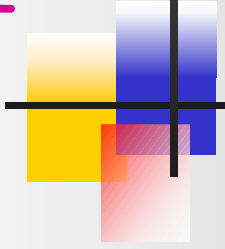
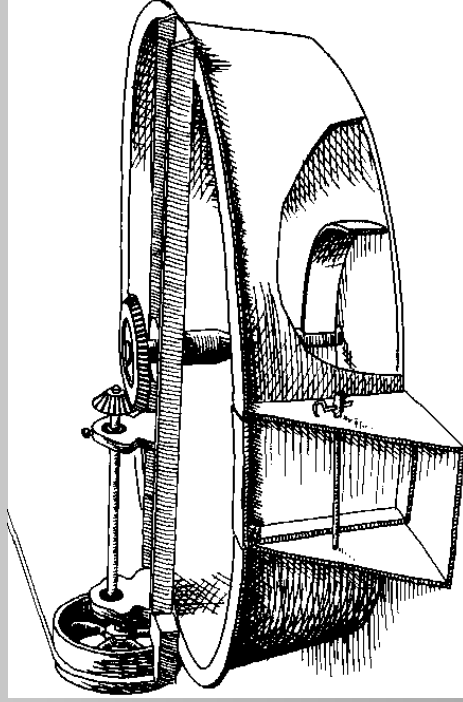


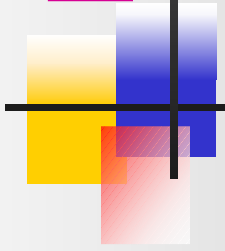
FOOD TECHNOLOGY



FATS AND OILS TECHNOLOGY-lecture1

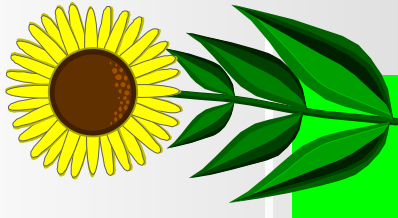
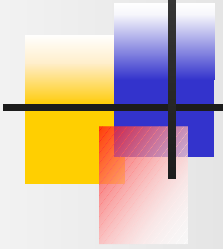
PROF. DR. ARTEMIS KARALI





Raw Materials

- Oil bearing materials used as raw materials in fats and oils manufacturing may be of either plant or animal origin.



Plants used to produce edible products:

Soybean, cottonseed, sunflower seed, safflower seed, corn germ, peanut, olive, rice bran, rapeseed, canola, coconut, palm fruit, and carob.

Plant sources for ind. oils:

Flax (linseed), castor bean, tung nut, and jojoba seed.



Animal sources and animal fat products:

Cattle, sheep, pigs, fish

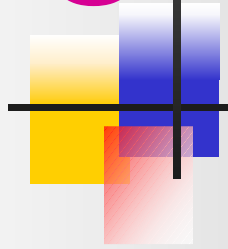
Butter, lard, tallow, whale oil and fish oil.



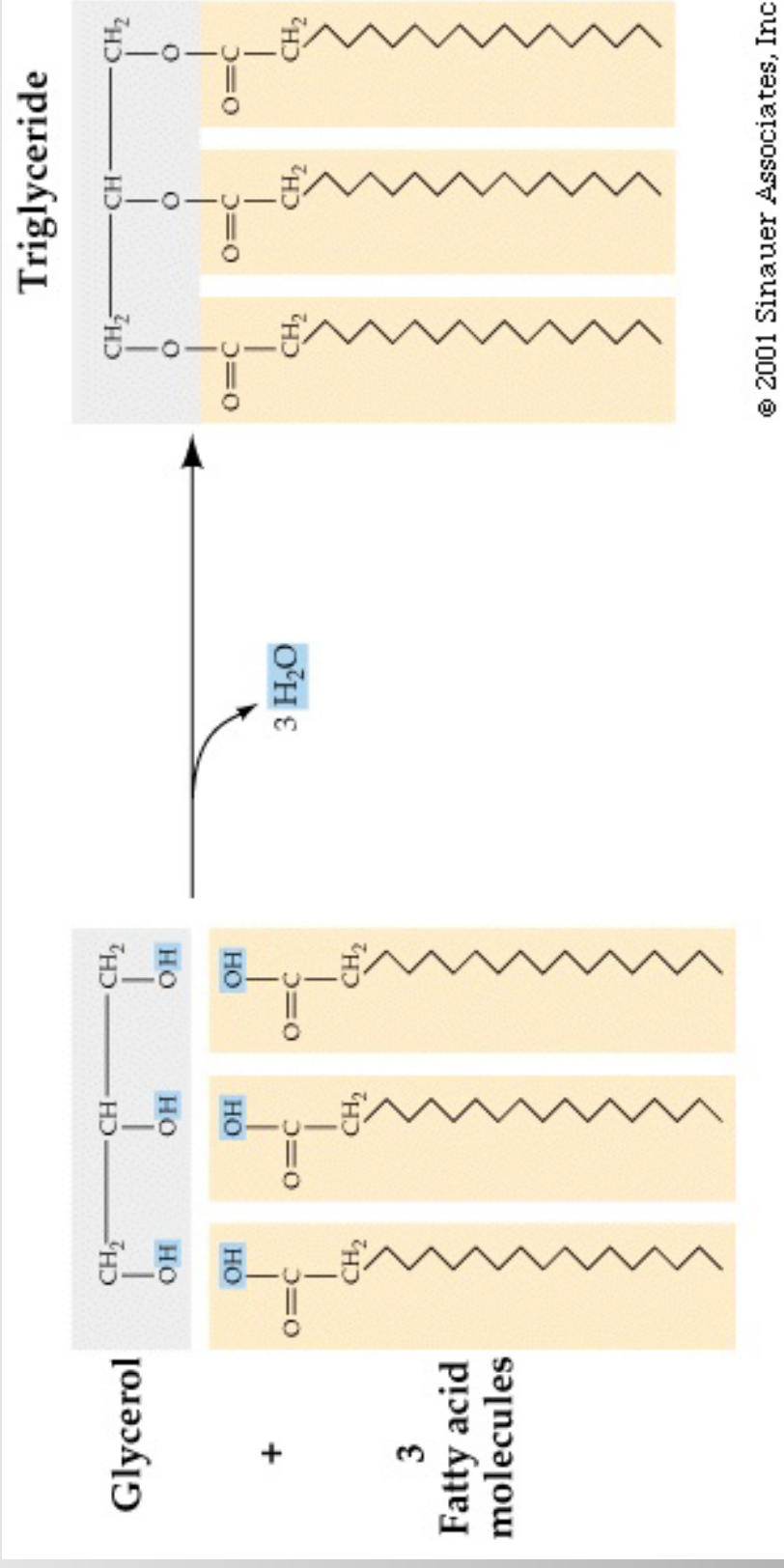
In TURKEY,

Main raw materials used for oil manufacturing
process are:

Cottonseed, sunflower seed, and olive.

