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“Knowledge is such a treasure which cannot be stolen”
Indian Standard

AGRICULTURAL PRODUCE MILLING MACHINERY — MILLING OF PULSES — FLOW DIAGRAM

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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(Page 2, clause 2.3.5, line 2) — Substitute ‘hull’ for ‘bull’.

(Page 2, clause 2.3.8, line 4) — Substitute ‘indented’ for ‘idented’ and ‘indents’ for ‘idents’.
FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Agricultural Produce Milling Machinery Sectional Committee had been approved by the Food and Agriculture Division Council.

This standard has been prepared to provide the basic idea about the various operational and equipments involved in pulse milling.

In formulation of this standard assistance has been derived from the Centre of Advanced Studies in Post Harvest Technology at G. B. Pant University of Agriculture and Technology, Pantnagar.
Indian Standard

AGRICULTURAL PRODUCE MILLING MACHINERY — MILLING OF PULSES — FLOW DIAGRAM

1 SCOPE
This standard covers the sequence of operations/flow diagrams for pulse milling operations.

2 TERMINOLOGY
For the purpose of this standard, the following definitions shall apply.

2.1 Product
2.1.1 Bean — Pulse grain of the Phaseolus, Cajan, Cicer, Lens etc. genuses.
2.1.2 Brokens — Broken dehusked or unhusked splits of a pulse grain.
2.1.3 Dehusked Whole Grain — Whole pulse grain with husk/hull removed.
2.1.4 Dhal — Dehusked whole/split or unhusked split cotyledon of the pulse grain.
2.1.5 Germ — The embryo in a pulse grain which grows into the new plant.
2.1.6 Husk — Seed coat, hull, or covering surrounding the pulse grain.
2.1.7 Powder — A mixture containing scoured material removed from dehusked pulse grain during milling plus ground husk and germ.
2.1.8 Pulse — Dried edible seed of a leguminous plant.
2.1.9 Unhusked Whole Grain — Whole pulse grain with husk/hull intact.

2.2 Operations
2.2.1 Aspirations — Aspiration is the process of cleaning by air blast and separating the foreign material which is substantially lower in specific gravity than the produce to be cleaned.
2.2.2 Chaffing — Chaffing is the process of pneumatic separation of very light material from the product.
2.2.3 Cleaning — Cleaning is the process of removal of foreign or dissimilar material by washing, screening, hand picking, aspiration or by any other mechanical means.
2.2.4 Dehusking/Dehulling — Dehusking/dehulling is the process of removing hull or husk from the pulse grain.
2.2.5 Drying — Drying is the process of reduction of moisture in the product usually to a predetermined value.
2.2.6 Grading — Grading is the process of sorting grains into different lots conforming to certain predetermined standards.
2.2.7 Pitting/Scratching — Pitting/scratching is the process in which the surface of the grain is scratched to impart cracks in the husk/hull so as to facilitate oil or water penetration.
2.2.8 Polishing — Polishing is the operation of providing glossiness to dhal by suitable mechanical operation.
2.2.9 Pretreatment — Pretreatment is the operation of treating the grain in order to loosen the husk or hull (seed coat). The pretreatment may consist of water and/or oil application, soaking and drying, heating and tempering, light roasting, or chemical treatment.
2.2.10 Scalping — Scalping is the process of cleaning in which good grains are dropped through screen opening while larger material is carried over the screen into a separate spout.
2.2.11 Scouring — Scouring is the process in which outer layers (mainly those comprising the husk/hull) are removed through abrasive action.
2.2.12 Screening — Screening is the process of separation of grains by a mechanical device where the desired material is carried over the device and the undesired material penetrates the device. It is a method of separating grains according to size alone.
2.2.13 Separation — Separation is an operation in which a product is separated from other products using the difference in physical, thermal, electrical or any other property of the product.
2.2.14 Soaking/Steeping — Soaking/steeping is the process in which the grain is soaked in water in order to raise its moisture content.
2.2.15 **Sorting** — Sorting is essentially a separation operation supplementary to grading.

