Overview of topics

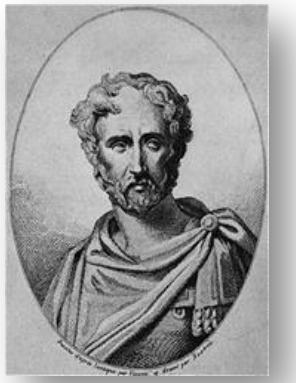
Chapter 1 NATURAL PRODUCTS

1. Edible and Essential oils
2. Soaps and Detergents; Glycerin
3. Starch and its Derivatives

Soaps and Detergents

1. History of Soap
2. History of glycerin
3. What are Soaps and Detergents ?
4. What is glycerin?
5. Cleaning action of soaps
6. What are the process methods available to produce soaps?
7. Difference between batch and Continuous process
8. Continuous Production process - soap
9. Process description
10. What are the process methods available to produce detergents?
11. What are the process methods available to produce Glycerin?
12. End uses of soaps and detergents; glycerin
13. Conclusions

1. History of soap and detergents



Pliny and Elder (23 AD – August 25, 79 AD)

A Roman author, naturalist and natural philosopher. He described the manufacture of hard soap and soft soap in the first century.

Michel Eugène Chevreul (31 August 1786 – 9 April 1889)

A French chemist whose work with fatty acids led to early applications in the fields of art and science He is credited with the discovery of margaric acid and designing an early form of soap made from animal fat and salt.

1. History of soap

Nicolas Leblanc (December 6, 1742 – January 16, 1806)

A French chemist and surgeon who discovered how to manufacture soda from common salt.

He showed that soap formation was actually a chemical reaction.

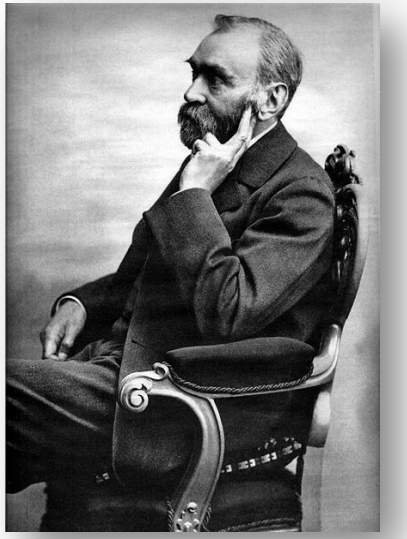
Domeier completed his research on the recovery of glycerin from saponification mixtures in this period

The raw material shortages of World War I led the Germans to develop "Synthetic soaps" or "Detergents"

2. History of Glycerin

Ascanio Sobrero(October 12, 1812 – May 26, 1888)

An Italian chemist who had produced the explosive nitrogylcerin for the first.



Alfred Nobel (October 21, 1833 – December 10, 1896)

A Swedish chemist, engineer, innovator, and armaments manufacturer. !n 1868 Alfred Nobel invented dynamite.

3. Soaps and Detergents

If an oil is hydrolyzed and or saponified with alkali soaps are obtained.

Any metallic salts of fatty acid is soap, but the term soap is applied to water soluble salts.

Soaps comprises of the sodium or potassium salts of various fatty acids but chiefly of oleic, stearic, palmitic, lauric and mystiric acids.

The saturated fat gives hard soaps, whereas unsaturated fat gives soft soaps on saponification

Soaps comprises of the sodium or potassium salts of various fatty acids but chiefly of oleic, stearic, palmitic, lauric and mystiric acids. It also comprises of salts of sodium and zinc oxide catalyst.

3. Soaps and Detergents

Detergents differ from soap in their action in hard water.

Detergents may react with hard water ions, but the resulting products are either soluble or remain colloidally dispersed in water.

Scientifically, the term detergent covers both soap and synthetic detergents or "Syndents" but it is widely used to indicate synthetic cleaning compound.

3. Soaps and Detergents

S. No	Soaps	Detergents
01.	Soaps from insoluble compounds with the calcium and magnesium ions present in hard water	Detergents may react with hard water ions, but the resulting products are either soluble or remain colloidally dispersed in water.
		Synthetic cleaning compound
02.	To make soap Tallow /or rice bran oil + Hydrolysis → (Splitting fats) Tallow fatty acid or fa	 Alkylbenzene sulfonate + oleum → Disulfonate and Sulfuric acid
03.	Tallow /or rice bran oil + NaOH → (Saponification) Sodium salt	Tallow fatty alcohol + oleum → Fatty alcohol sulfate
04.	Salt of fatty acid + builders, etc → Soap	Sulfonate + Sulfate + NaOH → Sodium salts
		Sodium salt + Builders → detergents

4. Glycerin

Glycerin is a clear, nearly colorless liquid having a sweet taste but no odor.

