Abstract

In this study, very powerful modern optimization techniques, such as Genetic Algorithm (GA), Particle Swarm Optimization (PSO) and Artificial neural network (ANN) were applied for estimating the optimal parameters of reactions kinetic based on minimizing the mean absolute errors between the actual and predicted data for both HDS and catalytic reforming processes.

HDS was carried out in a vapor phase fixed bed reactor using heavy naphtha as a feedstock and commercial cobalt-molybdenum on alumina (Co-Mo/γ-Al_2O_3) as a catalyst. The reactor temperature is varied from (315-400) °C, the pressure is about 35 bar and the liquid hourly space velocity (LHSV) is (0.5-2.1) hr^{-1}. The result showed that HDS of heavy naphtha follows the pseudo-first order reaction kinetics. This study signifies that the kinetic parameters calculated using least square non-linear regression was found to be more accurate and gives the highest correlation coefficient (R^2=0.9507) than the other methods. Among the three optimization methods, ANN technology by using the topology of (3-3-1-1) provides an effective analyzing tool to understand and simulate the non-linear behavior of the process. The final outlet result showed very good agreement with the experimental data with a mean absolute relative error (MARE) of less than 5%.

Catalytic reforming was carried out in four semi regenerative fixed bed reactors using sweet heavy naphtha as a feedstock and commercial platinum on alumina (Pt/Al_2O_3) as a catalyst. Each reactor temperature varied from (450-500) °C, and the pressure was (25-34) bar. The kinetic model proposed in this study contains 87 reactions and 33 reacting components. All reactions are assumed to be pseudo-first order with respect to hydrocarbons. The model explains the composition, temperature and pressure distributions along the four reforming reactors. The simulation and optimization results for the heavy

naphtha reforming unit shows that, the GA is faster than PSO in reaching the global optimum values, while the ANN does not produce acceptable accuracy due to the huge number of input/output variables and high nonlinearity of the reforming process. GA has strong ability of global searching and could achieve good global searching ability compared with the other optimization methods. Using GA, the kinetic model was fine tuned against industrial plant data and the final outlet results of the reformer such as RON, outlet reformate compositions, temperature and pressure have shown good agreement with actual values.