

# **HYDROGENATION OF OIL**

**SONYZA PRIYADARSINEE PATRA**

**ASSISTANT PROFESSOR**

**DEPT. OF SoABE**

# NECESSITY FOR HYDROGENATION

- Hydrogenated fat is basically a substitute to butter fats.
- **Hydrogenated oil** helps to increase shelf life and save cost.
- High costs of butter fat and its poor storage stability were detrimental factors that led to the investigation of alternative sources of hard fats.
- This investigation led to the invention of catalyzed H<sub>2</sub> addition across unsaturated sites of oils and fats and was quickly commercialized.
- Conversion of liquid oils to solid and semi-solid fats having wide spectrum of physical & chemical characteristics of products were thus obtained

➤ **HYDROGENATION** is a process that reduces unsaturated fatty acid content of triglycerides by attaching hydrogen atoms at the point of unsaturation in the presence of catalyst, usually Nickel.

➤ **Hydrogenation** is a process in which a liquid unsaturated fat is turned into a solid fat by adding hydrogen.

➤ Hydrogenation accomplishes two things-:

- It increases the melting point of the oil or fat.
- Resistance to oxidation and flavor deterioration.

➤ Hydrogenation process depends on several parameters:

- Pressure & Temperature,
- Type of catalyst,
- Speed of agitation etc.

- Hydrogenation converts the liquid **oils** into semisolid or plastic fats for special applications, such as in shortenings (100% fat) and margarine (80% fat), and it improves the oxidative stability of the **oil** .
- **Hydrogenation** requires a **catalyst** to make the reaction to go at a reasonable rate. The reaction will go without a **catalyst** , but it **needs** extremely high temperatures.
- A metal **catalyst** provides an alternate pathway with a lower activation energy. This allows the reaction to take place at lower temperatures.
- **Hydrogenation** includes the formation of a saturated compound from an unsaturated compound.

# MECHANISM

- The mechanism involved in fat hydrogenation is believed to be the reaction between unsaturated liquid oil and atomic hydrogen adsorbed on a metal catalyst.
- It is similar to hydrogenation of alkenes.
- Generally, hydrogenation reactions will not occur between hydrogen and organic compounds below 480 degrees Celsius without metal catalysts.
- Catalysts are responsible for binding the H<sub>2</sub> molecule and facilitating the reaction between the hydrogen and the substrate.

- Platinum, palladium, rhodium, and ruthenium are known to be active catalysts which can operate at lower temperatures and pressures.
- Research is ongoing to procure non-precious metal catalysts which can produce similar activity at lower temperatures and pressures.
- Nickel-based catalysts, such as Raney nickel, have been developed, but still require high temperatures and pressures.

# REQUIREMENTS

- Hydrogen Dry, As pure as possible (usually >99.8%)
- Oil
  - Refined,
  - Bleached,
  - Very low in soap (under 25 ppm) and dry.
  - Moisture-Less than 0.05%
  - FFA-Less than 0.05%
- Catalyst-
  - Reduced Nickel: Concentration-0.01-0.02% (Palladium, Platinum can also be used but avoided due to their high costs)

# REACTION CONDITIONS PARAMETER

- Condition Temperature: 140-250°C
- Hydrogen Pressure: 40-60 psi
- Agitator Speed :75-150 rpm
- Cool Water Temperature: 10-20°C
- Cooled Oil Temperature: 70-80°C
- Time: 40-60 min



