Company: QuantiVEX

CEO: Nithin T M

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Chemical Formula: R-C_6H_4-SO_3Na

Chemical Name: Linear Alkyl Benzene Sulphonate (LABS)

Use case:

a. What are the uses of LABS?

Linear Alkyl Benzene Sulfonate (LABS) is one of the most commonly used anionic surfactants, with applications across various industries. It is primarily used in the production of detergents and cleaning agents due to its excellent foaming, emulsifying, and dispersing properties. Following uses are listed and also included extended uses.

1) Household and Industrial Detergents: LABS is the primary active ingredient in laundry powders, liquid detergents, and dishwashing liquids due to its high solubility in water and effective removal of dirt, grease, and stains
2) Textile Industry: Used in textile processing and dyeing as a wetting agent and detergent.
3) Leather Industry: Helps in leather processing by acting as a cleaning and emulsifying agent.
4) Paper Industry: Used as a de-inking agent to remove ink from recycled paper.
5) Oilfield Chemicals: Acts as a surfactant in enhanced oil recovery, helping reduce interfacial tension between oil and water.
6) Agriculture: Used in pesticide formulations to improve wetting and spreading properties.
7) Construction Industry: Used as a wetting and dispersing agent in gypsum and cement-based plasters.

b. Are there any alternatives to LABS? Name a few.

Few alternative are listed with advantage and disadvantage

1) Alpha-Olefin Sulfonates (AOS): Widely used in personal care products and detergents, offering good biodegradability and mildness.
2) Methyl Ester Sulfonates (MES): Derived from renewable sources (palm oil or coconut oil), MES provides good detergency but may have formulation limitations.

3) Sodium Lauryl Sulfate (SLS) and Sodium Laureth Sulfate (SLES): Commonly used in personal care products, SLS/SLES offer high foaming properties but can cause skin irritation.
4) Alcohol Ethoxylates (AE): Non-ionic surfactants used in industrial and household cleaning formulations, offering good emulsification but lower foaming properties.
5) Sorbitan Esters and Polysorbates: Used in cosmetics and food emulsifiers, offering milder effects on the skin compared to LABS.
6) Bio-based Surfactants: Emerging alternatives such as rhamnolipids and sophorolipids, which are more environmentally friendly but expensive.

c. Why is LABS superior to its alternatives?

1) Cost-Effectiveness: LABS is cheaper to produce compared to MES and bio-based surfactants. The raw materials (LAB and sulfuric acid) are widely available and cost-efficient.
2) Versatility: LABS is used across multiple industries, from detergents to construction and oil recovery.
3) Foaming and Cleaning Performance: Compared to alternatives like AE, LABS provides superior foaming and cleaning efficiency.
4) Chemical Stability: LABS is resistant to high temperatures and pH variations, making it suitable for various applications.
5) Biodegradability: While synthetic, LABS degrades rapidly in wastewater treatment plants compared to some alternatives.

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

India imports a significant quantity of LABS despite domestic production. Below is a detailed import analysis:

- Annual Import Volume (2024): Approximately 49,000 metric tons
- Total Import Value: $57.8 million
- Average Import Price: $1.18 per kg
- Major Exporting Countries:
  - Saudi Arabia: 38% of total imports
  - United Arab Emirates: 32% of total imports
  - Indonesia: 15% of total imports

Monthly Import Trends (2024)

Month	Volume (Metric Tons)	Value (Million USD)	Price (USD/kg)
Jan	4,200	4.98	1.19
Feb	3,900	4.63	1.19
Mar	4,500	5.32	1.18
Apr	4,000	4.72	1.18
May	3,800	4.49	1.18
Jun	4,300	5.01	1.17
Jul	4,100	4.78	1.17
Aug	4,400	5.26	1.19
Sep	4,100	4.75	1.16
Oct	3,900	4.51	1.16
Nov	4,200	4.96	1.18
Dec	4,200	4.95	1.18

- India maintains a steady demand for LABS imports.
- Imports account for approximately 40% of the total LABS consumption

Economic feasibility:

a. What input raw materials are needed for its synthesis (same as reported in the Patent application)?

RAW MATERIALS REQUIRED:

1) LAB (Linear alkyl benzene)
2) Sulfonating agent - H_2SO_4 (Sulphuric acid)
3) Bleaching Agent - H_2O_2 (Hydrogen peroxide)
4) Neutralizing Agent - NaOH (Sodium Hydroxide is used primarily)

REACTIONS:

Step 1 Sulfonation

$$C_{12}H_{25}C_6H_4 + H_2SO_4 \longrightarrow C_{12}H_{25}C_6H_{25}C_6H_4SO_3H + H_2O$$

Step 2 Bleaching

$$C_{12}H_{25}C_6H_{25}C_6H_4SO_3H + H_2O_2 \rightarrow C_{12}H_{25}C_6H_4SO_3H + O_2$$

Step 3 Neutralization

$$C_{12}H_{25}C_6H_4SO_3H + NaOH \rightarrow C_{12}H_{25}C_6H_4SO_3Na + H_2O$$

b. Provide preliminary economic feasibility based on cost of raw materials, solvents and product selling price.

