EXPERIMENTAL DETERMINATION OF THE INFLUENCE OF SIZE OF SAND AND PARTICLE COMPOSITION OF BED ON FLUID DYNAMIC BEHAVIOR OF A BINARY BAMBOO-SAND MIXTURE IN FLUIDIZED BEDS

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Abstract

Binary mixtures composed by solid fuels and inert materials has received increasing attention in recent decades, due to its use in fluidized bed reactors for power generation. The objective of this study is to experimentally determine the influence of the size of the sand particles (inert material commonly used in power generation processes) and the composition of the bed up on the minimum fluidization velocity (U_{mf}), the onset fluidization velocity (U_{fi}) and full fluidization velocity (U_{fc}) of mixtures of sand and particles of grinded bamboo, the biomass of interest in this work. The analysis of the fluidization process was done by experimental determination of the pressure drop in the fluidized bed due to the gas flow, in order to raise the fluid bed curve and obtain U_{mf} , U_{fi} and U_{fc} of binary mixtures. Five different compositions of biomass in the bed (0%, 2.5%, 5%, 7.5% and 10%) were tested, and five different sizes of inert material (231, 324, 460, 653 and 920 μm), keeping fixed the relationship between bed's height (H) and diameter (D) to 1.

Key words: minimum fluidization velocity, binary bamboo-sand mixtures, fluidized beds.

Introduction

In the study of the fluidization phenomenon, U_{mf} is a basic parameter for the design of equipment to operate with such technology, because it influences the choice of the superficial gas velocity used in the process, and therefore the diameter of the column. The minimum fluidization velocity depends on the properties of particles [volume-surface diameter or Sauter's (d_p), sphericity (ϕ) and bulk density (ρ_p)], the porosity of the bed at minimum fluidization conditions and fluid properties (density and viscosity). In the case of binary mixtures U_{mf} also depends on the composition of the mixture. This study aims to evaluate the effect of bed composition and the size of the sand particles on the U_{mf} of binary mixtures of ground bamboo and sand.

Results and Discussion

The results of the studied solid particles characterization are presented in Tab. 1.

Table 1. Solid particles properties.

Particle	d_p (μm)	ρ_p (kg/m^3)	ϕ
Bamboo	820 ± 14	1353 ± 125	$0,11 \pm 0,03$
Sand 1	231 ± 7	2650 ± 9	$0,68 \pm 0,01$
Sand 2	324 ± 9	2658 ± 14	$0,64 \pm 0,01$
Sand 3	460 ± 12	2587 ± 21	$0,66 \pm 0,01$
Sand 4	653 ± 16	2634 ± 66	$0,69 \pm 0,01$
Sand 5	920 ± 21	2616 ± 42	$0,71 \pm 0,01$

The best fluidization results were obtained with the sand 3, and therefore, the results shown next

are from the varying composition of bamboo and this sand. The experimentally obtained values of U_{mf} , U_{fi} and U_{fc} are shown in Tab. 2

Table 2. U_{mf} , U_{fi} and U_{fc} for different compositions of the bed.

Bamboo %	U_{mf} (m/s)	U_{fi} (m/s)	U_{fc} (m/s)
0	$10,7 \pm 0,5$	-	-
2,5	$11,5 \pm 0,5$	$10,4 \pm 0,6$	$16,6 \pm 0,4$
5	$13,3 \pm 1,1$	$10,6 \pm 0,7$	$17,5 \pm 0,5$
7,5	$20,3 \pm 1,5$	$18,0 \pm 0,4$	$31,7 \pm 0,8$
10	$294 \pm 5,4$	$23,4 \pm 3,1$	$63,4 \pm 1,1$

Conclusions

The realization of this undergraduate research work allowed my development in the area of fluidization technology, with emphasis on its application in power generation processes. The results showed that both the inert material particle size and the composition of the bed influences the U_{mf} , U_{fi} and U_{fc} of the mixture.

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