2.2.16 **Splitting** — Splitting is the operation in which the pulse grain is separated into two cotyledons.

2.2.17 **Roasting/Toasting/Parching** — Roasting is the process in which the grains are subjected to dry heating for predetermined period of time.

2.2.18 **Tempering** — Tempering is the process where the grain is held temporarily between two successive operations, so that the moisture content and temperature within the grain mass and within the kernel equalize with moisture and temperature on the surface of grain or grain mass.

2.3 **Equipment**

2.3.1 **Aspirator** — Aspirator is a component used for cleaning the grains/seeds by drawing air through the grain/seed.

2.3.2 **Cleaner** — Cleaner is a machine to remove foreign matter from grain mass.

2.3.3 **Conveyor** — Conveyor is an equipment or component through which material is moved from one point to another.

2.3.4 **Cyclone Separator** — Cyclone separator is a separating device in which strong centrifugal force acting radially is used in place of relatively weak gravitational force acting vertically downwards.

2.3.5 **Dehuller** — Dehuller is a machine used for hulling. While removing the hull it also scours the kernel surface.

2.3.6 **Dehusker/Sheller** — Dehusker is a machine used to remove husk/hull from the pulse grain. The sheller may be vertical stone type/horizontal stone type or emery coated.

2.3.7 **Destoner** — A mechanical device which separates stones from the grain.

2.3.8 **Disc Separator** — An equipment in which particles longer or shorter than pulse grains but similar diameter are separated by means of idented discs with idented of predetermined shape and size.

2.3.9 **Dryer** — An equipment used to dry the grain to the desired moisture content/predetermined value.

2.3.10 **Elevator** — A conveyor in which the material is moved upwards.

2.3.11 **Grader** — A machine used for grading the grain.

2.3.12 **Rollers** — It consists of a pair of cylindrical rolls arranged with their exist parallel and set in a heavy frame. Rolls may be steel, stone or emery coated.

2.3.13 **Sieve** — Slotted sheet metal or woven wire mesh which separates grains by size.

2.3.14 **Separator** — A machine used to separate the milled product into different fractions.

2.3.15 **Splitting Machine** — A machine used for splitting the dehusked/unhusked pulse grain into two cotyledons. The machine may be paddle type (impact splitter) or engelberg type rice huller.

2.3.16 **Thicknes Grader** — A machine which separates product by thickness.

2.3.17 **Under Runner-Disc Sheller** — A machine which is used to remove husk/hull and consists of two horizontal discs, the top one stationary and the lower one rotating. The discs may be of emery or stone.

3 **FLOW DIAGRAMS**

Flow diagrams indicating various sequence of operations in pulse milling are given in Fig. 1 to 9. These include basic flow diagram for the mill system (Fig. 1); sequence of operations for conventional (dry and wet) milling processes of pigeonpea (Fig. 2 and 3 respectively); CFTRI and Pantnagar processes of pigeonpea milling (Fig. 4 and 5 respectively); chickpea milling process (Fig. 6); black gram (Urd bean)/green gram (Mung bean) milling process (Fig. 7); pea and lentil milling process (Fig. 8); and flow chart of CIAE process for pulse milling (Fig. 9). The operation of pitting is common to conventional dry milling and pigeonpea and milling of chickpea, black gram, green gram, pea and lentil.
RAW MATERIAL STORAGE

CLEANING AND CONDITIONING

MILLING AND SEPARATION

STORAGE OF FINISHED PRODUCTS AND BYPRODUCTS

FIG. 1 BASIC FLOW DIAGRAM OF THE MILL SYSTEM

WHOLE PIGEONPEA GRAIN

CLEANING AND GRADING

PITTING → HUSK

OIL (0.5-1.0%)

MIXING

SUN DRYING AND ALTERNATE HEAPING OVERNIGHT

WATER (1-2%)

