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Chemical Formula: $C_{12}H_{14}O_4$

Chemical Name: Diethyl phthalate

Use case:

- a. What is the use of this compound?

Diethyl phthalate is currently used through direct addition in cosmetic products and indirectly in fragrances, denaturants, and film formers. The compound finds extensive use in cosmetics (bath preparations, eye shadows, bath soaps, detergents, and nail polish). It is also used as a plasticizer in PVC, a fixative in perfume, a component in insecticide sprays and mosquito repellent.

- b. Are there any alternatives to this compound? Name a few.

Yes, certain compounds exist that are alternatives for the compound. Example: - Camphor, Di isobutyl Phthalate etc.

- c. Why this compound is superior to its alternatives?

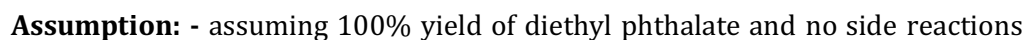
The most striking feature of the compound is its biodegradable nature, making it an eco-friendly chemical. The other contemporary chemicals pose a serious threat to the environment. Also, this compound is more effective as a plasticizer and solvent. It is more compatible with a wide variety of materials.

- d. Is this compound imported in India? What is the magnitude of imports?

Yes, the compound is imported in India. The import cost is roughly around Rs. 1100 per Unit. Market research forecasts the phthalates market to grow significantly to INR 132,586.98 million by 2030.

- The input raw materials needed for the synthesis are: -

- Reaction: -**



For a projected production of 1000 kg/day of Diethyl Phthalate: -

Moles of Diethyl Phthalate: - $(1000 \times 1000 \text{ g}) / (222.24 \text{ g/mol}) = 4499.64 \text{ moles}$

According to reaction stoichiometry, the moles of Phthalic Anhydride and Ethanol needed for per mole synthesis of the compound is 1 each.

Caustic Soda to be used is 5% of the weight of Diethyl Phthalate being produced.

Since we have 92% (w/w) Ethanol, for 1 mole ethanol (46g) we need 50g of solution which gives the weight of water required: - $50 - 46 = 4\text{g}$

The amount of 95% (w/w) Sulphuric acid required is 2 % of Diethyl Phthalate being produced. That is 4.48g of H_2SO_4 , that is 4.72 g of the solution is required which means 0.24 g of water as solvent needed.

COST ANALYSIS: -

Input Cost of Phthalic Anhydride: - $\text{Rs } (57/1000) * 148.5 = \text{Rs } 8.46$

Input Cost of Ethanol: - $\text{Rs } (34/1000) * 46 = \text{Rs } 1.564$

However, since the feed requires a 1:2 ratio of Phthalic anhydride and Ethanol thus final input cost of ethanol: is - $\text{Rs } 1.564 * 2 = \text{Rs } 3.128$

Input Cost of water: - $\text{Rs } (0.0432) * (0.008 + 0.24) = \text{Rs } 0.0107$

Input Cost of Sulphuric Acid: - $\text{Rs } (4.48) * (0.01) = \text{Rs } 0.0448$

Input Cost of Caustic Soda: - $\text{Rs } (0.05 * 222.24) * (0.06) = \text{Rs } 0.66672$

Total Input Cost: - $\text{Rs } (8.46 + 3.128 + 0.0107 + 0.0448 + 0.66672) = \text{Rs } 12.31$

Output Cost of Diethyl Phthalate: - $\text{Rs } (0.16) * (222.24) = \text{Rs } 35.56$

Profit for per mole production of Diethyl Phthalate is $\text{Rs } (35.56 - 12.31) = 23.25$

Thus profit for the production of 4499.64 (1000 kg) moles of Diethyl Phthalate is:- $23.25 * 4499.64 = \text{Rs. } 104616.63$

Thus, Daily Profit of production: - $23.25 * 4499.64 = \text{Rs. } 104616.63$

References:

<https://www.zauba.com/import-phthalic-anhydride-hs-code.html> :- Import cost for Phthalic anhydride

<https://dir.indiamart.com/impcat/concentrated-sulfuric-acid.html> :- Cost of Concentrated H_2SO_4

<https://dir.indiamart.com/impcat/fuel-grade-ethanol.html> :- Cost of Ethanol

<https://dir.indiamart.com/impcat/diethyl-phthalate.html> :- Selling price of Diethyl Phthalate

<https://dir.indiamart.com/impcat/caustic-soda-flakes.html> :- Caustic Soda Price



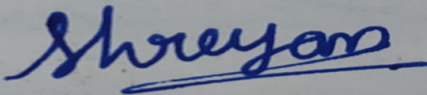

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extension://efaidnbmnnnibpcajpcgiclfendmkaj/https://www.atsdr.cdc.gov/ToxProfiles/tp73-c4.pdf :- Information about Product uses, Alternative compounds.

List the contributions of each author:

- Author 1,2 and 3 carried out market research for chemical trade data.
- Author 1 and 3 prepared the use case.
- Author 1 and 2 looked at economic feasibility.

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