Jatropha Oil

Extraction and Characterization

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Why Focus on Jatropha?

- Jatropha is a top candidate for future large-scale biodesel production
- Could yield 6 tones of biodiesel per acre (15 tones per hectare) annually
- Jatropha oil can be processed to produce a high-quality biofuel or biodiesel
- Jatropha contains 25-40% of oil in the seeds
- Jatropha oil contains 21% saturated fatty acids and 79% unsaturated fatty acids.
- Jatropha oil cake is rich in Nitrogen, Phosphorous and Potassium and can be used as an organic manure

Chemical compositions

- Moisture: 6.20%
- Protein: 18.00%
- Fat: 25-40%
- Carbohydrates: 17.00%
- Fiber: 15.50%
- Ash: 5.30%

Oil Extraction

There are two ways to extract oil from oilseeds

- Mechanical extraction

  90-95%

- Solvent extraction

  up to 99%.

Mechanical Extraction

Oil recovery

The oil that can be recovered from the seeds is affected by:

- **Throughput:**

The amount of material that is processed per unit of time (kg/hr)

Higher throughput gives lower oil recovery per kg of seeds

- **Oil point pressure:**

The pressure at which the oil starts to flow from the seeds

- **Pressure**:

at higher pressure more oil is recovered from the seeds (50-150 bar)

- **Nozzle size**:

smaller nozzle size leads to higher pressure and therefore higher oil yield.

- **Moisture content of the seeds**:

An optimal moisture content of 2-6%.

- **Hull content of the seeds**:

The hull appears vital to pressure build-up inside the press.

Removal of the hull would require less energy for pressing and result in zero presence of hull fibers in the crude oil.

Press technologies

- Ram press

  1-10 kg seed/hr

- Expellers

  More than 10 kg/hr

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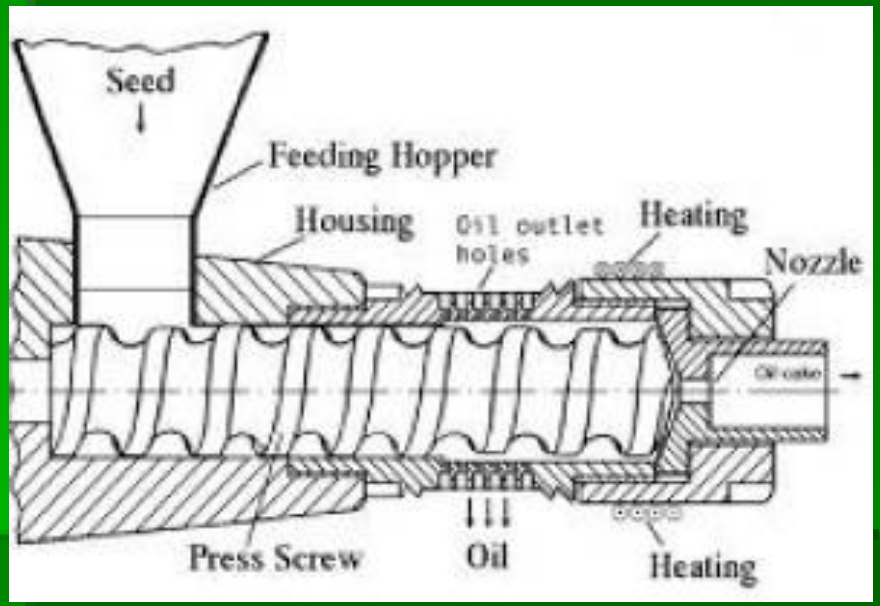
Ram press

