

# OIL SEED MILLING



# INTRODUCTION

- In a balanced diet, the oils and fats requirement per person per day is 35 g for vegetarians, 39 g for non-vegetarian and 38 g for average diet.
- Oilseeds and animals are the main sources of fat.
- The major responsibility of oil production in India, both for edible and industrial usages depends on vegetable oil seeds production.
- India accounts 10 percent of the total global output of the vegetable oils and fats.
- The difference between an oil and a fat is that an **oil is usually liquid at ambient temperature while a fat is solid.**

- The **major oilseeds** of India are groundnut, rape seed mustard, linseed, sesamum and castor.
- Groundnut and rape seed mustard account about **85 percent** of the **total production** of oilseeds in the country.
- Soybean, sunflower, safflower, cotton seed and coconut are the other **important oilseeds** produced in India.
- For processing of oilseeds and oil bearing materials, India has a large network of oil mills employing more **than 10 million** people.
- The installed capacity of oil mills is estimated as 35 million tonnes per annum besides, there is solvent extraction plants of about 6.8 million tonnes per annum capacity in the country.

- India has become a melancholy tale: Being an exporter of oil till 1964, it is a paradox that at present India has to import a big quantity of vegetable oils to meet her domestic need and thus spending about ten thousand million Rupees in terms of highly valued foreign exchange every year.
- Most of our installed capacity of oilseed processing industries are extremely **old** and **inefficient** with high consumption of steam and and thus have **low recoveries of oil**.
- The quality of the products is also poor and large quantities of oil is left in the oilmeal.
- It is reported that not less than **0.5 million tonnes** of oil of the value about **10,000 million** Rupees is lost due to improper processing of oilseeds.

# MAJOR CONSTRAINTS

- i) In-efficient processing
- (ii) Inadequate utilization of some oil bearing materials such as rice bran.
- (iii) Unscientific and inadequate storage,
- (iv) Exploitation of oilseed based proteins,
- (V) Inefficient and expensive packaging,
- (vi) Inadequate research and development, and
- (vii) Problems in exporting oilseed materials are the big hurdles in increasing oil yields in this century which need attention.

<b>Seed</b>	<b>Oil (%)</b>	<b>Use</b>
Almond	50	Food, salad oil, soap
Castor	50	Medicine, lubricant
Cotton seed	30	Food, paint, resin
Hemp seed	35	Paint, varnish, soap
Linseed	40	Paint, soap, varnish, linoleum
Olive	40	Salad oil, cooking oil
Peanuts	50	Salad oil, cooking oil
Perilla seed	50	Drying oil for paint, resin
Poppy seed	50	Salad oil, cooking oil
Rape seed	40	Salad oil, cooking oil
Sesame seed	50	Salad oil, cooking oil
Sunflower seed	35	Salad oil, cooking oil, soap

# POST HARVEST OPERATION OF OILSEED MILLING

## 1. HARVESTING AND HANDLING

- a. Seed moisture content(12-18)%
- b. Color of leaves
- c. Taste of seeds
- d. Color of pods

Total harvesting loss is (5-15)%

## 2. CLEANING AND GRADING

- a. Winnowing
- b. Grading

Total loss=2-5%

### 3. DRYING

- Oilseed are dried to **8%** M.C.

➤ Farmers generally dry by:

a. Delay harvesting of crop or

b. Crops are simply bundled and left to dry in the field.

- When oilseed reaches around **(12-16)%** M.C. , then threshing is done.

- Drying is done till the M.C. reaches the **EMC**.

- **TYPES OF DRYER USED ARE:**

a. Vertical dryer: The air temp is  $(70-95)^{\circ}\text{C}$  and exhaust air temp= $(38-44)^{\circ}\text{C}$  .