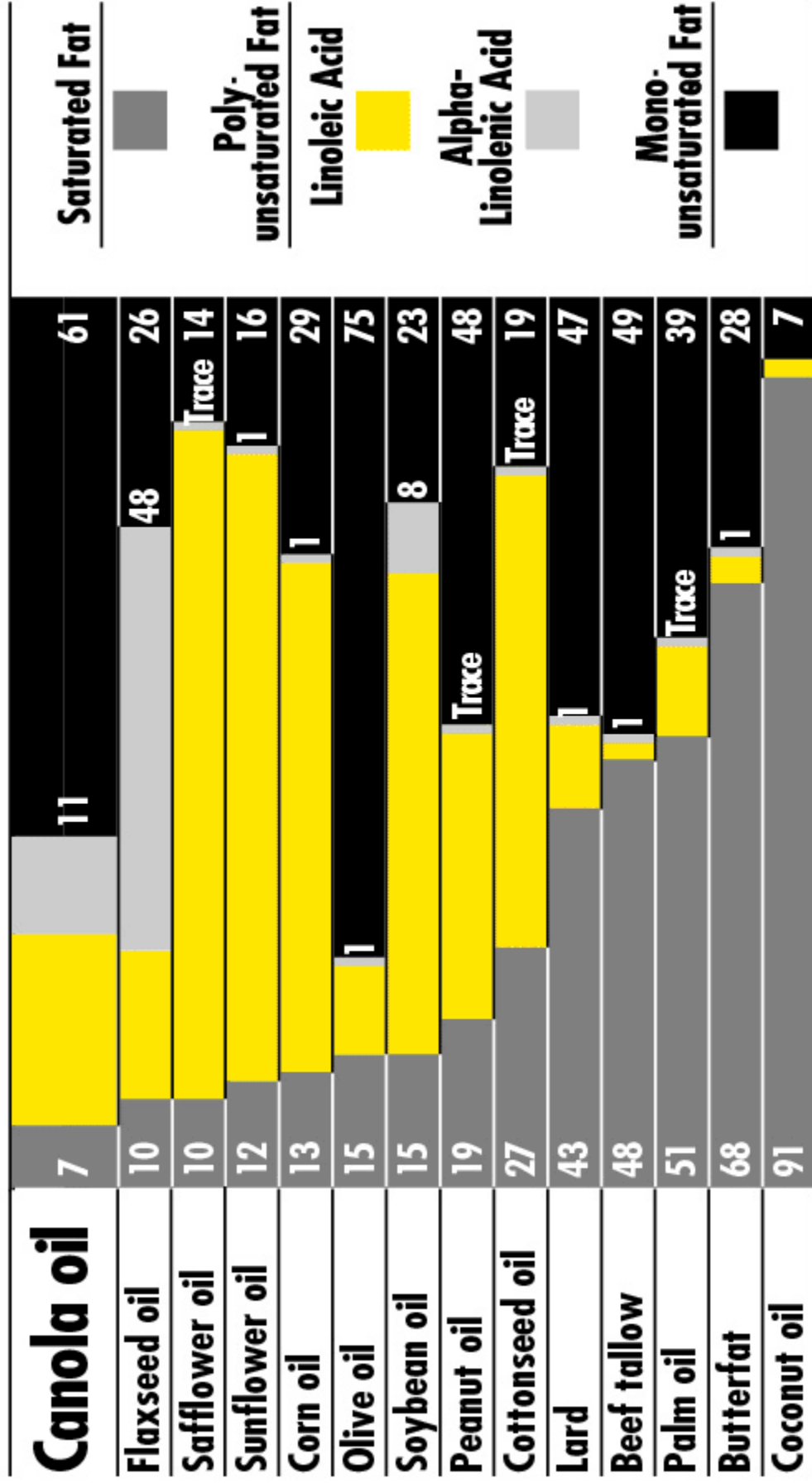


Chemistry



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Dietary Fat Content Comparisons



CanolaInfo

Dietary factor	Dietary source	Effects on CHD risk
Saturated fatty acids (SFA)	Butter, lard, milk fat, cheese, meat, sausages, coconut oil	<p>Strong association between a high intake of certain SFA (notably myristic, lauric and palmitic) with elevated levels of total and LDL cholesterol</p> <p>Increased risk of thrombosis from several SFA, such as stearic</p>
Polyunsaturated fatty acids		
Omega-6	Corn, sunflower and safflower oil	Reduced blood levels of total and LDL cholesterol but in large amounts, possible lowering of protective HDL
Omega-3	Fish oils and fats in vegetables and nuts (such as walnuts)	Reduced blood levels of LDL cholesterol (but only if initial levels high) and possible increase in HDL
Powerful antithrombotic and antiarrhythmic action		
Monounsaturated fatty acids	Olive oil, canola oil, rapeseed oil	Reduced blood levels of LDL cholesterol (perhaps an independent effect or due to displacement of SFAs)
		Protection of HDL
Trans fatty acids	Hydrogenated fat in margarines, biscuits, cakes, fast foods	<p>Raised blood levels of total and LDL cholesterol, lowered HDL cholesterol, and increased lipoprotein(a)</p> <p>Possibly more harmful than SFAs</p>
Total fat		<p>No strong association with blood cholesterol levels, but contribution to other risk factors such as obesity and Factor VII clotting activation. A high fat intake is often associated with a high SFA intake.</p>
Dietary cholesterol	Eggs, meat, butter, milk	<p>Raised blood levels of total cholesterol, but principal effect by amplifying the impact of SFAs</p> <p>Less effect when diet low in total fat (individuals vary greatly in their response)</p>

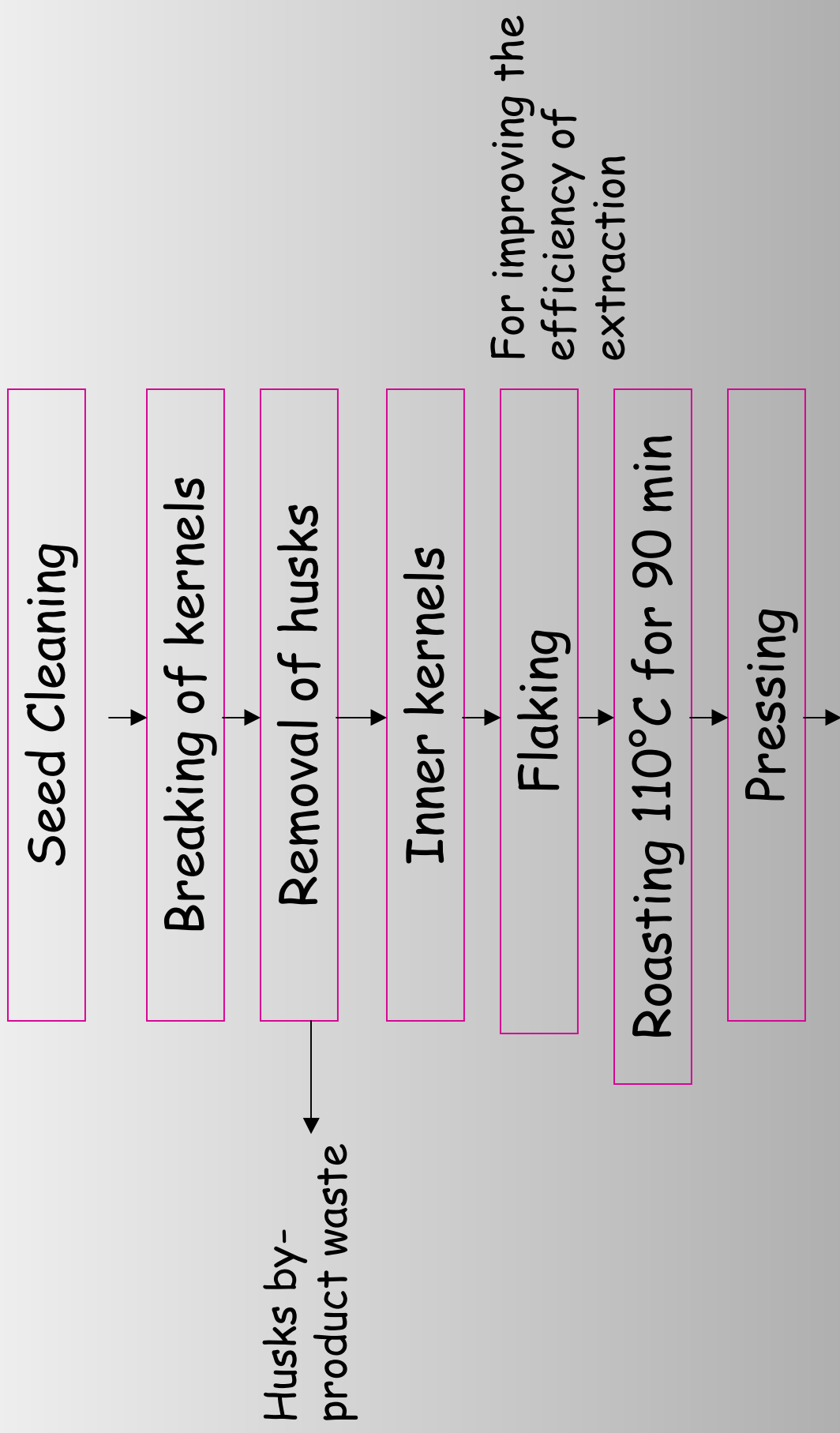


OIL and FAT PROCESSING

In general, oil bearing materials are processed as follows:

- Oil is first removed from the raw material and the resulting oil is processed into either edible or inedible products.
- The non-oil bearing by products and wastes (i.e. the oilseed cake, soapstock) are also processed to make a variety of edible and inedible products.

