

NEW SELF-BONDING NON-STICK POLYMERS

The very characteristics that make inert materials desirable also make them difficult to handle and apply. How does one bond a non-reactive material to a surface? Since it is the reactivity of a material that permits chemical bonding - can an inert material be made to easily react with the surface of a substrate?

Why Silicones Don't Bond:

Silicones are the most inert and chemically stable synthetic yet to be developed. They are so non-reactive that they do not chemically interact with or bond to any other material.

Silicones are also the most accurate impression material available today. Silicones can and do adapt to any surface they contact.

Silicone adhesives utilize this ability to intimately contour themselves against a substrate, acting as a luting agent. However there is no chemical bonding and the adhesive is easily removed from a surface as soon as any tear is initiated at the interface. The polymer also has very poor tear strength and durability against wear.

KISS-COTE® Self-Bonding Non-Stick Polymers:

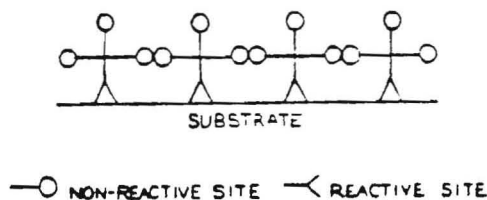
The primary objective of KISS-COTE, Inc.'s research was to develop a coating that presents a completely inert face to the environment, yet is securely bonded to the substrate it protects. The chosen preferred polymer is poly(dimethyl siloxane), one of the most non-reactive materials known.

The critical step was to develop a catalytic process that makes a part of the polymer chain reactive, so that a secure bond forms between the coating and the substrate. The chosen base polymer, poly(dimethyl siloxane), is resistant to most chemicals, provides a non-stick, non-wetting surface, and can only be removed by removing the surface layer of the substrate to which it is bonded.

The manufacture of silicone rubber involves extensive crosslinking between chains of a polymer. As the reaction proceeds, the reactive sites on each chain react other reactive sites, forming a highly cross-linked network of polymer. Silicone rubber is made by letting this cross-linking reaction proceed until all the reactive sites are linked.

Self-bonding non-stick polymers are made using patented technology and are sold under the trade-name of KISS-COTE®. Special inhibitors are added to the polymer to halt the cross-linking process prematurely and at a pre-selected point. This leaves many highly reactive sites on the polymer chain that are now available for bonding to the substrate. The non-reactive side of the cross-linked chains forms the inert face with the un-reacted sites reacting with the substrate to bond the inert layer to it (see Figure 1).

FIGURE 1

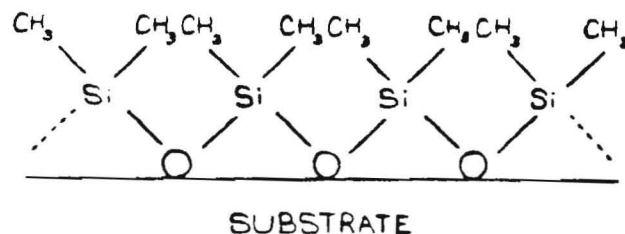


Self-bonding, non-stick polymers have their reactive (sticky) side bound to the substrate, leaving only non-reactive portions exposed to the outer environment.

Attributes of KISS-COTE® Self-Bonding Non-Stick Polymers

The KISS-COTE family of materials are a uniquely formulated type of surface treatment that has most of the same properties of the silicone base polymer: temperature, pressure, and chemical resistance and water-repellent capabilities,

FIGURE 2



Self-bonding inert polymers present a non-stick face to the environment (CH₃ methyl groups) with a strong but thin intermediary (Si Silicon) and a reactive side (O Oxygen) which bonds to the mold surface.

yet it adheres to surfaces and will not migrate.

The thinner the coating - the better it works

The key attributes of KISS-COTE treatment, at each interface, depend upon surface phenomena. On the one side is the reactive component which bonds to the substrate. On the other side is the inert surface which provides protection (see Figure 2).

The intermediate material - between the reactive adherent side and the inert surface - has no value and should be minimized. Correctly applied, a KISS-COTE surface treatment is a monomolecular layer approximately 120 Angstroms (0.012 micron) thick. The coating intimately adapts to the surface of the substrate and causes no significant changes in the dimensions or surface topography of the coated product.

KISS-COTE modified poly(dimethyl siloxanes) are very nonreactive and inert. They exhibit a well-organized methylated surface layer. Their surface energy is low and coated surfaces are hydrophobic. Unlike PTFE which is hydrophobic but wets well with organic solvents, KISS-COTE polymers do not wet well with water or with most other liquids.