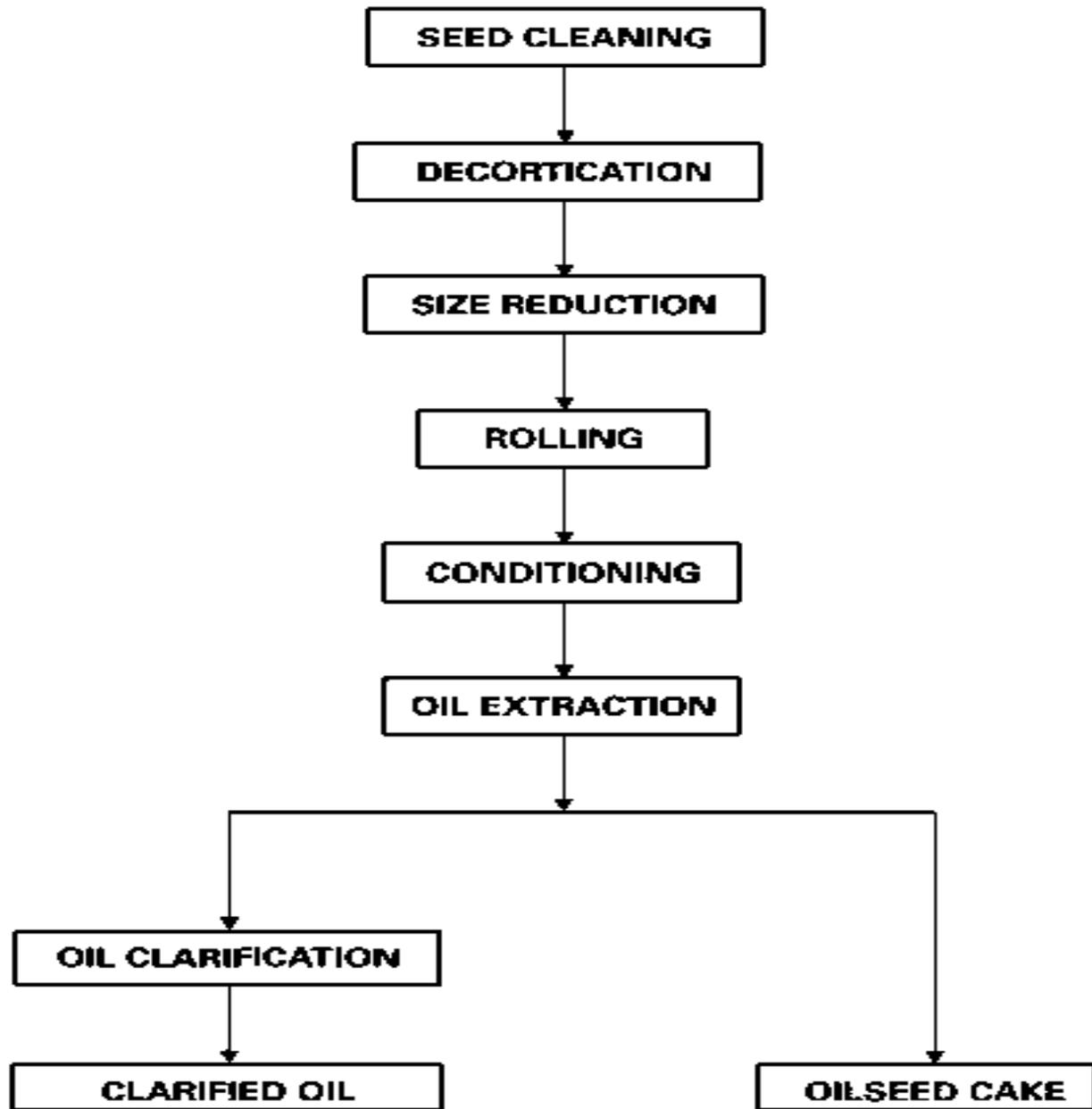
b. Horizontal rotary dryer: Good for wet materials

#### **4. CLEANING AND STORAGE:**

- a. Seeds are cleaned to remove plant residue ,soil , stones etc.
- b. Generally seeds are stored at 8% MC at 25°C which develop only 10g CO<sub>2</sub>/tonne/day and it can increase to 100 fold if the moisture content increases to 20%.
- c. Commercially the seeds are stored in metal or concrete silo of capacity 1000-8000 cm<sup>3</sup>.

# OILSEED MILLING

- Oil extraction from oilseeds and nuts ('milling') is carried out using the following steps:
1. The seeds are passed over magnetic separators to **remove metal** and sieved to **remove dirt and stones**
  2. If required, the shells or hulls are removed in **decorticating** machines;
  3. The kernels are reduced in size to produce **flakes** or small pieces by grinding between grooved rollers or using hammer mills.
  4. The crushed kernels are pressed in hydraulic or screw presses with or without heating, depending on the type of oil-bearing material and the oil quality required.



**OILSEED FLAKES**

# OIL EXTRACTION UNIT



# OILSEED PROCESSING

## ➤ Seed cleaning

- It is essential to winnow and sieve oilseeds, prior to expelling, to remove as much dirt, dust, sand and small stones as possible.
- The presence of sand results in high wear on critical components of expellers.

