

Borates in flame retarding cellulose materials

Cellulose, the basis of wood, cotton, and most other plant-derived raw materials, is in widespread industrial use. It is inherently flammable in many of its forms—paper being a typical example. The use of borates in cellulose materials imparts flame retardancy, enabling them to meet stringent safety standards and regulations.



Uses

The three major uses in cellulose for borate flame retardants are cellulose insulation, wood products and composites used in the construction industry, and cotton batting used as a filler in mattresses and futons. However, because most borates are water-soluble they are not suitable for clothing or materials that have to be laundered regularly.

Formulation factors

The decision to use borates depends on several factors including:

- The type of product
- The application methods
- The compatibility with other additives
- Compliance with fire test standards
- The composition/quality of final products
- The cost and local availability of borates
- Local legislative requirements

Combustion factors

Combustion of materials can occur both in a primary mode, where visible flames are present, and in a secondary mode, where flames are absent. In the latter case, the combustion is referred to as glowing or smoldering, depending on whether or not light is emitted. Borates are included in cellulose insulation, wood composites, mattresses, fabrics, and paper primarily to:

- Prevent flaming combustion
- Suppress glowing and smoldering
- Promote the formation of char

Cellulose insulation: Cellulose insulation is produced by passing shredded waste paper through a hammer mill which converts it to a fibrous consistency with a high thermal insulation value. Cellulose insulation is flammable and particularly prone to smoldering combustion, so it requires the incorporation of flame retardants. Boric

acid has long been recognized as an effective flame retardant additive due to its capability of preventing smoldering. The combination of *Optibor*[®] boric acid and *Neobor*[®] yields reliable fire and corrosion test performance. Cellulose insulation is used mainly as loose-fill for insulating lofts, attics or cavity walls, though spray-on varieties are available for application to ceilings or side walls by means of an adhesive.

Wood products: Flame retardant lumber, plywood shingles and shakes can be made by vacuum or pressure impregnation with boric acid or *Polybor*[®] solutions.

The production of various types of resin-bonded wood composite boards such as chipboard, waferboard and fiberboard has been rapidly increasing in recent years. Boric acid and *Polybor* are the principal boron compounds used as the flame retardant in wood composite board.

Mattresses/futons: Boric acid is commonly used to flame retard cotton-batting employed as an infill material in mattress and futon manufacture. The mattress or futon thus produced will have superior smoldering resistance.

Fabrics: Fabrics requiring flame retardant treatments include some clothing, drapes or curtains, rugs, ironing board covers, fireman's clothing, fabric heat deflectors for stoves or fireplaces, and fire-smothering blankets. Solutions of boric acid or *Polybor* can be applied by direct spraying or dipping.

Paper: Solutions of boric acid, *Polybor* or ammonium pentaborate can be applied on paper, such as high gloss or file storage boxes by spraying or dipping to yield a fire-retarded product. The high levels of flame retardants used in paper result in a stiffening effect which can be overcome by inclusion of a softening agent such as urea in the treating solution.



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 northeast of Los Angeles. We pioneer the elements of modern living, including:

- **Minerals that make a difference:** Consistent product quality secured by ISO 9001:2015 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

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 flame retarding cellulose materials:

