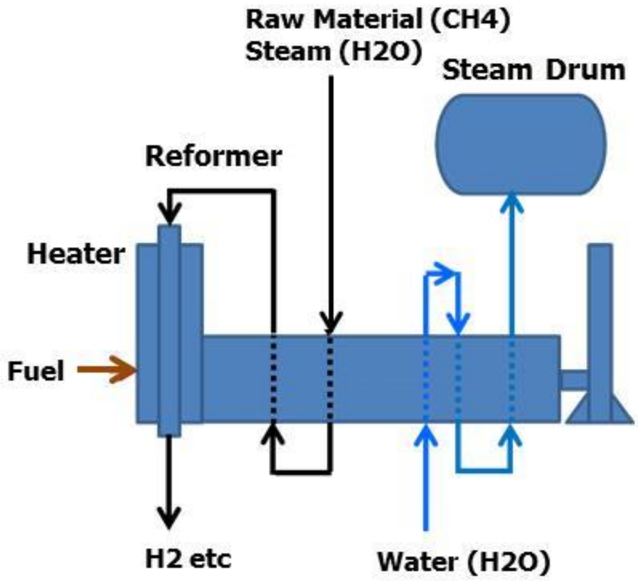

Figure 3. Schematic diagram of reformer in HPU.

2. Application of APC in hydrogen production units (HPU)

D. Efficiency improvement in hydrogen production

APC can help energy consumption in hydrogen production units (HPU) in the following two ways:

- APC installed in HCU results in lower hydrogen demand.
- APC installed in HPU results in lower energy demand per hydrogen produced.

The former is explained in the preceding paragraph. The latter is realized by inferring CH_4 slip (*) and calculation of its trend, which improves fuel efficiency of the heater in HPU.

(*: CH4 slip is a phenomenon of unreacted CH_4 is carried out to the produced hydrogen.)

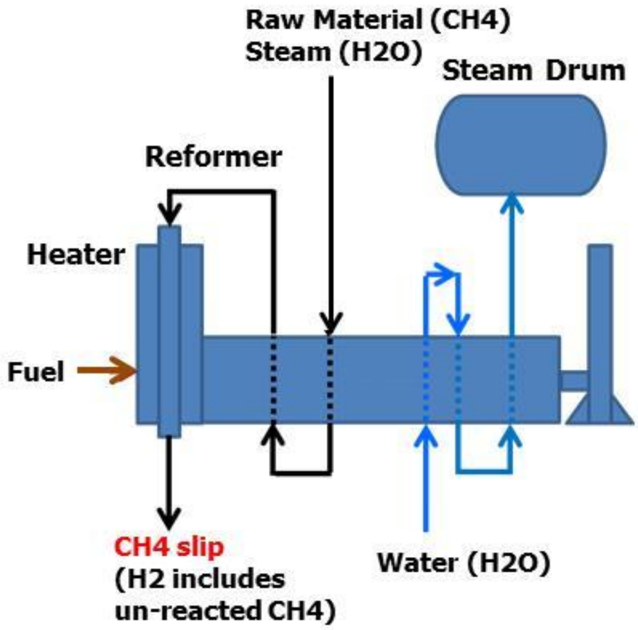

Figure 4. Schematic diagram of reformer in HPU and CH_4 slip.

3. Ensuring net emission reduction

The methodology assures net reduction by not taking into account for reduction in consumption of electricity and steam from outside the process (on-site generators and boilers) which occurs as a result of process optimization due to implementation of the project. Furthermore, CO_2 emission from chemical reaction in HPU is also reduced due to reduction in hydrogen demand in HCU, but this is not taken into account, leading to additional conservativeness.