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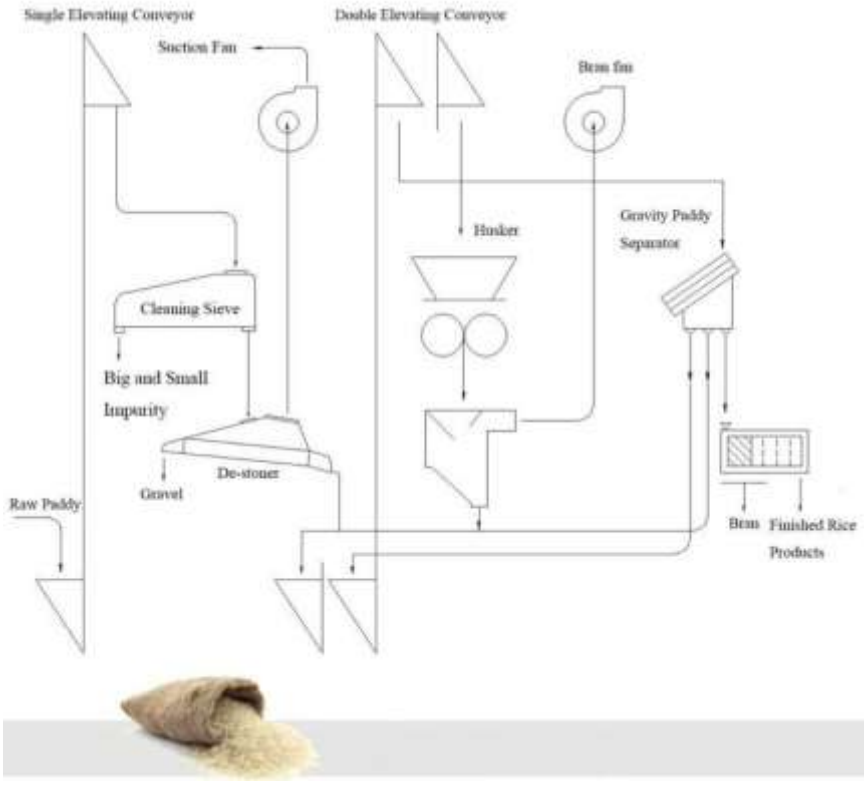
Unit 5 – Topic 5

Layout of Modern Rice Mill - Wheat Milling – Pulse Milling Methods



The layout of a modern rice mill involves careful planning and consideration of various factors to ensure efficient and streamlined operations. Below is a general outline of the typical layout of a modern rice mill:

1. **Reception and Storage:**
   - **Receiving Area:** The facility should have a designated area for receiving paddy from farmers or suppliers.
   - **Paddy Storage:** Adequate space for temporary storage of paddy before processing. Proper ventilation and pest control measures are essential.
2. **Cleaning and Destoning:**
   - **Cleaning Section:** Paddy undergoes cleaning processes to remove impurities like dust, stones, and other foreign materials.
   - **Destoning Section:** Stones and heavier impurities are removed to prevent damage to milling machinery.

3. **Parboiling Section (Optional):**
   - If the rice mill includes a parboiling process, there will be equipment for soaking, steaming, and drying paddy.
4. **Drying Section:**
   - **Paddy Drying Yard:** An open area or facility for drying paddy to reduce its moisture content before milling. This can include sun drying or mechanical drying systems.
5. **Storage Silos:**
   - **Raw Rice Storage:** Silos or bins for storing the dried paddy before it enters the milling process.
6. **Milling Section:**
   - **Husking/Dehusking:** The first stage involves removing the outer husk from the paddy.
   - **Polishing/Whitening:** The rice passes through polishers or whitening machines to improve appearance and texture.
   - **Grading/Sifting:** The milled rice is sorted into different grades based on size and quality.
   - **Sorting/Packaging:** The final rice is sorted and packaged for distribution.
7. **By-Product Handling:**
   - **Rice Bran Storage:** If the mill produces rice bran, there should be storage facilities for this by-product.
   - **Husk Disposal:** Proper disposal or utilization of rice husks generated during the milling process.
8. **Quality Control and Laboratory:**
   - **Quality Testing:** A dedicated area for quality control checks on rice samples.
   - **Laboratory:** A laboratory for conducting tests on the quality of rice, including moisture content, milling degree, and grain appearance.
9. **Mechanical and Electrical Rooms:**
   - **Machine Maintenance:** A designated space for maintaining and repairing milling machinery.
   - **Electrical Control Room:** Centralized control for the mill's electrical systems.
10. **Office and Administration:**
    - **Office Space:** Administrative offices for managing operations, logistics, and business transactions.
11. **Workers' Facilities:**
    - **Rest Areas:** Spaces for workers to take breaks and rest.
    - **Changing Rooms:** Facilities for workers to change into work attire.
12. **Security Measures:**
    - **Security Office:** A designated area for security personnel to monitor the premises.
    - **Surveillance Systems:** Installation of security cameras and alarms.

