High Performance Structural Hot Melts:
Technological Advances Enhance Performance

by Scott Tremblay, Senior Application Engineer
Loctite Corporation

In appliance assembly applications, adhesives are used to replace mechanical fasteners such as staples, screws and rivets, and frequently improve the overall aesthetics of an appliance. In addition to reducing component inventory, adhesives also decrease total manufacturing costs via automation of the bonding process. Hot melt adhesives have long been a staple of appliance design and assembly as they are less costly than other adhesive technologies and can be easily integrated into the high speed manufacturing processes typically demanded by the appliance industry.

Traditional hot melt adhesives are thermoplastic resins that can be softened and reshaped on exposure to heat and pressure. Hot melts provide excellent gap filling capabilities, bond a wide variety of substrates including pre-painted steel and polyolefin plastics, and offer low to no toxicity.

Newly developed, high performance hot melt adhesives can help appliance manufacturers to reduce product costs and improve manufacturing efficiencies. Yet the most recent advances in hot melt technology are not yet fully understood or utilized by most manufacturers. Over the years, the raw materials used to formulate hot melt adhesives have undergone continuous improvement, which has allowed adhesive manufacturers to engineer several new high performance structural hot melt formulations.

Raw materials such as tackifying resins, waxes, antioxidants, plasticizers, and other fillers are incorporated into base hot melt resins to enhance adhesive performance. For example, natural or synthetic tackifiers are generally added to certain hot melts to alter the adhesion, surface wetting, open time, polymer flexibility or tack of the adhesive. Waxes are formulated into hot melt adhesives to help diminish pellet blocking, reduce melt viscosity, and/or modify the tack or “green strength” of the adhesive. Antioxidants are added to hot melt formulations to prevent the resin from oxidizing and to aid in processing and tank stability.

Today's high performance structural hot melts, formulated with advanced raw materials, include ethyl vinyl acetate (EVA) adhesives for general purpose bonding, polyolefin adhesives for difficult to bond plastics, and polyamide adhesives for severe environments.

The newest and fastest growing category of high performance hot melt adhesives is reactive urethanes for high impact, toughened applications. Introduced in the early 1990's, reactive urethanes are a hybrid hot melt chemistry. These adhesives are the only thermosetting hot melts that combine the advantages of traditional thermoplastic technology with the high performance characteristics of crosslinked reactive adhesive chemistries. Reactive urethane hot melts begin to polymerize as they cool, but also undergo a secondary moisture cure that causes the adhesive to crosslink or chain extend, forming a new polyurethane polymer that provides higher strength and flexibility than traditional hot melts.

Applied as a drop or a thin bead, high viscosity urethanes set quickly, becoming structurally rigid in minutes. This rapid solidification allows the on-line manufacturing process to continue uninterrupted, while secondary moisture cure continues for up to 24 hours. Reactive urethane hot melts provide unmatched performance capabilities including excellent solvent and chemical resistance, flexibility, and bond versatility. Because they are thermoset adhesives, reactive urethane hot melts offer lower initial green strength and can be formulated to have extended open times in excess of three minutes if necessary. These extended open times allow reactive urethane hot melts to be applied using a variety of methods including roll coating, swirl spraying, or standard adhesive dispensing.

Appliance manufacturers experiencing problems effectively dispensing adhesives should investigate the compatibility of their hot melt formulation and their dispense system. Proper equipment and set-up can solve many hot melt performance and dispense issues including stringing, charring and premature solidification.

The application temperature of reactive urethanes is 250°F, substantially lower than the 375° to 450°F application temperatures of traditional hot melts, which makes them suitable for use on thermally sensitive substrates. Unique for hot melts, reactive urethane adhesives are heat resistant and can be used in heat sensitive end use applications, for example, adhering felt to a polypropylene dryer drum.

EVA, polyolefin, polyamide and reactive urethane hot melt adhesives are formulated for a wide range of appliance assembly applications including rubber gasket bonding, filling and sealing holes and gaps, bonding insulation in refrigerators and air conditioners, potting and encapsulating electronic devices, positioning electrical wire harnesses, and panel lamination.

Certain adhesive manufacturers offer specialty hot melts such as EVA products that are FDA approved for indirect food contact, and UL-approved polyamide hot melts specifically formulated for electrical applications where reduced flammability is critical.

For applications where even the newest high performance hot melts are not appropriate -- for example, where longer open times are necessary to complete a bonding application – appliance manufacturers may work with their adhesive supplier to develop custom-engineered hot melt products that provide the required performance characteristics.

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Caption for Graph: Traditional thermoplastic hot melts achieve full strength once cooled. Reactive urethanes achieve green strength once cooled and obtain performance properties within 24 hours. Typical non-hot melts such as cyanoacrylates, anaerobics, epoxies, and acrylics slowly increase in strength over time.