## ➤ Decortication

- Some oilseeds have a hard outer shell which must be removed before processing because they lack in oil content.
- This process is called decortication.
- It is done by a impact huller.
- Complete removal is not preferred as about 8-10% hull facilitate efficient oil expelling.

## ➤ **Breaking/Size reduction**

- Generally, small oilseeds (such as **sesame** or **rapeseed**) can be processed directly,
- Larger seeds (such as **copra**) need to be ground before processing.
- It is done by hammer mill.
- This also reduces power consumption.

## ➤ **Rolling(crushing/grinding/flaking)**

- Rolling a seed generally results in an improvement in oil extraction by increasing the surface area of the seed while at the same time retaining channels for the flow of oil.
- 0.3mm thick flakes require more extraction as compared to 0.15mm thick flakes.
- The flakes should be very fine and preferably **thinner than 0.1 mm**.
- Rolling before processing increases oil yields by **10%**.

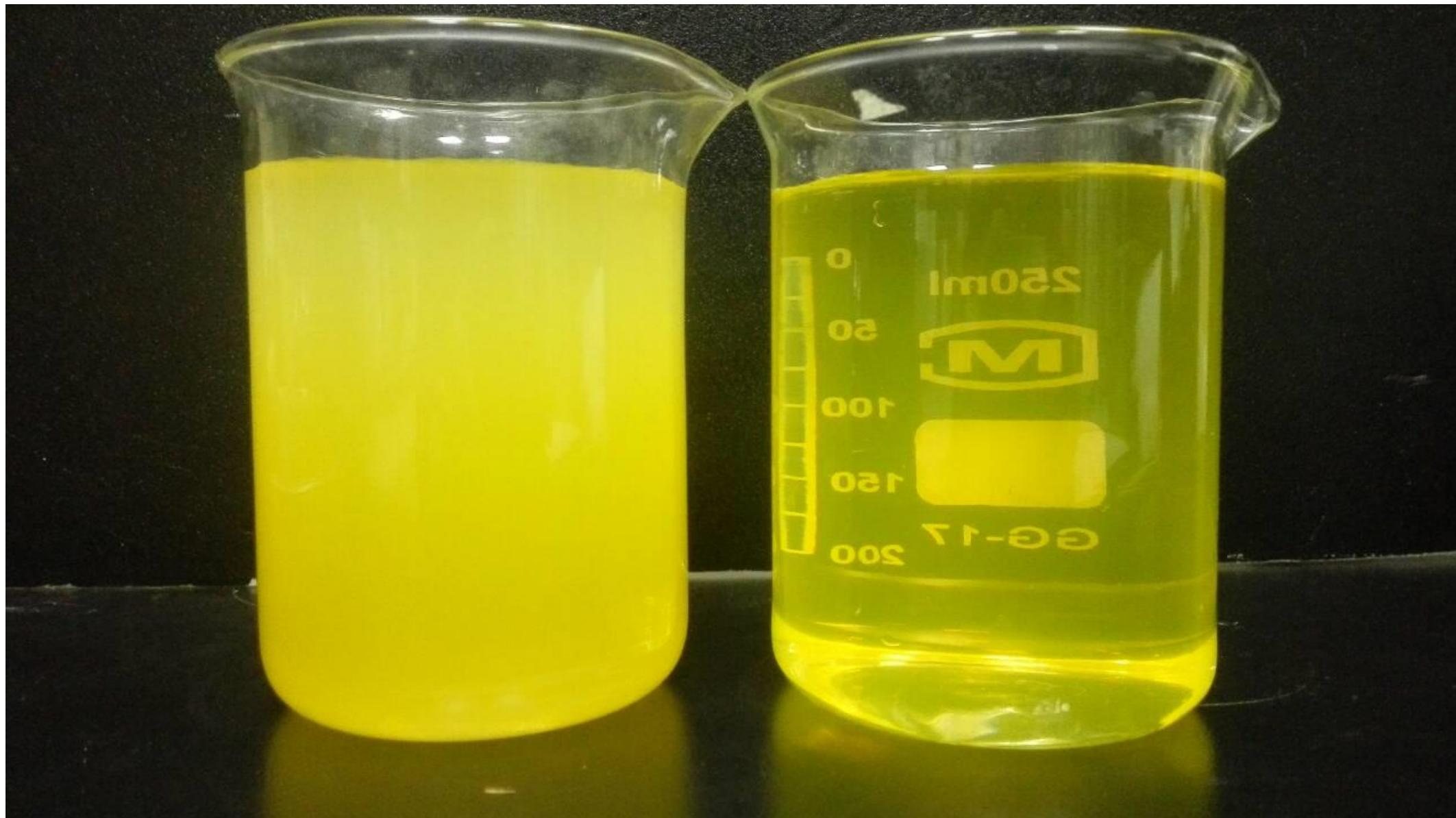
- **Conditioning/Heat treatment**
- Conditioning or 'cooking' oilseeds involves heating the oilseed in the presence of water.
- Heating breaks oil-protein emulsion making it easier for oil to extract.
- The water may be that which is naturally present in the seed, or it may be added.
- The changes brought about by conditioning are complex but include the **coalescence of the small droplets of oil**, present in the seed, into drops large enough to flow easily from the seed.
- In addition, higher processing temperatures improve oil flow by **reducing the viscosity** of the oil.

