C. AXIAL GAS HOLD-UP MEASUREMENTS

Axial gas hold-up measurements were made in two stainless steel (SS) columns (0.241 m ID and 0.051 m ID by 3.0 m tall). Experiments were conducted at 265°C using FT-300 wax in the 0.051 m ID column, and FT-300 and Sasol's Arge reactor wax in the 0.241 m ID column. The 1.85 mm orifice plate and 40 μm SMP distributors were employed in the 0.051 m ID column, whereas the 19 X 1.85 mm perforated plate distributor was used in the 0.241 m ID column. Increasing order of gas velocities were used for all experiments, except for the 1.85 mm orifice plate distributor, where a run was also conducted using decreasing order of velocities.

The major highlights associated with the axial gas hold-up measurements are:

- Axial gas hold-up increases with height along the column and gas velocity in the presence of foam.
- Axial gas hold-up shows a marginal increase with height along the column in the absence of foam.
- Average gas hold-ups obtained from differential pressure measurements are in good agreement with average gas hold-ups obtained in the glass columns.

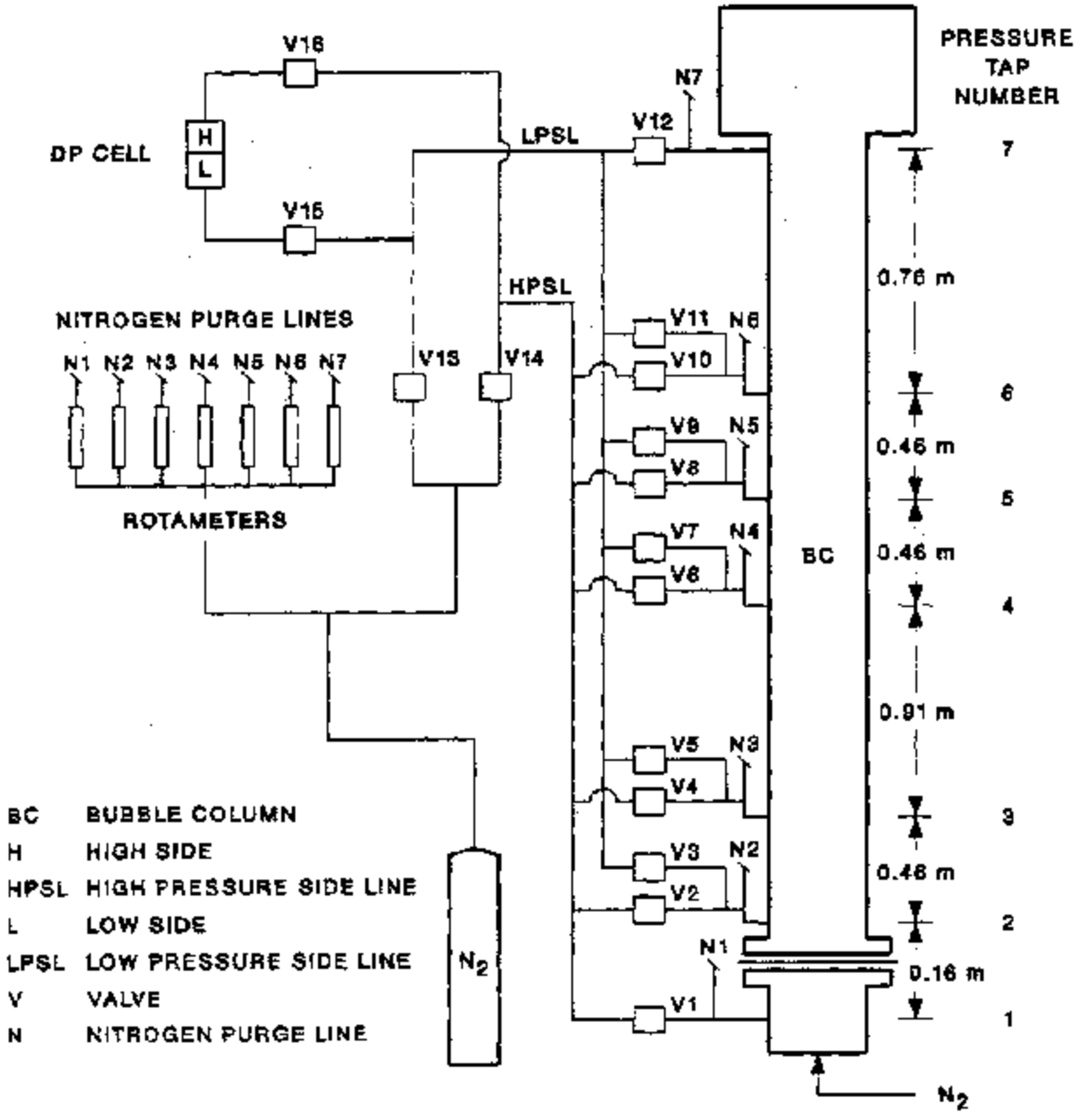
C.1. Experimental Apparatus

The two columns were constructed and operated in the same way, therefore, only a description of the differential pressure (DP) system and the operating procedure for obtaining axial gas hold-ups in the small stainless steel column will be presented.

Figure V-39 is a schematic representation of the DP system used with the small stainless steel column for axial gas hold-up measure-

FIGURE V-39

AXIAL GAS HOLD-UP APPARATUS



ments. The DP system consists of a series of pressure taps (1 - 7 in Figure V-39), with 0.64 mm holes at seven locations along the column height. Pressure tap 1 is located below the distributor, whereas taps 2 - 7 are located above the distributor. The pressure taps are purged with nitrogen, lines N1 - N7, in order to prevent the wax from entering the pressure tap lines. A series of rotameters (one for each pressure tap) control the nitrogen purge rates. Following the nitrogen purge lines, the pressure tap lines split and are connected to the high pressure side line (HPSL) and the low pressure side line (LPSL), with the exception of pressure taps 1 and 7. Pressure tap 1 is connected only to the HPSL and pressure tap 7 is connected only to the LPSL. Valves V1 - V12 allow axial pressure measurements across any two pressure ports. All of the pressure tap lines, the HPSL and the LPSL are electrically heated to 200°C. Valves