Chapter IV

EXPERIMENTAL CONSIDERATION

4.1 Minimum Fluidizing Velocity Conditions

Air inlet flow rate was varied from 0 to 100% rotameter reading. Pressure drop across the bed was recorded at every 10% interval. The same procedure was repeated at different height of bed: 6.7, 11.0, 15.0, 21.0 and 26.7. The minimum fluidizing velocity was determined as shown in Appendix B.

4.2 Experimental Procedures

4.2.1 Start-Up Procedure

The temperature controller was connected to the circuit of the electric heater and its thermocouple was inserted into the entering of air (see Figure 3-2). The desired operating temperature was set by the controller. The air compressor was started; tap water was run through the condenser; the electric heater was switched on; the air inlet flow rate was controlled and determined by the rotameter. The steady state desired temperature was observed when the temperature controller showed "on" and "off" signals alternately and periodically.

For continuous operation, after the procedure stated above the raw paddy was fed into the column to control the temperature in bed at steady state and adjust height of bed as desired.

4.2.2 Experimentation

The experimental work was carried out according to the schematic diagram in Figure 4-1.

The raw paddy was first precleaned to remove all impurities which would cause fermentation while soaking. It was then soaked in tap water at room temperature for a period of 72 hours (3 days) which was found adequate for absorption and uniform distribution of the soaking water. The paddy was cleaned again to remove some impurities and fermentation product which occured during soaking period. It was drained and steamed with about 1 kg/cm^2 pressure for 8 minutes. The wet parboiled paddy was weighed for one kg. and packed in plastic bag for several bags, each bag for one batch of drying. Then it was poured into the fluidized bed column which was at steady state (after start-up procedure). In continuous operation all wet parboiled paddy was fed by the screw feeder.

Experimental data during drying period was taken with variables followed subject 4.3. In batch drying; paddy was dried in initial drying period until its moisture content reached about 25-30%, then it was taken out for tempering in large plate at room temperature to equalize moisture. After tempering, cooled paddy was put into the bed again for final drying until its moisture content reached about 16-20%. During drying periods; a small amount of paddy in bed was sampled at every 2 (or 4) minutes, and put into small high heat resistant plastic bag for