The term glycerin is chosen for the technical product containing the pure trihydroxy alcohol "*glycerol*".

5. Cleaning action of soaps

The success of an cleaning agent is to supply compounds with hydrophobic (water hating) and hydrophilic (water loving) groups which will also appreciably decrease surface tension and increase wettability. i.e. surface tension is inversely proportional to the wettability.

In wash water, soaps or detergents increase the wetting ability of water so that it can more easily penetrate into the fabrics and reach the soil.

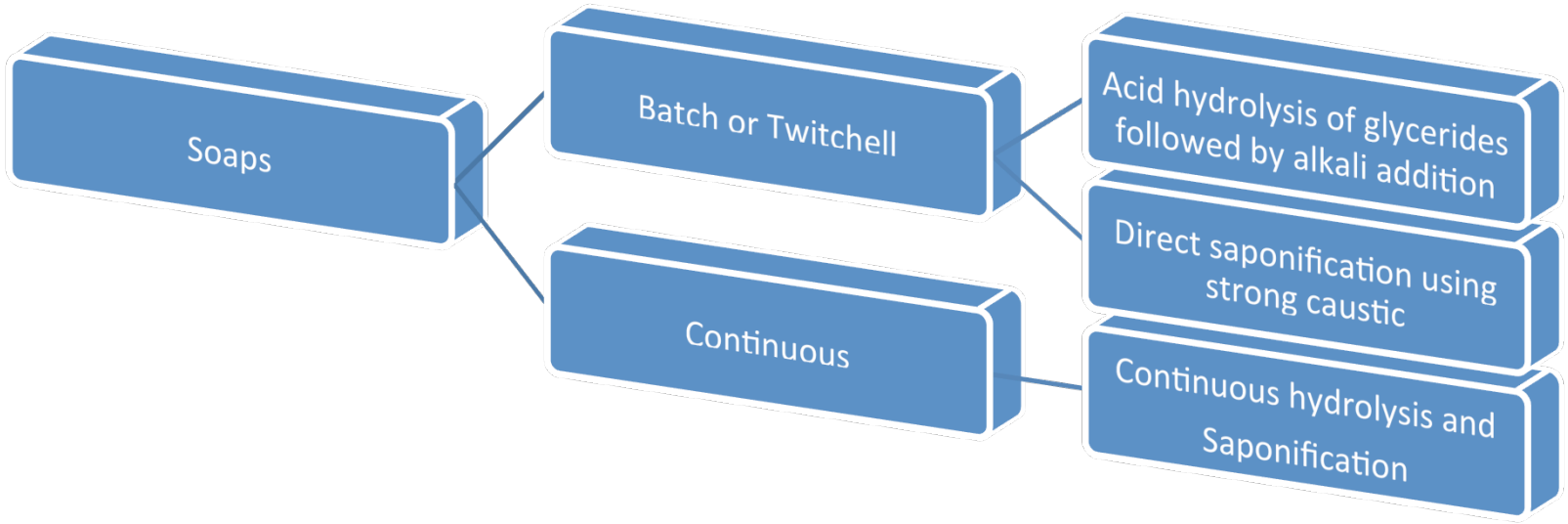
Each molecule of the cleaning solution may be considered a long chain. One end of the chain is hydrophilic(Water loving) and the other end of the chain is hydrophobic (Water hating or soil loving). The soil loving end are attracted to a soil particle and surround it.

5. Cleaning action of soaps

At the same time the water loving end pulls molecules and the soil particles away from the fabric and into the wash water.

This is the action which, when combined with the mechanical agitation of the washing machine, enables a soap or detergents to remove soil, suspend it, and keep it from redepositing on clothes.

6. Methods of production - Soap



7. Difference between batch and Continuous process

	Batch (Twitchell) Process	Continuous process
Temperature, deg. C	150 – 175	230 - 250
Pressure, mPa (g)	5.2 – 10	4.1 – 4.9 40 – 45 atm
Catalyst	Alkyl aryl sulfonic acids, Oxides of calcium, zinc and magnesium i.e. CaO, ZnO, MgO.	Same catalyst or optional
Acid used	Sulfuric acid	_____
Time, h	12 – 48	2 – 3
Operation equipment	Batch	Continuous
Hydrolysis	85 – 98 %	97 – 99%
Glycerol obtained	5 – 15%	10 – 25%
Advantages	Low temperature, adaptable to small scale	Small floor space, uniform product quality, high yield of acids, high glycerin concentration, automatic control
Disadvantages	Catalyst handling; ling reaction time, need more than one stage for good yield	High temperature and pressure, High cost and greater operating skill

8. Production Process – Soap

Continuous hydrolysis and Saponification

8. Production Process – Unit process

Hydrolysis (Fat – Splitting)