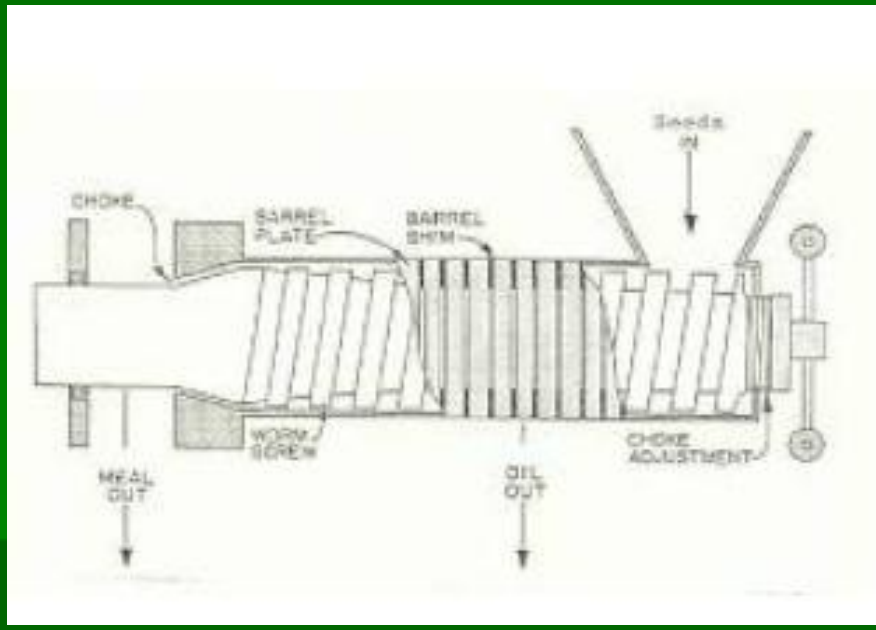
- The capacity is limited to 2-3 kg/hr.
- Oil recovery rate of 70-80%
- Oil density of 0.918 kg/liter this means < 1liter/hr

Expellers

Cylinder- hole' type



Strainer' type

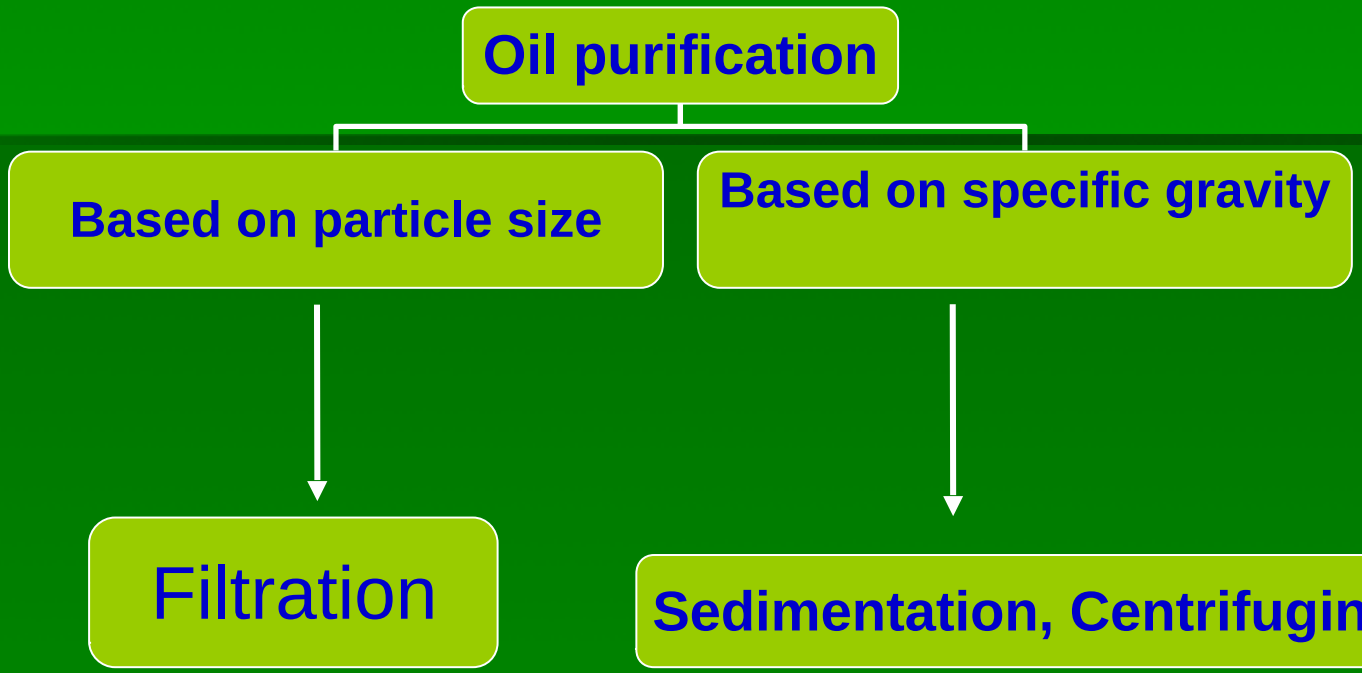


Cylinder-hole type

- Oil outlet is in the form of holes at the end of the cylindrical press cage
- Cylinder-hole type presses exist for small capacities (up to 200 kg/h seed

