

Company: SynTech

CEO: Anisha Nanda

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Chemical Formula: $(\text{H}_2\text{C}-\text{CHCl})_n$

Chemical Name: Polyvinyl Chloride (PVC)

Use case:

a. What is the use of this compound?

- PVC is widely used in various industries. The primary applications include:
 - **Plumbing jobs:** PVC is used in pipes for water supply and drainage due to its durability and cost effectiveness.
 - **Electrical insulation:** PVC is used as wire insulation material due to its dielectric properties and flame retardancy.
 - **Medical devices:** Used in blood bags, syringes, IV containers, other medical components.
 - **Construction material:** Used in window frames, doors, roofing materials due to strength and water resistance.
 - **Packaging material:** PVC is used in blister packs and clamshell packaging for its transparency, formability, and protective qualities.

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

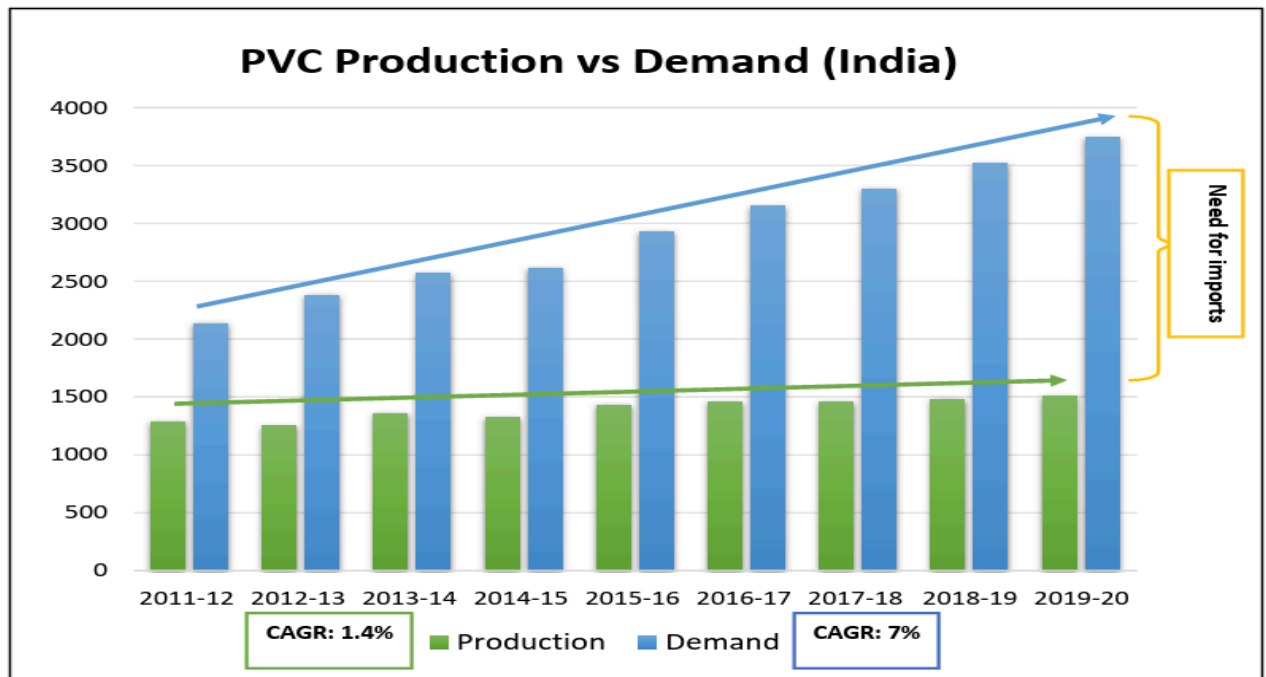
- Alternatives to PVC include:
 - **Polypropylene(PP):** Used in automotive bumpers, battery housings, etc. Has lower water absorption than PVC.
 - **Polycarbonate:** Used in safety glasses, face shields, media discs, lenses etc. Has poor scratch resistance.

c. Why is this compound superior to its alternatives?

- PVC is superior in many applications due to its :
 - **UV resistance:** PP can deform, turn yellow due to radiation. PVC is more resistant. So, PVC can be used in places where transparent or sunlight exposed equipments are to be prepared, like window sheets, lenses, etc., because PVC shows better UV resistance
 - **Cost:** PVC is generally cheaper than polycarbonate. Polycarbonate is used in safety helmets, headlamp lenses, window sheets, etc. PVC provides a cheaper alternative to polycarbonate.

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

Top Indian PVC manufacturers		
Company	Location	Installed capacity (tonnes/year)
Reliance Industries Ltd	Hazira, Gujarat	3,60,000
	Dahej, Gujarat	3,15,000
	Vadodara, Gujarat	80,000
Chemplast Sanmar Ltd	Cuddalore, Tamil Nadu	2,70,000
Finolex Industries Ltd	Ratnagiri, Maharashtra	2,60,000
DCW Ltd	Sahupuram, Tamil Nadu	90,000
DCM Shriram	Kota, Rajasthan	70,000



- India imports PVC worth \$2.71 Billion, mostly in the form of its resin, i.e., HS Code 3904. Major exporters of PVC resin to India are Japan, China, Taiwan, Thailand and USA.
- The global polyvinyl chloride market size was valued at USD 68.96 billion in 2022 and is expected to grow from USD 72.08 billion in 2023 to USD 95.88 billion by 2030, exhibiting a CAGR of 4.2% during the forecast period. Asia Pacific dominated the polyvinyl chloride market with a market share of 56.19% in 2023.
- Average import price for PVC was \$1.01 per kg.
- Despite the rise in import barriers, India has experienced a strong and steady growth in PVC imports at 22% over the last two decades.