$(R . COO)_3 . C_3H_5 + 3H_20 \longrightarrow 3R . COO . H + C_3H_5(OH)_3$

(Triglyceride) + (Water) $\longrightarrow$ Fatty acid + Glycerin

Fatty acid radical representing oleic, stearic, palmitic, lauric and mystric acids

$(C_{17}H_{35}C00)_3\ C_3H_5 + 3H_2O \longrightarrow 3C_{17}H_{35}COOH + H_2O$

Glyceryl stearate + Water $\longrightarrow$ Fatty acid (Stearic Acid) + Glycerin

Saponification (Caustic Addition)

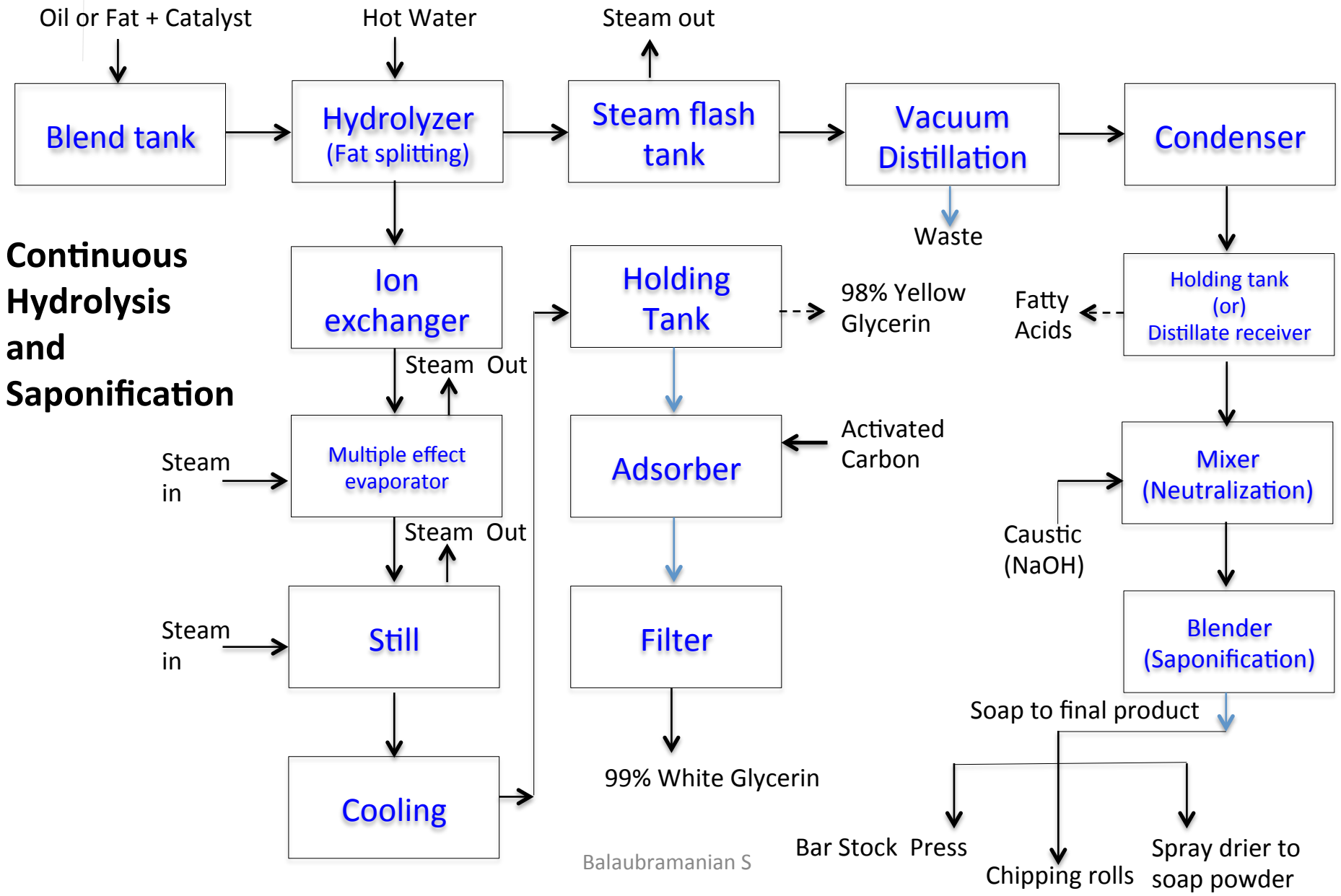
$R . COOH + M . OH \longrightarrow R . COO . M + H_2O$