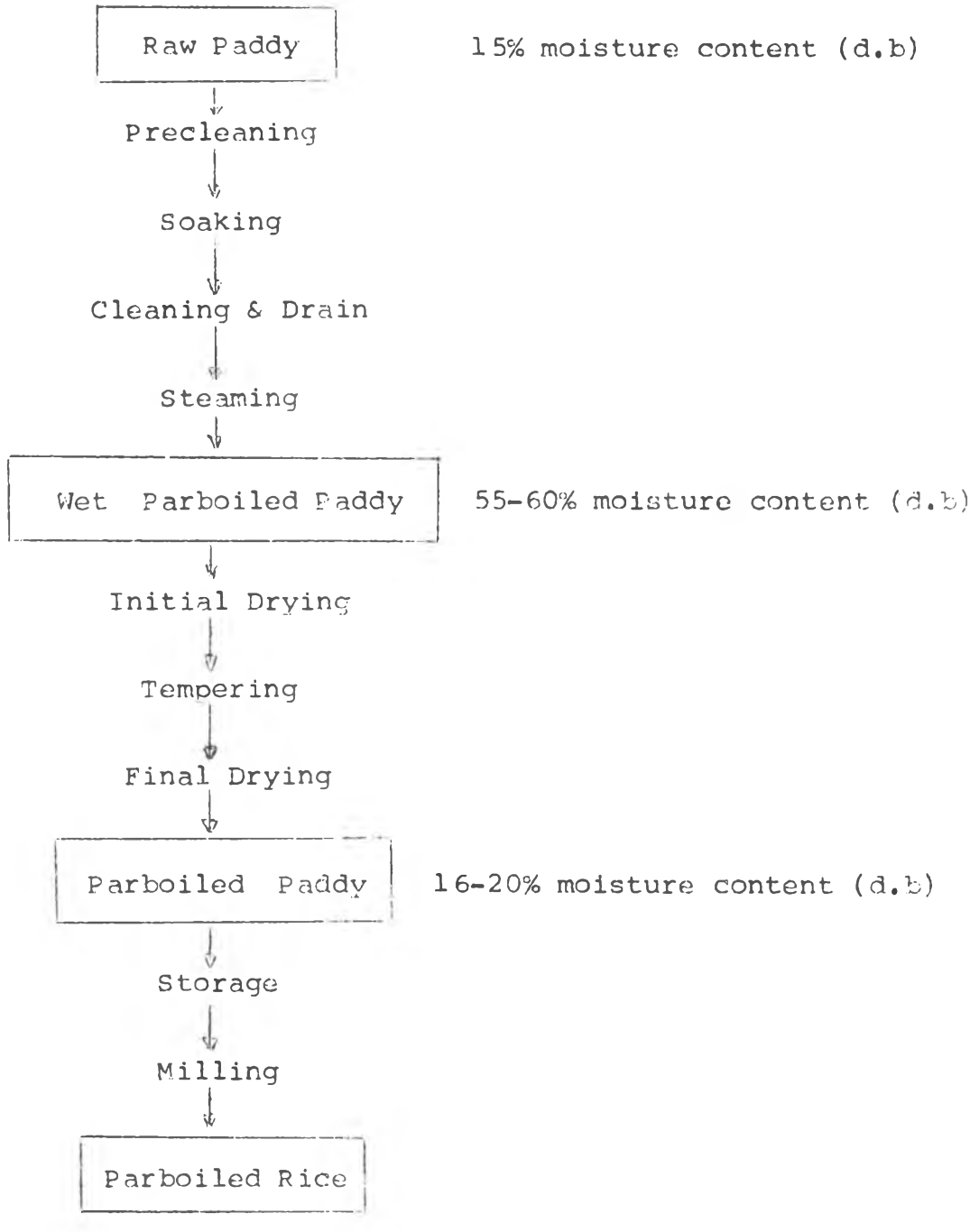

Figure 4-1 Schematic diagram of experimental procedure

determination the moisture content. For moisture content, sample was weighed with plastic bag before and after dried in oven 105$^{o}_{\pm}$ 5^{o}C until it had no moisture or about 72 hours, see Appendix D. In continuous drying, paddy was dried just two passes. Each pass was charging by screw feeder into bed, being in the bed for an interval of time, and leaving out at outlet pipe.

After drying the parboiled paddy would have 14-20% moisture content, and it would be cooled down while storage before milling and then its moisture content was decreased until 11-14% only. All the experimental data was shown in Appendix C.

4.3 Conditions of Operation

4.3.1 Batch operation

1. The flow rate of air inlet was fixed at 1.3297 X 10^{-2} m^3/sec at STP. Six temperatures of air inlet were varied: 80,100, 120,143,160 and 185^{o}C

2. The temperature of air inlet was fixed at 100^{o}C. Four flow rates of air inlet were varied: 1.0804 X 10^{-2},1.5790 X 10^{-2}, 1.8283 X 10^{-2},and 1.9941 X 10^{-2} m^3/sec at STP.

4.3.2 Continuous operation

The temperature and flow rate of air inlet were fixed at 183^{o}C and 1.5790 X 10^{-2} m^3/sec at STP.; respectively. Seven production rates were varied: 8.7753 X 10^{-3},7.6645 X 10^{-3},6.9980 X 10^{-3},6.4148 X 10^{-3},5.7483 X 10^{-3},5.4984X10^{-3},and 4.3821X10^{-3} kg/sec.

4.4 Milling Qualities Determination

The milling qualities of parboiled paddy were determined at the laboratory of Rice Division, Department of Agriculture; and the procedures are as follows:

1. The paddy was cleaned to remove all impurities by passing it through the aspirator two or three times until it was cleaned.

2. Its moisture content was measured by the moisture tester (Steinlite).

3. It was weighed 125 grams. (A).

4. Husk was cracked by the equipment, Statake, and weighed after cracking (B).

5. It was then polished by Mc. Gill Miller No.2; putting a knob for first minute, and taking out for next half minute. Rice was weighed after cooling (C).

6. Head rice and broken rice were separated by sizing device using sieves mesh no.10 on the top and no.135 at the bottom. The head rice was weighed (D).

From the procedures above; % husk, % bran, % broken rice, and % head rice were determined as follows:

$$\% \text{ Husk} = \frac{A-B}{A} \times 100$$

$$\% \text{ Bran} = \frac{B-C}{A} \times 100$$

$$\% \text{ Broken rice} = \frac{C-D}{A} \times 100$$

% Head rice = 100-% Husk - % Bran - % Broken rice

All the data from milling was shown in Appendix C.

4.5 Determination of Physical Properties of Bed

The physical properties of bed : void fraction, sphericity, density, diameter, and bed surface area were determined. The experiments were all taken at room temperature.

4.5.1 Determination of void fraction (εm) in a random packed bed, and sphericity (ϕs) of raw paddy

Known volume of two small amounts of raw paddy random packing and water were put together in a measuring cylinder. Volume of mixing was recorded. The void fraction was calculated as shown in Appendix D. The sphericity was then determined by using the relationship between void fraction and sphericity from Figure 1 in Ref. no.(12) p.66.

4.5.2 Determination of diameter of sphere having the volume of the raw paddy (dp)

A small amount of raw paddy was weighed and counted. dp was calculated (m) as shown in Appendix D.

4.5.3 Determination of density of paddy (ρ_s)

A small amount of raw paddy was weighed and measured its volume. The density of raw paddy was calculated as shown in Appendix D. The same procedure was used to calculate the density of wet parboiled paddy.

4.5.4 Determination of bed surface area (As)

When the volume of bed, dp, and Øs were known. The bed surface area was determined by using the relasionship between specific surface (a') and sphericity (Øs) which was defined in Ref.no.(12)p.66. For batch drying As was constant because the bed volume was assumed constant (bed weight was constant 1 kg for every batch). But for continuous drying As was not constant because the production rate was changed which resulted in bed volume changed. Bed surface area for both types were calculated as shown in Appendix D.