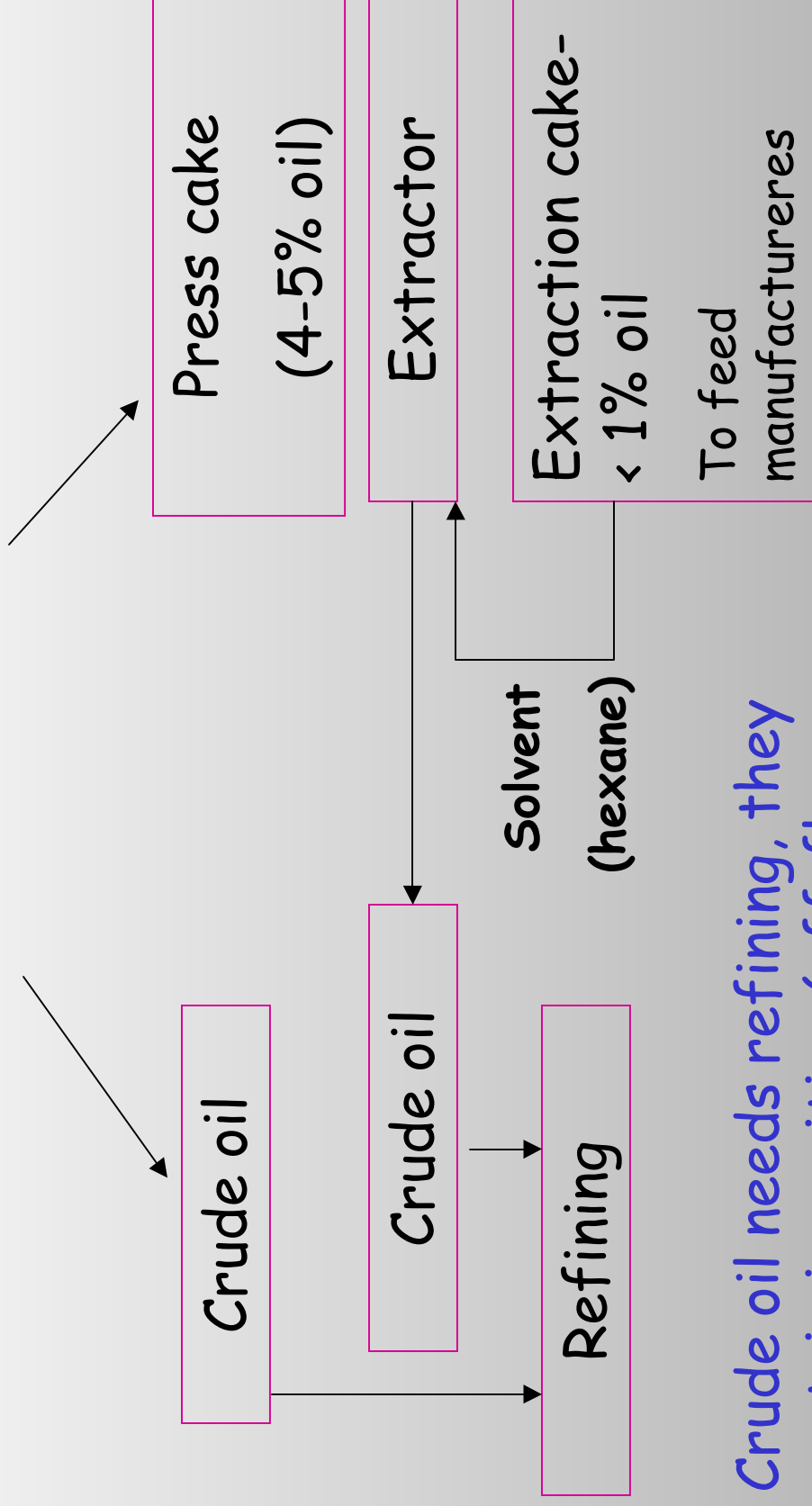
OILSEED PROCESSING



Husks by-product waste

For improving the efficiency of extraction

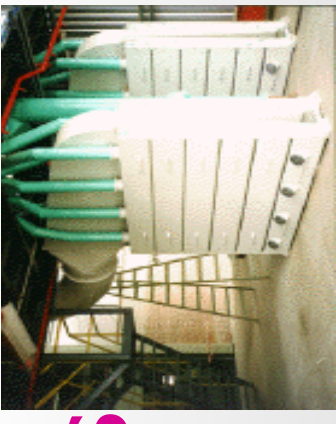
OILSEED PROCESSING



Crude oil needs refining, they contain impurities (off-flavors, waxes, gums, dark pigments).

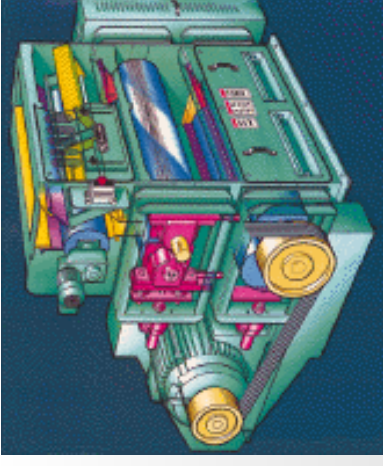
Preparation of Raw Materials

Cleaning



- All good preparation processes start with cleaning. Cleaning is important not only to ensure the good quality of the final products- meal and oil- but also to avoid premature wear of the preparation equipment.
- Cleaning uses a combination of **screening, air aspiration** and, when necessary, other methods, to separate pods, fines, stones, sand, metal, etc., from the product.

Dehulling



- Dehulling (decortivating), or partial dehulling, is an additional and sometimes a complex process. Its purpose is to increase the protein content and reduce the fibre content of the extracted seed cake(also called meal).
- Sunflower and soya are typical seeds for dehulling. In the case of cottonseed, partial delinting and dehulling at least, is required by the process. Rape or canola seed is almost never dehulled.



Dehulling

- Hulls are lighter than the kernel or meat. Dehulling is generally a succession of unit operations: impacting or **cracking, screening, and gravity separation through multiple aspirators**. Aims: To enhance the protein and fibre levels of the meal, and for reducing the amount of oil lost with the hulls.
- The hulls are generally sold as fibre complement, to feed cattle, or burnt as fuel.



Cracking



- Seeds are cracked to reduce the particle size to ensure uniform cooking.
- Cracking is achieved on corrugated roll stands. **Cracking mills** with one or two pairs of rolls are used.
- **Hammermills** are used for certain raw materials like palm kernel.