## ➤ REFINING

- Cold press oil can be of such high quality as to need no refining if it comes from seeds that are fresh and of good quality.
- All other oil, especially that which has been pressed from lower quality feedstock, is likely to have some undesirable **cloudiness, color,** or **flavor** that needs to be removed.

## Removal of Cloudiness

- Pressed oils need to be filtered to remove particles from the pressing operation, if the oil is to be clear and clean.
- If the cloudiness is caused by **gums** precipitating, the gums can be removed by **washing the oil with about 2 percent water**.
- For this process to be effective, the oil should be **heated**, and the **hot oil mixed with water**, with active stirring.
- Next the water and oil must be separated. For this, a **centrifuge** is most effective.
- The degummed oil should be **dried by heating** to drive off all moisture, for the reasons cited previously.
- Degumming can also be done by using **acid** and **enzymes**.



## ➤ Removal of Excess Color

For the removal of excess color, **bleaching earths** are effective.

- The oil is heated and mixed with **1-2 percent** of its weight of an effective **bleaching earth**.
- After a contact time of approximately **one hour**, the bleaching earth is **separated by filtration**.
- **Activated carbon** can also be used.



## ➤ Removal of Unwanted Flavors

- Unwanted flavors are more difficult to remove.
- They may be due to excessive free fatty acids. (Acidity of over 10 percent is common; if over 20 percent acid, the oil is good only for making soap.)
- Free fatty acids can be removed from the oil by washing the oil with alkali.
- The fatty acid will react with the soda to form soap, which stays in the water phase.
- It is let to stay for several hours and siphon off the oil layer.
- If the oil still contains fatty acids, you should repeat the operation.

- Other types of flavors than those of fatty acids can be removed from oil, but an expensive and difficult process known as **deodorization** is used.
- It involves **distilling off the unwanted flavors under high heat and high vacuum**.
- Normally the oils being processed by small-scale pressing would have the flavors of the raw material from which they came, and there would be no need for deodorization

# OBJECTIVE OF OIL EXTRACTION:

- To obtain higher yield of oil.
- To minimize damage to quality of oil
- To obtain purer components, namely oil and oil cake.
- To produce oil cake with better utility.

## ➤ METHODS OF EXTRACTING OIL FROM NUTS AND SEEDS

- Oil can be extracted from nuts and seeds by
  - a. Heat,
  - b. Solvents, or
  - c. Pressure.
- Extraction by **heat is not used** commercially for vegetable oils.
- Extraction by solvents and pressure is generally used.

# OIL EXTRACTION BY PRESSING

- It require **pretreatment**.
- Pretreatment is done to reduce proportion of non-oil bearing husk and break the cellular structure by mechanical action and cooking.
- Cooking also control moisture content of feed.
- It is of **two** types
  1. SMALL BATCH PRESSES
  2. COMMERCIAL BATCH PRESS
  3. EXPELLERS OR CONTINUOUS SCREW PRESSES

# ➤ Small Batch Presses

- Small batch presses are simple, but inefficient.
- It is done by using **screw press** known as **expeller**.
- Few resources are needed for an operation on this scale: **wood** fires for **heating**, and **hand labor** for **pressing**.
- Much hand labor is required to produce a small amount of oil this way.
- Oilseed is pressed to cake of moderate oil content which is further processed on solvent extraction plant to recover remaining oil.
- This process is widely used.

- The press is fed using a variable speed conveyor within the feeder unit.
- Oil releases along the length of the cage is allowed to drain into the base, where it is collected.
- The solid material within press is discharged into conveyors is removed in subsequent processing.

