

# tech.topic

## Additives: Lubricants, Release Agents and Anti-Static Agents

### ■ INTRODUCTION

Attractive forces (adhesion and cohesion) are constantly present with polypropylene (PP) and polyethylene (PE). Cohesive forces help bind individual PP and PE molecules together. Because these types of molecules cohere to each other, molders can weld two parts together. Adhesive forces result in the attraction of the polymers to other surfaces, such as runner systems, dies, molds, etc. The adhesion characteristics of PP and PE allow labels and other graphics to stick to end-use parts.

### ■ COHESIVE FORCES

PP and PE can be used to produce useful parts which retain their shape over a wide range of temperatures because of the cohesion between individual molecules of the polymer. PP and PE parts can be joined by welding (either ultrasonic, vibrational, or hot-plate) because of the attraction between the molecules of polymer in each part. However, the cohesive properties of these polyolefins can have a detrimental effect on the dispersion of additives and fillers within the resin. Compounders and resin producers, therefore, sometimes add internal lubricants to help disperse additives such as clarifying and nucleating agents and fillers,

### ■ ADHESIVE FORCES

Most molders are familiar with the use of external release agents. These release agents are usually available in an aerosol can and are sprayed onto the mold cavity and core to aid in the removal of parts. Usually the external release agent needs to be reapplied every 5-10 shots to keep the parts from sticking again.

Additives such as external lubricants and internal release agents aid in keeping the PP and PE from sticking to runner systems, dies and molds. Primarily, these additives are effective in reducing the attraction of the polymers to metal surfaces.

External lubricants reduce the attraction of the polymer to runners and dies because of their shear-sensitive solubility. In other words, in constricted areas of the molding process, such as small openings in dies and runners, the external lubricant is incompatible with the polymer and is pushed to the surface. There, the lubricant reduces the adhesive forces between the polymer and the metal surface.

Internal release agents "bloom" to the surface during the injection or extrusion step. Internal release agents also reduce the adhesive attraction between the polymer and the mold surface. These agents generally stop blooming once the part has solidified and act to some extent as anti-static agents during the time they are "blooming." Once the part solidifies, however, these agents no longer provide anti-static properties.

The application of external release agents can have detrimental effects on the environment. Additionally, the periodic application of these agents can result in uneven performance in the finished parts: labels and graphics may not adhere consistently and gloss may not be uniform.

### ■ ANTI-STATIC AGENTS

Polyolefins, and PP in particular, are non-conductive polymers which are, for the most part, incapable of transmitting an electrical charge. These insulating properties make PP a good choice for wire and cable insulation jackets, for example. However, the insulating properties of these polymers also result in an increase in the amount of static electric charges retained on the surface of the polymer. These surface electric properties can be seen in parts that are difficult to separate when they are stacked after molding. The buildup of static electric charges also causes products to attract dust and discharges of the static electricity (in the form of a spark) can be extremely hazardous in high-oxygen environments or areas where flammable vapors are present.

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Anti-static agents, also called anti-stats, are incorporated into the polymer to reduce the build-up of static charges. Anti-stats are effective at attracting water molecules to the surface of the part. While the amount of water molecules attracted (from the air) is not enough to make the part seem wet, it is enough to effectively dissipate the static charge.

There are two theories as to how the static charge is dissipated. First, the attraction of the water molecules to the surface sets up a boundary layer that drains the static charge away via conduction. The second theory is that the water molecules on the surface absorb the static charge and then evaporate back into the air and dissipate the charge. Either way, the water molecules on the surface of the part help reduce or eliminate the static electricity and also remove the static charge from dust particles so they no longer adhere to the part.

Anti-stats continue to bloom to the surface of the part over time and can interfere with the adhesion of post-mold graphics. However, this problem can be solved by cleaning the surface of the part or by open flame or corona discharge treatments.

### ■ DEFINITIONS:

<b>Lubricant:</b>	reduces the attraction (adhesion or cohesion) of the polymer.
<b>Internal Lubricant:</b>	reduces the cohesive property of the polymer allowing easier dispersion of fillers and additives.
<b>External Lubricant:</b>	reduces the adhesive property of the polymer to prevent its sticking to runners and dies.
<b>Release Agent:</b>	material that aids in the removal of a part from a mold.
<b>Internal Release Agent:</b>	an additive incorporated into the polymer that aids in the ejection of the finished part.
<b>External Release Agent:</b>	a coating (either temporary or permanent) on the mold's surface which aids in the ejection of the finished part.
<b>Anti-static Agent:</b>	an additive that reduces the static electric charge on the surface of the part.

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