

Mummies to modern industry: Borates in adhesives

Sometimes, a sticky situation is exactly where you want to be. That's definitely the case when adhesives are a part of your product or manufacturing process. And, borates have a long history as a go-to additive for improved adhesive properties in the formulation of starch-based adhesives.

Adhesives treated with borates

Traditionally, adhesives were created from naturally sticky substances: Tree saps, starches, and animal extracts. Thousands of years ago, portions of Babylonian statues were glued with a tar-like material. Ancient Greeks and Romans made adhesives from animal bones and blood, egg whites, and other foodstuffs.

Adhesives & Sealants Industry (ASI) magazine notes that many of these traditional starch-based adhesive formulas included borax to improve durability, stability, and wet tack. The use of boron compounds in adhesives has been popular for centuries. ASI points out that, while only a theory, the idea that a borate-containing ore might have contributed to the bonding properties of the cloth used in Egyptian mummification ceremonies isn't too far-fetched.

But the formulation of starch-based adhesives really took off during the Industrial Revolution, when they were developed for use in furniture manufacturing. In the 1930s, the Stein-Hall process—used to produce starch adhesives for the manufacture of corrugated cardboard boxes—featured the addition of borax. The process is still used in the packaging industry.

What makes borates such an important addition for adhesives? The key is the borate anion's ability to induce chemical changes. As a natural polymeric product, starch is already a good adhesive. But for industrial purposes, it can have too slow a tack and too low a viscosity. Borate compounds create a more highly-branched chain polymer with a higher molecular weight. As a result, starch-based adhesives gain improved tack, viscosity, and fluid properties.

Better bonding with boron

By adding borates to starch-based and dextrin-based adhesives, manufacturers see increased viscosity, resulting in greater tack, faster bonding, and better fluid properties. These qualities are vital for several industries, including packaging, construction, and home decoration.

Borate-treated adhesives:

- Are less likely to overrun bonded materials
- Help keep machinery running smoothly
- Can provide additional benefits, such as a fire retardancy and wood protection

Paper products

Borax decahydrate, boric acid (such as U.S. Borax product *Optibor*®), sodium borate, and sodium metaborate are essential to the adhesives used in the manufacture of many paper-bonding and paper products, including:

- Paper grocery and multiwall bags, paper boxes, and corrugated box board
- Bookbinding and wallpaper pastes
- Carton and case sealing
- Laminated paper board
- Textile sizing
- Tube winding

BROCHURE: BORATES IN ADHESIVES

Wood and cellulosic products

Borax makes an excellent addition to urea-formaldehyde (UF) and phenol formaldehyde (PF) adhesive formulations, used in the making of:

- Plywood
- Particle board
- Medium-density fiberboard (MDF)

Borates can significantly reduce formaldehyde emissions, without affecting mechanical strength. And, *Optibor* used in polyurethane-based (PU) wood glues, helps to protect wood without reducing bonding strength.

Soy protein-based adhesives are also popular for use in oriented strand board (OSB) and plywood, especially as a formaldehyde-free adhesive. Here, the addition of *Optibor* boosts the shear strength of bonded samples when treated with water—a sign of improved water resistance and adhesion.

Tiles

Optibor or borax is also used in tile-adhesive thickener. Thanks to these borates, manufacturers can see better thickening action than formulations without borates.

About U.S. Borax

U.S. Borax, part of Rio Tinto, is a global leader in the supply and science of borates—naturally-occurring minerals containing boron and other elements. We are 1,000 people serving 650 customers with more than 1,800 delivery locations globally. We supply around 30% of the world's need for refined borates from our world-class mine in Boron, California, about 100 miles northeast of Los Angeles.

About 20 Mule Team products

U.S. Borax produces the 20 Mule Team® borates family of products from naturally occurring minerals and have an excellent reputation for purity and safety when used as directed. Borates are key ingredients in a number of industrial applications including fiberglass, glass, ceramics, batteries and capacitors, wood preservatives, and flame retardants.

High quality, high reliability, high performance borate products. It's what we're known for.