ANALYZING THE FLUIDIZATION OF A MIXTURE OF GAS-SAND-BIOMASS USING CFD TECHNIQUES

Mikele C. S. Sant'Anna[a]*, Wenna R. Cruz[b], Gabriel F. Silva[a], Ricardo A Medronho[c] and Sergio Lucena[d]
[a]Universidade Federal de Sergipe;
Av. Marechal Rondon, São Cristóvão, Brazil, 49100-000
[b]Universidade Tiradentes
Av. Murilo Dantas, 300- Farolândia, Aracaju, Brazil, 49032-490
[c]Universidade Federal do Rio de Janeiro
Av. Athos da Silva Ramos, 149, Ilha do Fundão, Rio de Janeiro, Brasil, 21941-909.
[d]Universidade Federal de Pernambuco
Av. Prof. Moraes Rego, 1235, Recife, Brasil, 50670-901
E: mikelecandida@gmail.com

Fluidization taking into account the presence of the material to be gasified is a differential addressed in this study. Accordingly the solid phase was composed of a binary mixture of sand and biomass. This paper deals with the numerical simulation of a gasifier bubbling fluidized bed using CFD for the system composed of gas - biomass – sand. In order to determine the best fluidization conditions, a factorial design 2^3 was carried out varying the biomass particle density and diameter and the biomass percentage in the solid phase. To perform the simulations, ANSYS CFX 15.0 was used, adopting an Eulerian approach coupled to the Kinetic Theory of Granular Flow. The k- ε turbulence model was adopted. Seventeen simulations were performed setting the gas superficial velocity to 0.38 m s^{-1}. Based on the results of the factorial design, it was possible to qualitatively identify the tests to which the system reached a bubbling fluidization (1, 2, 5, 6, 9, 11, 12 and 14). The variable with the highest significance in the model equation was the diameter of the biomass particle. Volumetric fraction profiles of gas, sand and biomass were obtained to the 17 factorial design conditions as well as a model that predicts the bed expansion. The assay that reached greater bed height (0.50 m), staying on bubbling regime, was the one with 15% biomass particles with 375 □m diameter and 85% sand, indicating those are good conditions for fluidization.

Table 1- Results of the factorial design 2^3

Ensaios	ρ (kg m^{-3})	d_B (μm)	$\%_{biomass}$	H_f (m)
1	700	250	10	0,47
2	1300	250	10	0,43
3	700	500	10	0,40
4	1300	500	10	0,40
5	700	250	20	0,50
6	1300	250	20	0,47
7	700	500	20	0,40
8	1300	500	20	0,38
9	496	375	15	0,40
10	1504	375	15	0,38
11	1000	165	15	0,50
12	1000	585	15	0,39
13	1000	375	6,6	0,40
14	1000	375	23,4	0,42
15	1000	375	15	0,40
16	1000	375	15	0,40

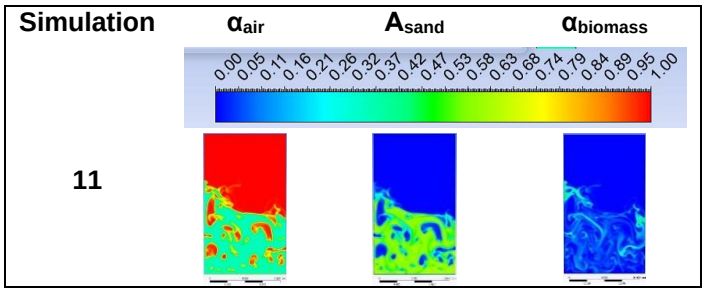

Figure 1: Volume fraction profiles of air-sand-biomass system

REFERENCES

1. A. Tagliaferri, L. Mazzei, P. Lettieri, A. Marzocchella, G. Olivieri, P. Salatino. CFD simulation bubbling fluidized bidispese mixtures: Effect of integration method sand restitution coefficient, Chem. Eng. Sci., 102: 324-334, 2013.
2. F. Taghipour, N. Ellis, C. Wong. Experimental and computational study of gas–solid fluidized bed hydrodynamics, Chem. Eng. Sci., 60: 6857–6867, 2005.