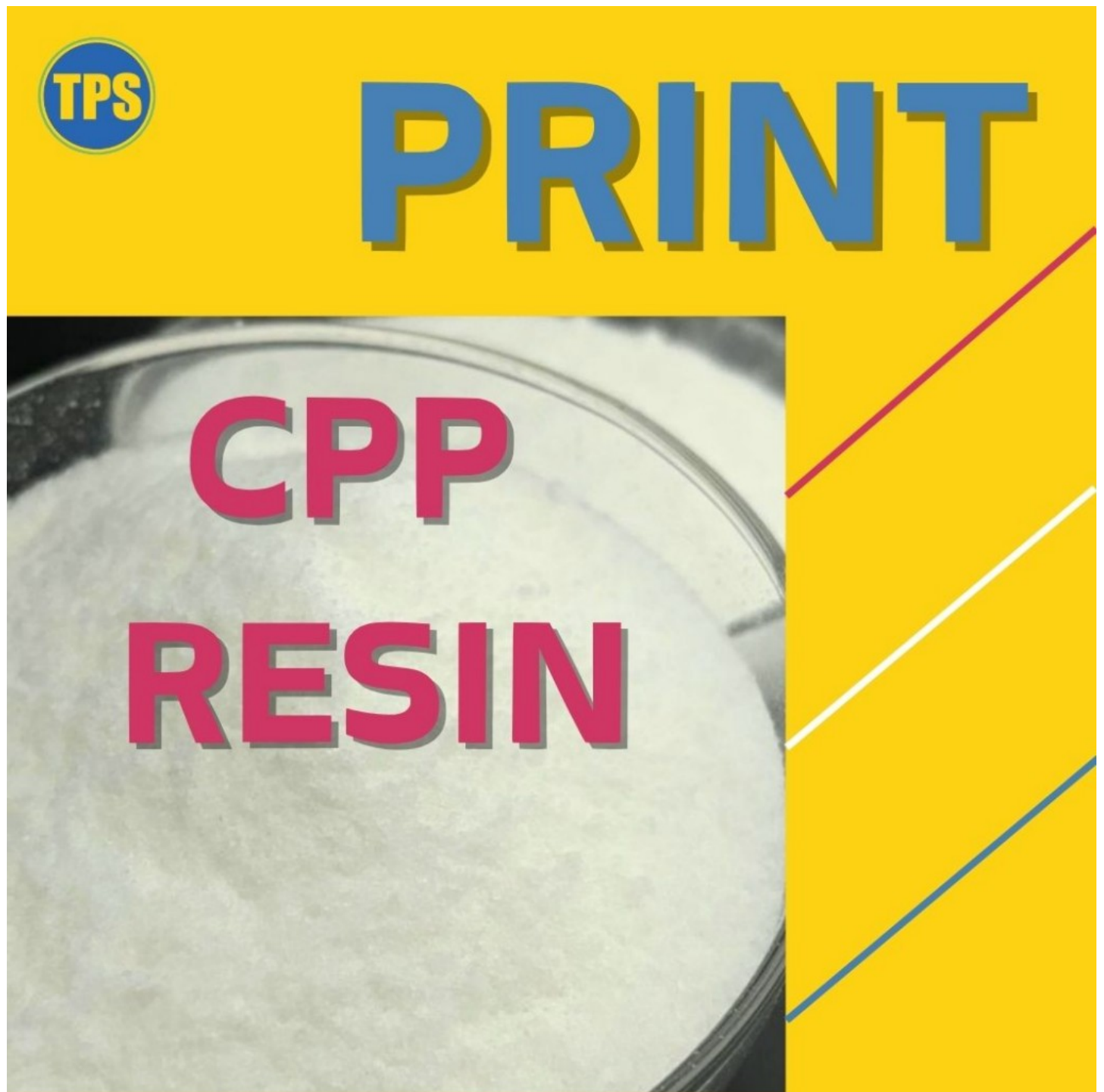


Why Chlorinated Polypropylene (CPP) Resin Exhibits Exceptional Adhesion in Inks



Hong Kong, Hong Kong S.A.R. Jun 4, 2026 ([Issuewire.com](https://www.issuewire.com)) - "Why does one ink peel off easily from a BOPP film while another remains firmly bonded?"

This question often arises among ink formulators and production engineers. The answer lies in the molecular structure of [chlorinated polypropylene](#) (CPP) and how it interacts with polypropylene (PP)

substrates.

Many professionals know that using CPP improves adhesion, but fewer understand the molecular science behind it. This article explores why CPP works so effectively, from the molecular level to practical application.