## **Advantages of small batch presses:**

- They can be made of locally available materials.
- They can produce a good quality product.
- They are easy to repair.
- Their cost is low.
- They do not require trained operators.

## **Disadvantages of small batch presses:**

- They are labor intensive.
- Complete recovery of the oil from the seeds is difficult.
- If seeds are plentiful, this is a serious problem.

## • Commercial Batch Presses

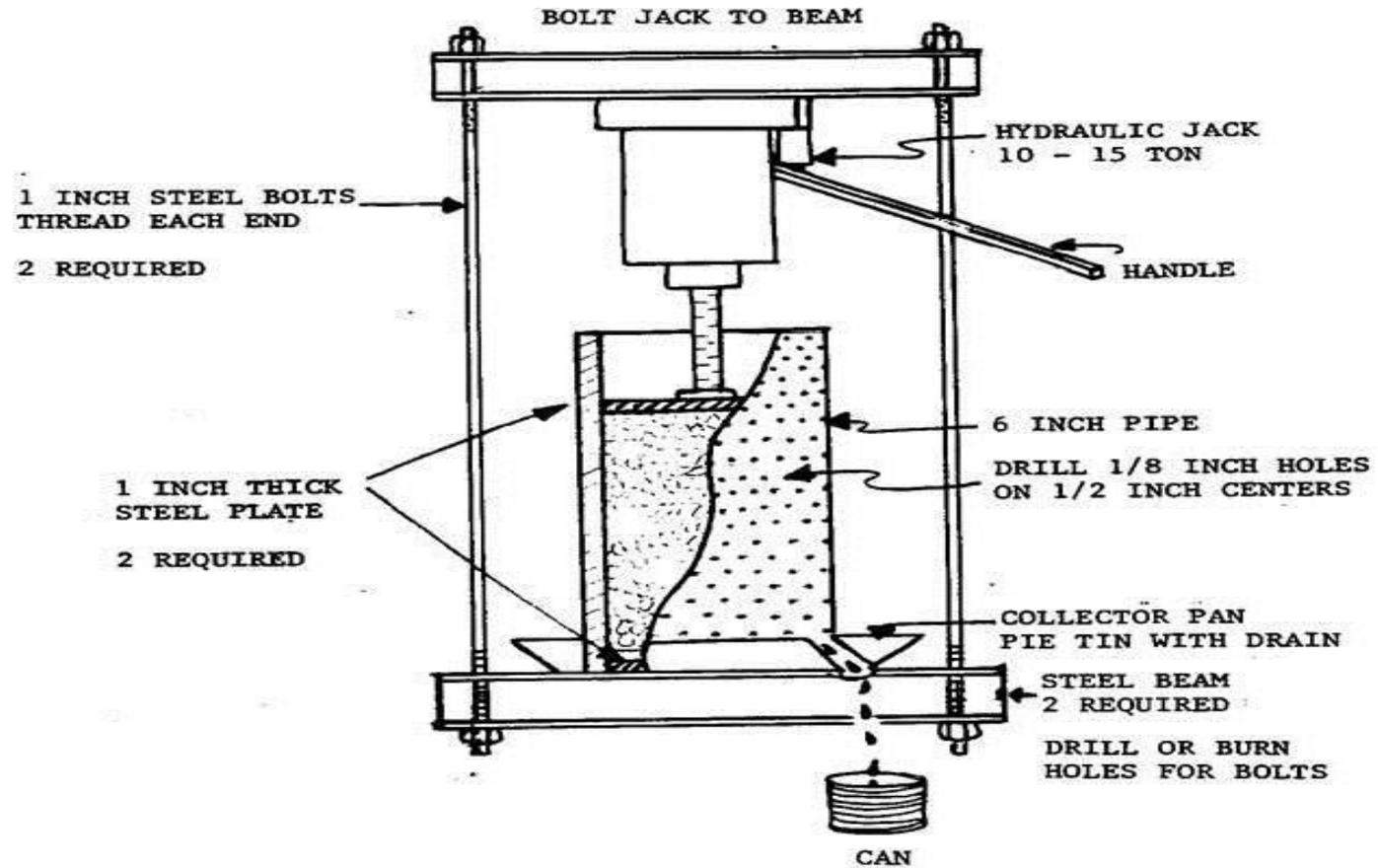
- ❖ Hydraulic presses, which are suitable only for batch processing, may be powered either by hand or by electricity.
- ❖ In many parts of the world, they are the most practical and economical way to extract oil from seeds

### Advantages

- 1.They can be driven by hand or by electricity.
- 2.They are economical to operate.
- 3.They are simple to operate and maintain.
- 4.Operators require only minimum training.
- 5.Recovery of oil from seeds is excellent.