Cooking-Conditioning

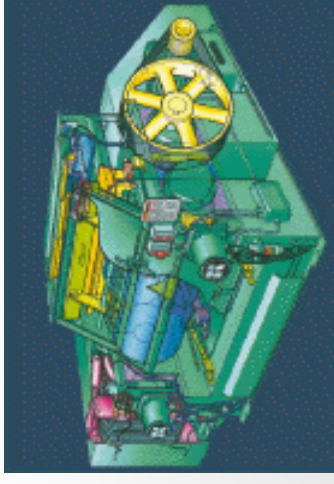


During cooking, the seeds are heated and conditioned to a **desired moisture level**. The main objectives of the process are:

1. Give plasticity to the seeds or meats.
2. Decrease the viscosity of the oil.
3. Coagulate the proteins.
4. Sterilise the seeds.
5. Detoxify certain undesirable seed constituents.

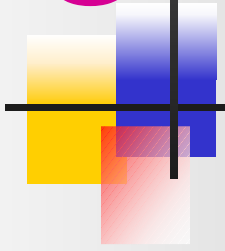
Multi-stage vertical **stack cookers** or large, single stage, rotary horizontal conditioners are used in industry. The seed is usually heated to **90-110°C for pressing or 65-72°C for direct extraction**.

Flaking



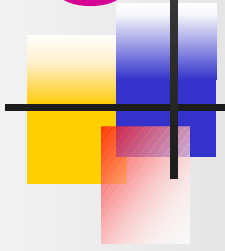
- All seeds must be flaked. Oil extraction is aided by passing the seed between large diameter smooth rolls to produce flakes of, typically, **0.3 to 0.4mm thickness**. The flakes are produced by friction between the rolls that turn at different speeds.





Oil Extraction

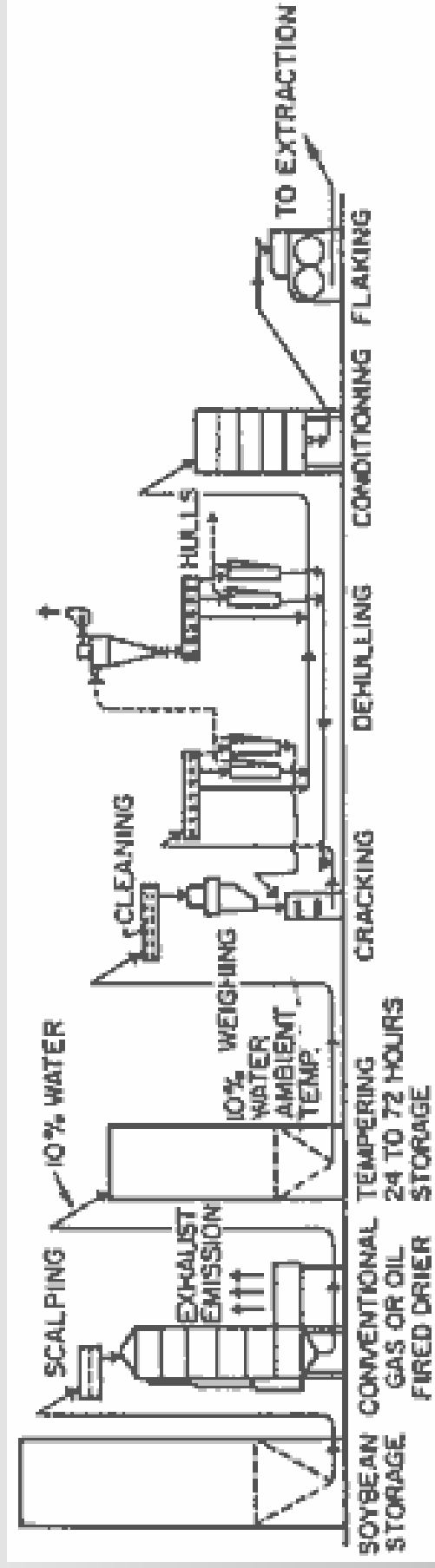
- **Solvent extraction** is a high technology process that has to be carried out at comparatively large scale. Essentially the process is one of **continuous countercurrent extraction** with the raw material flowing in one direction against a solvent; usually **hexane**.
- After oil extraction the solvent passes to a **recovery plant** where the solvent is stripped off **under vacuum**. The crude oil then passes on for refining.



Oil Extraction

- In mechanical extraction, hydraulic presses are used and in the press, flakes pass between a specially designed screw and a cage which is lined with steel screen bars spaced a fraction of an inch part. Screw presses are also available in several configurations.

Soybean Preparation



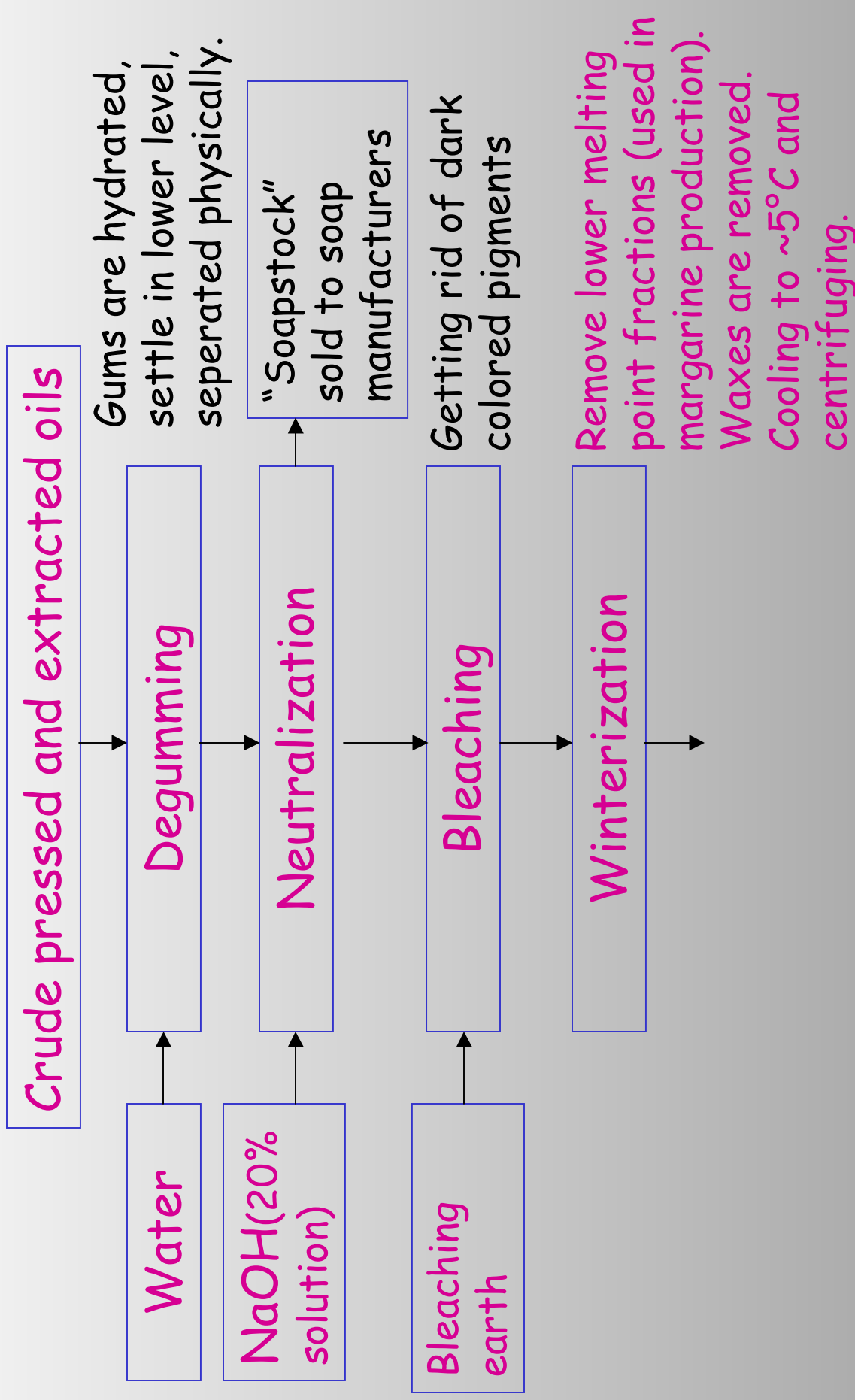
Conventional Preparation System for Soybeans (Source: Moore 1983)