1. Raw Material Requirements per 1 kg of LABS:

- Linear Alkylbenzene (LAB): 0.85 kg
- Sulfuric Acid (H_2SO_4): 0.96 kg
- Hydrogen Peroxide (H_2O_2): 0.04 kg
- Sodium Hydroxide (NaOH): 0.35 kg

2. Raw Material Costs (per kg):

- LAB: ₹65/kg
- H_2SO_4: ₹10/kg
- H_2O_2: ₹30/kg
- NaOH: ₹35/kg

3. Total Raw Material Cost per 1 kg of LABS:

LAB :0.85kg×₹65/kg=₹55.25

H_2SO_4 :0.96kg×₹10/kg=₹9.60

H_2O_2 :0.04kg×₹30/kg=₹1.20

NaOH :0.35kg×₹35/kg=₹12.25

Total Raw Material Cost: ₹78.3 per kg of LABS

5. Profit Calculation:

- Selling Price: ₹140 per kg (taking of highest grade from IndiaMart)
- Raw Material Cost: ₹78.3 per kg
- Gross Profit per kg: ₹140 - ₹78.3 = ₹61.7
- Gross Profit Margin: (₹61.7 / ₹140) × 100 ≈ **44**%

6. Daily and Annual Production:

- Daily Production: 1 tonne (1,000 kg)
- Daily Gross Profit: ₹61.7 × 1,000 kg = ₹61,700
- Annual Gross Profit: ₹61,700 × 365 days = ₹22,520,500/yr (approximately ₹2.25 crore/yr)

Cost Analysis with Recycling of Raw Materials

By recycling, we recover and reuse a portion of the excess reactants, reducing raw material consumption. Based on industry estimates, we assume the following recoveries:

- H_2SO_4: 30% can be recovered and reused.
- NaOH: 40% can be recovered.

1) Adjusted Raw Material Costs with Recycling (Per kg of LABS Production)

- LAB: ₹65/kg × 0.85 kg = ₹55.25 (No change, as LAB is fully consumed).
- H_2SO_4: ₹10/kg × (0.96 × 0.7) = ₹6.72 (30% recovered, only 70% fresh H_2SO_4 needed).
- H_2O_2: ₹30/kg × 0.04 kg = ₹1.20 (No significant recycling possible).
- NaOH: ₹35/kg × (0.35 × 0.6) = ₹7.35 (40% recovered, only 60% fresh NaOH needed).

2)Total Raw Material Cost with Recycling

- Total cost =₹55.25 + ₹6.72 + ₹1.20 + ₹7.35 = **₹70.52/kg**

3)Selling Price and Gross Profit Margin Calculation (with Recycling)

- Selling Price of LABS = ₹140/kg
- Gross Profit = Selling Price - Total Cost = ₹140 - ₹70.52 = ₹69.48/kg
- Gross Profit Margin % = (69.48 / 140) × 100 = **49.62**%

- Profit Margin increases from 44% to nearly 50%

To optimize this process taking account from the Patent report it has stated that we need pH of final solution to be in range of 7-8 so we can use mild neutralizing agent instead of NaOH such as Na2CO3 and Ca(OH)2 which will reduce the cost of raw materials and in recycle we can recycle this also which is not possible in case of NaOH thus increasing our Gross profit margin.

References:

1. Uses of the LABS
2. Alternative and why superior
3. Import Data From Zauba
4. Price of Raw Materials and LABS [1] IndiaMart [2] Ark Chemicals
5. amount of raw materials per kg of LABS - [1]

List the contributions of each author:

- Venugopal and Shivam looked at use cases.
- Priyanka carried import data.
- Sajag looked at economic feasibility & wrote the report.

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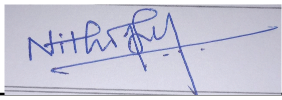
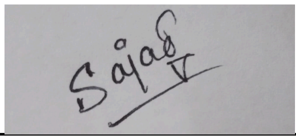
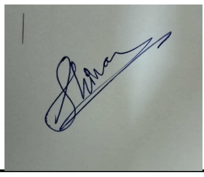
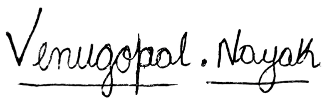
Nithin T M [CEO]	230709	
Sajag Masane	230896	
Shivam Dongare	230971	
Venugopal Nayak	231140	
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