### Disadvantages

- 1.The cost of the machinery is substantial, and delivery
- 2.Time may be long.
- 3.Spare parts are difficult to obtain in remote areas.
- 4.Electric power, or generators to produce it, may not be available to operate the larger models.

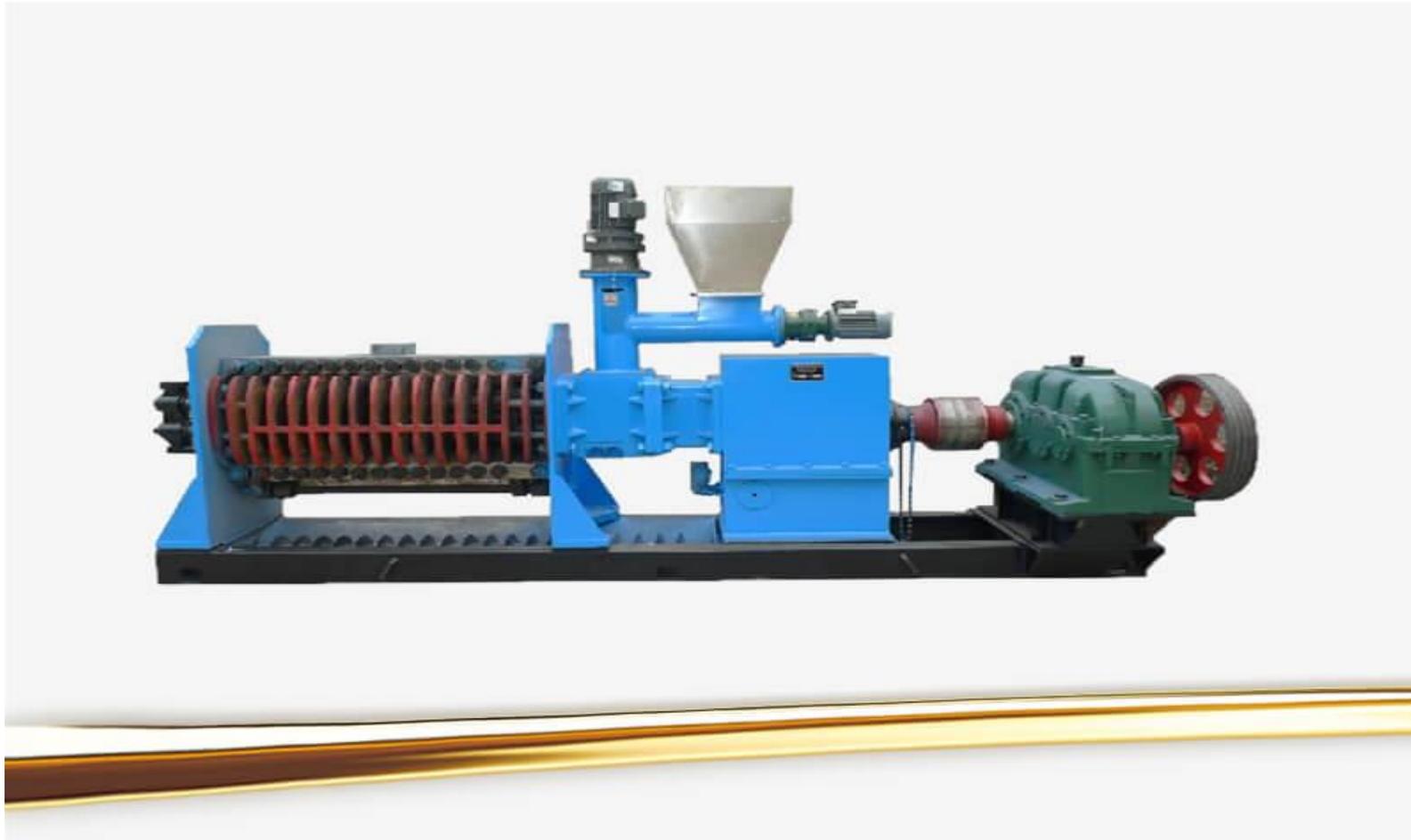




Hand operated palm oil  
extractor



**Machine operated cold press**



**MECHANICAL SCREW PRESS**

# FACTORS AFFECTING MECHANICAL SCREW PRESS

- Compression ratio: 10:1 or 5:1 or 15:1
- Feed moisture content: 5-11% wb
- Pressing temperature:  $<100^{\circ}\text{C}$
- Applied pressure: pressure is directly proportional to oil recovery.
- Pressing time: oil recovery increases with pressing time.
- Oil recovery: oil is reduced to 3%. If 450kg/tonne /day feed is handled then it reduces oil content to 10%