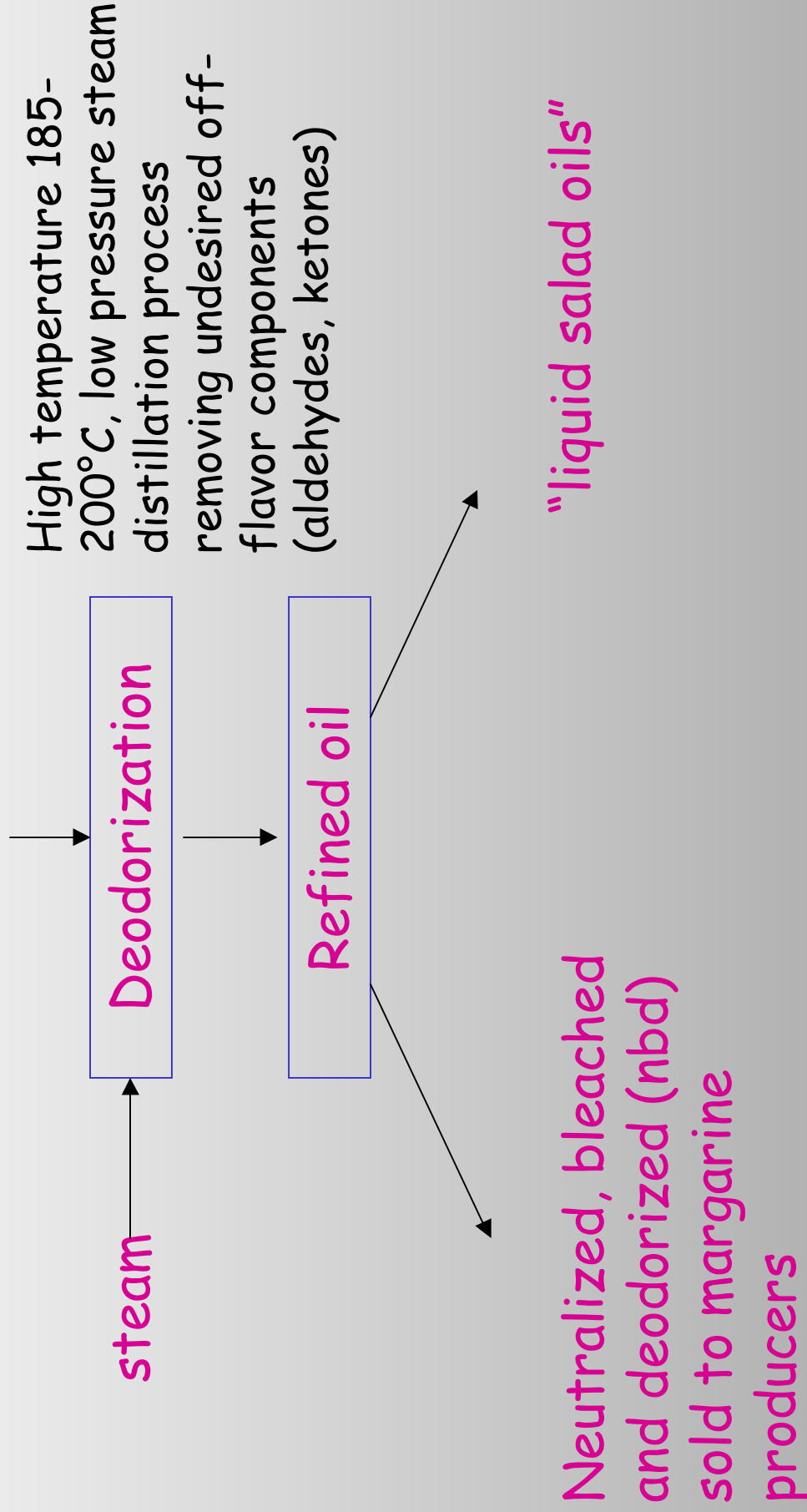
REFINING

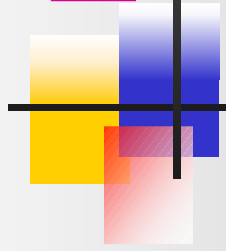
- Crude oils as received from the extraction plant or rendering plant, contain several non-triglyceride components which must be removed.
- Refining consists of several processes which accomplish this aim.

REFINING CRUDE OILS



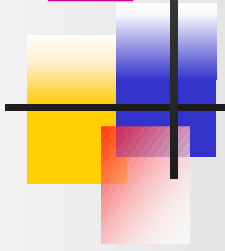
REFINING CRUDE OILS





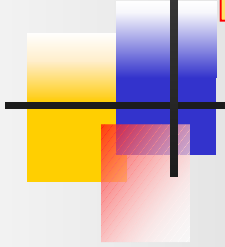
Degumming

- Gums in vegetable oil need to be removed to avoid **colour and taste** reversion during subsequent refining steps.
- Degumming is the **removal of phosphatides from the oils**. Some phosphatides can be removed by water-degumming, “non-hydratable phosphatides” require a chemical degumming process for their removal.



