

## PRESSURE DROP IN THE FULL COLUMN

### Aim

Observation of pressure drop in filled column.

### THEORY

In a number of chemical processes, solid-gas, liquid-gas or gas-liquid-solid are used. Examples of these processes are filtration, absorption, ion exchangers and combustion. The resistance shown to a fluid flowing through the cavities in a solid bed is equal to the sum of the drag forces of the particles in the bed. Depending on the Reynolds number, there are laminar flow and turbulent flow formation.

When a single phase flows in a filled column, the pressure drop in the column can be calculated from the Ergun equation. For this, a suitable equivalent filler diameter must be defined first. The equivalent diameter of a particle or filler may be defined as the diameter of the same bulky sphere. In addition, the difference in the shape of the particle can also be classified by the shape factor. The pressure drop in the gas can be calculated from the Ergun equation given below for the filled bed.

$$\frac{\Delta p}{L} = 150 \frac{(1 - \varepsilon)^2}{\varepsilon^3} \frac{\mu u_0}{d_p^2} + 1.75 \frac{(1 - \varepsilon)}{\varepsilon^3} \frac{\rho_g u_0^2}{d_p}$$

### EXPERIMENTAL METHOD

A-Test Assembly Figure 1 shows a filled column that can be used in gas absorption. Fillers placed on a grill below the column give the name of the column. To prevent the movement and entrainment of the filler at high speeds, another grid is placed on the top. Examples of the various fillers used in filled towers are shown in Figure 2. The reason for the fillers in various shapes is to increase the amount of interface between liquid and gas.

Figure 1. Packed column

Figure 2. Packing materials

The filled column is made of pyrex glass and is installed in the laboratory. The filled column is capable of working in three phases. Gas is used as air, water as liquid and glass Rasching rings are filled as solid.

### B- Experiment

1. Determine the pressure drop at at least five different airflow rates in the rotameter range without using fluids.

2. Set the fluid flow rate to a recommended low speed and repeat the above first. In this case, observe the loading and overflow points. Determine the air flow rate and pressure drop at these points.
3. Repeat the above operations in sequence by adjusting the fluid flow rate to two different values.
4. Leave the system re-used by closing the fluid and air flow rates.

#### DATA TABLE

*Dry packed data's*

| Gas Rate | Pressure difference |
|----------|---------------------|
|          |                     |
|          |                     |
|          |                     |
|          |                     |
|          |                     |

-----*at liquid flow rate*

| Gas Rate | Pressure difference |
|----------|---------------------|
|          |                     |
|          |                     |
|          |                     |
|          |                     |
|          |                     |

----- *at liquid flow rate*

| Gas Rate | Pressure difference |
|----------|---------------------|
|          |                     |
|          |                     |
|          |                     |
|          |                     |
|          |                     |

----- at liquid flow rate

| Gas Rate | Pressure difference |
|----------|---------------------|
|          |                     |
|          |                     |
|          |                     |
|          |                     |
|          |                     |

### CALCULATIONS

1. Create a graph showing the air flow rate against the pressure drop on the logarithmic scale and show the loading and overflow points. Draw the dry fill curve.
2. Compare the loading and overflow points obtained experimentally.
3. Calculate the clearance fraction in the column using pressure drop data.

### PRELIMINARY

The questions given below will be answered in the form of homework and will be delivered to the instructor.

1. To obtain information from the sources given below.
2. Define loading and overflow points.
3. Provide brief information about fillers.
4. How does the pressure drop in the column change with the fluid and air flow rate?
5. Explain the effect of the type and size of the filler on the pressure drop in the column.

### Resources

1. Uysal, B.Z., Kütle Transferi-Esasları ve Uygulamaları, Gazi Üniversitesi Yayınları, Ankara, 1996.
2. Treybal, R.E., Mass Transfer Operations, 3rd Ed., McGraw-Hill, New York, 1981.
3. Mscabe, W.L., Smith, J.C. and Harriott, P., Unit Operations of Chemical Engineering, 3rd Ed., McGraw-Hill, New York, 1974.

4. Geankoplis, C., Transport Process and Unit Operations, 2nd Ed., Allyn and Bacon Inc., Boston, 1983.
5. Davidson, J.R., Clift, R. and Harrison, D., Fluidization, 2nd Ed., Academic Press, Florida, 1985.
6. Kunii, D. and Levenspiel, O., Fluidization Engineering, 1st Ed., John Wiley and Sons Co., Florida, 1987.