CFD ASSESSMENT ON DIFFERENT BED HEIGHT EFFECT OVER DRAG MODEL OF FLUIDIZED BED

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Bismillahirahmanirahim

To my beloved wife and kids, with their sincere prayers afforded me

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Assoc. Prof Dr Kahar bin Osman

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ABSTRACT

Fluidized beds are widely used by various industries because of low pressure drop, uniform temperature distribution, high heat transfer rate and large contact area which enhances chemical reaction. It seems that the efficiency of the fluidized bed depends on the knowledge of the flow behaviour which are important for scaling, design and optimization. In modelling of gas-solid phase, drag force is one of the main mechanisms for inter-phase momentum transfer. Therefore in this study, 2D model of fluidized bed was developed to study the effect of using various drag models over different bed height of H/D ratio such as 0.5, 1 and 2. The drag correlations of Gidaspow, Wen Yu, Syamlal-O'Brien, Hill Koch Ladd (HKL) and Representative Unit Cell (RUC) are to be implemented using a multiphase Eulerian Granular Model (EGM) to simulate the interaction between phases. Simulation of the model is be conducted via commercial CFD software ANSYS FLUENT 14. The main contribution of this study is to identify the important of bed height during gasification process in order to contribute in the development of TNB Research of IGCC. From the results obtained show that EGM greatly suitable for dense particle flow. As overall, the result shows Wen Yu and Gidaspow drag model are suitable for dense fluidized bed application. While for Syamlal-O'Brien drag model is more suitable for all range of application. Finally for RUC and HKL can predict highest drag at volume fraction which is more likely occur in dense phase.

ABSTRAK

Fluidized bed seringkali digunakan secara meluas oleh pelbagai industri kerana ia mampu memberikan tekanan yang rendah, pengagihan suhu yang seragam, kadar pemindahan haba yang tinggi dan kawasan sentuhan besar yang mana dapat meningkatkan tindak balas kimia. Oleh yang demikian kecekapan *Fluidized bed* bergantung kepada pengetahuan mengenai sifat bendalir yang mana ia sangat penting dalam menentukan skala reaktor, rekabentuk dan pengoptimum sesuatu reaktor. Dalam model fasa gas-pepejal, daya seretan merupakan salah satu mekanisme utama bagi pemindahan momentum setiap fasa yang berlaku. Oleh yang demikian dalam kajian ini, model 2D *Fluidized bed* telah dibangunkan untuk mengkaji kesan penggunaan pelbagai model seretan dengan perbezaan ketinggian *bed* mengikut nisbah H/D sebagai contoh 0.5, 1 dan 2. Model seretan *Gidaspow, Wen Yu, Syamlal-O'Brien, Hill Koch Ladd* (HKL) dan *Representative Unit Cell* (RUC) akan diguna pakai dengan menggunakan *Multiphase Eulerian Granular Model (EGM)* bagi melaksanakan simulasi bagi mendapatkan kesan interaksi bagi setiap fasa. Simulasi model akan dilaksanakan dengan menggunakan perisian CFD komersial ANSYS FLUENT 14. Sumbangan utama kajian ini adalah untuk mengenal pasti kepentingan ketinggian *bed* semasa proses pengegasan dalam memberi sumbangan terhadap pembangunan penyelidikan TNB mengenai IGCC. Daripada keputusan yang diperolehi menunjukkan model seretan bagi Wen Yu dan Gidaspow sesuai digunakan untuk aplikasi padat *fluidized bed*. Manakala bagi model seretan Syamlal-O'Brien boleh digunakan untuk semua aplikasi. Akhir sekali untuk model seretan RUC dan HKL mampu meramal ketinggian maksimum untuk seretan yang berlaku pada jumlah kecil dimana ia lebih cenderung berlaku pada fasa padat.