ABSTRACT

The effect of inclined fluidized bed at different inclination angles(90^o, 75^o , 60^o , and 45^o) with and without promoter on bed dynamics relating to minimum fluidization velocity, bed pressure drop, bed expansion and fluctuation with column inclination have been experimentally and computationally investigated.

The study included manufacturing of three different types of promoters used in the investigation (rod type with four numbers of varying rod configuration and blockage with open area 95.27%, 92.24%, 89.22%, 84.68%, disk type with seven types of varying disk thicknesses and diameters with open area 82.98%, 61.24%, 27%, and ring-type with three types of varying ring thicknesses and open area 72.2%, 48.8%), Other system variables included bed materials of different sizes and densities and initial static bed heights.

In the computation, an Artificial Neural Network using Particle Swarm Optimization and back propagation with and without promoter has been used. Four different Artificial Neural Network models; one for unpromoted bed and three beds promoted with rod, disk, and ring type promoter have been used for the prediction of bed expansion ratio and bed fluctuation ratio by using the package MATLAB version (6.5). Developed correlations of Artificial Neural Network models are based on experimental data for the prediction of bed expansion ratio, fluctuation ratio, pressure ratio, minimum bubbling velocity, and minimum slugging velocity.

The experimental results showed that the ring promoter is found effective for large particles in reducing bed expansion and fluctuation ratio to values that were close to the value for the case with small particles in unpromoted bed. It can be observed that the pressure drop ratio increases rapidly with the increase in particle's size, i.e. increase in fluidization velocity for all types of beds. The ring promoter was found to have the highest fluidization velocity. It was noted that at the same blockage volume, ring models are the best ones in reducing bed expansion ratio and fluctuation ratio around (23.5%) and (21.87%),

respectively at inclination angle of (45º). It was found that the expansion and fluctuation ratio reduces with decreasing bed inclination from (90º to 45º) for all bed types (promoted and unpromoted bed).

In the present work, the network was trained for each type of fluidized bed. The network structure together with the learning rate was varied to obtain an optimum structure with a view to minimize the mean square error at the output.

Correlations were developed with the help of relevant dimensionless groups involving interacting parameters by using Dimensional Analysis, Back Propagation and Particle Swarm Optimization with respect to bed inclination. From the comparison, the predicted results using the developed correlations were found to be in good agreement with the corresponding experimental ones and those predicted by Artificial Neural Network -models by using Back Propagation and Particle Swarm Optimization were better than Dimensional Analysis (Particle Swarm Optimization more accurate in reducing mean and standard deviation).