CHAPTER 4

EXPERIMENTAL APPARATUS , MATERIALS AND PROCEDURE FOR DETERMINATION OF AXIAL DISPERSION COEFFICIENTS

This chapter describes the apparatus as well as materials used in this study , and then emphasizes the procedure used to carry out the whole set of experiments .

4.1 Schematic diagram of apparatus

Figure 4.1 depicts the apparatus used for determining axial dispersion coefficients in this study . Basically the equipment consists of four main items as follows :

1. A packed column
2. A gas flow meter
3. An air bath system
4. A gas analysis system

4.1.1 The packed column

The test columns were made of 24 inches long copper tubing packed with various particle sizes of 3 Å molecular sieve carbon of

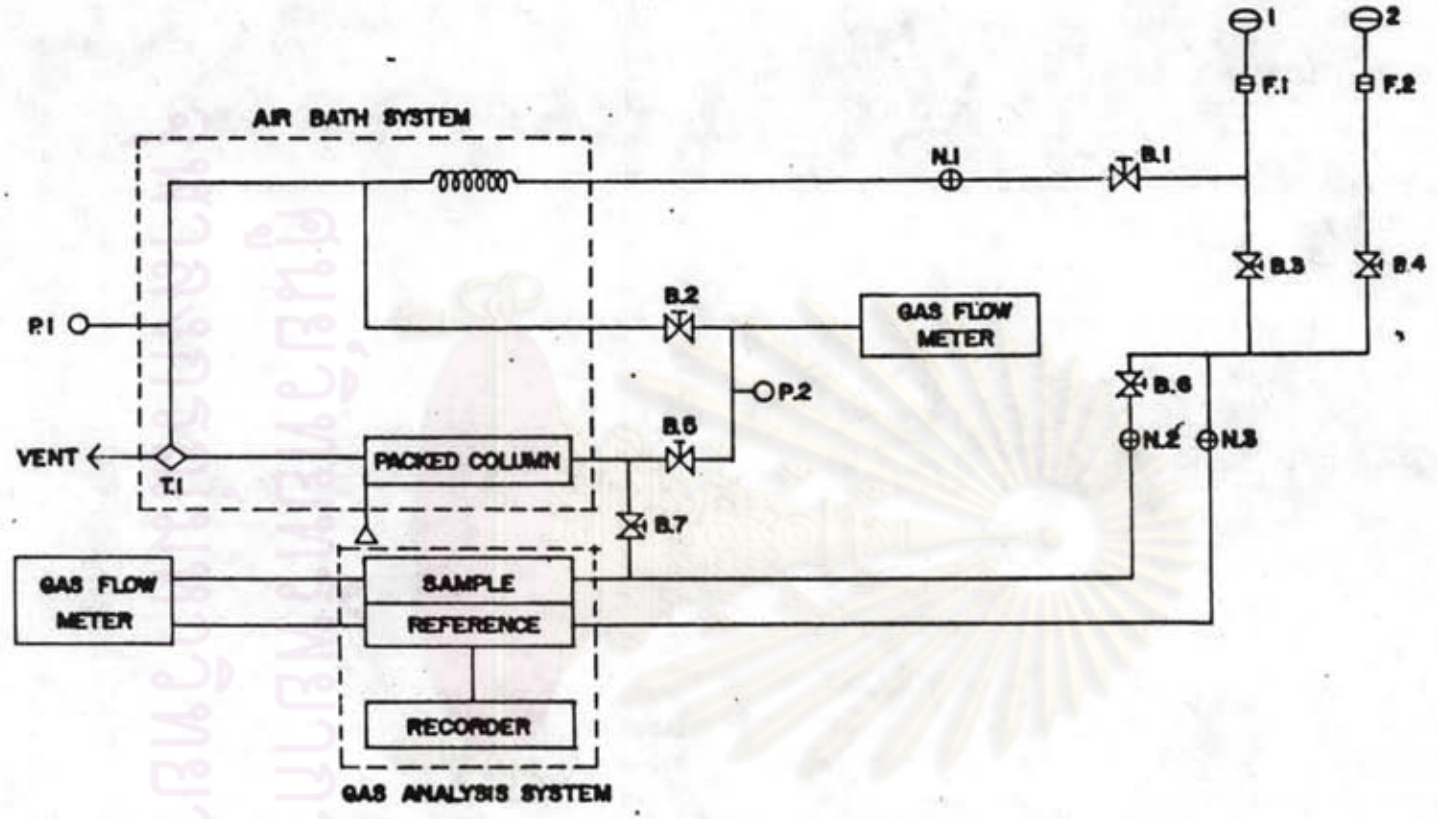

Fig.4.1 Schematic diagram of apparatus used for determining axial dispersion coefficients

various sizes to yield the appropriate tube to particle diameter ratios equal to or greater than 10 . The details and other necessary information of the packed column used are listed in table 5.1 .

4.1.2 The gas flow meter

A 50 ml. burette was adapted as a soap gas flow meter used for measuring the gas flow rate throughout the study . The construction of which involves removing the ordinary glass valve at the tip of the burette and replacing it with a three way glass fitting . One end is the entrance point for the gas to be metered and the other end is attached to a rubber syringe ball containing a small amount of soap water to form the bubbles required for flow rate readings .