Reduced Friction - Reduced Wear

The inert KISS-COTE treatment is used to lubricate coated surfaces, reducing surface friction and drag with a non-stick finish. Laboratory and field tests of the lubrication capabilities of the coatings have only just begun. Early

evidence demonstrates they increase the wear cycle and lifetime of treated wear parts, particularly those in sliding contact with one another. For example, Lightfield Ammunitions, Inc. coated the front end of projectiles and reported a ten percent increase in exit muzzle velocity. KISS-COTE coatings also have been used to

improve performance of many record-setting and World Champion power and sail boats since 1986.

Non-stick and Slippery

Most conventional lubricants and mold release agents are slippery and separate because of interfacial shear between the molecules of the lubricant or release agent. They don't usually affect the solid surfaces they lubricate. KISS-COTE based lubrication and release agents operate on a different concept: The coating changes the properties - including coefficient of friction - of the solid material itself. Coated surfaces require smaller amounts of lubricants and less frequent lubricant changes than uncoated surfaces. Coated surfaces show less wear than uncoated parts.

Use of KISS-COTE® Self-bonding Inert Polymers as Mold Release Agents

A KISS-COTE lining protects any type of mold from most acids, bases, solvents, and detergents. The non-stick finish permits multiple releases without re-application. When the mold is separated the release agent remains securely on the mold and does not transfer to the finished parts. Since the KISS-COTE does not transfer, contamination and migration do not occur.

Limitations on Performance of KISS-COTE® Self-bonding Inert Polymers

The quality of protection provided by the KISS-COTE treatment depends upon:

1. a stable substrate, which is able to withstand the mechanical stresses of the environment in which the product functions;
2. as smooth a surface as possible to prevent mechanical retention of fouling materials; and
3. a substrate surface which is non-reactive to gas vapor. The KISS-COTE surface treatment is resistant to most acids, alkalis, solvents and detergents. It is hydrophobic (nonwetting), but is vapor-permeable. Therefore susceptible substrate surfaces should be pre-treated to prevent corrosion that may be caused by gaseous agents.

Impact

Research on mold release agents and the development of new products continues to have a broad impact on dozens of industries. Self-bonding polymers are already being applied to a range of materials for different reasons, at varying stages of the manufacturing process. The same materials that keep parts from sticking in molds also may be used to keep barnacles from sticking to boat bottoms and water cooling systems at power

plants. They keep mildew from growing on building materials and blood cells from sticking to the inside of artificial hearts.

These innovative surface treatments have marine, automotive, aviation, construction, power generation, ammunition and weaponry, computer and electronic, consumer good, medical and dental applications. These chemical- and corrosion-resistant, water-repellent, gas-permeable self-bonding polymers and the inert coatings they produce can be applied to virtually any material to serve any or all of the following purposes:

- Protecting the coated material from moisture, corrosion and chemical or biological fouling.
- Lubricating the coated surface by reducing surface friction and drag and, when used as an additive, improving the slipperiness and temperature stability of other lubricants or surface treatments.
- Preventing unwanted substances - water, ice, mildew, paint, natural or man-made detritus - from adhering to treated surfaces.
- Polishing and preserving metal, wood, resin and ceramic surfaces serving as a replacement for high-gloss wax.
- Sealing equipment and structures subjected to repeated heat/freeze cycles and keeping treated surfaces dry.
- Keeping water off one side of a treated surface while allowing vapors (including water vapors) from the dry side to pass out.

These new self-bonding polymers share most of Teflon's desirable performance characteristics, but have few of Teflon's liabilities. Unlike Teflon, the coatings are easy to apply and require no pre-application treatments or post-application curing. These polymers are non-toxic, non-volatile and environmentally friendly. If the coatings are damaged in use, they can be repaired easily and readily; repair of Teflon is difficult and costly.

Information about KISS-COTE® Technology and Products is available from: KISS-COTE, Inc., 12515 Sugar Pine Way, Tampa, Florida, 33624; telephone: (813) 962-2703; fax: (813) 961-0579. Licensing, distributor and dealer information are available upon request.

Kent Integrated Scientific Systems, Inc. (K.I.S.S.) and KISS-COTE, Inc. are pleased to provide technical assistance and problem-solving relating to mold release agents, coatings, surface protection, interfacial phenomena and drag-reduction. ■