Strainer

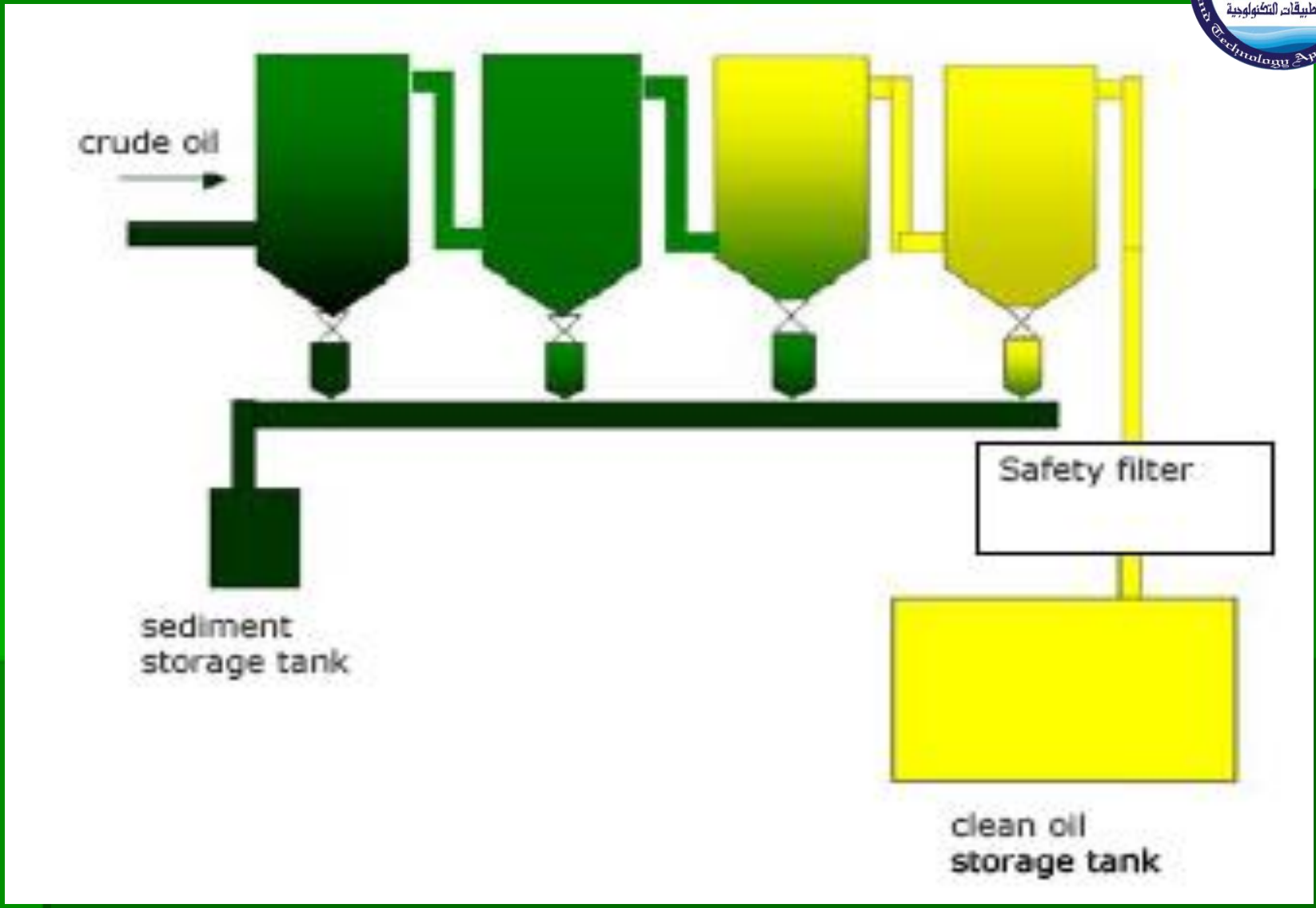
- The strainer is actually a cylindrical cage built-up of separate horizontal bars or vertical rings arranged at a small interspacing
- Capacity range from 15 kg of seed/hr to 10 tones of seed/hr.


