DESIGN DEVELOPMENT FOR PNEUMATIC CONVEYING AT SMALL SCALE RICE MILLS

A.R. Ariyaratne

Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya

Introduction

Manual handling of paddy or milled rice is the common practice in small scale milling industry in Sri Lanka. The process in a small scale mill involves use of machinery such as rubber roll sheller or steel huller, polisher, aspirator and destoner. Starting from the step of weighing of paddy brought in, it requires moving of material between equipment and lifting up to feed hoppers of each item. Since the process is done in a continuous manner, the labour use is intensive. In general, a single operator manages the entire process. Therefore, an operator is required to feed more than one machine at a time in a coordinated manner to assure smooth operation. Due to the heavy work involved and the cumbersome nature, the employment at a small scale rice mill is unattractive to many.

The conveying technologies used in large and medium scale mills are not suitable for the small scale applications due to technical and economic reasons. The rice processing machinery available in Sri Lanka for small scale milling is for one-ton per hour capacity, in general. Therefore, in small scale processing, the milling outturn capacity is one-ton per hour or multiplies of it. A conveying capacity of one-ton per hour suits many rice mills operated in the rural sector. An introduction of suitable conveying technology could reduce the heavy work by the operator.

The objective of the study is to develop appropriate pneumatic conveying technology for handling paddy at small scale rice mills.

Materials and Methods

A pneumatic conveyor that operates on positive pressure and a feeding mechanism was designed. Since the material discharge from equipment is located above the pneumatic conveyor feeding point, gravity flow and Venturi effect were used to design a feeding unit (Ariyaratne, 2009). With this feeding mechanism, a positive pressure pneumatic conveying was selected from the many possible alternatives (George *et al.*, 1997). This combination provides a simple methodology for conveying paddy or milled rice in horizontal or vertical directions.

The conveying apparatus included a feeding unit, conveying duct and a blower. A blower powered by a 3-phase motor (1 hp) and a motor speed controller was used to vary air flow rates. Air velocity measurements were made with a probe type digital anemometer. The conveying duct was made of 60 mm PVC pipes (Type 600). Paddy conveying rates at different air velocities were observed.

Results and Discussion

The tests on the pneumatic conveyor model with paddy as the material to be conveyed indicated it could function with different capacities depending on air velocity. The air velocities above 9 m/s generated adequate material flow to suit processing machinery of a small scale rice mill (David *et al.*, 2004). Since commonly used machines have the capacity of one ton per hour, the apparatus could provide conveying of material between machine units. The blower units required for this function could be fabricated as done by local machinery manufacturers. The feeder unit and the duct system could be fabricated with PVC pipes. Since conveying is required between several machines at a time, multiple units of conveyors are needed to meet the needs of a small scale rice mill.

Conclusions

The study indicates that the feeding unit based on the Venturi effect and the duct system could be used to convey paddy in vertical and horizontal directions to facilitate moving of material from one machine to another. The capacity of conveyance obtained from the design is satisfactory for operation of a one ton per hour capacity which is the most common type of machinery combination available with small scale rice mills in Sri Lanka.

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