Company: ChemiEvolve Industries

CEO: Adityaamlan Panda

Report Authors: Abhijit Dalai, Harshit Gupta

Chemical Formula: $C_7H_8O_2$, $C_8H_{10}O_3$, $C_9H_{12}O_4$

Chemical Name: Phenol Formaldehyde Resins

Use case:

USES

- Used as the basis for Bakelite, Phenol Formaldehyde resins (PFs) were the first commercial synthetic resins (plastics). They have been widely used for the production of molded products including billiard balls, laboratory countertops, and as coatings and adhesives.
- Phenolic laminates are made by impregnating one or more layers of a base material such as paper, fiberglass, or cotton with phenolic resin and laminating the resin-saturated base material under heat and pressure.
- Glass phenolics are particularly well suited for use in the high speed bearing market. Phenolic micro-balloons are used for density control.
- The binding agent in normal (organic) brake pads, brake shoes, and clutch discs are phenolic resin. Synthetic resin bonded paper, made from phenolic resin and paper, is used to make countertops. Another use of phenolic resins is the making of duroplast, famously used in Trabant automobiles.
- Phenolic resins are also used for making exterior plywood commonly known as weather and boil proof (WBP) plywood because phenolic resins have no melting point but only a decomposing point in the temperature zone of 220 °C (428 °F) and above.
- Phenolic resin is used as a binder in loudspeaker driver suspension components which are made of cloth.
- Higher end billiard balls are made from phenolic resins, as opposed to the polyesters used in less expensive sets.
- Sometimes people select fibre reinforced phenolic resin parts because their coefficient of thermal expansion closely matches that of the aluminium used for other parts of a system, as in early computer systems and Duramold.

ALTERNATIVES

- **Lignin - PF resins**: Lignin is a natural wood component that can replace phenol in different amounts. Lignin is the most abundant natural polyphenol and has similar chemical structures to phenol.
- **Furan resins:** These resins can be used as a substitute for phenol-formaldehyde resins, which are commonly used in plywood manufacturing to improve the water resistance of plywood.
- **Tannins:** These natural compounds can be used as a substitute for phenol due to their phenolic nature. In 2005, Ballerini et al. synthesized tannin-glyoxal resins, which were used to produce wood-based panels that do not contain formaldehyde.

ADAVANTAGE OVER ALTERNATIVES

- High Thermal Resistance and Flame Retardancy
- Excellent Electrical Insulation Properties
- Chemical Resistance and Versatility
- Dimensional Stability and Longevity
- Relatively Low Cost

MAGNITUDE OF IMPORTS TO INDIA

Phenol formaldehyde resin, worth **$8.87 million** have been imported to India. The average import price for was **$3.13 per unit**. The top three suppliers of Bakelite include China, Japan and Nehterlands . **China is the largest exporter** of the compound accounting to 69.65% of the total imports to India. Japan is the second largest exporter accounting to 16.38% of the total imports. Netherlands being the third accounts for 13.97% of the total imports.

Economic feasibility:

INPUT RAW MATERIALS

- Phenol
- Methanol
- Oxygen
- Vanadium Pentoxide
- Water
- Liquor Ammonia

***NOTE**: Ammonia is used as a catalyst in the phenol-formaldehyde reaction because the ammonia-catalyzed resins have a molecular weight that is 2–3 times higher than those obtained using sulfuric acid as catalyst*

RAW MATERIAL COST DISTRIBUTION

- **Phenol**: 2.258 kg at ₹46.66 per kilogram is approximately **₹107.62**
- **Methanol**: 1.536 kg at ₹33.75 per kilogram is approximately **₹51.84**
- **Oxygen:** Less than for every kg of Liquid oxygen
- **Vanadium Pentoxide:** Will be a catalyst and Stock of 50 kg at **₹2000**
- **Water**: 0.636 kg - 3.326 kg at ₹10 per kilogram is approximately **₹6.36 - ₹33.26**
- **Liquor Ammonia**: 0.816 kg at ₹24 per kilogram is approximately **₹19.58**

Adding all these up, the total estimated cost for the quantities of raw materials is around **₹ 212.3** (Exclusing Vanadium Pentoxide cost as it will be regenerated)

PRODUCT SELLING PRICE: **₹465.25** per kilogram

RAW MATERIAL COST PRICE: **₹213.3** per kilogram

PROFIT = SELLING PRICE – COST PRICE = 465.25 - 213.3 = **₹251.95** per kilogram

References:

https://en.wikipedia.org/wiki/Phenol_formaldehyde_resin

https://www.indiamart.com/

https://gem.gov.in/

https://www.zauba.com/

https://patents.google.com/patent/US4656239A/en

List the contributions of each author:

- **ABHIJIT DALAI** carried out the **market research** for chemical trade data.
- **HARSHIT GUPTA** prepared the **use case.**
- **ABHIJIT DALAI** looked at **economic feasibility**.

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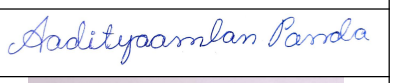
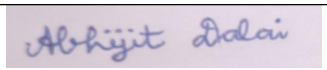
Adityaamlan Panda	220007	
Abhijit Dalai	220030	
Harshit Gupta	220439