4.1.3 The air bath system

A constant temperature air bath chamber of 2 x 1.5 x 1.5 $feet^3$ size was made up of three clear plastic sheets and an aluminium plate . Inside the bath , a heater for heating and two fans for recirculating the air were installed . A PID controller , with an accuracy of + 0.1 ^0C , was set at 10 , 2 and 1 for proportional , integral and differential modes respectively in order to regulate the temperature to 45 ^0C . In figure 4.2 the curve which represents the performance of this PID controller is shown .

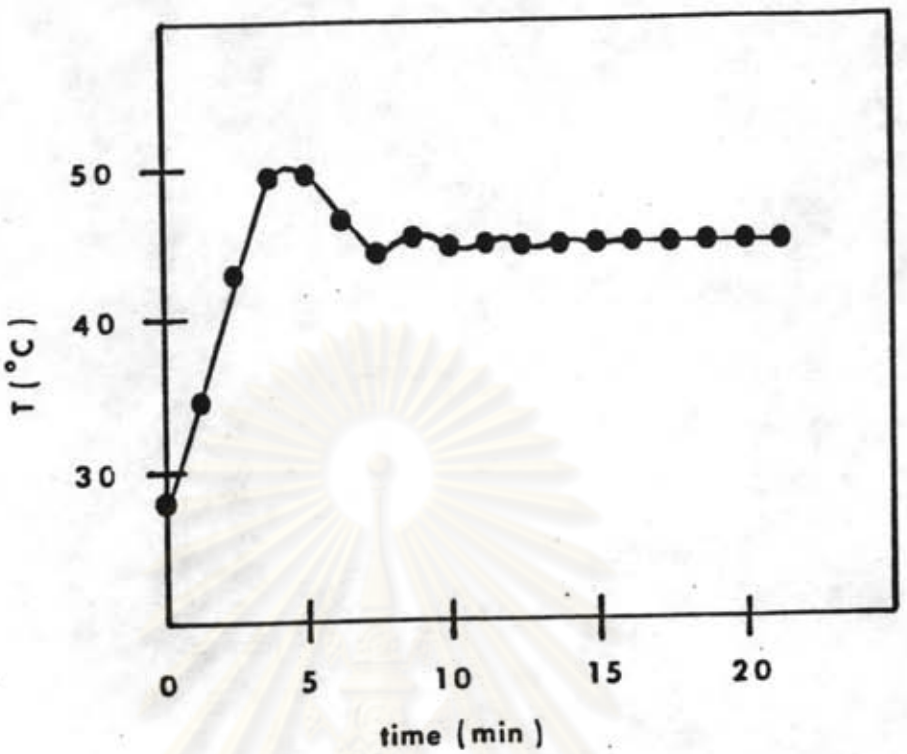

Fig. 4.2 Performance curve for the temperature control system by PID

4.1.4 The gas analysis system

A Varian 3400 gas chromatograph was directly connected to a 1/8 inch stainless tube from the exit of packed column to the thermal conductivity detector . It was utilized to determine the tracer gas concentration in the outlet stream of the packed column .

The operating conditions of the gas chromatograph are presented as follows :

Oven temperature	40	^0C
Detector temperature	70	^0C

Carrier gas flow rate (propane) and filament current vary according to the required conditions .

4.2 Materials

The MSC-3A used as an adsorbent in this study was made available with compliments from The Takeda Chemicals Ind. Co., Ltd . This molecular sieve carbon was reported to have micropores of 3×10^{-10} m.

The gases used in this experiment were high purity graded methane and propane as shown in table 4.1 .

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Table 4.1 : Properties of gases used in this investigation

GAS	QUALITY	PURITY %	MANUFACTURER
Propane	high graded	99.7	Thai Industrial Gases
MEthane	high graded	99.5	Thai Industrial Gases

4.3 The experimental procedure

The following procedure was performed in each set of experiments. The details are listed step by step as follows :

1. Prior to the run ,turn all valves in the system off
2. Set the temperature controller to 45 ^{0}C
3. Open pressure regulator no. 1
4. Open ball valve no. 1 , 3 . Then adjust needle valve no. 1 , 3 until the equivalent , desired flow rates are obtained .
5. Close ball valve no 2 .
6. Turn 3-way valve to packed column and open ball valve no. 5 .
7. Measure the exit flow rate and record pressure from pressure gauge no. 1 and 2 .
8. Close ball valve no. 5 , then open ball valve no. 7 and measure the exit flow rate from GC .
9. Inject one cc of methane into the packed column at septum no. 1 and record result by gas chromatograph .
10. Repeat step 4 to 9 for other flow rates .

Each run is repeated three times to check reproducibility of recorded signal . Before the next run is made , ample time is allowed to make sure of process conditions .

Since the distance from the tracer injection point at the entrance of the packed bed to the detection point was 160 cm , but the packed bed portion was invariably 60 cm in length . Therefore a 100 cm of 0.019 in empty tube diameter was used to connect from the exit of packed bed to the detection point . It was desirable to carry out all blank experiments for this empty tube distance at the same experimental conditions as the normal runs so as to correct the response curve to approach more reliably a closed - closed system condition .

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