# 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 cellulosics 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

**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.

BORAX®

20 MULE TEAM®

**Neobor®** Borax Pentahydrate
**Optibor®** Boric Acids
**Polybor®** Disodium Octaborate Tetrahydrate
**Ammonium Pentaborate**

The combination of 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 the company**
Rio Tinto Borax supplies nearly half the world's demand for borates from its principal mine in California. The company offers an integrated approach to mining, refining, and distributing borates, as well as:

- Strategic Inventory Placement and long-term contracts with shippers to ensure supply reliability.
- Acknowledged world leadership in borate chemistry and technology development that translates to unparalleled technical support for customers.
- Consistent product quality supported by ISO 9000 registered Quality Management Systems, statistical process control and Certificates of Analysis.

**About the products**
Borates are naturally-occurring mineral salts, essential for plant life and part of a healthy diet for people. Borate products have an excellent reputation for safety – and a long track-record of being safe when used as directed.

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