Experiment (1)

FLUIDIZED BED DRYER

Unit Operations Lap

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INTRODUCTION

Fluidized bed technology is based on the fluid-like behavior of a bed of solid particles when subjected to the buoyant forces exerted by a gas or liquid. Though composed of an inhomogeneous mixture of fluid and solids, the bed – fluidized by the gas or liquid – behaves like a fluid (i.e., exhibiting hydrostatic surface properties and an effective bulk density lower than the original solids). The outcrop of this behavior is a host of attractive benefits including enhancement of heat and mass transport, high contacting efficiency for reactants, and improved flow and transport options for the solids. Understanding the behavior of fluidized beds is important to realizing these and other benefits. This behavior can be seen in the short video captured in Figure 1, where a bed of small glass beads moves from the slumped condition through bubbling fluidization and back again as the air flow rate is first increased then decreased.

AIM

To study the drying characteristics of a given material in a fluidized bed dryer.

EXPERIMENTAL PROCEDURE:

- Prepare a feed of a solid material (saw dust) to be dried in dryer.

- Measure its dry weight.
- Take a small container, then fill it with dry saw dust.
- Measure its weight and note down it.
- Add known amount of water in the saw dust (feed) and mix it properly.
- Then again fill the container with wet feed sample and weight it.
- Calculate the initial moisture content.
- Turn on the blower and heater and set the required temperature and air flow rate.

- After achieving the required temperature fill the glass column with the wet feed and note down the height of the feed filled.
- Note down the initial temperature reading.
- After 10 minute take out a sample of feed and fill the container with it then weight the container.
- Repeat this procedure and continue to take sample at every 10 minute and weight it until feed is completely dried and steady state achieved.
- Calculate the moisture content for each reading.
- Repeat the experiment for different air flow rates, drying temperature.

CALCULATIONS

$$\text{Head in term of air } (\Delta H) = \left(\frac{h_1 - h_2}{100}\right)\left(\frac{\rho_w}{\rho_a} - 1\right) \text{m of air}$$

$$\text{Flow rate of air } (Q_a) = \frac{a_o \times a_p}{\sqrt{a_p^2 - a_o^2}} C_d \times \sqrt{2g\Delta H} - - - - - - - - \text{m}^3/\text{sec}$$

Moisture content present in sample, $x = \frac{Ws - Sd}{Sd}$ gm water/gm of dry solid.

Now plot a X V/s t on X-Y scale.

From this plot we calculate the slope = - dx/dt. Now we have the drying rate as

$N = -S\frac{dx}{dt}\frac{1}{A}$ kg/m^2-s

CALCULATION TABLE

S.No.	Time t, min	T1 (DBT),℃	T2 (WBT),℃	T3 (DBT),℃	T4 (WBT),℃	Weight(gm)
1	10	49	48	41.6	32	138
2	20	50.3	49.6	40.4	32.5	133
3	30	49.6	49	43.5	32	130

OBSERVATION & CALCULATION

DATA

Dia. of Column, D = `0.08 m

Height of the glass column (h) = 0.5 m

Dia. Of Pipe, dp = 0.042 m

Dia. of Orifice, do = 0.021 m

Coefficient of discharge (Cd) = 0.64

Drying temperature = ……….oC

Surface area of the material (A) = 2×3.14×r×h

OBSERVATION

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Weight of initial Dry Sample, Si = ________gm (neglect the weight of the container)

Weight of initial wet Sample, Wi = ________ gm

Weight of water in initial sample = -------gm

Initial Moisture content present in sample feed material, $X = \frac{Wi - Si}{Si}$

Discussion

1-What is the fluidized bed dryer?

2-How does fluidized bed dryer work?

3-What is fluidization principle?

4- What is the fluidized bed dryer Advantages and Disadvantages?

5- Calculate the moisture content present in sample and the drying rate?

6 **-**Draw the slope between the drying rate and the moisture content