Alkali element such as Na or K

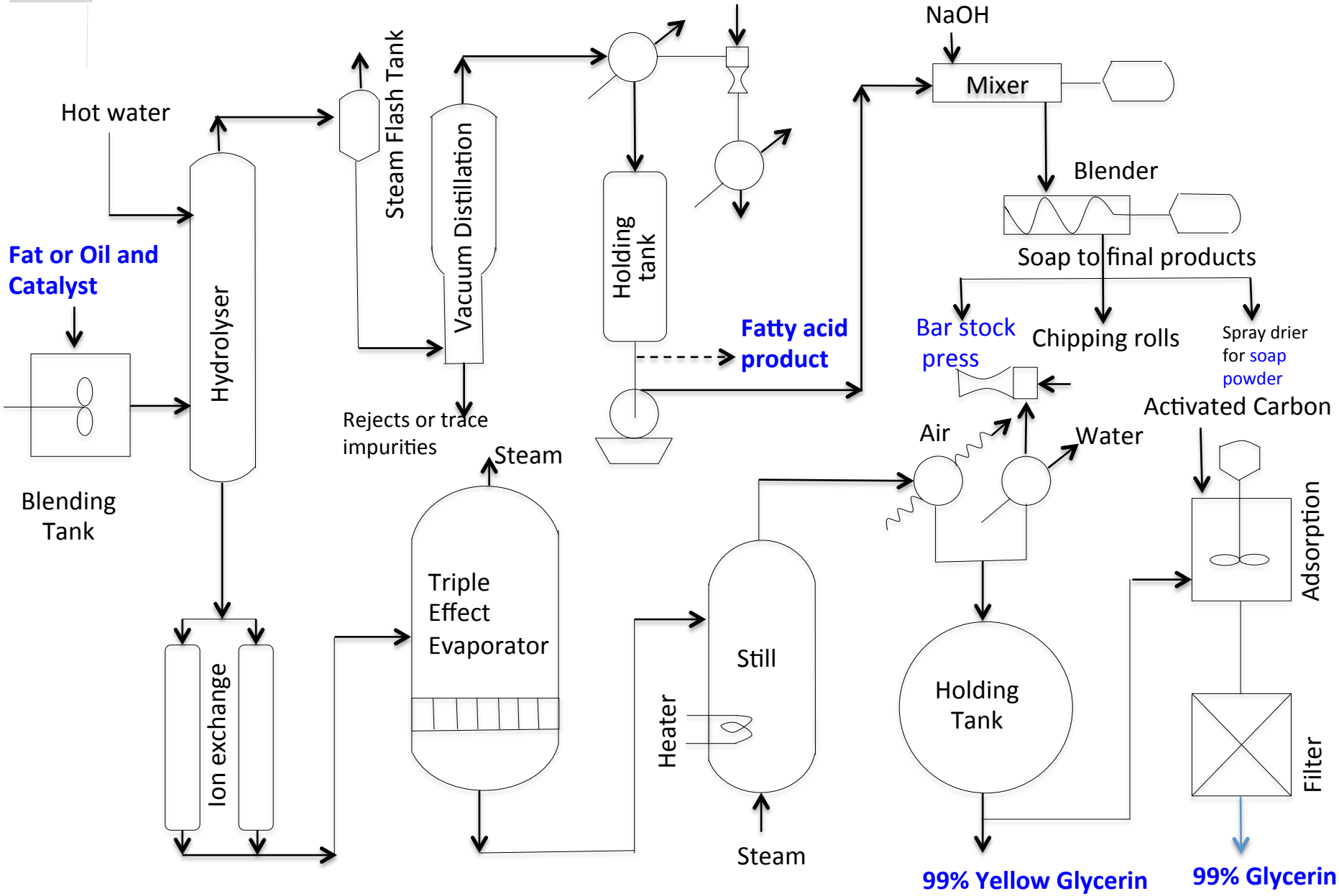
$C_{17}H_{35}COOH + NaOH \longrightarrow C_{17}H_{35}COONa + H_20$

(Stearic acid) + (Caustic) $\longrightarrow$ Sodium stearate + water

8. Production Process – Block diagram



8. Production Process–process diagram



9. Process description

S. No	Process	Equipment	Unit operations	Unit process	Objective	Operating conditions
1.	Continuous Hydrolysis and Saponification (Continuous Process)	(a) Blend tank	Physical blending	_____	Blending of fat or oil and catalyst	_____
		(b) Hydrolyzer	_____	Hydrolysis	Splitting of fats	230 - 250 deg. C 40 – 45 atm
		(c) Ion exchanger	Ion exchange	_____	Separation of dissolved salts and glycerides collected from the hydrolyzer as the bottom product	_____
		(d) Evaporator	Evaporation	_____	Separation of water and glycerides (or) Concentration of glycerides	_____

9. Process description

S. No	Process	Equipment	Unit operations	Unit process	Objective	Operating conditions
		(e) Distillation still	Distillation	_____	Glycerides obtained from the evaporator is purified to produce 99% Yellow Glycerin	_____
		(f) Cooler (or) Heat exchanger	Cooling or Heat transfer	_____	Cool the glycerides obtained from the still	_____
		(g) Holding tank	Storage	_____	Cooled glycerides Stored	_____
		(h) Adsorber	Adsorption	_____	Removal of color constituents using activated carbon as the adsorbent	_____

