

Company Name: VortexChem

CEO: Kumar Shubham

Report Authors: Names in the order of contribution (highest contributor's name will be first. Author's must be listed under the Market Analysis Division)

Chemical Formula: $C_{28}H_{22}Cl_2FNO_3$

Chemical Name: Flumethrin

Cyano(4-fluoro-3-phenoxyphenyl)methyl
3-[(Z)-2-chloro-2-(4-chlorophenyl)ethenyl]-2,2-dimethylcyclopropane-1-carboxylate

Use case:

- a) What are the uses of this compound?

Flumethrin is a synthetic pyrethroid insecticide renowned for its efficacy in controlling ectoparasites. Its primary applications include:

- **Veterinary Medicine:** Widely used to treat and prevent infestations of ticks, mites, fleas, lice, and maggots in livestock and companion animals. Flumethrin sprays and pour-on formulations are common in managing these ectoparasites.
- **Beekeeping:** Employed to control varroa mites in honeybee colonies, thereby protecting bee health and ensuring pollination efficiency.
- **Public Health:** Utilized in controlling disease vectors such as mosquitoes and flies, contributing to the prevention of vector-borne diseases.
- **Dairy and Poultry Farming:** Helps prevent ectoparasitic infestations in dairy cows and poultry, reducing stress and improving productivity.
- **Companion Animal Protection:** Used in flea and tick collars, shampoos, and sprays for dogs and cats.
- **Integrated Pest Management (IPM):** Used as part of IPM programs to control resistant pest populations.
- **Stored Grain Protection:** Occasionally used to prevent insect infestations in stored grains and animal feed.

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

Yes, several alternatives to Flumethrin are available, including:

- **Permethrin:** A synthetic pyrethroid effective against a broad range of ectoparasites; commonly used in both veterinary and public health applications.
- **Cypermethrin:** Another pyrethroid insecticide used for controlling pests in agriculture and on animals.
- **Deltamethrin:** Known for its potency against insects; used in veterinary medicine and for insect control in various settings.
- **Amitraz:** An acaricide effective against ticks and mites, particularly in livestock.
- **Fipronil:** A phenylpyrazole insecticide used for flea and tick control in pets and crop protection.
- **Ivermectin:** A macrocyclic lactone used to control internal and external parasites in livestock and pets.
- **Spinosad:** A natural insecticide derived from bacteria, effective against fleas and some agricultural pests.
- **Carbaryl:** A broad-spectrum insecticide used in agriculture and veterinary medicine.

c) Why is Flumethrin superior to its alternatives?

Flumethrin offers several advantages over other insecticides:

- **Safety Profile:** Exhibits a favorable safety margin for use in animals, with minimal adverse effects when used as directed.
- **Residual Activity:** Provides prolonged protection against ectoparasites due to its residual activity on the animal's skin and coat.
- **Specificity:** Targets a wide range of ectoparasites effectively while being less toxic to mammals compared to some alternatives.
- **Low Environmental Persistence:** Breaks down faster in the environment compared to some pyrethroids, reducing ecological impact.
- **Minimal Cross-Resistance:** Effective against some resistant pest populations where other pyrethroids have failed.
- **Non-Systemic Action:** Does not enter the animal's bloodstream, reducing systemic toxicity risks.

- **Odorless and Non-Staining:** Unlike some chemical treatments, Flumethrin formulations do not produce strong odors or stains.

