CHAPTER 2
DEVELOPMENT OF A BOX TYPE INJECTOR FEEDER

2.1 INTRODUCTION

In order to study the influence of design parameters on the flow rate of conveyed material, it became necessary to develop a suitable feeder. It was first decided not to have any rotary metering device to feed the material, so that the flow rate of material could automatically change as the parameters are changed. Before the final injector feeder with proper hopper was designed for experimental purpose, a few trial hopper cum feeders were fabricated. They helped to make some preliminary observations on the free flow of material down the hopper. An important offshoot of these observations was the decision to include distance between primary nozzle and secondary nozzle (Figure 2.4) as one of the parameters for the present work. The trial hopper cum feeders as well as the final feeder arrangement are reported in the next sections.

2.2 TRIAL HOPPERS CUM FEEDERS

The first trial shown in Figure 2.1 did not have a feeder box or chamber and it consisted of only a hopper of rectangular shape and a nozzle for the conveyance of the material. The hopper was made of acrylic plastic sheet of size 175 x 75 x 475 mm and joined at the bottom with the mild steel plate of size 300 x 215 x 6 mm. The nozzle made of aluminium and of 16.5 mm diameter was used as the driving jet. The nozzle and a conveyor pipe of 19.0 mm dia. were mounted on the opposite walls of the hopper. The conveying material used was wheat. The purpose of fabricating and testing this model was to get some preliminary idea regarding conveyance of material. However, it was then decided to study the effect of fluidization. Therefore the introduction of auxiliary air supply from bottom became necessary. Accordingly the next model was fabricated.
The next trial namely the circular pipe feeder is shown in Figure 2.2. The circular feeder box was made of galvanized iron pipe. In this model also one end was mounted with a straight tube air jet of 16.5 mm diameter. The air jet diameter was reduced from 20 mm to 16.5 mm. The opposite end was mounted with a transport pipe with a convergent inlet end as shown in Figure 2.2. Another pipe of 10.0 mm dia was connected to the bottom of the circular feeder box, to give an auxiliary air supply (perhaps a crude way of fluidization). The granular material wheat was used as the conveying material. However it was observed that as the auxiliary air tended to prevent the flow of material from the hopper this model was not quite effective in the conveyance of solids especially during fluidization. The circular feeder box used also was smaller in size.

A further modification of the previous model is that of a semi circular type feeder box with a rectangular hopper of size 145 x 55 x 225 mm mounted over that as given in Figure 2.3. An auxiliary hopper which forms an integral part of the hopper served for feeding the material into the hopper. The flow rate of material from the auxiliary hopper to the hopper was controlled manually by variation of the slider plate position. A driving jet of diameter 7 mm was used to inject the material into the transport pipe and provision had been made to vary the location of this nozzle position. A secondary nozzle having inlet tube as shown in figure was mounted on the hopper. The end of the secondary nozzle was connected to the plastic transport pipe of 28m length. For fluidizing purpose another pipe of 10 mm diameter was connected to the bottom of the semi circular box. The purpose of providing the auxiliary feeder was to gradually feed the material into the hopper and then to the circular feeder box. Further, one can find out whether there is flow of material without any interruption and also whether fluidization has got any effect on the flow rate of material. It was observed that there was flow of material and also some effect on the fluidization.
2.3 THE BOX TYPE INJECTOR FEEDER

The final version of the hopper along with feeder is shown in Figure 2.4. The circular feeder box of Figure 2.3 was changed to a rectangular box for the purpose of making the bottom plate of the same to use as a distributor and also for attaching a calming section. In the secondary nozzle, changes had been made to incorporate a mixing tube for thorough mixing of the air and material and a diffuser tube for pressure built up. The primary nozzle was made into a convergent section. The present work has been carried out using this final version.
FIGURE 2.1 FEED HOPPER AND NOZZLE
FIGURE 2.2 CIRCULAR PIPE FEEDER
FIGURE 2.4 PRIMARY AND SECONDARY NOZZLES

1. PRIMARY NOZZLE
2. SECONDARY NOZZLE INLET TUBE
3. SECONDARY NOZZLE MIXING TUBE
4. SECONDARY NOZZLE DIFFUSER TUBE

PRESSURE TAPPINGS