13. **Utilities:**

- **Water Supply:** Adequate water supply for various processing needs.
- **Power Supply:** Reliable power sources to run milling machinery.

It's important to note that the layout can vary based on factors such as the scale of the rice mill, available space, and specific processing requirements. Compliance with safety and environmental regulations is crucial in designing and operating a modern rice mill. Additionally, considerations for future expansion and technological upgrades should be taken into account during the planning phase.

MILLING OF WHEAT

4.1 Introduction

Wheat is the one of the important cereal crop of the World, with an estimated annual production of 540 - 580 million metric tonnes. Wheat belongs to the genus *Triticum* of the grass family Gramineae. Common wheat (*Triticum aestivum*) and durum wheat (*Triticum durum*) are the two major wheat groups grown for food use now. Wheat is the most valuable of all food grains and is widely used in all its stages, from whole to finely milled and sifted. In the bakery, wheat flour is the most important ingredient, which provides bulk and structure to most bakery products, including breads, cakes, cookies, and pastries. Wheat is classified into two groups: hard and soft. Hard wheat is higher in protein compared to soft wheat. It yields stronger flour, which forms more elastic dough, and is better for bread making when strong elastic dough is essential for high leavened volume. Soft wheat is lower in protein, which forms weaker dough or batter, and is better for cake making.

4.2 Wheat Processing

4.2.1 Storage

Quality of wheat is to be preserved while moving from field to storage and subsequently to the processing mill. If not properly stored; insects, moisture damage, molds or other conditions may cause losses. Moisture content must be less than 20% before harvesting, and wheat is then carefully dried to moisture below 12.5%, a level which is regarded as safe for storage. The desired moisture content is achieved in kiln or in modern driers taking care of the temperature of grain does not exceed 50�C.

4.2.2 Milling

The objective of wheat milling is to grind cleaned and tempered wheat by separating the outer husk from the internal endosperm. Early processing of wheat was accomplished by means of hand grinding, grinding stones, or a mortar and pestle. Later on wheat was milled between two circular millstones, one fixed and the other mobile and rotating. Recent technology of wheat milling involves metal cylinders or rollers for milling purposes.

4.2.2.1 Cleaning

Wheat received at mill may contain certain impurities entering from field, during storage and transportation, or accidentally. Frequently encountered impurities include: straws, chaff, sticks, weed seeds, other cereal grains, shrunken and broken kernels, infected kernels, mud, dust, stones, metal objects, etc. Wheat cleaning operation makes use of certain characteristics of impurities which are different from those of wheat e.g. size (length and width), shape, terminal velocity in the air currents, specific gravity, magnetic and electrostatic properties, colour, surface roughness, etc.

The grain is initially passed through a series of screens of selected apertures that removes matter either smaller or larger in size than the wheat kernel. Gross foreign material is removed over a set of sieves (rubble separator).

In gravity separator, impurities which are similar to wheat in size but different in specific gravity are separated out. Wheat grains are then moved on tilted screen, through which adjusted air currents are drawn. Heavier materials such as stones are separated and remain closer to screen, while lighter impurities and wheat floats down the screen.

After gravity separation, series of rotating discs separators remove impurities that are similar in diameter but different in shape from the wheat. This rotating discs with indentations pick-up only those wheat kernels that fit into the pockets and allow other grains such as oats, barley to pass through.

Dry scouring of wheat kernel removes any dirt adhering to it. In the scorer wheat kernel is bounced against a wall, which may be of a perforated sheet metal, a steel wire woven screen or any emery surface.