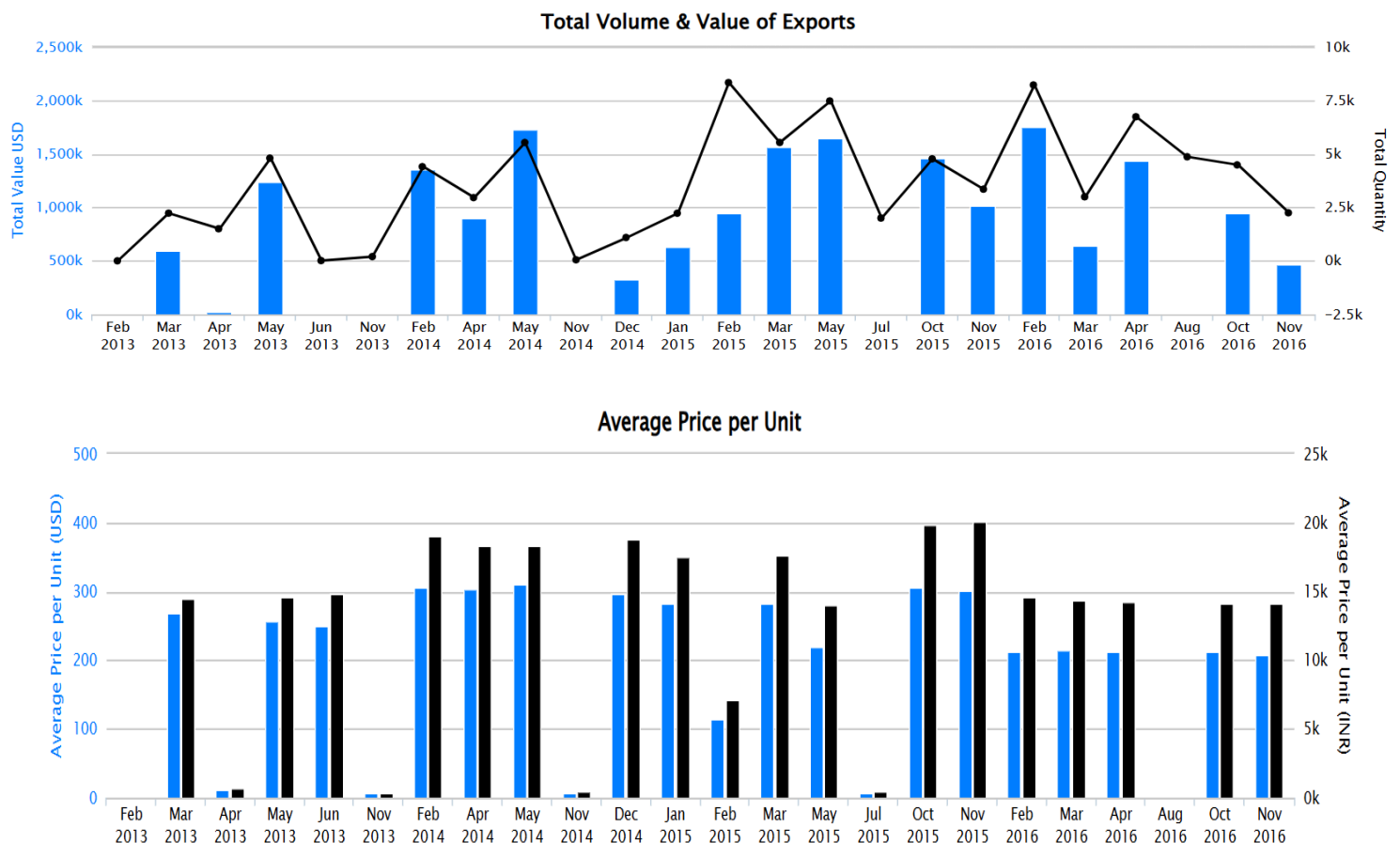
d) Is this compound imported in India? What is the magnitude of imports?

Yes, It is **imported** in India below is detailed analysis:

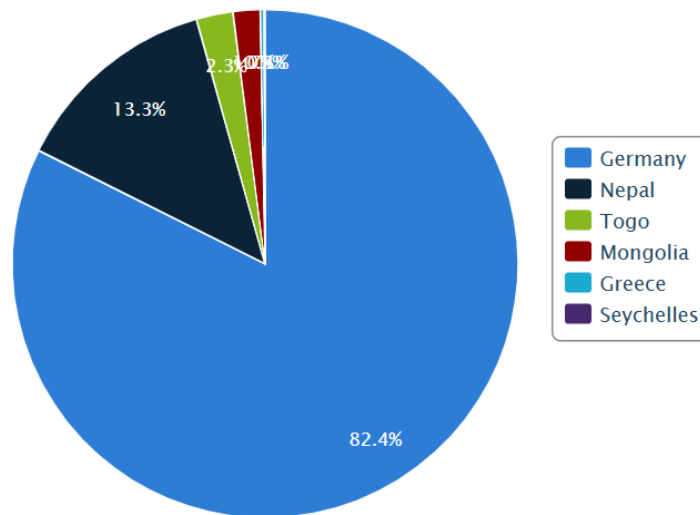
- Total Quantity: 97,324,510 KGS
- Total Price: 848,006,547 USD
- Average price per unit : 8.71 USD
- Average value per shipment : 1055 USD

