

## Borax

From ceramic material's website:

Also known as hydrated sodium tetraborate or sodium diborate, depending on whether the borate is viewed as 4 atoms of boron or 2 of boric oxide. The 'hydrated' designation recognizes its water of crystallization.

Borax has very strong fluxing power (comparable to lead oxide).

Borax ( $\text{Na}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$ ) is available in large crystal, powder, and granular form, the latter being the most practical for ceramic use. Although the 10 molecules of water in the theoretical formula vary somewhat, they are the source of the designation "10 Mol Borax". Borax begins to melt in its own water of crystallization at 60.8C. It is soluble in water, acids, glycol and other solvents. Almost all American borax comes from deposits of the crystalline precipitate mineral tincal in the Mohave Desert of California (Asian borax is called Tincal).

Since borax is water soluble it is necessary to introduce it into glaze batches in the fritted form. Although the boron in the frits is no longer in the form of borax, it is common to use the term "Borax Frit" in recognition of the source of the borate.

Borax is widely used as a flux and glass former at almost all temperature ranges, but especially with earthenware. Like silica, boric oxides combines readily with bases and is thus important in the development of color. However, exchange of silica for borax usually comes at the price of glaze hardness. Use of borax in the presence of lime may cause the development of blue-white calcium borate crystals which impart a milky appearance to transparent glazes.

Many borax frits are available and boric oxide behaves as a very active flux and its frits can often be used to eliminate lead in low fire glazes. It can be used to increase flow to help glazes heal imperfections. Its low expansion (even lower than silica) makes it very valuable to keep crazing under control in low temperature glazes which cannot accommodate a lot of silica.

Borax is a principal ingredient in enamels (15-45%) because of its vigorous melting and attack of other ingredients, its comparative toughness, luster, color response and low expansion.

Borax is very important in glass manufacture to obtain the low expansion and quick heat transfer necessary for hot-cold cycle endurance. It also imparts corrosion resistance and lower temperature workability (at the expense of working range). Small amounts in ordinary soda-lime glass (1-1.5%) give greater strength, brilliance, durability, thermal shock resistance and protect against the tendency to crystallize during the cool cycle. Adding boric oxide for silica reduces melting temperature, substituting it for soda improves thermal properties and durability.

The water content of borax can vary with storage (it tends to lose water with time). Where precision is required, it is necessary to measure the water content just before use.

Borax can also be sourced from the more economical Sodium Tetraborate Pentahydrate ( $\text{Na}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ); 74.6 lb. of this material are equivalent to 100 lb. of regular borax. Anhydrous borax contains almost no water of crystallization, about 53 lb. being equal to 100 lb. of raw borax. This material does not puff or swell during melting, minimizing loss of powder in kilns with strong drafts and saving fuel because of easier melting and lack of an insulating factor.

Boric acid ( $0.5(\text{B}_2\text{O}_3 \cdot 3\text{H}_2\text{O})$ ) is useful where sodium must be eliminated.

Mineral, of the ideal form  $\text{Na}_2[\text{B}_4\text{O}_5(\text{OH})_4] \cdot 8\text{H}_2\text{O}$  with a typical empirical analysis of Na<sub>2</sub>O 16.26%, B<sub>2</sub>O<sub>3</sub> 36.51%, H<sub>2</sub>O 47.23% Hardness: 2-2.5 Density: 1.7-1.8 Soluble in water Similar to kernite, sassolite. Strong flux below 1100°C, used freshly mixed before the mix sediments to a hard chunk.

Data

- \* Melting Point (MP): 741C M
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