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MEASUREMENT OF MINIMUM FLUIDIZATION VELOCITIES AT ELEVATED TEMPERATURES

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SUMMARY

Minimum fluidization velocities at elevated temperatures have been determined for a variety of fluidizing gases at various temperatures. The implications of this work are discussed.

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1. INTRODUCTION

Fluidization is a technique which has been used extensively at elevated temperatures. However direct experimental information regarding the effects of temperature on the characteristics of fluidization is limited.

In many cases it may be necessary to operate the bed at the lowest possible flowrate and in addition the character of the solids and fluidizing gases may change at elevated temperatures. Correlations for prediction of minimum fluidization velocities are based on experimental work at room temperatures and as such have only limited accuracy.

The purpose of the present study was to develop equipment which could be used to study the effects of operating variables on fluidization at elevated temperatures.

2. EXPERIMENTAL TECHNIQUE AND EQUIPMENT

The minimum fluidization velocity was determined by measuring the pressure drop across the bed for both increasing and decreasing flowrates. The work was carried out in a 150 mm diameter bed fitted with a double plate distributor. This bed was immersed in a constant temperature bath which consisted of a bed of fluidized sand through which hot gases from a furnace were passed. The temperature of this bed was controlled by by-passing some of the hot gases to atmosphere. The fluidizing gases to the test column were preheated in an external furnace prior to passing through a coil also immersed in the outer constant temperature bath. The gas flow was measured by standard rotameters before heating and the bed pressure drop was measured by inserting a probe approximately 1 cm above the distributor plate. Temperatures were measured with Chromel Alumel thermocouples. The temperature of the fluidized bed could be maintained within $\pm$ 10K during a run.

The following fluidizing gases were used: -

(i) Air
(ii) Argon
(iii) Steam
(iv) Hydrogen
(v) Acetylene
(vi) Natural gas

Steam flowrates were measured by collecting the condensate at the exit of the bed. Silica sand having a weight mean particle diameter of 195 μm was used as the bed material.

3. RESULTS AND DISCUSSION

The temperature range investigated was from 293 K to 973 K and the corresponding viscosity varied from 8. 7 to 54 μ. Ns/m^2. The particle Reynolds Number was less than 0. 6 in all cases.

The minimum fluidization velocity was found to be inversely proportional to the viscosity over the range of variables studied. This behaviour is in agreement with theoretical predictions. Previous correlations, however, based on work at room temperature have suggested that the exponent of viscosity was of the order of -0. 8 and this is significantly larger than the exponent determined under working conditions.