Oil purification
Based on particle size
Based on specific gravity
Filtration
Sedimentation, Centrifuging

Sedimentation

- Sedimentation is the simplest and cheapest way of cleaning
- Sedimentation is only recommended for small processes
- production rates of < 50 liters/hr

Flow diagram of a sedimentation system



Centrifugation

Filtration

- The basic principle of filtration is blocking any particles bigger than the pore size in a membrane
- A nominal capacity of 85%
- Filtering is easier at lower viscosity of the oil
- optimal Temperature between 40- 55°C
- Filtration include several methods (Gravity filters, Band filter, Filter press, Candle filters)

Gravity filters

- Bags with different pore sizes, ranging from 200 µm to 1µm.
- It is recommended to leave the oil to settle for 4- 7 days before filtering

- Takes between 5 minutes to 1 hour per 20 liters

Band filter

- Remove sediment without interrupting the filtration process
- The moving cloth on the band filter helps to reduce clogging problems and enables easier cleaning
- The capacity of this model is 20- 60 liters/hour.
- 5 µm pore size

Filter press

Widely applied in the food industry

The filter cloth material can be used several times before cleaning

The oil is forced through the cloth and the filter cake remains in the cavities

The filter press is capable of removing particles <0.01µm

Candle filters

- Polishing filters as they perform the final touch in the cleaning process.
- Particle >1µm are removed at efficiency of 92%.
- Need to be replaced every 6- 8 weeks
- Throughput of 200 liter/hr

Oil quality

Different applications of jatropha oil require different levels of quality

- **Soap-making, Lamps and stoves:** proper filtering of the oil is sufficient for these applications

Diesel engines: oil should comply with DIN 51605 norm to minimize the chance of engine damage.

- FFA and phosphorus most problematic and require chemical cleaning (degumming and neutralizing)

Oil degumming

Oil

Heating 70-80° C

Add water

Delete gums and phosphatides

- **Phosphorus content should be below 12mg/kg**

Oil neutralization

Oil

heating (40-80°C)