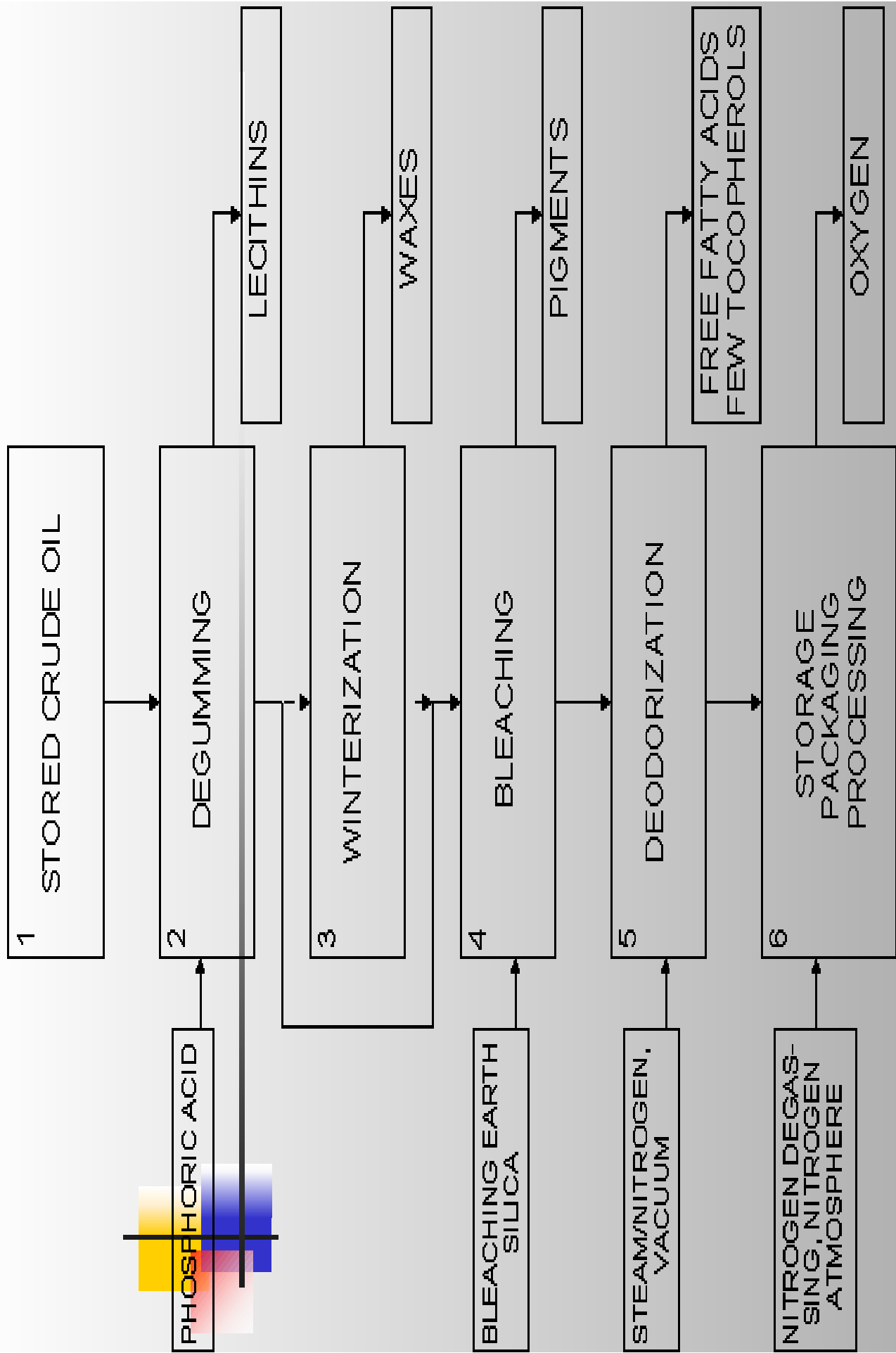
Degumming

- The total degumming process involves dispersing a non-toxic acid such as **phosphoric acid** into the oil, allowing a contact time and subsequently, the oil is passed to a **centrifugal separator** to remove gums (Physical refining).



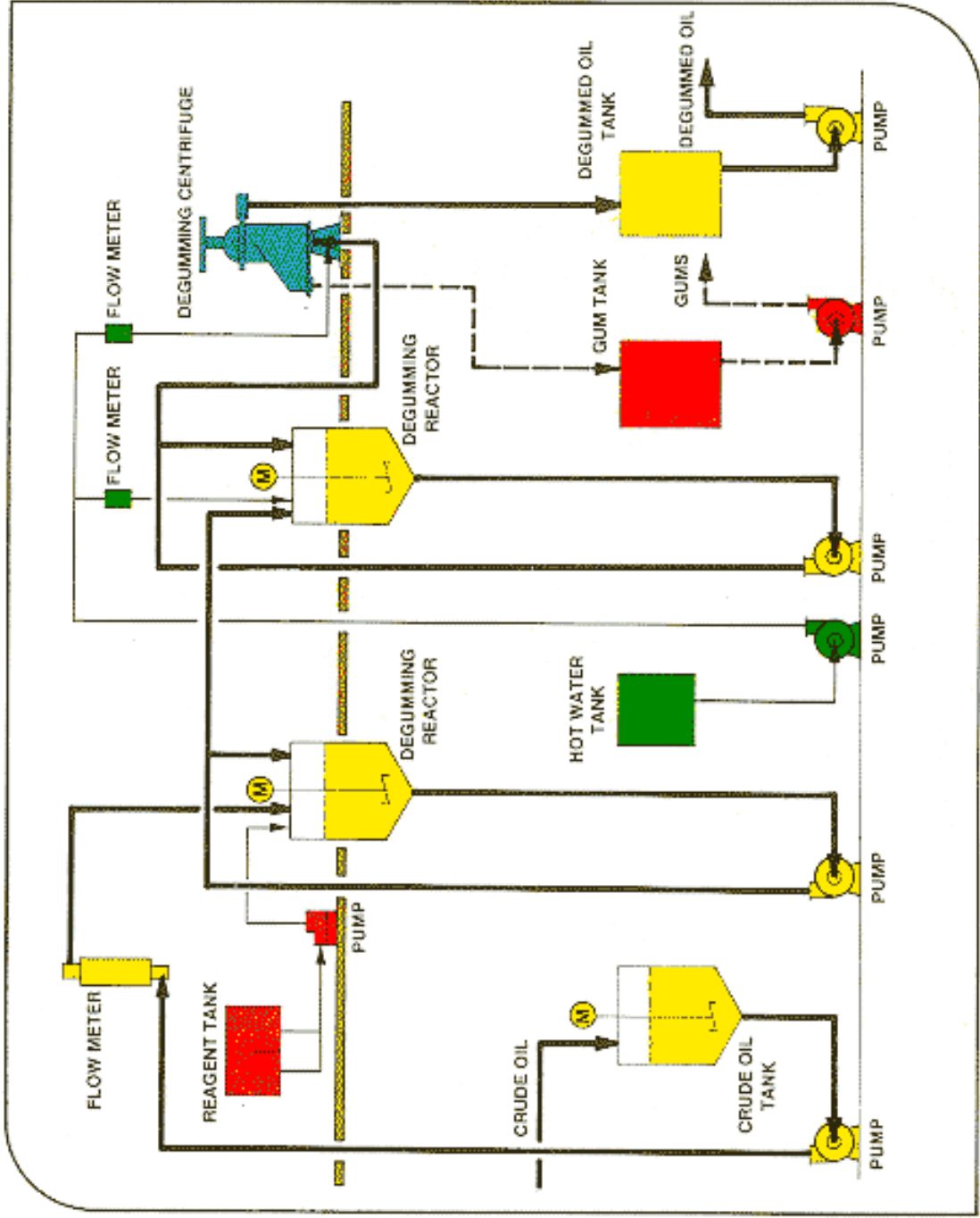
PHYSICAL REFINING

- **Physical refining** is basically an acid pretreatment (usually 0.05 to 0.2% of phosphoric acid added and well mixed at about 100C), followed immediately by heavy conventional adsorptive bleaching using up to 2-3% clay.



