Zeotech

TECHNICAL DATA SHEET #1
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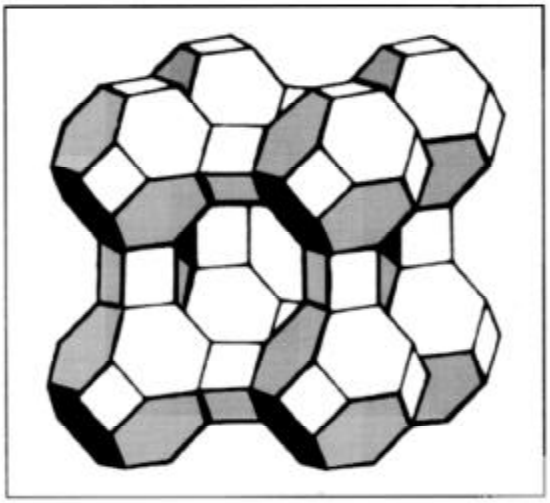
POOL WATER CHLORAMINE CONTROL WITH ZEOBRITE® FILTRATION MEDIA

Zeobrite® pool filtration media can be used in a comprehensive pool maintenance program to reduce chloramine production in pool water. **Zeobrite®** is a surface-active, molecular sieve that traps ammonium ions and disrupts the normal cycle of chloramine formation. A pool filtered with **Zeobrite®** media can remain effective considerably longer between breakpoint chlorination (shocking) treatment than pools with ordinary silica sand. The result is less chloramine odor and "red eye" and a significant savings in chemical costs. Pool water, depending upon water chemistry and bather load, may last twice as long before the need to treat with breakpoint chlorination (shocking) when using **Zeobrite®** media. Since some ammonium ions are stripped from the media every time the pool is shocked, **Zeobrite®** may only need to be regenerated with a saline solution once every two or three months of operation. A DPD chlorine test kit, available from pool supply stores, measures free chlorine and total chlorine. Subtracting free chlorine from total chlorine gives the amount of chloramines (combined chlorine) in the water. Concentrations greater than 0.5 ppm are undesirable. If a pool needs shocking every couple of weeks to remove chloramines it is probably time to also regenerate the **Zeobrite®** with a saline solution. **Zeobrite®** media lasts from 6 weeks to over 3 months before regeneration is needed.

Zeolite crystals in **Zeobrite®** pool media magnified approximately 2,000 times. The crystals are smaller that the diameter of human hair. Silt and other very fine suspended solids are removed from pool water by filtering through the large surface area created by the porous media. Backwashing removes contaminants and cleans the bed in preparation for the next filter cycle. **Zeobrite®** is engineered to last for several years in a standard sand filter vessel.



Example of the zeolite mineral lattice showing a molecular cage. Within each zeolite crystal are millions of these cages. The molecular structure creates apertures and channelways in each zeolite crystal. Ammonium ions are chemically bonded to the mineral lattice by exchanging for sodium and calcium ions. The ion exchange can be reversed as needed by backwashing with a saline solution.

CHLORINE DISINFECTION CHEMISTRY

Pool disinfectants containing chlorine such as sodium hypochlorite, calcium hypochlorite, HTH or chlorine gas form hypochlorous acid in water. Hypochlorous acid is an effective oxidizer for destroying bacteria, micro-organisms and organic matter. As it becomes spent by sunlight and interaction with organic matter, it forms the chloride ion (Cl^-), which is not detected when measuring chlorine levels and is not harmful to pool water. Chloramines are formed when hypochlorous acid reacts with ammonia. Chloramines have little sanitizing capability and are irritants to eyes and mucous membranes. They are the cause of "chlorine odor" in indoor pools. Pools usually need to be treated with breakpoint chlorination (shocking) when chloramine levels become greater than 0.5 ppm.

ZEOBRITE MOLECULAR SIEVE AND ION-EXCHANGE MEDIA

Zeolite crystals of the clinoptilolite type are present throughout each **Zeobrite®** granule. The crystals are composed of a mineral lattice of silica (SiO_4) and alumina (AlO_4) tetrahedra linked together by the sharing of oxygen atoms. This chemical structure produces open molecular cages with a negative electron charge, which is balanced by common positive ions (cations) such as calcium and sodium. The unique crystals, with their high ion-exchange capacity and small molecular cages (see drawing) of 4 to 5 angstrom units prefer ammonium ions ($NH4^+$) over most other ions. When ammonia and/or ammonium ions are present in pool water, even in trace amounts, they are chemically bonded to the zeolite by ion-exchange as water passes through the filter granules. This is very important because ammonia is the most common water contaminant from the decomposition of sweat, urine and organic material. The formation of chloramines requires ammonia. By removing ammonia from pool water, **Zeobrite®** disrupts the normal cycle of formation of chloramine.

