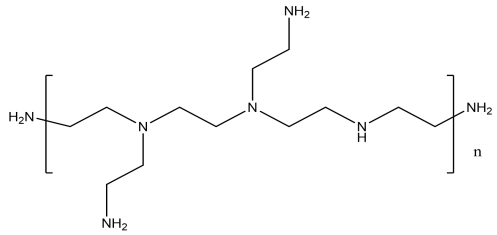
SIOResin® PEI-25K Polyethylenimine

Product Overview

Polyethylenimine (PEI), also known as polyaziridine, is a highly cationic, water-soluble polymer with the highest cationic charge density among organic polymers. Its fundamental repeating unit consists of "two carbon atoms + one nitrogen atom," with the molecular formula $(CH_2CH_2NH)_n$. PEI-25K is a medium molecular weight grade (25,000) in the SIOResin PEI product line. It appears as a colorless or light yellow viscous liquid with a slight ammonia odor.

The PEI-25K molecule contains a high density of primary ($-NH_2$), secondary (-NH-), and tertiary (-N<) amine groups, combining polar (amine) and hydrophobic (ethylene) structures. These functional groups can interact via hydrogen bonding, ionic bonding, or covalent bonding with hydroxyl, carboxyl, carbonyl, and other reactive groups, imparting excellent adhesion, cationic properties, and chemical reactivity. PEI-25K is suitable for applications in coatings/inks, textiles, antimicrobial treatments, corrosion inhibition, and other fields.

Chemical structure：



PEI

Key Features

1. **High Adhesion and Adsorption**: The polar amine groups of PEI-25K can bind with hydroxyl (hydrogen bonding), carboxyl (ionic bonding), and carbonyl (covalent bonding) groups, enhancing adhesion to polar substrates such as paper, films, and fibers. This makes it ideal for applications requiring improved adhesion strength, including coating tack enhancement and ink fixation.
2. **Moderate Cationic Character**: In aqueous systems, PEI-25K exists as a polymeric cation capable of neutralizing or adsorbing anionic substances, assisting in particle dispersion or stabilization (e.g., pigments, ceramic powders). Its cationic density is lower than high molecular weight grades (like PEI-70K), making it suitable for applications requiring moderate cationic strength.
3. **High Reactivity**: Rich in primary and secondary amine groups, PEI-25K reacts readily with epoxies, aldehydes, isocyanates, and other functional compounds, enabling its use in coating crosslinking, aldehyde adsorption, and functional finishing (e.g., flame retardant fixation).
4. **Fast Drying and Water Resistance (Coatings/Inks)**: In acrylic emulsion systems, PEI-25K can significantly improve coating drying speed and water resistance, enhancing film-forming performance.

Physical Properties

Property	PEI-25K Specification
Molecular Weight	25,000±1000
Viscosity (mPa·s)	200000-350000
Solid Content	>99%
Chroma,Hazen	≤100

Property	PEI-25K Specification
Total amine value,mmol/g	17-20
Appearance	Colorless or light yellow liquid
pH (5% aqueous solution)	10–12
CAS No.	9002-98-6
Solubility	Completely dissolved in water, alcohol, ketone, ester and other common solvents

Applications

1. Paper Chemicals

In the paper industry, PEI-25K is widely used as a retention aid, drainage aid, and paper-strengthening additive. Its high-density amine groups confer strong cationic properties in aqueous systems, allowing rapid neutralization of negative charges on pulp fibers and inorganic fillers, thereby improving retention of fine fibers and fillers. Its medium molecular weight provides effective bridging, forming stable floc structures between fibers and fillers, enhancing sheet formation efficiency and dewatering. For dry strength enhancement, PEI amine groups form extensive hydrogen-bond networks with cellulose hydroxyls, improving fiber-to-fiber bonding and maintaining paper strength even under high filler load.

2. Water and Wastewater Treatment

PEI-25K serves as an efficient flocculant or coagulant for various industrial wastewater systems. Its high cationic charge density allows rapid neutralization of negatively charged colloids and suspended particles, destabilizing dispersions and promoting aggregation and sedimentation. The polymer chains can form multi-point adsorption bridges between particles, generating larger, more porous flocs and improving settling and filtration performance. Additionally, amine groups chelate heavy metal ions, enabling solid-liquid separation and enhancing heavy metal removal, balancing operational efficiency and treatment effectiveness.

3. Coatings and Inks

In water-based coatings and inks, PEI-25K functions as a pigment dispersant or grinding aid. Its amine groups adsorb firmly on pigment or carbon black surfaces, modifying surface charges and improving electrostatic stability. The polymer chains create steric hindrance in the aqueous phase, preventing pigment re-agglomeration during storage or application. This combination of electrostatic and steric stabilization ensures good dispersion, rheological stability, and color uniformity at high solids or pigment loading, improving the final appearance of coatings or prints.

4. Adhesion Promotion and Surface Bonding

As an adhesion promoter, PEI-25K demonstrates excellent performance on metals and polar substrates. Its amine groups coordinate or hydrogen bond with metal oxide surfaces, forming a stable chemisorbed layer. Simultaneously, PEI chains can physically entangle or chemically react with resin components in coatings, creating molecular bridges between substrate and film-forming resin. This dual mechanism improves wetting and interfacial bonding, ensuring coating adhesion and durability under challenging conditions.

5. Adhesives and Resin Modification

In adhesives and resin systems, PEI-25K can act as a reactive component for crosslinking or as a functional modifier to enhance overall performance. Amines react with epoxy or other active groups to form crosslinked

networks, increasing cohesive strength and chemical resistance. Its moderate molecular weight provides sufficient crosslinking points without over-crosslinking, maintaining toughness and balanced mechanical properties. The polar structure also improves substrate compatibility, enhancing bonding reliability.

6. Textiles, Nonwovens, and Functional Finishing

In textile and nonwoven applications, PEI-25K is used for fabric finishing, dye fixation, and functional surface treatment. Its cationic amines form stable ionic bonds with anionic dyes, improving dye fixation and wash/rub fastness. The polymer's hydrophilicity and moisture absorption confer water affinity and anti-static properties. These functional features make PEI-25K valuable in performance textiles and medical nonwovens.

Storage and Handling Precautions

1. Storage Stability

- Recommended conditions: low temperature (<25 °C; 4–10 °C for long-term storage), protected from light, dry, and sealed.
- High temperature risk: storage above 80 °C or exposure to air may cause oxidation, darkening, surface film formation, and performance deterioration (e.g., decreased amine value, reduced viscosity).
- Hygroscopicity: PEI-25K is hygroscopic and absorbs CO_2; containers must be tightly sealed to avoid moisture contact (otherwise salts may precipitate or the product may degrade).

2. Material Compatibility

- Recommended materials: stainless steel, polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC).
- Prohibited materials: mild steel/iron (may oxidize, discolor, or harden solution); copper/brass alloys (may form green compounds and contaminate product).

3. Usage and Handling

- Ensure container integrity before use to avoid contamination (water, dust); reseal immediately after use to minimize air exposure.
- For dilution or blending, use deionized water or weakly polar solvents (e.g., ethanol); avoid strong acids or bases that may damage amine groups.

4. Long-Term Storage Recommendations

- Store in a cool, dark warehouse with impermeable flooring to prevent leaks; avoid sunlight and rain exposure.
- Inspect packaging (drums/bottles) regularly; discontinue use and contact the supplier if bulging, leakage, or abnormal odor (intensified ammonia smell) occurs.

Packaging

- Packaging specifications are 4x5Kg plastic drum, 25Kg plastic drum and user specified packaging.