

Borates in starch adhesives

Starch is a natural polymeric product and is found in almost every plant. Today, the principal sources of most commercial starches are maize, potato, tapioca and wheat. Adhesives derived from starch can be significantly improved by borate additives through:

- Increased viscosity
- Quicker tack
- Better fluid properties



Modifying the starch molecule

The chemical makeup of the starch polymer makes it a good adhesive, but for many industrial applications its tack is too slow and its viscosity too low.

If starch is treated with a hot aqueous solution of soda ash or caustic soda plus a borate compound, extensive chemical changes are brought about. Interchain linkages can be formed through the borate ester anions, resulting in a desirable modification of the starch's physical properties.

It is the change to a more highly branched chain polymer with higher molecular weight that improves the viscosity, tack, and fluid properties of starch adhesives.

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 500 customers with more than 1,700 delivery locations globally. We supply 30% of the world's need for refined borates from our world-class mine in Boron, California, about 100 miles east of Los Angeles. We pioneer the elements of modern living, including:

- **Minerals that make a difference:** Consistent product quality secured by ISO 9000:2001 registration of its integrated quality management systems
- **People who make a difference:** Experts in borate chemistry, technical support, and customer service
- **Solutions that make a difference:** Strategic inventory placement and long-term contracts with shippers to ensure supply reliability

Industrial applications

The starch and adhesive industry depends on unique characteristics imparted by the addition of borates in adhesives. Products and processes requiring starch adhesives include:

- Corrugated box board
- Paper bags (grocery and multi-wall)
- Paper boxes
- Carton sealing
- Case sealing
- Tube winding (paper and board)
- Laminated paper board
- Gummed tape
- Gummed paper
- Textile sizing

About 20 Mule Team® products

20 Mule Team borates are produced from naturally occurring minerals and have an excellent reputation for safety when used as directed. Borates are essential nutrients for plants and key ingredients in fiberglass, glass, ceramics, detergents, fertilizers, wood preservatives, flame retardants, and personal care products.

20 Mule Team Borax products in starch adhesives:

- *Neobor*® Borax Pentahydrate
- Borax Decahydrate
- *Optibor*® Boric Acids