# EXPELLERS OR CONTINUOUS SCREW PRESSES

- Expellers, or continuous screw presses, are used throughout the world for the expression of oil from copra, palm kernels, peanuts, cottonseeds, flaxseed, and almost every other variety of seed.
- Expellers achieve the pressure needed to express the oil by means of an auger that turns inside a barrel. The barrel is closed, except for an opening through which the oil drains.
- An expeller can exert much greater pressure on the seed cake than a hydraulic batch press can. This increased pressure permits the recovery of a larger proportion of the oil.
- Generally, about 3 to 4 percent of the oil is left in the cake with an expeller, compared to 6 to 4 percent with a hydraulic press.
- It is used both by itself and as a pre-press before solvent extraction.

# EXPELLERS OR CONTINUOUS SCREW PRESSES

## ADVANTAGES

- They are the **most common type** of mechanical extraction equipment in use commercially today.
- They require **less labor** than any other method.
- Where **power is reasonable** in cost, and labor is expensive, continuous expellers are economical.
- Plant **capacity is higher** than with batch equipment.
- Expellers **extract a greater proportion of the oil** than do hydraulic batch presses.

## DISADVANTAGES

- **Maintenance costs** are high, and maintenance requires skilled mechanics.
- **More energy** is required than for batch processing.
- The press must **operate continuously** for at least eight hours; intermittent operation is unsatisfactory.
- Oil from an expeller has **more impurities** than oil from a batch press, and must be heated and filtered to obtain a clean oil.

# Equipment required

- **Pre-extraction equipment:** Dehullers, Seed/ kernel crackers, Roasters
- **Extraction equipment:** manual presses, ghanis, expellers
- **Equipment for basic refining** of the oil: Filters, Settling tanks.

# TINYTECH TINY OIL MILL

GROUND NUT  
100 KG.



THIS PLANT  
PRODUCE  
1000 LITER OIL  
IN 24 HOURS



WORKING  
IN 80  
COUNTRIES



GROUNDNUT  
DECORTICATOR

HUSK  
28 KG.

BOILER

KERNEL  
72 KG.



CAKE  
42 KG.

OIL



FILTER PRESS



PURE OIL 30 KG.