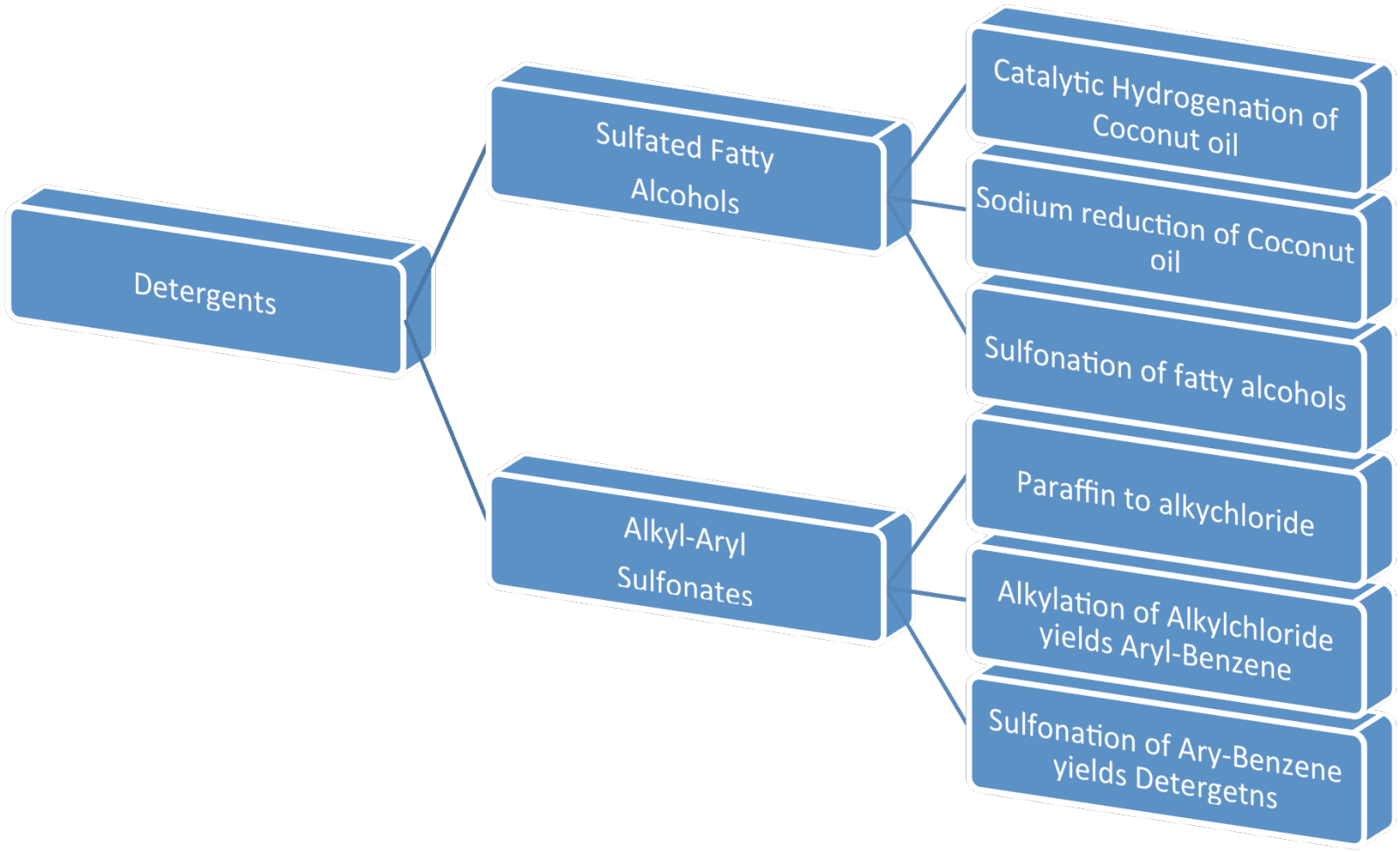
9. Process description

S. No	Process	Equipment	Unit operations	Unit process	Objective	Operating conditions
		(i) Filter	Filtration	_____	Final separation of glycerides	_____
		(j) Steam flash tank	Steam separation	_____	Separation of steam from fatty acid	_____
		(k) Vacuum distillation column	Distillation	_____	Separation of fatty acids and trace impurities	_____
		(l) Condenser	Condensation	_____	Vapors of fatty acids converted to liquid	_____
		(m) Holding tank (or) Distillate receiver	Storage	_____	The distillate from the condenser is stored	_____