Physical Refining

The Continuous acid / Water degumming process



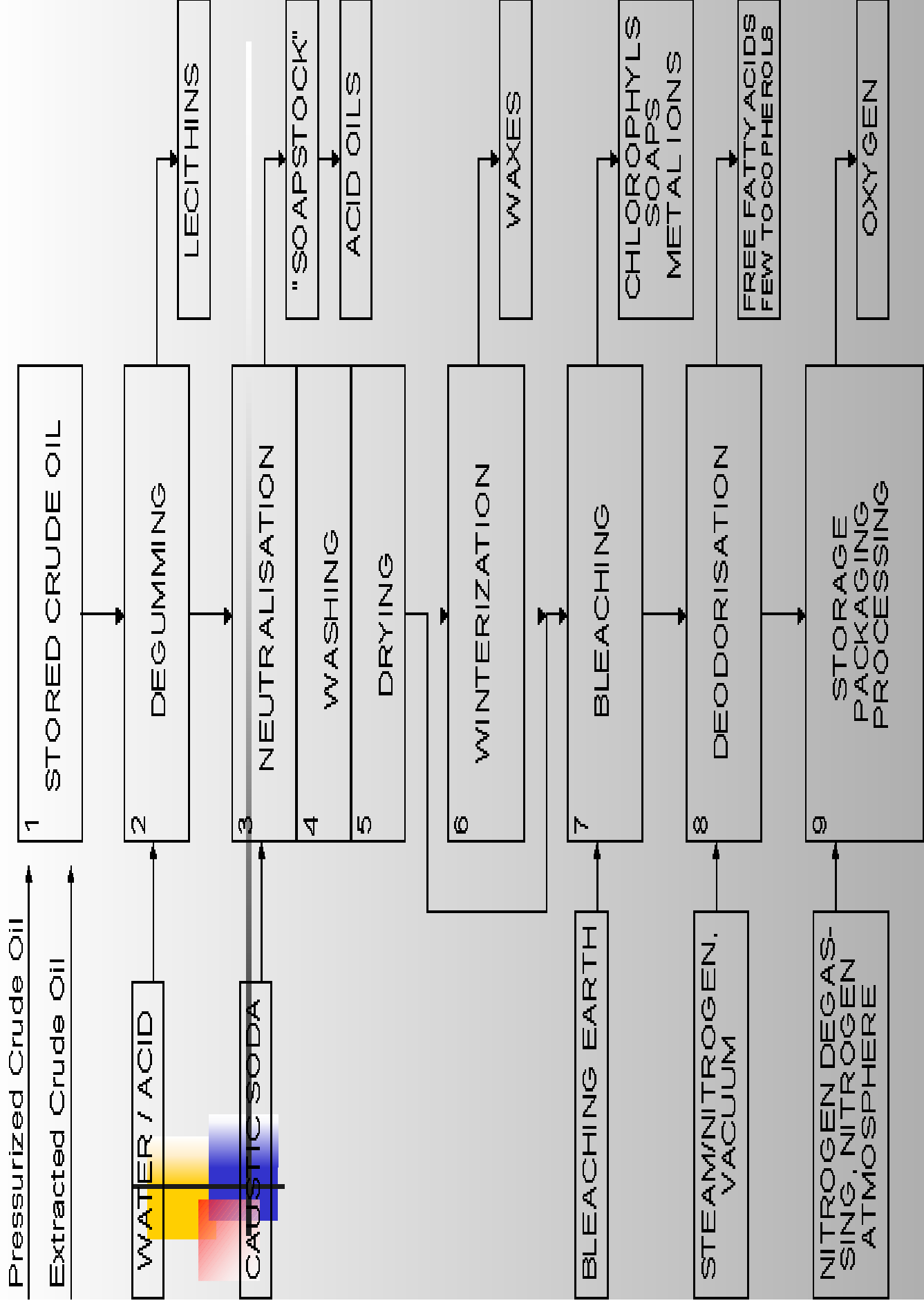


Neutralization

- Many crude oils contain **free fatty acids (FFA)** which impart unpleasant odours and flavours. The FFA's are neutralised by treating the oil with a carefully controlled quantity of **caustic soda solution**. In larger oil refineries the caustic soda washes are sold on for **soap manufacture** and are known as **soap stock**.
- Neutralisation also results in removal of **phosphatides**, removal of free fatty acids and removal of **colour bodies**. Removal of traces of soap and moisture occurs in the washing and drying steps.
- The neutralisation process consists of caustic refining and re-refining (wherever required) **first water washing, second water washing and vacuum drying**.

“CHEMICAL REFINING” NEUTRALISATION”

- **Chemical (Alkali) refining** works on almost all the undesirable, non-triglyceride components
- Alkali refining process consists of:
 - Mixing of an aqueous caustic phase into the oil phase to produce soap,
 - Development of the aqueous phase (soap) from the oil
 - Separation of the aqueous phase from the oil.



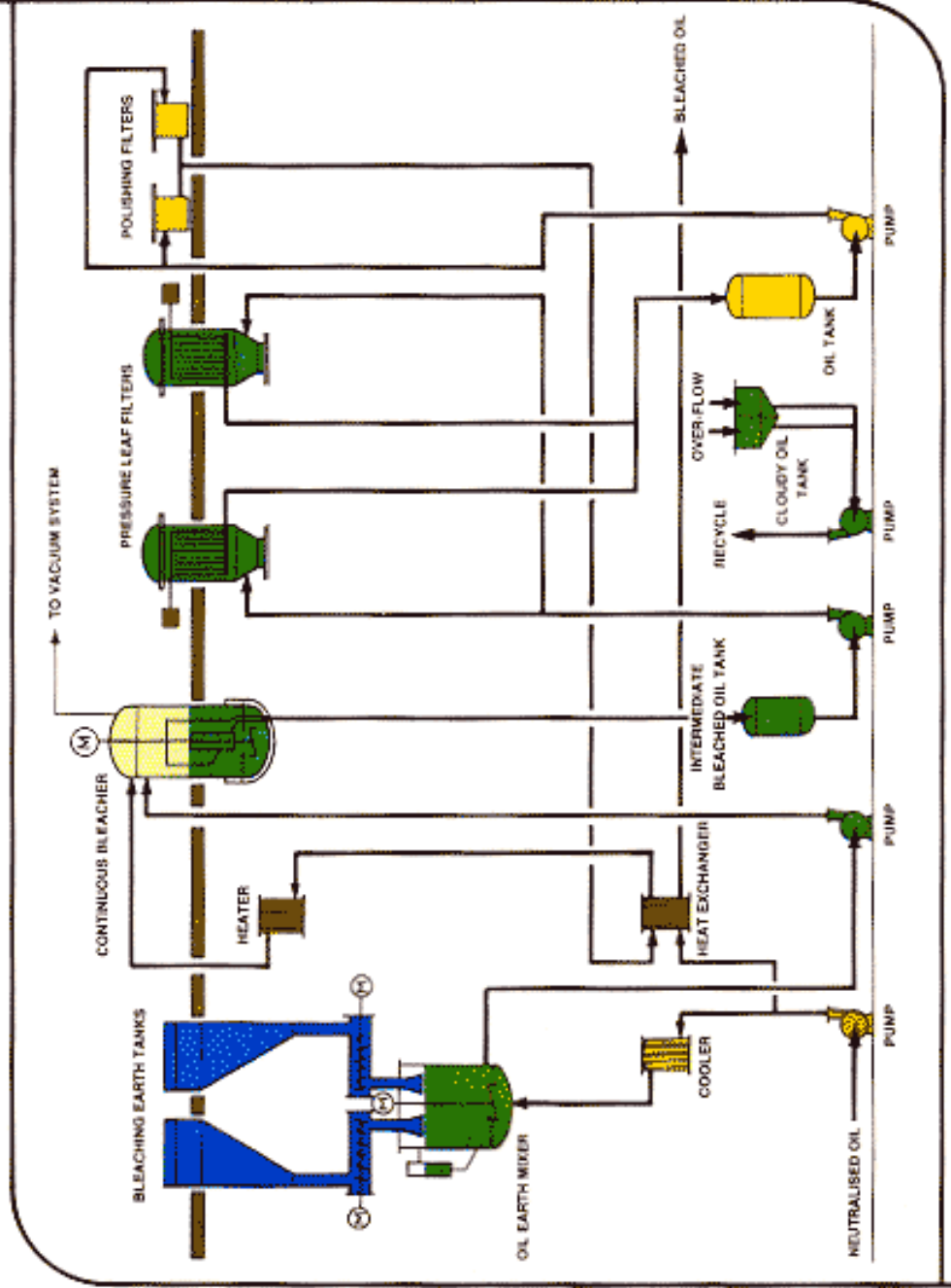
Chemical Refining

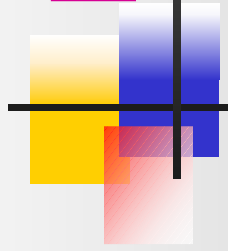


Bleaching

- Some oils are rather dark in colour due to presence of oxidised pigments and can be bleached by the addition of a small amount of **bleaching earth** or **activated carbon** prior to filtration.
- Bleaching is also the last stage where residual phosphatides, metals and oxidation products can be removed prior to deodorisation/deacidification.
- The removal of these minor impurities is very important since they have a direct effect on the **organoleptic quality and oxidative stability** of the deodorised product.

