SI Group Tackifier Resins

Introduction
SI Group currently offers over a dozen different tackifier resins for use in the manufacture of rubber articles

- Octylphenol based Tackifers: SP 1068, HRJ 2765, HR 4047, HRJ 10420, SMD 31161, SMD 31224, R7510P, R7510PJ, R7521, XR 1411E
- Butylphenol based Tackifiers: SMD 31144, SMD 31144HT
- Super Tackifers: SP 1077, Elastobond® T6000, Elastobond® T3100

Tackifier resins are used extensively in the manufacture of rubber articles, especially in the manufacture of tires for automotive, truck and heavy equipment uses, as well as in technical rubber applications such as conveyor belts, v-belts and hoses.

Description and Properties
These resins are off-white to pale yellow solids, with softening points around 100°C. Tackifier resins are soluble in typical organic solvents like alcohol or acetone, but are considered insoluble in water. The solid resins have densities of about 1.0 and have a characteristic phenolic odor. In the language of phenolic resins these materials are considered novolac resins having relatively low levels of residual formaldehyde typically less than 50 ppb. They can contain unreacted alkylphenol monomers in varying amounts usually within the range of 1-4 % by weight. These residual monomers are tightly encapsulated in the resin structure and are not
considered bio-accessible under normal environmental conditions. Products are typically sold in bags in either flaked or pastille form.

**Uses**

Natural rubber has “tackiness” or the ability to stick or cling to itself, as an inherent property. This property is highly advantageous since many rubber articles are constructed from the building up of successive layers of different rubber compounds into a final structure such as an automotive tire, belt or hose. During their manufacture, these articles may be stored in an un-vulcanized state for some period of time and must not de-laminate prior to being heat-cured into a final form by a process commonly referred to as vulcanization. The vulcanization step cross-links and cures the rubber giving the finished article the desired physical properties and shape.

The on-going search for rubber articles having better performance characteristics has led to the widespread use of synthetic rubbers which have inherently less tack. High performance tackifier resins can be used to increase tack and make the construction of modern multi-component rubber articles possible. In tire applications the ability to impart tack is a safety concern because, during manufacture, if tire plies delaminate before the rubber is cured by vulcanization, voids can occur deep in the tire structure causing the tire to weaken and could ultimately lead to tire failure under use conditions. The advantages of SI Group phenolic tackifiers over general purpose tackifiers include:

- Initial high tack performance with better tack retention over time
- Better heat and humidity performance
- Lower loading levels to achieve the same level of tack

**Health Information**

Tackifier resins are generally non-toxic to humans. The oral toxicity of a typical octylphenol based tackifier resin, SP 1068, is greater than 5,000 mg/kg in rat studies. Both SP 1068 and SP 1077 showed little or no potential for skin sensitization utilizing the Buehler test in guinea pigs. SP 1068 resin is negative in the Ames test. Tackifier resins are not expected to be corrosive, be reproductive toxins, neurotoxic or to have specific organ toxicity. Although not a classifiable hazard, product dust may be irritating to the eyes, skin and respiratory system and personal protective equipment such as dust masks should be used to prevent inhalation of dust particles. Exposure to product dust should be avoided to minimize the risk of dermal irritation. Normal industrial hygiene procedures should be followed when handling these products.

**Exposure Potential**

**Workplace Exposure**

This refers to potential exposure in the manufacturing facility or through various industrial applications. Generally, exposure of personnel in manufacturing facilities is relatively low due to the predominantly enclosed nature of the process, storage and handling operations. In packaging operations and use in industrial settings, exposure can also occur from inhalation to particulate dusts in packaged material. The Occupational Safety and Health Administration (OSHA) exposure limits for nuisance dust are 5 mg/m³ (respirable dust) and 15 mg/m³ (total dust). The
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) are 10 mg/m³ for inhalable particulates (total dust) and 3 mg/m³ for respirable particulates (total dust) for Particulates Not Otherwise Classified (PNOC).

Consumer Use of Products Containing SI Group Tackifier Resins

Consumer exposure to tackifier resins is not anticipated. Rubber articles containing tackifier resins are solid articles such as tires, where the resin components are encapsulated and/or reacted, in the rubber matrix and would therefore not be bio-accessible under normal conditions of use.

Environmental Release

Environmental release of tackifier resins is not anticipated due to their encapsulation and lack of bio-accessibility.

Environmental Information

Some products are based on the reaction of formaldehyde and 4-tert-octylphenol (PTOP) or 4-tert-butylphenol (PTBP). While most chemical reactions have a high degree of completion, some reaction residuals may remain within a polymer’s chemical structure and typical tackifier resins may contain up to the 1-4 wt. % of alkylphenol monomers. In the European Union PTOP is classified as a Category 1 and PTBP Category 2 for both Acute and Chronic Environmental Hazards. However, SI Group has conducted test protocols indicating that the water accommodated fraction generated by contact with the resins for 72 hours showed no acute toxicity to fish, daphnia or algae in standardized OECD (Organization for Economic Cooperation and Development) tests for aquatic toxicity. The results indicate tackier resins pose no appreciable threat to the aquatic environment.

Physical Hazards

SI Group tackifier resins are typically shipped in 25 kg bags or in larger super sack containers. Due to the possibility of static discharge while emptying large containers, products are available in super sacks designed to be electrically grounded or being made of materials designed to dissipate electrical energy according to individual customer requirements. For additional recommendations, consult an applicable guideline such as National Fire Protection Association [NFPA] 77, “Recommended Practices on Static Electricity” and API RP “Recommended Practice 2003, Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents” (2008).

Alkylphenol resins, including tackifier resins, do not pose a combustible dust hazard in their as shipped condition. However, they are capable of producing small quantities of combustible dust particles during down-stream handling which, if allowed to accumulate in the workplace in sufficient quantities, could pose potential explosion hazard. Although these accumulations would be highly unlikely if good housekeeping practices are in effect, the Minimum Ignition Energy for phenolic resins can be as low as 3 mJ [millijoules]. The Minimum Explosive Concentration for phenolic resins can be as low as 0.025 oz./ft³ or ~20 g/m³. Tackifier resin dust, when produced for the purposes of testing, typically represent a strong dust explosion hazard of Class St 2 with accompanying Kst values of >200≤ 300.
Derivation/Manufacturing
SI Group tackifier resins are polymeric materials resulting from the catalyzed condensation of the respective alkylated phenols with formaldehyde. These products are made at several of SI Group’s global facilities including: Rotterdam Junction, New York; Bethune, France; Rio Claro, Brazil; Lote, India; and Nanjing and Shanghai, China.

Regulatory Information
SI Group tackifier resins are not regulated as a hazardous material by any agency regulating the transport of materials such as: the United States (DOT) or Canadian (TDG) transportation regulations for ADR/RID, ADNR, IMDG Code, or ICAO/IATA_DGR.

Product Stewardship
SI Group is committed to managing its family of tackifier resins so that they can be safely transported and used by our customers. Our relationships with our customers encourage communication about safety and environmental stewardship, and we strive to work with them to minimize any the risks of personnel exposure or environmental release. SI Group is staffed and organized to investigate and provide advice regarding appropriate corrective actions if such needs occur.

Conclusion
SI Group tackifier resins provide a high level of performance while being designed for their safe use by our customers. Tackifier resins play a crucial role in the safe performance of many rubber products such as automotive tires by allowing the building up of tire layers with excellent green tack and tack retention. Tackifier resins are essentially non-toxic to mammalian species and pose little or no risk to the environment.