9. Process description

S. No	Process	Equipment	Unit operations	Unit process	Objective	Operating conditions
		(n) Mixer	Mixing	_____	Neutralization of fatty acids	_____
		(o) Blender	Blending	Saponification	Saponification of neutralized fatty acids	_____
		(p) Spray drier	Drying	_____	Drying of soaps into powder after saponification.	_____

10. Methods of production-Detergents



10. Methods of production-Detergents

Two of the most prominent detergents used today are

1. Sulfated fatty alcohols
2. Alkyl-Aryl sulfonates

Manufacturing method

1. Sulfated fatty alcohols

   Deriving higher molecular weight of alcohols from oils of plant origin by sodium reduction or hydrogenation followed by sulfonation. The steps involved in the manufacture of sulfated fatty alcohols are as follows,

   a) Catalytic hydrogenation of coconut oil

   b) Sodium reduction

   c) Sulfation of fatty acids

10. Methods of production-Detergents

Manufacturing method

1. Alkyl-Aryl sulfonates

   The steps involved in the manufacture of Alkyl-Aryl sulfonates are as follows

   (a) Conversion of hydrocarbon (paraffin) to alkyl chloride

   (b) Alkylation of Alkylchloride yields Aryl-Benzene compounds

   (c) Aryl-Benzene compound on sulfonation in presence of oleum yields detergents (Aryl-Benzene sulfonate)

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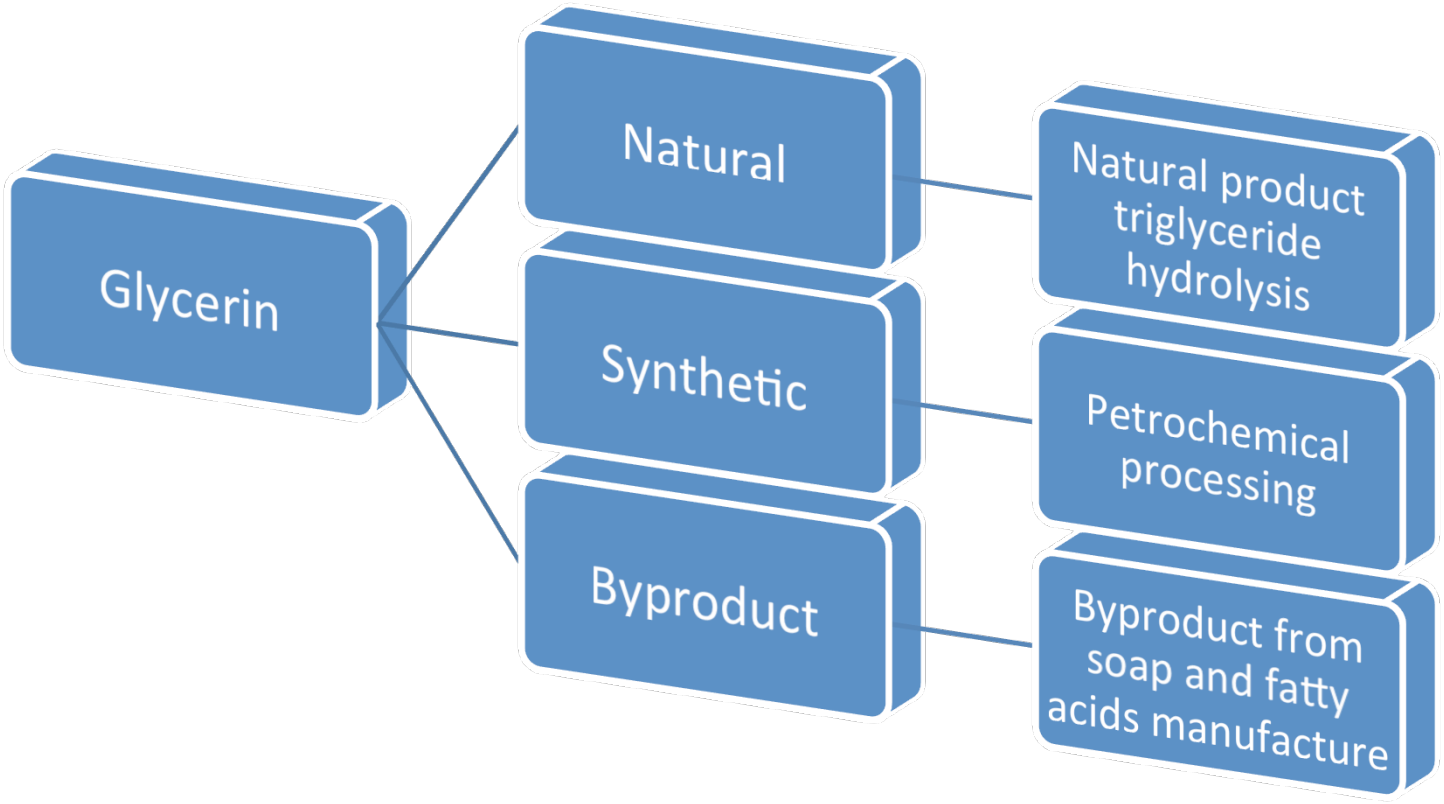
11. Methods of production-Glycerin