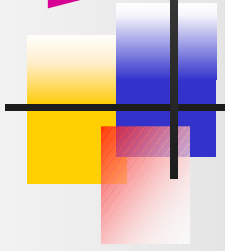
Continuous Bleaching Process





Deodorisation

- It is a high temperature, high vacuum steam distillation process to remove volatile, odoriferous materials. Deodorization increases the oil's flavor and oxidative stability by nearly complete removal of free fatty acids (FFA) and other volatile odor and flavor materials, and by thermal destruction of peroxides. But it also partially removes the tocopherols.



Winterization

- Winterization is an operation designed to preserve **liquidity** and refined oils **brightness**.
- It involves two steps:
- Winterization involves allowing the oil to **stand at low temperatures**, during which time higher melting glycerides crystallise as a solid phase and are **separated by centrifugation or filtration**.

Processing Equipment

Seed Preparation and Crushing

Mills - hammer, flaking, cracking, disc, colloid

Cleaning - multi deck grain dryer, aspirator
cooker prepress/full press, bench press

Solvent Extraction Equipment

Crown solvent extractors
inverting basket centrifuge for powders

Refining Equipment Centrifuges

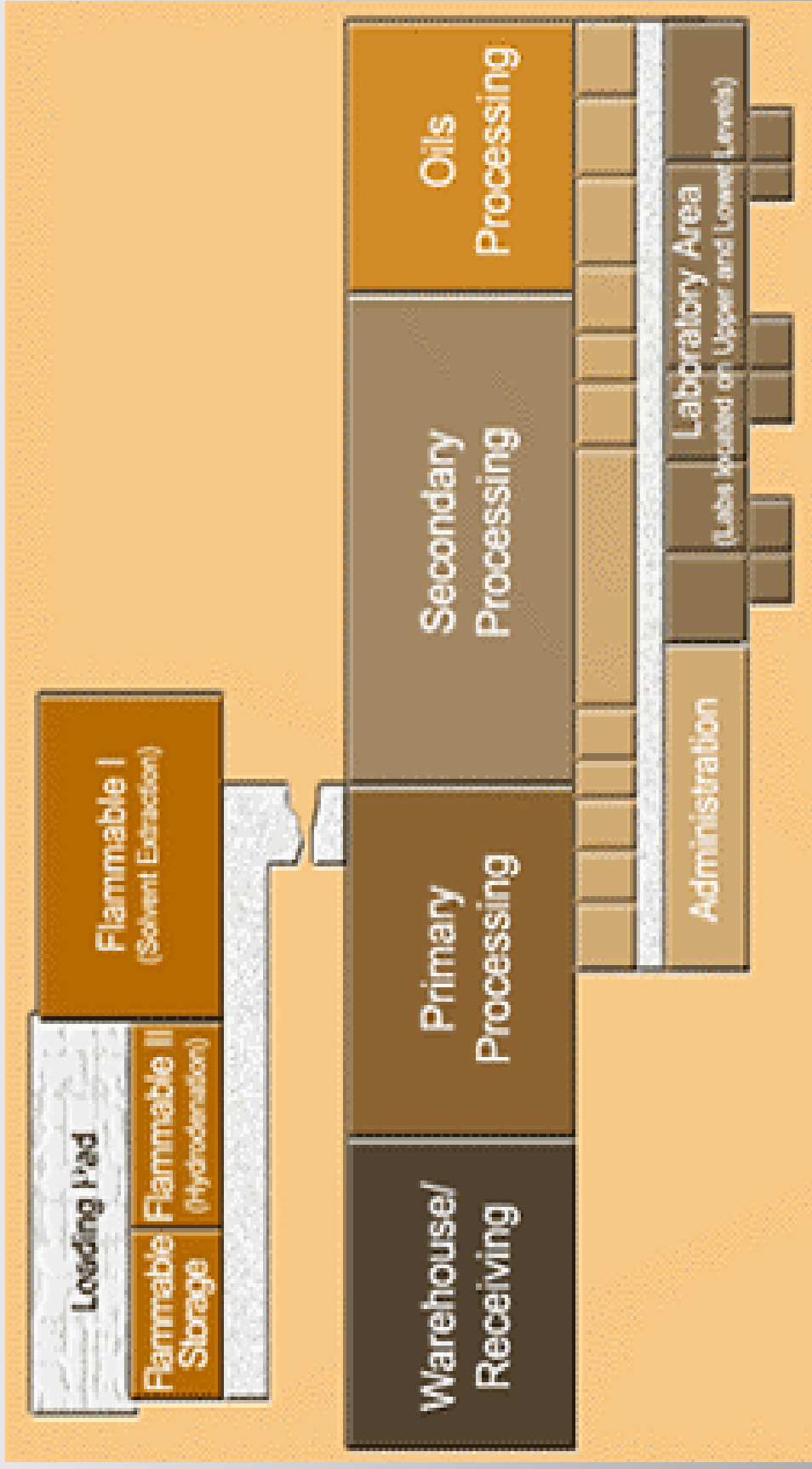
Reactors & Filters:

for bleaching, interesterification and hydrogenation.

Deodorizers: continuous or batch.

Winterization vessels

Ideal floor plan of an integrated oil plant





Primary Processing Area:

The Primary Area is used to prepare grains, oilseeds, legumes and other materials for further processing. Pilot scale industrial equipment can be available to clean seeds, mill materials to any particle size, dry to specification and screw press oil seeds.

Common processes include:

- **crushing of oilseeds**
- **dehulling of grains & legumes**
- **milling of grains & legumes**
- **separation of components from grains & legumes**



Secondary processing area:

The Secondary Processing area provides a wet processing environment for centrifuges, evaporators, dryers, ultrafiltration units, filters, mixers, pumps, tanks and heat exchangers configured to suit the needs of following secondary processes:

- **wet milling, aqueous extraction and fractionation of oilseed components**
- **preparation of protein concentrates and isolates**
- **aqueous extraction and purification of bioactive components from plant materials.**

Oil processing area:

Common processes for oils such as soy, sunflower, include:

- degumming
- refining
- pretreating/bleaching
- steam stripping

fatty acid concentration

inter-esterification

winterization

deodorization.



Contemporary Issues

Global:

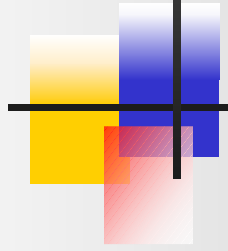
- **Herbicide resistant soybeans and insect resistant corn :products developed to help growers save on input costs**
- **High-oleic soybeans (the goal for transgenic soybeans is to reach 80-85% oleic acidsince oleic acid is considered more "healthy" and more stable against rancidity than other oils) are two examples of GM foods.**

Contemporary Issues

- **Local(National):**
- Shortage of oilseed crops(domestic production insufficient for local consumption)
- Import Quotas for olive oil from Turkey (since Spain, Greece, Italy, Portugal and France also produce it(CAP: common Agricultural Policy) **in order to enforce minimum import prices**
- **Export subsidies to sell EU products put surpluses on other world markets too.**

Possible Measures

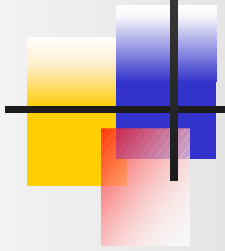
- **Being our major competitors, Italy, Greece, Spain and Portugal take advantage of being full-members of the European Union. Turkey, on the other hand, while exporting non-quota products to the EU countries is obliged to pay a tax of 16.8%. Moreover, with the purpose of improving its global trade, Italy keeps on creating new product variations, putting herself one-step forward. Turkey should do the same.**
- **It is possible for Turkey to have a better position in agricultural exports provided that the producers, entrepreneurs and the state act hand-in-hand, while taking the necessary precautions and that the state incentives are increased with agricultural planning, avoiding the disintegration of fields, foundation of producer unions, standardization of the issues like storing, transportation, and packaging.**



Oil refining machinery pictures taken at an oil refining plant



Degumming



Neutralization



Dewaxing



Bleaching



Winterization



Deodorisation