APPENDIX A

CALCULATION OF BED HEIGHT AND PRESSURE DROP FOR RUN G50E13

$U_G = 3.58$ cm/sec

The manometers are read at static conditions (when gas and liquid velocities are zero) to correct for the slightly different position of the manometers with the meter sticks. Then for a given gas flow rate, the liquid rate is varied, and the manometer heights measured at each liquid rate. The pressure drop due to flow between a particular manometer and the bottom pressure tap is calculated from the following:

$$\Delta h_i = m_1 - m_i + (m_{i,o} - m_{1,o}) \quad , \qquad (44)$$

where

Δh_i = pressure drop due to flow between taps i and 1,

m_1 = height of liquid in manometer 1 (bottom tap),

m_i = height of liquid in manometer i,

$m_{i,o}$ = height of liquid in manometer i under static conditions,

$m_{1,o}$ = height of liquid in manometer 1 under static conditions.

Some of the raw data for run G50E13 are shown in Table 8. The first line shows the manometer heights under static conditions. Line 2 shows the manometer heights for a superficial liquid velocity of 10.14 cm/sec. The pressure

Table 8. Raw data for run G50E13

	Line 1	Line 2
Gas velocity, cm/sec	0	3.58
Liquid velocity, cm/sec	0	10.14
Bed height, cm	37	65
m_1, cm water	45.8	66.5
m_2, cm water	45.8	63.5
m_3, cm water	45.8	60.3
m_4, cm water	45.6	57.3
m_5, cm water	45.5	54.2
m_6, cm water	45.5	51.0
m_7, cm water	45.5	48.3
m_8, cm water	45.4	45.4
m_9, cm water	45.5	44.8
m_{10}, cm water	45.5	45.9
m_{11}, cm water	45.5	47.0

drops can then be calculated by using the following equation:

$$\Delta h_2 = m_1 - m_2 + (m_{2,o} - m_{1,o}) \quad , \qquad (45)$$

$\Delta h_2 = 66.5 - 63.5 + (45.8 - 45.8) = 3.0$ cm water,

$\Delta h_3 = 66.5 - 60.3 + (45.8 - 45.8) = 6.2$ cm water,

$\Delta h_4 = 66.5 - 57.3 + (45.6 - 45.8) = 9.0$ cm water,

$\Delta h_5 = 66.5 - 54.2 + (45.5 - 45.8) = 12.0$ cm water,

$\Delta h_6 = 66.5 - 51.0 + (45.5 - 45.8) = 15.2$ cm water,

$\Delta h_7 = 66.5 - 48.3 + (45.5 - 45.8) = 17.9$ cm water,

$\Delta h_8 = 66.5 - 45.4 + (45.4 - 45.8) = 20.7$ cm water,

$\Delta h_9 = 66.5 - 44.8 + (45.5 - 45.8) = 21.4$ cm water,

$\Delta h_{10} = 66.5 - 45.9 + (45.5 - 45.8) = 20.3$ cm water,

$\Delta h_{11} = 66.5 - 47.0 + (45.5 - 45.8) = 19.2$ cm water.

The pressure taps 2-11 in the 7.62-cm-ID column are located along the column wall at heights of 8.8, 17.8, 26.8, 35.8, 44.8, 53.6, 62.3, 71.3, 80.3, and 88.8 cm, respectively, above the bottom of the bed. Plotting the pressure drops Δh versus their respective tap height results in Fig. 2 (see page 8). Fitting straight lines to the pressure drop in and above the bed results in:

$$\Delta h_{\text{in bed}} = 0.194 + 0.3307\, h \quad , \qquad (46)$$

$$\Delta h_{\text{above bed}} = 30.37 - 0.1257\, h \quad , \qquad (47)$$

where h is the height above the bottom of the bed. Solving these two equations simultaneously gives the point of intersection of the two lines, corresponding to the calculated bed height and the pressure drop across the bed. As shown in Fig. 2 (see page 8), the point of intersection corresponds to a calculated height of 66 cm and a pressure drop of 22 cm water.

Calculating the bed pressure drop in this manner for each liquid rate and then plotting the two values as shown in Fig. 48, the minimum liquid fluidization velocity at the set gas rate can be found as the intersection of the curve for the pressure drop through the packed bed and that for the pressure drop through the bed once it has been fluidized. For U_G = 3.58 cm/sec, $U_{L,mf}$ is found to be 2.15 cm/sec.