12. End Uses – Soaps and Detergents; Glycerin

A partial list of soaps and detergents; glycerin is given to show the diversity of application

Soaps and detergents

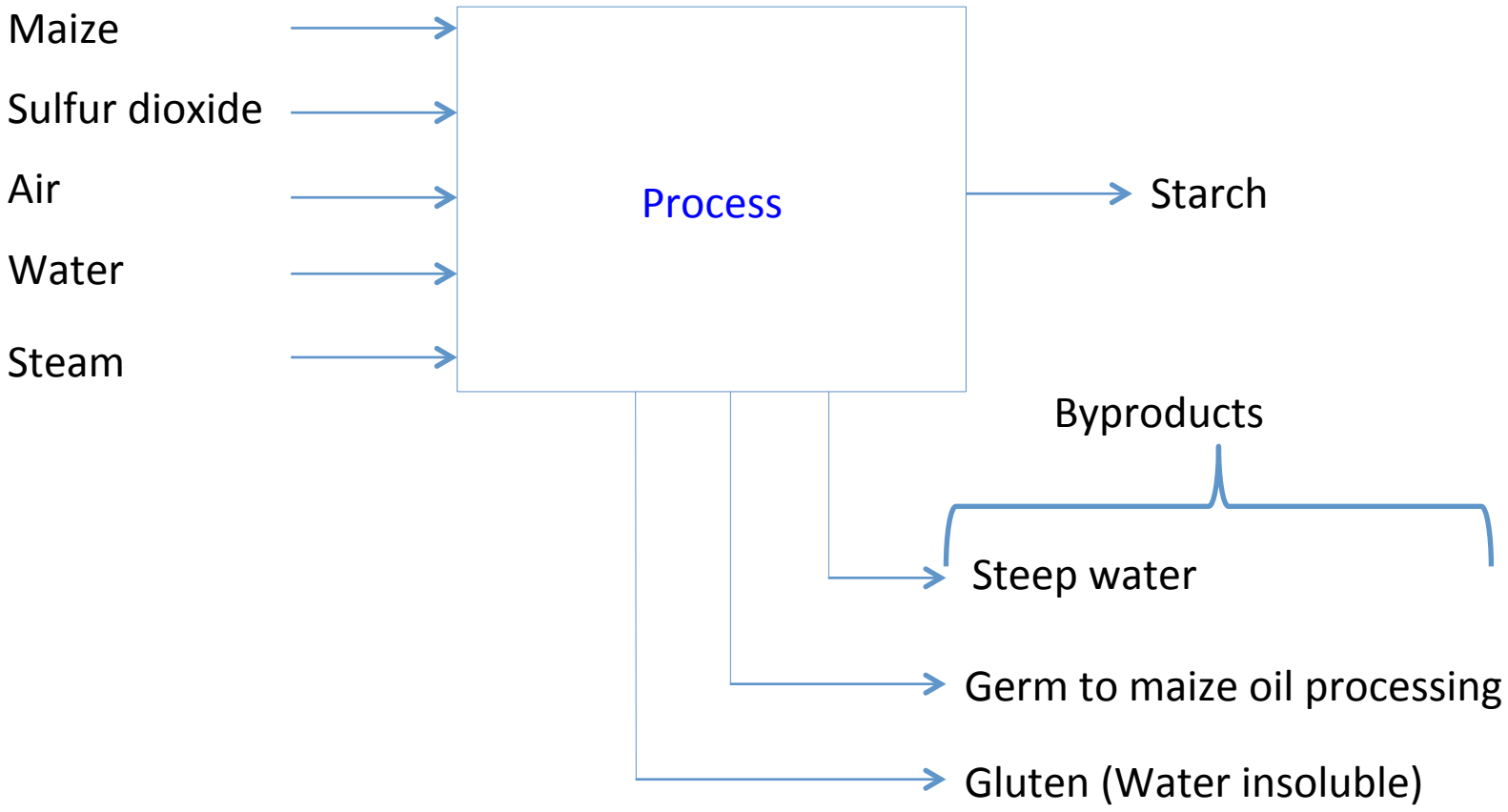
Textile manufacture
Sanitation
Food processing
Shaving soaps
Synthetic rubber and plastics emulsion polymerization
Paints - water emulsion formulations
Paper - Application of sizing