Magnetic separators separate foreign materials such as nails, pieces of metal that could damage equipments or generate spark, which could cause a dust explosion.

In final cleaning operation, wheat is washed by water. Wheat is immersed in water (0.5 – 1.0 lit per kg) and then conveyed by means of a worm to a centrifugal machine called whizzer, where it is vigorously agitated and spun dried. Washing of wheat removes crease dust.

4.2.2.2 Conditioning / Tempering

Conditioning of wheat is carried out primarily to improve the physical state of grain for milling. In conditioning moisture content of wheat kernel is adjusted. This includes heating and cooling of the grain for definite period of time, in order to obtain the desired moisture content and distribution. At this adjusted moisture level of wheat before milling, wheat endosperm becomes mellow and bran becomes tough. Bran that absorbs proper amount of moisture becomes elastic and will not splinter during grinding to contaminate the flour with fine particles, and thus flour becomes whiter in colour. The endosperm becomes mellower and more friable, thereby reducing the amount of power required to grind it.

Several methods are employed to condition the wheat. Heating the wheat, application of warm water, application of live steam, or just intensive mixing of wheat and water are some of the methods used to increase the amount and rate of water penetration into kernel.

Three factors affect the rate and level of water penetration into the kernel: temperature, amount of water (% moisture content) and time. The ideal water and wheat temperature for tempering condition is 25�C. Higher temperature will increase the rate of penetration into the kernel. Temperature above 50�C will change endosperm starch and protein characteristics.

Typical moisture contents of tempered wheat and tempering times are as follow:

Table 4.1 Typical moisture contents of tempered wheat and tempering times

Type of wheat	Optimum moisture content of tempered wheat	Tempering time (Hrs)
Hard spring wheat	16 – 17%	36
Hard red winter wheat	15.5 – 16.5%	24
Soft wheat	14.5 – 15.5%	10
Durum wheat	16 – 17.5%	6

4.2.2.3 Milling / Separation of flour

Objective of wheat milling is to separate the branny cover and germ of the wheat kernel from the endosperm **Fig. 4.1 .**

Wheat flour milling is a process that consists of controlled breaking, reduction and separation, Wheat flour milling involves three basic processes:

i). Grinding: Fragmenting the grain or its parts
ii). Sieving: Classifying mixtures of particles based on its particle size
iii). Purifying: Separating bran from endosperm particles based on their terminal velocity, by means of air currents.

Grinding of the wheat occurs between two cast rolls (break rolls) that rotates against each other. These rollers are fluted and they are not in contact with each other. The upper roller rotates two and a half time for each rotation of the lower one. Hence, the grain is engaged between fluted serrations of the rolls and broken or cut by the faster roll as it is held back by the slower roll. This initial stage in milling process is referred as breaks. The breaks are used in the grinding steps to separate the bran, germ and endosperm from each

other. The grist coming out from the rolls is sifted through a plansifters. The plansifter is a machine consisting of a vertical nest of horizontal sieves, the whole assembly gyrating in a horizontal plane. A single plansifter consist of four or five different mesh sizes may yield five or six fractions of different particle size.

The series of break rolls and sieves converts the grain into semolina, which is small granule made up of endosperm. The outer husk is collected separately as bran. The semolina is separated into three grades: fine, medium, coarse in an operation called ﷺgradual reduction systemﷺ. Here the rolls are smooth and one rotates only one and a quarter times for each rotation of the other.

These three streams are then put through purifiers. Purifier consists of a long, narrow, sieve set. The sieves become coarser progressively in size of mesh from head to tail. The sieve section is connected to a fan and the air is drawn up through each sieve section to draw off branny particles.

The number of parts of flour by weight produced per 100 parts of wheat milled is known as the flour yield, or percentage extraction rate. The wheat grain contains 82% of white starchy endosperm, but it is never possible to separate it out fully from the bran. Extraction rates of different flours are as follow:

Table 4.2 Extraction rates of different flours

Sr. No.	Flour	Extraction rate (%)
1	Wholemeal flour	95
2	Brownish flour	85
3	Creamy flour	80
4	White flour	70

4.3 Air Classification of Specialty Flour

Air classification of flour is used where there is a demand for extremely precise specification of granulation and protein content of flour. Flour with a narrow range of particle size has the advantage of increasing the tolerance of oven temperature and water absorption during the baking of cakes. Commercial flour particles granulation is between 0-150ﷺm. A flour fraction of 1-17 ﷺm contains a high level of protein. A flour fraction of 17-40 ﷺm will usually be marked as to its higher starch content and lower protein level. It is not practical to separate particles of less than 73 ﷺm with conventional sieves. Accordingly, particles are segregated by air using differences in particle shape, specific gravity and size.