SESAME

COTTONSEED

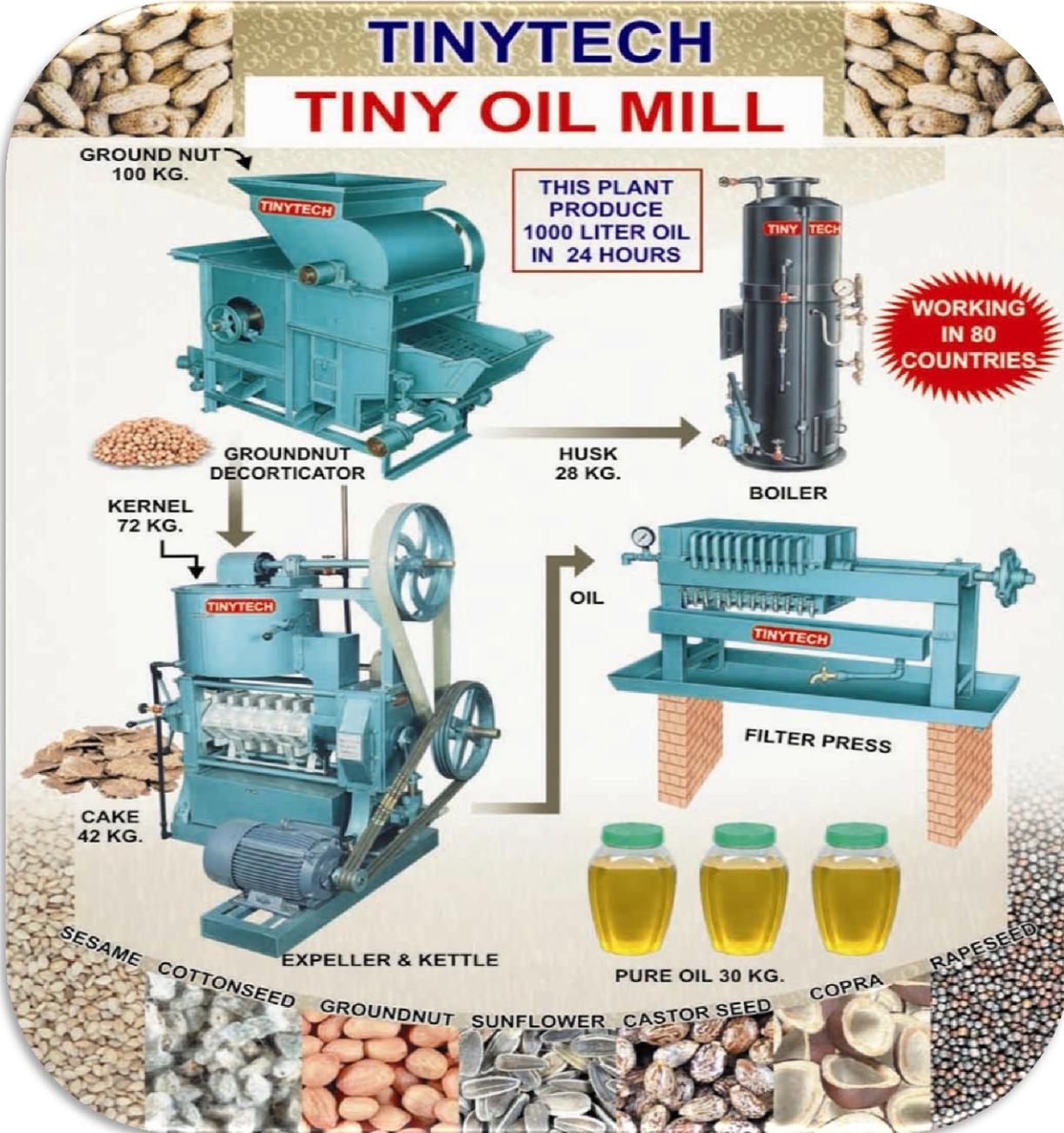
GROUNDNUT

SUNFLOWER

CASTOR SEED

COPRA

RAPESEED



# OIL CLARIFICATION

- Certain amount of fine cake or meal come along with the expelled oil so, to improve the quality of oil, these materials need to be removed completely.
- Clarification is done in two stages:
  - a) **Screening**: It is done by using a static or vibratory screener.
  - b) **Filtration**: hermetically sealed filter with stainless steel leaves is used.

# GHANI

- Oil extraction is done by animal/power drawn ghanis which are predecessors of present day expellers.
- The application of pressure effects the oil expulsion from oilseeds in a ghani.
- Ghani consists of:
  - a. Wooden mortar and
  - b. Pestle
- The mortar is fixed while the pestle is attached to one or a pair of animals is rotated in the mortar.

- The seed get crushed by the generation of **friction** or **pressure**.
- The oil is collected from a opening at the bottom.
- The oil cake is scooped out from the top in the mortar.
- Ghanies are made up of **wood** with the exception of a small iron band fixed around the top edge of the mortar.
- It can be easily made using locally available material.
- The pressing method is different from place to place.
- The pestle is turned around at a **speed** of **5-7rpm**.

- While in operation ,it makes up and down movement ,crushing the material in the material.
- The traditional ghani, operated by bullocks has capacity of **6-10kg/charge**(daily crushing capacity 60-80kg) of **90 minutes** and require a floor space of **36m<sup>2</sup>**.
- It generally takes **3 h** to crush one charge of **16kg mustard** seed.

# POWER GHANI

- Ghani are driven by 2hp/3phase/1440rpm electric motor.
- It moves the pestle at a speed of 11rpm through **belt pulley arrangement**.
- Power increases oil yield by 1% and reduces time of crushing by 20%.
- The improved **overhead power ghani** can crush 12-15kg seed/charge of 60 min each.
- It is also made of wood or iron.
- The floor space required is 7.2m<sup>2</sup>.

# GHANI OPERATION

- Oilseeds in ghanies are neither reduced in size nor cooked prior to their crushing.
- Heat is developed during crushing (below 50°C).
- About 4% water is added for hydration of proteins which help in expulsion of oil.
- Oilseed cake obtained from ghani contains 12-14% of oil.
- Further in solvent extraction the left over oil are extracted.

- The oil obtained from is of **premier quality**.
- It has good flavor and contain useful constituents.
- This is possible due to low temperature during processing operation.

# GHANI