- China was the largest exporter of PVC to India
- Taiwan was the second largest exporter of PVC

Production Pathways of PVC

PVC is commercially produced using four primary processes:

1. Suspension Polymerisation
2. Emulsion Polymerisation
3. Bulk Polymerisation
4. Solution Polymerisation

Economic feasibility:

PVC is primarily produced using the Suspension Polymerisation. It offers excellent control over the reaction heat, allows for easy separation of the polymer particles from the aqueous phase, produces a consistent particle size distribution, and is cost-effective compared to other polymerization methods, making it highly suitable for large-scale PVC manufacturing; roughly 80% of PVC is produced using suspension polymerization.

Process	Cost per ton	Purity Level	Energy Requirement	Byproducts	Applications
Suspension Polymerisation	\$800-\$1000	95% +	Significant	HCl, Acetylene	Pipes, wire insulations
Emulsion Polymerisation	\$850	99.5%+	High	None	Coatings, adhesives
Bulk Polymerisation	\$850-\$1500	99.8%+	High	HCl, Acetylene	Rigid plastic packaging
Solution Polymerisation	\$900-\$1000	99%+	High	HCl	medical tubing, plastic films

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

Raw Materials Required for Suspension Polymerisation:

- Vinyl Chloride Monomer (VCM) (C_2H_3Cl):
VCM is typically derived from ethylene dichloride (EDC) or acetylene. It is crucial to ensure the VCM is of high purity to prevent side reactions and achieve desired polymer quality. VCM is stored and transported as a liquid under pressure. VCM is generally

produced by thermal cracking of ethylene dichloride . So, the more fundamental raw material is **Ethylene Dichloride**.

- **Initiators (e.g., Peroxides, Azo Compounds):**
Free radical initiators such as benzoyl peroxide or azobisisobutyronitrile (AIBN) facilitate polymerization. The choice of initiator depends on the desired polymerization temperature and reaction rate.
- **Suspension Agents (e.g., Polyvinyl Alcohol, Gelatin):**
Suspension Agents help to maintain the polymer particles in suspension. The type and concentration of suspending agent influence the particle size, morphology, and porosity of the final PVC product.
- **Dispersants (e.g., Cellulose Derivatives, Surfactants):**
Dispersants ensure the uniform particle size.
- **Water:**
Deionized water is used as the continuous phase. Impurities in the water can interfere with the polymerization process.

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

The prices are highly fluctuating. Taking in account prices according to 2nd quarter of 2024

Compound Rate	Rate (in Rs/kg)	Rate (in Rs/Kmol)	Quantity (in Kmole)	Amount (in Rs)
Ethylene Dichloride	29 [1]	2295.64	100	229564
Benzoyl Peroxide	99 [2]	23979.78	1	23979.78
Water				
Sodium Lauryl Sulfate	400 [3]	114613.18	0.1	11461.32

- Total input costs of raw materials for producing 100 kmol PVC = Rs
(229564+23979.78+11461.32) = Rs 265005.09
- Net Profit in producing 100 Kmole PVC = Rs (446093.75-265005.09) = Rs 181088.65
- Profit Percentage = (181088.65/446093.75)*100 = 40.59%

Real-World Use Case in India

India is one of the largest consumers of PVC, primarily for manufacturing of pipes, medical equipment, wiring insulations etc. The country's dependency on imports is due to the large difference in demand and supply due to very low domestic production. Fluctuations in global prices directly impact the profitability of Indian manufacturers.

PVC prices in India fluctuated throughout February 2025, with an initial rise driven by strong crude oil prices and PVC futures, followed by stabilization due to weak calcium carbide markets and moderate downstream demand. RIL announced a ₹1,000/MT price cut, while global plant shutdowns impacted supply. Market stability is expected in March 2025.

Conclusion

The production of PVC in India, primarily via the suspension polymerisation process, is economically feasible, especially given the high domestic consumption. However, the industry's profitability is closely tied to global raw material prices, import costs, seasonal price variations and domestic operational efficiencies. Development of domestic production facilities, scaling of existing ones and monitoring of the international trade market is important to ensure profitability.

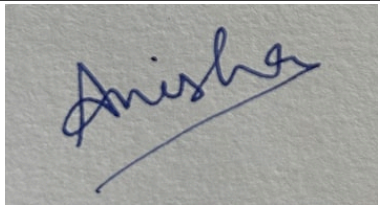
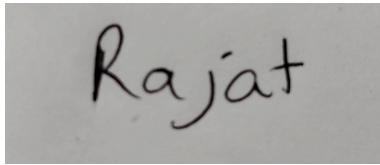
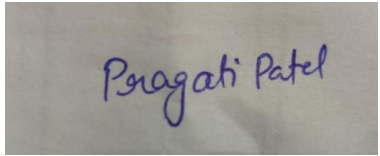
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List the contributions of each author:

- Rajat and Pragati carried out the market research for chemical trade data.
- Rajat prepared the report.
- Pragati prepared the use case and discussed the profitability.
- Aarnav Gupta worked on real world use cases.

Market Analysis Report

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