BROCHURE

Borates in flame retarding cellulose materials

Cellulose is inherently flammable in many of its forms. 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 cellulosics for borate flame retardants are:

- Cellulose insulation
- Wood products and composites
- Cotton batting (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:

- Product type
- Application methods
- Compatibility with other additives
- Compliance with fire test standards
- Composition/quality of final products
- Cost and local availability of borates
- Local legislative requirements

Combustion factors

Material combustion 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 and 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 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.

U.S. Borax products for use in flame retarding cellulose materials

Ammonium Pentaborate

Optibor®

Neobor®

Polybor®