Chapter V

DISCUSSION AND CONCLUSION

(1) From Table C-2 to C-21, it is found that the vacuum along the axis of the Cyclones varies slightly. However, it can be concluded that the vacuum along its axis is approximately constant upto 40 per cent of the Cyclone height.

(2) From Fig. 4-3 to 4-6, it is seen that at a constant flow rate of compressed air, the vacuum in the Cyclones increases rapidly when the Cyclone angle increased from 0° to 5° . The vacuum decreases when the Cyclone angle increases to 10° and above. This indicates that the maximum vacuum occurs in the range of 0° to 10 . However, in Fig. 4-3 the Cyclone angle at 10° produces a greater vacuum than at 15° and the Cyclone angle at 15° produces a greater vacuum than at 0° and 5°. This indicates that for a smaller Cyclone height the maximum vacuum occurs in the range of 5° to 15° . In addition, the curve of Cyclone angles at 0°, 5°, and 20° are not smooth for the compressed air when supplied at greater than 300 Lit/min. The cause of this phenomenon cannot be explained at this stage because some characteristics in the Cyclone such as pressure and velocity distribution of air have not been studied adequately. Besides, during the test it was found that there was a noise from pulsating flow in the Cyclone.

(3) From Fig. 4-3 to 4-6, The results show that at any

constant rate of flow of compressed air and a constant Cyclone height the maximum vacuum occurs at approximately 6° of Cyclone angle. However, for a 7.5 cm Cyclone height, the maximum vacuum occurs at 10° of Cyclone angle. This confirms the previous conclusion in (2). It can be concluded that at any constant supplied air pressure,the Cyclone angle giving maximum vacuum in the Cyclone is constant at 6°.

(4) Considering Fig. 4-11 to 4-15 and Fig. 4-7 to 4-10 it can be said that at any Cyclone design height, the Cyclone angle should be 6° or 10° . Therefore, Cyclone angles between 6° and 10° are of interest in this study. For the Cyclone angle of 5°, the maximum vacuum occurs at H = 17 cm (see Fig. 4-12). From Fig. 4-13 there is no maximum vacuum, but the vacuum increases as the Cyclone height is decreased. Therefore, it can be concluded that in the designing of Cyclones the height should be equal to 17 cm for a 5° Cyclone angle. However, with smaller Cyclone, the Cyclone angle of 10° should also be considered in the design.

(5) Fig. 4-16 to 4-19 illustrate the rates of suction air in the Cyclones of constant Cyclones angles and heights. According to the previous discussion the ratio of the flow of suction air to the compressed air supplied is in the range of 55 per cent to 75 per cent for the Cyclone height 7.5 cm and the Cyclone angles 5° and 10°; and the Cyclone height 15 cm with the Cyclone angle 5° and 10°. Therefore, a well-designed Cyclone will create a minimum suction air greater than 55 per

cent of compressed air supplied.

(6) From Fig. 4-20 to 4-22 which show the conveying capacity of Cyclones, the Cyclone having a 7.5 cm Cyclone height with a 10° Cyclone angle creates the greatest conveying capacity because it can produce the greatest vacuum. It can be observed that at the zero rate of material conveyance, the greater the Cyclone height, the more compressed air supplied to produce enough vacuum to induce material into the conveying line is used. That is to say, the energy loss in the Cyclone increases as the Cyclone height is increasing, From Fig. 4-20 to 4-22 when comparing the three graphs, the characteristic curves are similar. Thus, the characteristics of Cyclones are not changed by different conveying materials.

(7) From the calculation of the power consumption (see Appendix D), the power used to supply compressed air for the system of the Cyclone conveyor is divided into two parts. In the first part some power is used to produce a vacuum to convey material in the vacuum system of the Cyclone conveyor. The remaining power is used to convey material in the pressure system of the Cyclone conveyor. It is seen that the power lost in the Cyclone is considerably great.

Since in this study the system of the Cyclone conveyor is limited to a small scale, the comparision of the power consumption of the system with the other pneumatic conveying system cannot be made at this stage. However, in comparision of the system of the Cyclone conveyor with the combination vacuum-pressure system, there are the following advantages:

(i) The system of the Cyclone conveyor needs a cyclone receiver at the terminal point, but it does not need a Cyclone separator including a rotary feeder to supply material for the pressure system. Besides, for a plant having an air compressor with sufficient capacity, a blower is not necessarily provided. Therefore, the initial cost of the system of the Cyclone conveyor is less than that of the combination vacuum-pressure system.

(ii) Since the system of the Cyclone conveyor does not need an intermediate cyclone separator between the vacuum system and the pressure system of the Cyclone conveyor, this system is more flexible. That is to say, the Cyclone can be arranged conveniently. For example, a Cyclone can be fixed near a material storage area. Then the suction line length is reduced and therefore the vacuum required in the Cyclone is less. This results in more remaining power for the pressure system of the Cyclone conveyor. Therefore, the conveying distance may be increased. In addition, a Cyclone can be easily made and is also portable.

Therefore, from the discussion above, the conclusions from this expermental study can be summarized as follows:

(i) In designing a Cyclone, the Cyclone angle and height should be 5° and 17 cm respectively. But for a smaller Cyclone, a Cyclone angle of 10° can be more efficient.

(ii) The system of the Cyclone conveyor used as a new variation of pneumatic conveyors is feasible.

(iii) The system of the Cyclone conveyor in comparision with the combination vacuum-pressure system has some advantages such as greater operational flexibility and lower initial cost.