SPRAYING AND HEAPING OVERNIGHT

DEHUSKING, SPLITTING AND ASPIRATING

POWDER HUSK DEHUSKED SPLITS BROKENS WHOLE DEHUSKED AND UNHUSKED GRAINS

FIG. 2 FLOW DIAGRAM FOR TRADITIONAL MILLING OF PIGEONPEA BY DRY METHOD
WHOLE PIGEONPEA GRAIN

CLEANING

GRADING

WATER

STEEPING IN WATER
(4-12 HOURS)

WATER

DRAINING

MIXING RED EARTH PASTE WITH STEEPED GRAIN

HEAPING OVERNIGHT

SUN DRYING AND ALTERNATE HEAPING AT NIGHT

DEHUSKING, SPLITTING AND ASPIRATING

POWDER HUSK DEHUSKED SPLITS BROKENS WHOLE DEHUSKED AND UNHUSKED GRAINS

FIG. 3 FLOW CHART FOR TRADITIONAL MILLING OF PIGEONPEA BY WET METHOD
WHOLE PIGEONPEA GRAIN

CLEANING AND GRADING

FIRST CONDITIONING (HEATING)

FIRST CONDITIONING (TEMPERING)

SECOND CONDITIONING (HEATING)

SECOND CONDITIONING (TEMPERING)

DEHUSKING

POWDER HUSK BROKENS DEHUSKED SPLITS WHOLE DEHUSKED AND UNHUHSED GRAIN

WATER → MIXING

TEMPERING

LUMP BREAKING

AERATING

SPLITTING AND SEPARATING

UNHUHSED WHOLE GRAIN DEHUSKED WHOLE GRAINS DEHUSKED SPLITS

REPROCESSING SPLITTING DEHUSKED SPLITS

FIG. 4 FLOW CHART OF CFTR1 PIGEONPEA MILLING PROCESS
WHOLE PIGEONPEA GRAIN

CLEANING AND GRADING

MIXING 8% SODIUM BICARBONATE SOLUTION

TEMPERING, 6h

DRYING: SUN/MECHANICAL

TEMPERING

MILLING ON A CONCENTRIC DOUBLE CYLINDER MACHINE

POWDER

HUSK FINE POWDER TO CYCLONE SEPARATOR

CYLINDRICAL SCREEN SEPARATOR

DEHUSKED SPLITS

WHOLE DEHUSKED AND UNHUSKED GRAIN

BROKENS

MIXING WITH WATER

TEMPERING

AERATING/DRYING

SPLITTING AND SEPARATION

WHOLE DEHUSKED GRAINS

DEHUSKED SPLITS

Fig. 5 Flow Chart of Pantnagar Process
CHICKPEA GRAIN

CLEANING AND GRADING

PITTING

WATER (8-10%) → MIXING

TEMPERING AND SUN DRYING, 2-3 DAYS

DEHUSKING, SPLITTING AND ASPIRATING

POWDER

HUSK

DEHUSKED SPLITS

BROKENs

WHOLE DEHUSKED AND UNHUSKED GRAINS

Fig. 6 Flow Diagram for Traditional Milling of Chickpea
Fig. 7 Flow Diagram for Traditional Milling of Black Gram (Urd Bean) and Green Gram (Mung Bean)
FIG. 8 FLOW DIAGRAM FOR TRADITIONAL MILLING OF PEAS AND LENTIL
WHOLE PIGEONPEA/GREEN GRAM/BLACK GRAM

CLEANING AND GRADING

PITTING/SCRATCHING

SIEVING

STEEPING IN WATER, 1/2 h FOR PIGEONPEA
1 h FOR GREEN GRAM/BLACK GRAM

DRAINING

DRYING, SUN/MECHANICAL

MILLING IN A CONCENTRIC ABRASIVE CYLINDRICAL MACHINE

GRADING/ASPIRATING

BROKENS

HUSK

DHAL

WHOLE DEHUSKED AND UNHUSKED GRAINS

MILLING IN A VERTICAL BURR MILL.

Fig. 9 Flow Chart of CIAE Process for Pulse Milling
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