Abstract

Reduction of air pollution from sulfur recovery unit tail gas is a serious problem due to its high pollution. Some sulfuric compounds like sulfur dioxide and hydrogen sulfide leave the sulfur recovery unit as unreacted. Among different processes, Amine- based hydrogenation unit was selected as the best process to treat sulfur recovery unit tail gas. Then pilot of the selected process was designated and manufadtured for 1st time in Iran. Taguchi method was used for experiment design and Qualitek-4 software was used for Analysis of the results.

The process was surveyed in three sections such as: hydrogenation, absorbtion and kinetic modeling (for 1st time in Iran). Hydrogenation section was surveyed in two stages. In 1st stage, five factors like catalyst type, weight hourly space velociety, hydrogen to sulfur dioxide ratio, SO_2 content and temperature each at four levels were selected. L_{16} orthogonal array was used. Based on the results, catalyst type and temperature were the most important factors. In the 2nd stage, three weight hourly space velociety, hydrogen to sulfur dioxide ratio and SO_2 content factors each at three levels were selected and L_9 orthogonal array was selected for experiment design. Experiments were repeated for two HDS catalysts and a synthetic catalyst. The all catalysts were Co/ Mo on γ- Alumina. It was concluded for two catalysts, sulfur dioxide and for the other one weight hourly space velociety were the most important parameters. These results were used for kinetic modeling too. Selection of the best model was done by nion- Linear regression method by using Polymath software. All three catalysts results showed that, H_2O desorption stage in first mechanism, (Eley- Riedel mechanism), is the rate controlling step because it could predict the experimental datas better than the others.

In continue, absorption section was simulated using Aspen- Plus software. Two L_{16} and L_{18} orthogonal arrays were used for experiment design in this section. According to the results, H_2S content in lean amine, amine temperature and absorber pressure were the most important factors.

Keywords: Sulfur dioxide; Hydrogen Sulfide; Amine- based Hydrogenation Unit; Catalytic Hydrogenation; Kinetic Modelling; Taguchi method.

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Ph. D. Thesis:

Kinetic Modeling and Laboratory Scale Study of Hydrogenation of sulfur dioxide of Sulfur Recovery Unit in an Oil Refinery

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March 2011