How to Remove Silicon Dioxide (SiO2) Fining Agents in Fermentation Vessels and Brite Tanks in the Brewery

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ABSTRACT
Brewers have been using silicon dioxide (SiO2)-containing products, also known as silicic acid, silica, or kieselsol, to remove yeast and haze-forming particles from beer in the fermenter or brite tank for many years now. The use of silicon dioxide allows brewers to achieve a relatively "brite" (clear) beer without the need of filtration, which can remove not only proteins but also many positive flavor components from the beer. The mechanism of how silica-containing auxiliary fining products work has been discussed in great detail over the years, but the removal of residual silica has not. The cleaning process for silica is not generally understood and has been causing problems for craft brewers in recent years. This article details how to adequately remove silicon dioxide in the cleaning process.

Keywords: Silicon dioxide removal, Keg cleaning, Brewery sanita-tion, Brite tank cleaning, Beerstone solutions, Clean in place

The Situation
Biofine Clear, manufactured by Kerry, and Nalco 1072, manufactured by Nalco, are two popular silicon dioxide fining products currently used by craft brewers. Many craft brewers, either by choice or by necessity, do not filter their beer using one or more of the following methods: centrifuge, diatomaceous earth, pearlite, sheet filter, or membrane filtration. The clarity of finished beers using silica is remarkable, and the flavor of the beer made by fining with SiO2 can be even more remarkable. Because the beer has not had many of the positive flavor components removed in filtration, the "fined but not filtered" beers have nice mouthfeel, hop flavor and aroma, and head retention, and they finish dry and clean. How does it work?

Without going into a lot of detail (which has already been demonstrated for decades) on what silicon dioxide is and how it works, it is typically added at the end of fermentation, after the yeast has been removed. This can occur either in the unitank fermenter if the beer is not going to a brite tank or, as recently recommended in a Master Brewers podcast on the subject, added in-line to the beer as it is transferred to the secondary fermenter or brite tank, where it then clears the beer nicely. The latter of the two methods was preferred by presenter Chika Ezeani (1) to provide the least amount of sediment in the vessel and the greatest overall beer clarity. There was not, however, a mention or discussion on how to properly clean tanks that have been fined with SiO2. Vessels that have been fined with SiO2 must be cleaned with alkaline products first before cleaning and sanitizing with acid-containing cleaners and sanitizers.

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The reason is that silicon and silicate precipitate in acid. Brewers will sometimes mistake the resulting whitish deposit for beerstone (calcium oxalate), which it is not. When silicon is cleaned with acid instead of caustic, it precipitates and leaves a smooth, white deposit like this:

The Technique

Fermenter cleaning is typically done with alkaline products first, so there is not as big of an issue removing the silicon dioxide. But, as this author has discussed in the past (2), some cleaning regimens specify cleaning with acid under pressure, with carbon dioxide (CO2) still remaining in the vessel. Cleaning fermenters or brite tanks with acid first or acid and detergent only can have serious consequences for the cleanliness of the vessel if it previously contained silica.

When a deposit like the one illustrated earlier appears, the tank must be cleaned with a very strong hot caustic solution to remove it. Cir-Q-Late, a proprietary mixture of sodium hydroxide, potassium hydroxide, surfactants, chelators, water conditioners, and polymers, made by Birko Corporation in Denver, Colorado, has shown good efficacy in removing silicate, silicone, and most importantly SiO2 deposits, especially when combined with 34% hydrogen peroxide at the point of use. The solution to remove silica deposits is as follows:

- 1 gal (3.8 L) of Cir-Q-Late is added per 5 gal (20 L) of 160–180□F (70–80□C) water.
- It is combined with 1 oz. (30 mL) of Pur-Ox (34% hydro-gen peroxide) per gallon of the above cleaning solution, added at the point of use.

The clean-in-place (CIP) cycle takes approximately 45 min to 1 h. It is followed by rinsing. Oftentimes, the deposit will not be completely removed the first time. In other words, additional cleanings, at normal concentrations of caustic (5–10%) may be needed to fully remove the deposit. Once fully removed the entire vessel should look like this:

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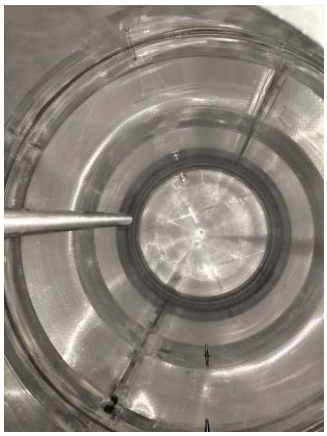

Summary

Silicon dioxide fining agents are a wonderful way to make a bright beer without the need of filtration, but care must be taken when cleaning the fermenter or brite tank that contained the precipitated mixture of yeast, proteins, and SiO2. Most specialty caustic and noncaustic alkaline cleaners formulated for the brewing industry by reputable chemical companies contain the surfactants, chelators, and water conditioners to adequately remove the deposit when used according to directions.

However, if the alkaline cleaner does not remove the deposit, or if acid cleaning is done in lieu of cleaning with an alkaline cleaner first, the resulting silicon and silicate deposits are more difficult to remove and take a great deal of chemical, time, and energy. That situation is best avoided. It is easier to clean tanks of SiO2 utilizing alkaline formulations and additional hydrogen peroxide.

You can learn more about the MBAA here: https://www.mbaa.com.

REFERENCES

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A homebrewer since 1989, Dana consults for craft breweries, wineries & distilleries on food safety & sanitation practices. He has more than 25 years of experience serving Birko's brewery customers and is known in the industry as one of the leading voices on sanitation. He has formulated many Birko products, has authored numerous articles, is a frequent speaker, and leads many industry support committees.