Exports Analysis:

- Total Quantity: 86,002 KGS
- Total Price: 18,692,955 USD
- Average price per unit : 217.35 USD
- Average value per shipment : 434,720 USD



Total Quantity of Exports by Countries



India plays a significant role in the global flumethrin export market, with several key exporters contributing to its prominence.

Top Exporters of Flumethrin from India:

1. Karnataka Antibiotics and Pharmaceuticals Ltd
2. Synergia Sciences Private Limited
3. Bayer Vapi Pvt Ltd
4. Coromandel International Limited
5. Tagros Chemicals India Pvt Ltd

Export Statistics:

- Between March 2023 and February 2024, India exported 52 shipments of flumethrin, marking a 32% decline compared to the previous year.
- In February 2024 alone, 5 flumethrin export shipments were recorded from India, representing a 76% decrease year-over-year but a 67% increase from January 2024.

Economic feasibility:

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

Economic Feasibility Analysis for Flumethrin Production**Raw Materials for Flumethrin Synthesis**

Flumethrin ($C_{28}H_{22}Cl_2FNO_3$) is produced via a two-step synthesis. The required raw materials for each step are as follows:

Step 1 (Bayticol P Acid → Bayticol P Acid Chloride):

- Bayticol P Acid (cyclopropane carboxylic acid derivative)
- Thionyl Chloride ($SOCl_2$) – Chlorinating agent
- Toluene – Solvent (used in the reaction; most is recovered)
- Dimethylformamide (DMF) – Catalytic promoter
- Water – Used for neutralization
- Sodium Hydroxide (NaOH) – Neutralizes acidic by-products

Step 2 (Acid Chloride + NaCN + Aldehyde → Flumethrin):

- Bayticol P Acid Chloride (from Step 1)
- Sodium Cyanide (NaCN) – Nucleophilic reactant
- 4-Fluoro-3-Phenoxybenzaldehyde – Key aromatic component
- Toluene – Solvent (again, largely recovered)
- Sodium Bisulfite ($NaHSO_3$) – Used for impurity removal
- Water – Facilitates separation
- Tetrabutylammonium Bromide (TBAB) – Phase-transfer catalyst

Prices (Industrial Scale)

Estimated bulk prices for each key raw material (in ₹ per kg) are as follows (sourced from IndiaMART listings or comparable industrial data):

Raw Material	Approx. Price (₹/kg)	Notes
Bayticol P Acid (cyclopropane acid)	~₹300	Estimated for a specialty pyrethroid intermediate
Thionyl Chloride (SOCl ₂)	~₹50	Bulk pricing
Toluene (solvent)	~₹70	Market price; note that most is recovered
Dimethylformamide (DMF)	~₹75	Bulk price
Sodium Hydroxide (NaOH)	~₹35	Flake form
Sodium Cyanide (NaCN)	~₹200	Industrial grade
4-Fluoro-3-Phenoxyben zaldehyde	~₹250	Based on bulk supplier data (conservative estimate)
Sodium Bisulfite (NaHSO ₃)	~₹50	Bulk price
Tetrabutylammonium Bromide (TBAB)	~₹900	Mid-range value for 99% purity

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

Material Balance (per Batch)

Inputs (kg):

- Bayticol P Acid: 627
- Toluene (to stage 2): 941
- 4-Fluoro-3-Phenoxybenzaldehyde: 430
- Sodium Cyanide: 222
- Toluene (additional): 2174