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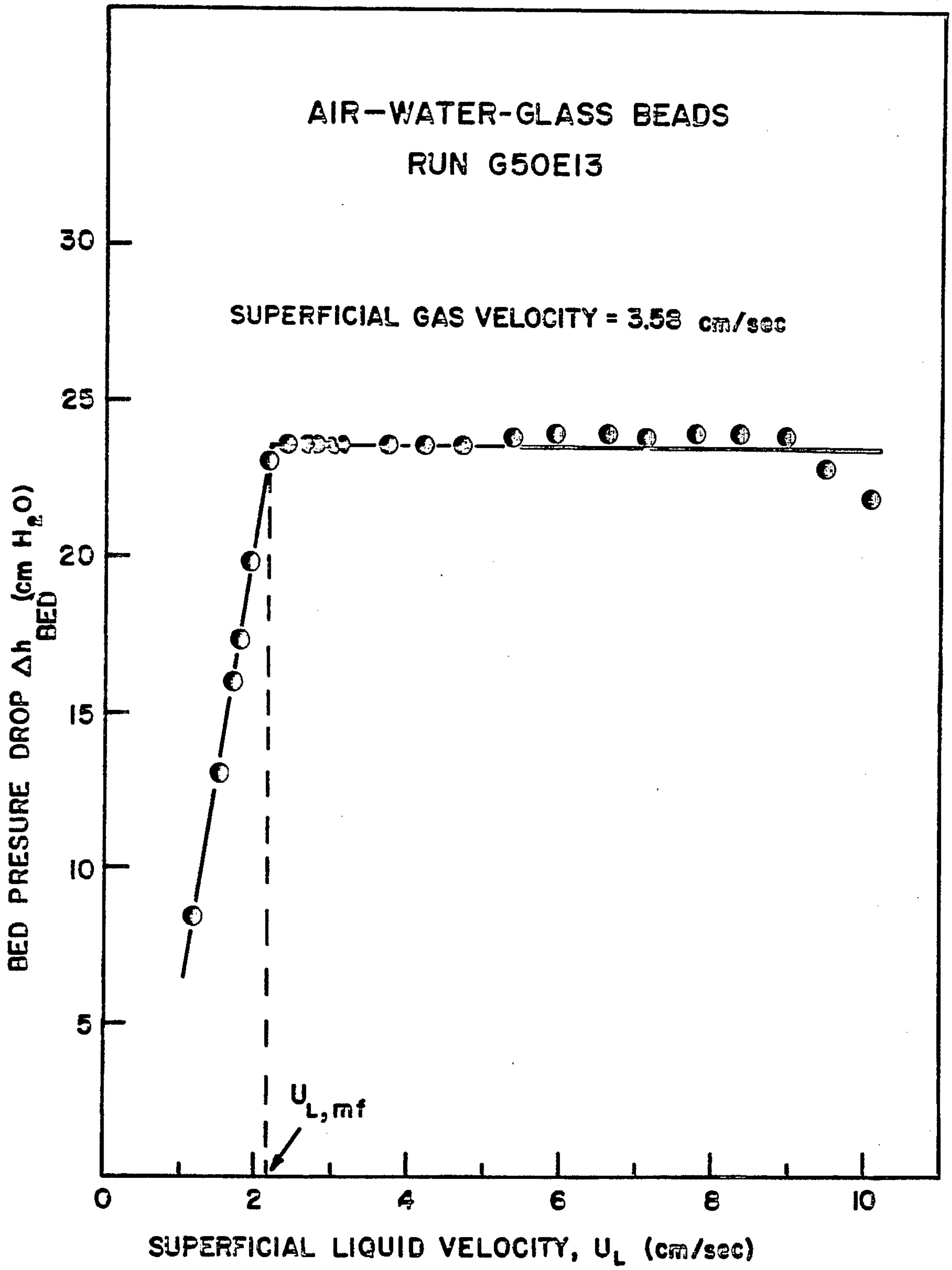

Figure 48. Use of the bed pressure-drop-versus-liquid velocity curves to obtain the minimum liquid fluidization velocity.