4.4 Milling By-Products

The by-products from wheat milling process are known as ﷺwheat feedﷺ. They comprise bran, the coarse residue from break grinds, fine wheat feed, accumulated particles from the purifiers and reduction grinding. Bran and fine wheat feed are used in compound animal feeds.

PULSE MILLING METHODS

15.1 Introduction

Pulses are defined as dried edible seeds of cultivated legumes. Pulses occupy important place in human diet. They serve as major sources of dietary protein and energy. The production of pulses in India was 13.19 million tones in 2001-02, which was 27% of the World's production. Bengal gram/Chick pea (chana), pigeon pea (tur/arhar), cow pea (lobia), black gram (urad), green gram (moong), lentils (masur), peas (matar) are some of the major pulses grown in India.

Pulses are consumed in its dehusked and split form which is termed as dal. Pulse milling (dal milling) is accomplished in three major steps namely: loosening of husk, dehusking and splitting of pulses. Pulses are generally consumed in the form of Dal. Traditional methods for processing of pulses were labour intensive, time consuming and incurred losses. Modern technologies for processing of pulses have replaced old age methods and thus avoid losses and saves time. Processing of pulses involves two basic steps – (i) seed coat/husk loosening and its removal and (ii) conversion of seed grain into splits and grinding into flour depending upon its end-use. Various methods are employed for pulse/dal milling. Pulses undergo some basic unit operations during pulse milling such as cleaning and grading, drying, loosening of husk, dehusking, splitting and polishing.

15.2 Methods of Pulse Milling

15.2.1 Wet milling of pulses

Wet method of pulse processing (Fig. 15.1) involves cleaning to remove dust, dirt, chaff, stone pieces, immature grains and other seeds. The easy to dehusk pulses are then soaked into water for a period of 2 – 8 hrs whereas difficult to dehusk type of pulses (pigeonpea, black gram, green gram) are often treated with red earth. The pulses are subsequently dried and then subjected to dehusking and splitting to obtain Dal.

15.2.2 Dry method of pulse milling

In case of dry method of pulse milling (Fig. 15.2), the pulses after cleaning are fed into roller dehusker where a scratch, dent and crack is formed on the outer seed coat. Pitted pulses are then stored for – day to 3 days after applying oil on the surface. Generally 150 – 250 gm oil per 100 kg pulses is applied. The oil diffuses between husk and cotyledon and thus facilitates loosening of the husk. Water treatment (2.5 – 3.5 kg water/100 kg pulses for overnight period) helps in further loosening of the husk. Then the pulses are subjected to drying and cooling. Now, the dried pulses are dehusked and splited to obtain dal.

