Agrochemical: Cypermethrin and synthesis route

Applicant: ChemEverse

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Chemical Formula: $C_{22}H_{19}Cl_2NO_3$

Chemical Name: Cypermethrin

Chemical synthesis routes:

Patent for the Production of Cypermethrin

Field of the Invention

The present invention relates to an improved method for synthesizing cypermethrin, a widely used pyrethroid insecticide, ensuring high yield, purity, and efficiency.

Background of the Invention

Cypermethrin is a synthetic insecticide belonging to the pyrethroid family, used extensively for agricultural and household pest control. Traditional synthesis methods involve multiple steps that are time-consuming and energy-intensive. The present invention provides a more efficient synthesis process with improved reaction conditions, resulting in high-purity cypermethrin with minimal by-products.

Summary of the Invention

The invention provides a method for synthesizing cypermethrin by reacting 3-phenoxybenzaldehyde with sodium cyanide under controlled conditions to form cyanalcohol, followed by esterification with DV-acyl chloride to yield cypermethrin. A phase-transfer catalyst is used to enhance reaction efficiency and selectivity. The process achieves high purity (>98.5%) and minimizes the presence of unreacted starting materials.

Detailed Description of the Invention

Materials Required:

- Sodium cyanide (NaCN)
- Phase-transfer catalyst (diethylammonium ethanol-based ammonium chloride or benzyltriethylammonium chloride)
- 3-phenoxybenzaldehyde
- Solvent (normal hexane, suberane, toluene, or trichloromethane)
- DV-acyl chloride
- Water

Reaction Process:

1. Dissolve sodium cyanide (11–12 g) in water (60–70 g) and add phase-transfer catalyst (0.015 – 0.025 g) while stirring.
2. Add 3-phenoxybenzaldehyde (36–39 g, 98.5% purity) to the mixture and stir at 25–35°C for 25–35 minutes to form cyanalcohol.
3. Lower the temperature to 15–17°C, then add DV-acyl chloride (40–48 g, 98% purity).
4. Increase the temperature to 20 ± 3°C and maintain until cypermethrin concentration reaches ≥98.5%.
5. Stir for 8–12 minutes, allow the mixture to settle, and separate the waste water from the organic layer.
6. Wash the upper organic layer with water twice, then remove the solvent under vacuum and negative pressure to obtain cypermethrin.

Chemical Reactions:

Formation of Cyanalcohol:

3-Phenoxybenzaldehyde reacts with sodium cyanide in an aqueous medium:

$$C_6H_5OC_6H_4CHO + NaCN + H_2O \rightarrow C_6H_5OC_6H_4CH(OH)CN + NaOH$$

Esterification Reaction:

The cyanalcohol undergoes esterification with DV-acyl chloride:

$$C_6H_5OC_6H_4CH(OH)CN + ClCOC_3H_6 \rightarrow C_6H_5OC_6H_4CH(COC_3H_6)CN + HCl$$

Advantages of the Invention

- Increased Efficiency: Shorter reaction time (~1 hour) compared to traditional methods (~7 hours).
- Higher Purity: Cypermethrin yield exceeds 98.5%, with minimal residual reactants.
- Energy Savings: Optimized reaction conditions reduce solvent consumption and waste generation.

Example Implementation

In an exemplary run:

- Sodium cyanide (11.5 g) was dissolved in 65 g of water, with 0.02 g of phase-transfer catalyst added.
- 3-phenoxybenzaldehyde (37.5 g) and normal hexane (50 mL) were stirred at 25–30°C for 30 minutes.
- The temperature was reduced to 16°C, and 44 g of DV-acyl chloride was added.
- The reaction was completed at 20 ± 3°C, yielding 98.8% cypermethrin purity.
- Final product yield: 99.5% after vacuum solvent removal.

This invention presents a highly effective and industrially scalable process for cypermethrin production, improving efficiency, cost-effectiveness, and product purity.

References:-

- "Synthesis method of cypermethrin compound"

  Patent Number: CN102746191A Google Patents

List the contributions of each author:

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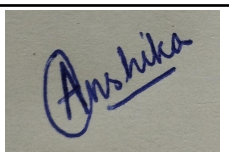
Anshika Agrawal	230160	
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