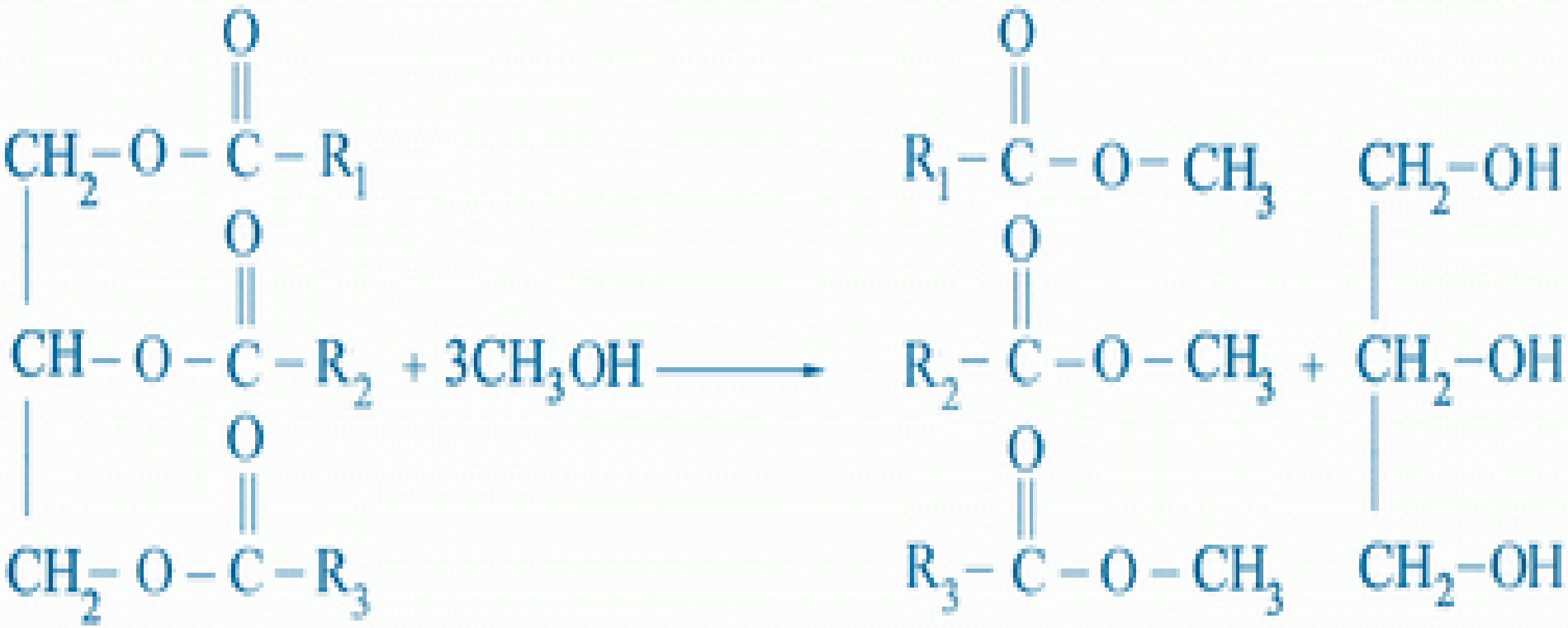
Add KOH or NaOH

stirring

Soap containing FFA

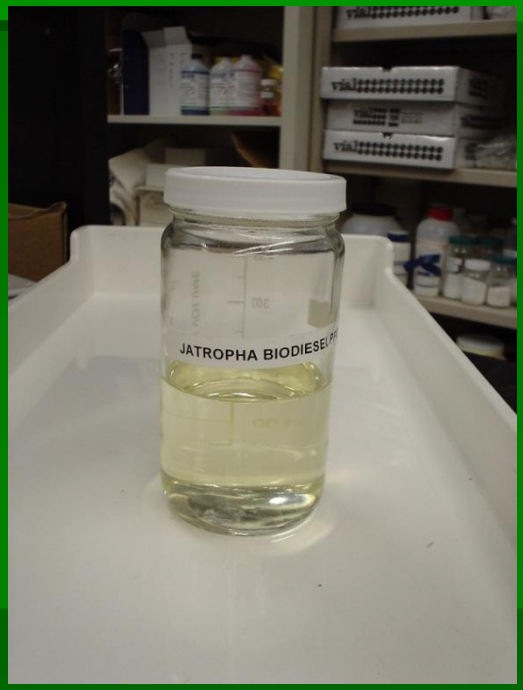
- Acid number should be below 2 mg KOH/g.
- This corresponds with an FFA content of 1%

Transesterification



Trans-estrefication

CH_3OH



Jatropha Oil

Jatropha Biodiesel

Several things have to be kept in mind:

Contamination:

This describes how much foreign material (particles) may be present in the oil .

Acid value:

This is a measurement of the content of free fatty acids in the oil

Oxidation stability:

The oil should not degrade in a hot environment

Phosphorus:

Phosphorus (phospholipids) blocking of the engine's fuel filter.

Oxidation of the oil on a high temperature

Ash content:

Reflects the amount of material that remains unburned after combustion of the oil in the engine

Water content:

water causes the fuel filter material to swell and hence block

water causes oxidation inside the injection equipment

By products

- Fertilizer
- Animal feeding
- Paper industry
- Medicine and cosmetics
- Biogas production

OIL CONTENT IN JATROPHA SEEDS AT MUCSAT

Plot 1

Genotype	Treatment	Oil Content (%)
JAT-106	A1B1C1	37.58
Michoacan	A1B1C1	40.11
JCL-Max-3	A1B1C1	31.78
GHS-B	A1B1C1	38.37

Plot 2

Genotype	Treatment	Oil Content (%)
JAT-106	A2B1C1	37.58
Michocan	A2B1C1	34.42
JCL-Max-3	A2B1C1	31.40
GHS-B	A2B1C1	27.50

Plot 3

Genotype	Treatment	Oil Content (%)
JAT-106	A1B2C1	32.13
Michocan	A1B2C1	37.93
JCL-Max-3	A1B2C1	37.11
GHS-B	A1B2C1	36.76

Plot 4

Genotype	Treatment	Oil Content (%)
JAT-106	A2B2C1	33.75
Michocan	A2B2C1	35.14
JCL-Max-3	A2B2C1	33.96
GHS-B	A2B2C1	36.44

THANK YOU