

Borates in industrial fabric detergents

Most people are familiar with the home laundry product, 20 Mule Team® Borax. But, borates and perborates* are also used in industrial cleaning solutions to boost surfactant performance, buffer pH, fight corrosion, and enhance stain and oils removal.

Borate benefits in industrial cleaners

- Alkaline buffering and pH control of washing solution
- Water softening by producing (via sequestration) a soluble calcium complex
- Surfactant performance by preventing precipitation of a calcium/surfactant complex
- Pigment-soil removal and prevention of redeposition
- Perborates are excellent detergent bleaches

Alkaline buffering

High alkalinity in the washwater improves detergency and helps with the cleaning process. In such systems, negative electrostatic charges on fabric and soil are created. These negative charges repel each other and help remove soil from fabric. Alkalinity also helps remove fatty soils through saponification.

Benefits of borates/perborates

- Borates are excellent pH buffers in the range of pH 9.1-9.3—their natural pH
- Perborates are more alkaline (pH 10.4 for 1.0% solution) and like borates have excellent buffering capacity in the pH range 9-10

Other detergent components

Sodium carbonate buffers work best at about pH 10 which, unlike borates, is not its natural pH (11.6 for a 1.0% solution).

Water softening

Reducing calcium and other metals improves water hardness and allows detergents to function well. The three most important ways of doing this are:

1. Formation of soluble complexes of the calcium ion
2. Formation of insoluble complexes of the calcium ion
3. Ion-exchange of the calcium ion

Detergent components that perform these types of functions and soften the water are called builders.

Benefits of borates/perborates

Borates and perborates act as sequestrant builders, forming soluble complexes with the calcium ion and thus removing its unwanted effect. Soluble complex formulation is often the best way to achieve builder effect.

Other detergent components

Insoluble complexes—for example with carbonate or percarbonate—can precipitate onto fabric during washing, leaving harsh-feeling deposits. Ion-exchangers are typically insoluble zeolite particles that can also build up on fabrics.

Surfactant performance

To improve surfactant performance, positively charged calcium ions associated with washwater and certain soils must be prevented from complexing with negatively charged surfactants used in detergent formulations, since the resultant complexes are insoluble. Should this reaction take place, some of the surfactant is effectively removed from the wash and unable to perform its function.

Benefits of borates/perborates

- Borates and perborates prevent the precipitation of important types of negatively charged surfactants (unless exceptionally high levels of calcium are present in the wash)
- They compete successfully with the surfactant for calcium ions and form soluble complexes thus enhancing water softening qualities

Other detergent components

Carbonates and percarbonates prevent the precipitation of surfactants by producing a calcium carbonate precipitate. However, this precipitate can deposit on fabrics causing a graying effect and harsh feel.

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Soil removal

To improve surfactant performance, positively charged calcium ions associated with washwater and certain soils must be prevented from complexing with the negatively charged surfactants used in detergent formulations, since the resultant complexes would be insoluble. Should this reaction take place, some of the surfactant is effectively removed from the wash and unable to perform its function.

Benefits of borates/perborates

- Borates and perborates cause a greater reduction in interfacial tensions than is simply due to pH, thus improving oily soil detergency
- Borates inhibit particulate soil deposition through their specific influence on surface charge—this is not just a pH effect

Other detergent components

Tripolyphosphates show similar behavior to borates and perborates in reducing these interfacial tensions. Carbonate and percarbonate appear only to reduce interfacial tension through their influence on the solution's pH.

Bleaching chemistry

Bleaching is the process of whitening, lightening, and brightening fabrics by chemical means. Hydrogen peroxide and chlorine are the most effective bleaches in some contexts, but manufacturers cannot incorporate either directly into washing powders.

*** Note:** Perborates are made from a chemical reaction of borate with hydrogen peroxide. U.S. Borax does not make or sell perborate products.

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.

Benefits of borates/perborates

- Excellent bleaches
- Very stable in powders
- Effective yet gentle as an oxidizing bleach
- Aids overall detergency
- Perborate monohydrate dissolves rapidly

Other detergent components

Sodium percarbonate is used as bleach in some detergents but is much less versatile because of instability in most formulations.

Proven performance

Two fully formulated zeolite-based detergents—one containing 20% percarbonate and the other 20% perborate—were tested on four types of soiled cotton.

Those soil tests in which perborate performance exceeded percarbonate performance included:

- Clay
- Clay and sebum
- Carbon black/olive oil
- Carbon black/mineral oil

In the fourth soil test, the perborate and percarbonate detergents performed equally well.

Other borate/perborate benefits

- Excellent enzyme stabilizers in liquid detergents
- As little as 1% perborate helps to inhibit dye transfer
- Reaction with neighboring hydroxyl groups enhances performance of sugar-based builders and surfactants

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.



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