1. Understanding Adhesion Challenges: Why Polypropylene is Difficult to Bond

To appreciate why CPP adheres so well, we first need to understand why PP is inherently resistant to adhesion.

PP is a non-polar, semi-crystalline polymer composed almost entirely of carbon-hydrogen bonds. Its surface lacks polar functional groups, giving it an extremely low surface energy—around 28–30 dynes/cm for untreated PP.

This low surface energy makes it difficult for most ink binders (like polyurethane or nitrocellulose) to spread and bond. By comparison, these binders typically have surface energies above 40 dynes/cm.

The situation is similar to water on wax: droplets form rather than a continuous film. According to wetting theory, for proper spreading, the liquid's surface tension must be lower than the substrate's surface energy. With PP, the opposite is true, which is why conventional inks struggle to adhere.

Solutions for improving adhesion usually follow one of two approaches:

- Increase PP surface energy – for example, via corona treatment.
- Reduce polarity mismatch between the ink and the PP surface.

CPP follows the second approach.

2. The Molecular “Like-to-Like” Affinity of CPP

[CPP](#) adheres so effectively because its molecular structure is closely related to PP.

PP has a simple hydrocarbon backbone, and CPP is created by introducing chlorine atoms along this same backbone. This shared structure means CPP and PP have a high degree of compatibility at the molecular level.

When CPP-containing ink is applied to a PP surface, the solvent temporarily softens the surface polymer chains, allowing CPP molecules to penetrate and intertwine with the substrate chains. As the solvent evaporates, these chains become physically interlocked. In some regions, partial co-crystallization occurs, creating a molecular-level entanglement rather than simple surface adhesion.

This is the core reason [CPP resin](#) provides superior adhesion: it bonds with PP at the molecular level rather than merely sticking like glue.

3. Chlorine’s Role: Balancing Polarity and Flexibility

If the shared polypropylene backbone is the key, chlorine atoms are what make that key work optimally.

3.1 Adjusting Polarity

Pure PP is non-polar, so it naturally resists bonding with polar ink systems. Introducing chlorine adds moderate polarity to the CPP molecules. This polarity must be carefully balanced:

- Too low (<20%): Poor compatibility with ink, difficult dissolution.
- Optimal (20–40%): Balanced adhesion between PP and ink.
- Too high (>40%): Reduced structural compatibility with PP, weaker adhesion.

Most commercial ink-grade **CPP resins** fall within the 20–40% chlorine range, enabling formulators to match the resin to specific substrates and solvent systems.

3.2 Increasing Chain Flexibility

Chlorine atoms are bulkier than hydrogen, which increases free volume along the polymer chain and lowers crystallinity. This enhances chain flexibility, allowing CPP to conform better to PP surfaces and form stronger entanglements.

Additionally, chlorination improves chemical resistance, providing tolerance to mild acids or alkalis—an advantage in specialized packaging applications.

4. Acid Modification: From Physical Entanglement to Chemical Bonding

Many high-performance **CPP resins** are acid-modified, often using maleic anhydride grafting. This introduces polar functional groups (like carboxyl or anhydride groups) along the CPP chain.

These groups can interact with hydroxyl or carbonyl groups formed on PP surfaces through corona treatment, creating hydrogen bonds or covalent bonds. The result is adhesion that combines both physical interlocking and chemical bonding, providing improved durability under heat, humidity, or aging.

Acid-modified **CPP resins** also demonstrate excellent solvent resistance, making them suitable for automotive coatings and other demanding applications.

5. Common Questions About CPP Adhesion
Q1 Does higher chlorine content always improve adhesion? Not necessarily. Adhesion follows a bell-shaped curve with chlorine content. Optimal performance is achieved at 20–40%, depending on the application.
Q2 How does acid-modified CPP differ from standard CPP in real-world performance? Acid-modified CPP maintains high adhesion even after humidity or thermal aging, thanks to hydrogen bonding and covalent interactions with treated PP surfaces.
Q3 Does CPP adhesion drop in toluene-free solvent systems? Not if fully dissolved. Alternative solvents like methylcyclohexane may require slightly higher temperatures or longer dissolution times, but adhesion remains comparable once the resin is fully dissolved.
Conclusion

Chlorinated polypropylene resin achieves exceptional adhesion through careful molecular design:

- Shared PP backbone → molecular entanglement.
- Chlorination → optimal polarity and chain flexibility.
- Acid modification → hydrogen bonding and chemical bonding for long-term stability.

This combination bridges the gap between low-energy PP surfaces and high-performance inks, making CPP the go-to adhesion-promoting resin for BOPP films and polypropylene-based substrates.

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