Outputs (kg):

- Flumethrin: 1,000
- Recovered Toluene: 3026
- Aqueous Effluent, Residue, etc.: (Other outputs not directly costed here)

Net Toluene Consumption:

Total Toluene Input = $941 + 2174 = 3115$ kg

Recovered Toluene = 3026 kg

→ Net consumed = $3115 - 3026 = 89$ kg

Additional chemicals from ancillary operations:

- Sodium Bisulfite: 111 kg
- Water: 1213 kg
- Tetrabutylammonium Bromide (TBAB): 2 kg

(For this feasibility, water is priced at ₹1/kg and is a minor cost.)

Cost Breakdown per 1,000 kg Batch of Flumethrin:

Raw Material	Quantity (kg)	Cost (₹)	Calculation
Bayticol P Acid	627	₹188,100	627 kg × ₹300/kg
Toluene (net consumption)	89	₹6,230	89 kg × ₹70/kg
4-Fluoro-3-Phenoxybenzaldehyde	430	₹107,500	430 kg × ₹250/kg
Sodium Cyanide	222	₹44,400	222 kg × ₹200/kg
Sodium Bisulfite	111	₹5,550	111 kg × ₹50/kg
Water	1213	₹1,213	1213 kg × ₹1/kg
Tetrabutylammonium Bromide (TBAB)	2	₹1,800	2 kg × ₹900/kg
Total Raw Material Cost (100% yield)	—	₹354,793	Sum of above

Yield Adjustment

The overall process yield is ~85% (with Step 1 ~95% and Step 2 ~90%). Adjusting for yield loss:

- Effective Raw Material Cost:**

$₹354,793 / 0.85 \approx ₹417,406$ per 1,000 kg of Flumethrin

This means that due to process inefficiencies, the raw material cost effectively rises to about ₹417 per kg of final product.

Profitability Analysis

Using the benchmark selling price of \$8.71/kg (\approx ₹700/kg):

Metric	Value
Selling Price	₹700 per kg
Effective Raw Material Cost (@85% yield)	~₹417 per kg
Gross Profit per kg	₹700 – ₹417 = ₹283 per kg
Gross Profit Margin	$(₹283 / ₹700) \times 100 \approx 40.4\%$

Annualized Production (Assuming 1 ton/day)

- Daily Production: 1,000 kg
- Daily Gross Profit: 1,000 kg \times ₹283/kg = ₹283,000
- Annual Gross Profit (365 days): 283,000 \times 365 \approx ₹103,295,000 (\approx ₹10.33 crores per year)

Summary

- Raw Material Cost (100% yield): ~₹354,793 per 1,000 kg
- Effective Cost (at 85% yield): ~₹417,406 per 1,000 kg (~₹417/kg)
- Revenue (at ₹700/kg): ₹700,000 per 1,000 kg
- Gross Profit: ~₹283,000 per 1,000 kg, which is about a 40.4% gross margin
- At 1 ton/day production, annual gross profit is ~₹10.33 crores.

References:

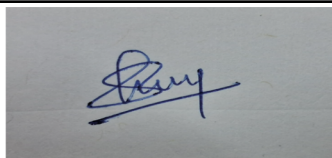
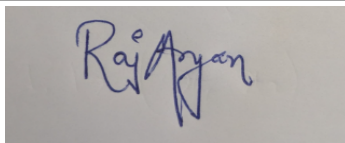
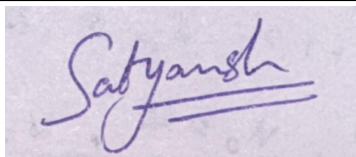
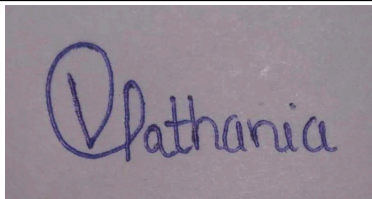
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List the contributions of each author:

- Raj Aryan carried out import and export data.
- Satyansh Sharma looked at economic feasibility
- Vishwas and Anurag looked at use cases

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