TECHNICAL BULLETIN

Borates for pH control in nylon carpet dyeing

Introduction

Aqueous U.S. Borax borax decahdyrate or *Neobor*® borax pentahydrate solutions are known to exhibit relatively stable pH values at various concentrations and temperatures. For this reason, borax decahydrate is an excellent buffer and is recommended for pH control in the dyeing of nylon carpeting. Borax decahydrate offers the following advantages:

- pH remains relatively constant: Monitoring and periodic bath adjustments are reduced significantly
- Precludes initial high starting pH which minimizes change in pink and cerise shades, thereby allowing better shade matching
- Prevents staining by the jute backing

In the dyeing process, a mildly alkaline condition (pH = 8.5-9.0) is necessary to optimize the color level and dye penetration, as well as to keep the fiber clean. Sufficient alkalinity is required to prevent the deposition of fugitive stains from the jute. Of more importance is pH control during the dyeing cycle. A steady pH minimizes the problem of shade matching due to the susceptibility of certain dyes to pH fluctuations.

Effect of TSP, TSPP, and soda ash on pH

Laboratory work has been performed on the effect of various compounds as buffers or the ability of these materials to pro vide a uniform pH during the dyeing operation. It was found that the two most commonly used compounds, trisodium phosphate (TSP) and tetrasodium pyrophosphate (TSPP), while able to provide sufficient alkalinity (high pH) during the initial stages of the dyeing process, failed to maintain a sufficiently high enough pH throughout the dyeing operation. Both compounds underwent a severe drop in pH in the presence of jute, indicating that the jute probably neutralized some of the alkalinity.

The pH values of both solutions (at the three concentrations tested) drops rapidly to a low level by the end of the two hour tests. Of equal significance is the drop in pH during the warm-up period to 96 °C (205 °F). Although the addition of sufficient alkali would ensure the final desirable pH, this would result in a starting pH of 10-11 which would not be satisfactory since, as noted above, certain dyes are sensitive to high pH values.

Soda ash systems also show a considerable pH drop during the initial warm up. While such systems display a leveling of pH after the initial warm up a starting pH of 10-11 is again required to ensure a safe pH level during the dyeing operation.

Effect of borax on pH

The effect of borax decahydrate on pH shows very little decrease in pH during the test cycle. Completion of a two hour dyeing test indicates that at concentrations of 3-4% (based on total dry weight of carpet), the drop in pH is very slight or on the order of 0.4 pH units. Borax is an excellent buffer for such systems providing a minimum of 3% borax is used.

The use of U.S. Borax borax decahydrate or *Neobor* borax pentahydrate, obviously, offers advantages over phosphates:

- pH remains constant, significantly reducing monitoring and periodic adjustments
- Eliminates the need for alkali additions, thus avoiding the danger of pH fluctuations with resulting shade variations

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Borate solutions can be prepared form either borax decahydrate or *Neobor* borax pentahydrate. Use of *Neobor* would result in a savings because of lower freight costs, storage, and handling requirements, since 0.76 units of *Neobor* is equivalent to one unit of borax.

Alternative systems

Buffered mixtures can also be used to control pH fluctuations. It was found that a starting pH approximating 9.0 dropping to about 8.5 during the dyeing operation (at 205 °F), can be obtained by using 1% borax decahydrate with 0.11% sodium hydroxide. This system, while suitable, might not be desirable, in that extra storage and mixing of two materials are required. The use of a single material such as borax, would be more conventional and leaves little room for error by the operator.

About U.S. Borax

U.S. Borax 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 our customers with more than 1,200 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.

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