1. INTRODUCTION

This experiment is outlined below. We will only be concerned with the fluidization portion of this experiment. The washer coating experiment will not be done this semester. Refer to the paper below for a description of the experiment. Washington University duplicated this experiment to provide instruction on fluidization. Washington University has contributed very important research in this area of study.

In this experiment you will determine the velocity for the bed to become fluidized. You will compare this with the bed pressure drop calculation based on Ergun formula. Refer to the references and your unit operations text for details; Separation Process Principles 3ed edition, by Seader, Henley, Roper p. 768.

Be very careful with your units when using the Ergun equation!

http://users.rowan.edu/~hesketh/hesketh/Hesketh%20et%20al%20fluid%20bed.pdf

There will be no prelab for this experiment. The experiment will be done after your pump prelab. You will only have to submit a technical memo for this lab, not a full report.

For this experiment read the referenced paper on the fluidized bead coating. We will only be doing the portion on the fluidization velocity.

2. EXPERIMENTAL SETUP & PROCEDURE

The experiment consists of two major sections:

• Determination of minimum fluidization velocity

• Studying the effect of operating conditions on coating thickness

I. Minimum fluidization velocity

1. Measure initial bed height in three locations - average gives the initial bed height

2. Turn the air flow to the distributor at the bottom of the column record air ambient temperature

3. Record:

• Inlet air pressure
• Pressure drop across the bed
• Bed height
• Flow rate

for 4 flow rates below the minimum fluidization.

4. Repeat 3. for 4 flow rates above minimum fluidization Observe and record bed behavior during this.

5. Repeat 4. & 3. Going backwards from higher to lower flow rates

6. Plot pressure drop vs. flow rate to determine minimum fluidization velocity

2. Coating:
   I. Set air velocity at approx. 1.5 times minimum fluidization velocity
   2. Measure thickness, inner radius and outer radius of a metal washer
   3. Measure initial weight of the washer
   4. Heat the washer using air heater (use hook to place washer)

3. DATA COLLECTION

Here is a specific list of measured quantities:

1. Initial data:
   - Bed height, inch, measured at three different locations
   - Ambient air temperature. °C

2. Minimum fluidization velocity
   - Flow meter reading, standard cubic feet/min
   - Bed Height, inch, (three locations)
   - Pressure drop, water height in inch, from atmospheric to plate top
   - Inlet pressure, psig

   - Also, write down your observations of packed bed behavior during fluidization; Can you classify this behavior according to Geldart classification?

For experimental conditions considered — see experimental procedure.
3. Coating:
- Preheat temperature, °C
- Dip time, s
- Washer thickness, in
- Washer inner diameter, in
- Washer outer diameter, in
- Initial washer weight, g
- Final washer weight, g

Also, write down experimental conditions during coating: flow rate, scfm, average bed height, in,

For experimental conditions considered — see experimental procedure.

4. SAFETY ISSUES

This experiment involves handling metal objects heated to high temperature. You should wear appropriate gloves and tongs; be careful with heat gun. Safety goggles and glasses should be worn to protect students from fine powder (used in fluidized bed). Polymer powder produces dust — paper towel should be secured over the top of the column when operating at high air flow rates. As always, normal laboratory procedures should be followed.

5. ADDITIONAL DATA

Bed porosity in state of minimum fluidization = 0.40

Particles diameter = 250 µm

Density of polymer = 954 kg/m³

Column diameter = 0.469 ft

Information on Geldart’s Classifications of Materials can be found here:

http://web.fi.uib.no/~hoffmann/papershtml/npt00/npt99.html
REFERENCES:


2. Levenspiel, O. “Omnibook”