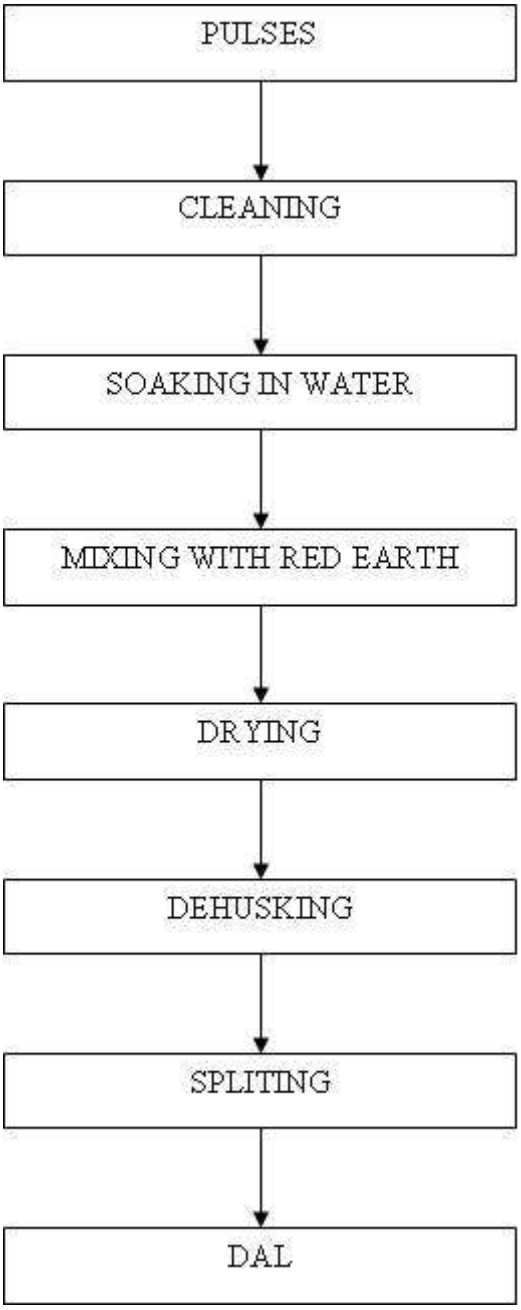


Fig. 15.1 Wet milling of pulses

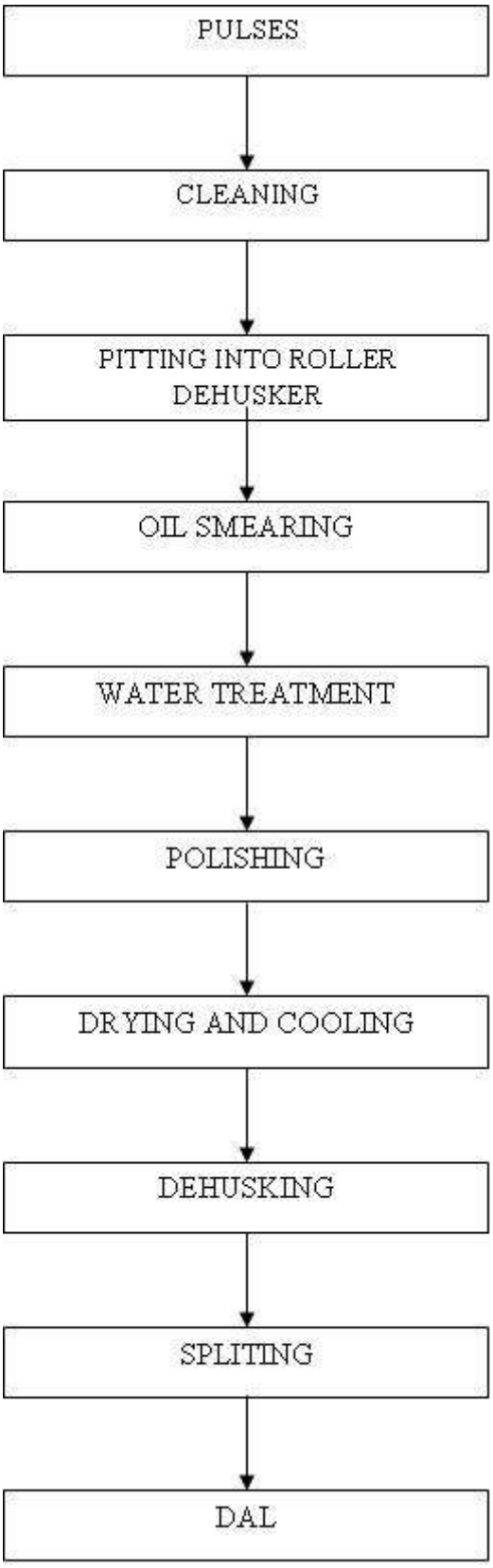


Fig. 15.2 Dry milling of pulses

15.3 Home Scale Milling of Pulses

The home scale method of processing of pulses involves pounding of pulses into mortar and pestle. Home scale method of pulse milling is different for different pulses and varies from region to region. In this method, the husk is loosen either by wet or dry method; treating the pulses with water and/or oil. The pulses are then generally stored overnight and the next day they are sun dried. The removal of husk is then carried out in pestle and mortar or by a hand operated stone mill. The husk then is separated by winnowing.