World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:13, No:09, 2019

Modelling and Optimisation of Floating Drum Biogas Reactor

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Abstract : This study entails the development and optimization of a mathematical model for a floating drum biogas reactor from first principles using thermal and empirical considerations. The model was derived on the basis of mass conservation, lumped mass heat transfer formulations and empirical biogas formation laws. The treatment leads to a system of coupled nonlinear ordinary differential equations whose solution mapped four-time independent controllable parameters to five output variables which adequately serve to describe the reactor performance. These equations were solved numerically using fourth order Runge-Kutta method for a range of input parameter values. Using the data so obtained an Artificial Neural Network with a single hidden layer was trained using Levenberg-Marquardt Damped Least Squares (DLS) algorithm. This network was then fine-tuned for optimal mapping by varying hidden layer size. This fast forward model was then employed as a health score generator in the Bacterial Foraging Optimization code. The optimal operating state of the simplified Biogas reactor was thus obtained.

Keywords : biogas, floating drum reactor, neural network model, optimization
Conference Title : ICAFMD 2019 : International Conference on Applied Fluid Mechanics and Dynamics
Conference Location : Singapore, Singapore
Conference Dates : September 10-11, 2019