V13 - V16 comprise the secondary nitrogen purge system which is used to clear the HPSL and the LPSL if wax enters the lines. The HPSL and the LPSL are attached to the high side (H) and the low side (L) of the DP cell (Validyne Model DP-15), respectively. A readout (Validyne Model CD-223), which is connected to the DP cell, displays the pressure. Pressure fluctuations are recorded with a chart recorder (Cole Parmer Model 8376-30).

C.2. Operating Procedure

The axial gas hold-up is calculated from the axial pressure drop measurements. While making measurements, the secondary purge line valves (V13 and V14) were kept closed and the DP cell connecting valves (V15 and V16) were opened. The DP cell was first calibrated by recording the pressure drop across the column length for different known heights of

distilled water (i.e. a liquid of known density). The rotameters, on the purge lines, were then adjusted to obtain a zero reading across all possible combinations of pressure tap pairs (one high side and low side port) when the column was empty. However, the purge flow through any given rotameter was maintained below 45 cc/min.

After adjusting the DP cell, the column was filled with wax up to the desired height and measurements commenced. The pressure drop across all possible combinations of the pressure taps was measured approximately 45 minutes to one hour after achieving the desired column temperature and gas flow rate. It was necessary to wait at least 45 minutes to ensure that steady state was achieved, particularly when foam was present. For all experiments, the liquid static height was approximately 2.0 to 2.4 m with the exception of the experiment in the small column with the SMP distributor (H_s = 1.0 m). Periodically, the HPSL and the LPSL were cleared by using the secondary nitrogen purge system (i.e. by closing valves V15 and V16 and opening valves V13 and V14).

C.3. Experimental Results

The differential pressure measurements obtained from the experiments were converted to axial and average hold-up values using the data reduction procedure outlined in APPENDIX B.

C.3a. 1.85 mm Single Hole Orifice Plate Distributor

Axial gas hold-up profiles obtained from the experiments conducted in increasing and decreasing order of gas velocities (0.051 m ID column) are shown in Figures V-40 and V-41 respectively. In the experiments conducted from low to high gas flow rates (Figure V-40), three zones of gas hold-up can be noted at the higher gas velocities. (1) low hold-ups are obtained