Glycerin

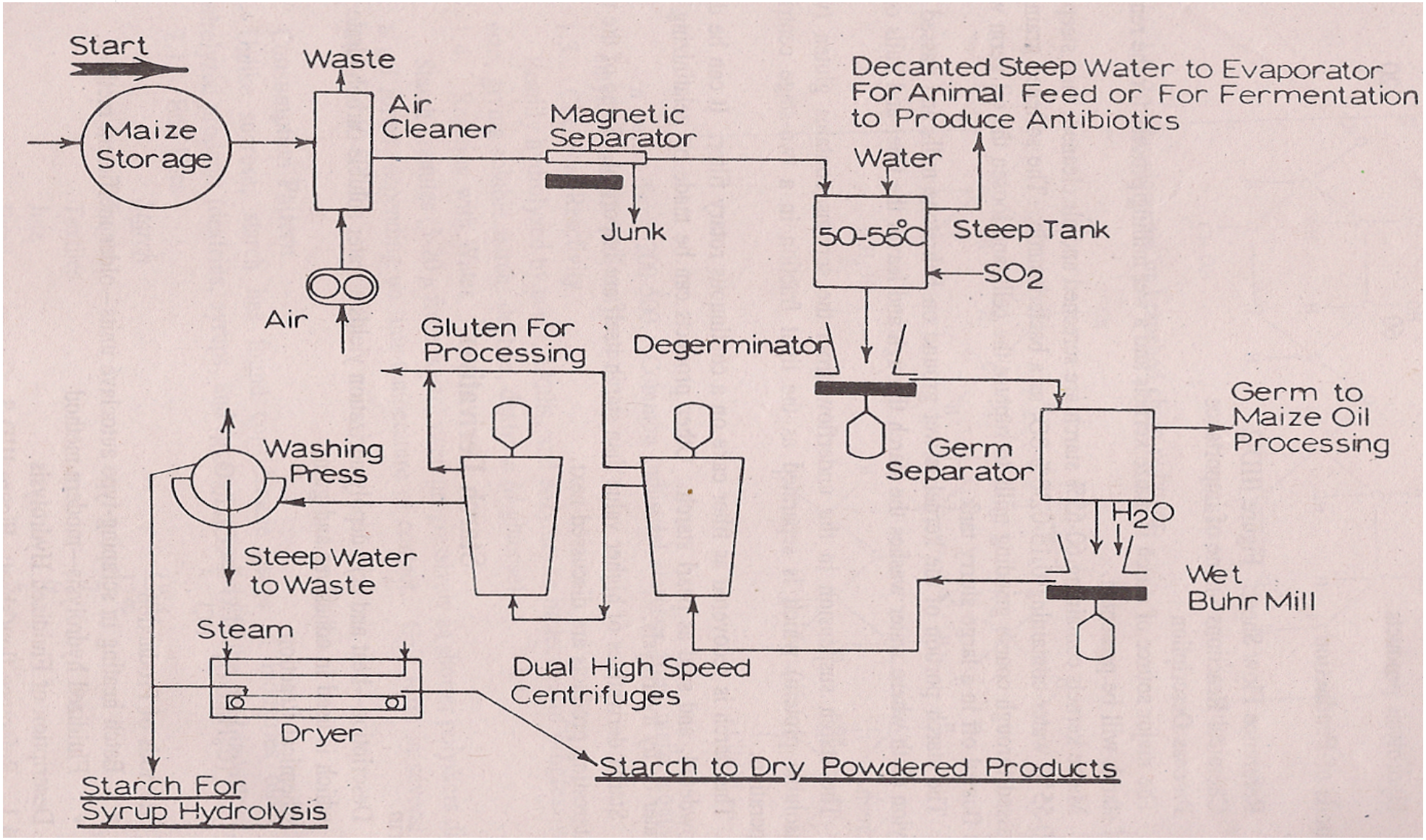
Alkyl resin and Plastics
Tobacco humidification
Cellulose Plasticizer
Explosives
Food and Pharmaceuticals

Starch Manufacture – Manufacture

General process



Starch Manufacture



Starch Manufacture-Process description

Process	Equipment	Unit Operation	Unit Process	Objective	Operating Conditions
Continuous	Maize Storage	Storage	-------	To store the maize	-------
Continuous	Air cleaner	Cleaning	-------	Remove the dust and fines	-------
Continuous	Magnetic Separator	Particle Separation	-------	Separate metal particles	-------
Continuous	Steep tank	Decantation	-------	Add water to facilitate the germination and Removal of steep water by decantation. SO_2 is added as bacteriostatic.	50 – 55 deg. C
Continuous	Degerminator	Grinding	-------	To rupture the cells to remove germs	-------
Continuous	Germ separator	Particle Separation	-------	To separate the germs and send it to maize Oil processing	-------
Continuous	Wet Bhur Mill	Size reduction and separation	-------	Crush the fiber and removes the undesired hulls	-------
Continuous	Dual High Speed Centrifuge	Solid-Liquid Separation	-------	To separate the gluten a water insoluble protein and starch	-------

14. References

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