EXAMPLE OF CHEMICAL REACTIONS

calcium hypochlorite + water → hypochlorous acid + calcium ions
(the good disinfectant)

hypochlorous acid + ammonia → monochloramine + water
(foul odor and irritant)

monochloramine + hypochlorous acid → dichloramine + water
(another bad chloramine

ammonia + water → ammonium ions

Zeobrite + ammonium ions → ammonium Zeobrite + calcium and sodium ions
The ammonium zeolite can be regenerated to a sodium Zeobrite with a saline soaking while th undesirable ammonium ions are flushed out with the backwash water.

MECHANISM OF CHLORAMINE REDUCTION WI H ZEOBRITE®

The formation of chloramines requires a nitrogen compound, and the most common nitrogen compound in pool water is ammonia. Ammonia is converted to ammonium ions by hydrolysis at normal pool water pH. By removing ammonium ions from pool water, **Zeobrite®** disrupts the formation of chloramines. Indoor pool operators have reported that chloramine odor has been greatly reduced for up to several months with **Zeobrite®**. Other operators have reported that their pools have required considerably less frequent chlorine shocking. One hundred pounds of **Zeobrite®** media could theoretically lock up, by ion-exchange, all of the ammonium

ions at a concentration of 1 ppm in 300,000 gallons of pool water. Since free chlorine at 1 to 3 ppm in pool water breaks down most of the ammonium, the **Zeobrite®** media is only needed to remove trace residual amounts of ammonium ions in order to keep chloramine formation at a minimum. Most pool filters contain several hundred pounds of **Zeobrite®**, allowing for a large volume of ammonium exchange capacity. Experience with **Zeobrite®** in indoor and outdoor pools suggests that many pools can go twice as long before chlorine shocking is needed. Odor in indoor pools may not buildup for several months. It is difficult to give a "rule of thumb" for the duration of the **Zeobrite®** dampening effect on chloramine formation because each pool water chemistry, bather load and the nature and type of water contaminants is different.

TESTING YOUR POOL WATER FOR CHLORAMINE

Ammonia and ammonium ions do not last long in well-balanced pool chemistry water. They are oxidized by free chlorine. Remaining amounts of ammonium ions are removed by **Zeobrite®** filtration media. As **Zeobrite®** becomes saturated with ammonium and/or if the free chlorine, pH and alkalinity are not in proper balance, chloramines begin to build up in the water. A DPD chlorine test kit can be used to determine if the pool needs shocking to remove the chloramines or if the **Zeobrite®** media should be regenerated. Follow directions on the test kit, available at most pool supply stores, to determine free chlorine and then total chlorine. Subtracting free chlorine from total chlorine will give the amount of chloramines (combined chlorine) in the water. A level of chloramine below 0.2 ppm is generally acceptable while 0.5 ppm is noticeable and above 1.0 ppm is high.

REGENERATING ZEOBRITE® FILTER MEDIA

Zeobrite® filter media used along with well planned pool breakpoint chlorination can control chloramine levels thereby reducing malodors and "red eye" problems. Pool water chemistry is quite complex. Zeotech Corporation and other companies continue to evaluate **Zeobrite®**, chlorine and chlorine by-product interactions. Removal of trace levels of ammonium ions from pool water by **Zeobrite®** disrupts the production cycle of chloramines. When **Zeobrite®** becomes saturated with ammonium, chloramines begin to build-up in pool water. Breakpoint chlorination (shocking) destroys chloramine levels in the pool and it may also destroy some of the ammonia that is bonded onto the **Zeobrite®** media. Additional testing remains to be done. **Zeobrite®** should be regenerated with an eight percent sodium chloride solution (three pounds of salt in five gallons of water) at least once per season in outdoor pools and perhaps every two to three months in indoor pools, when chloramine levels rise to unacceptable levels. Regeneration of the media bed can be performed with rock salt, water softening salt or table salt.

1. Drain the existing water from the filter, then close the inlet and outlet valves
2. Mix the salt solution in a container. For large commercial filters a salt solution tank and valve can be installed for ease of use
3. Open the filter vessel and pour the salt water solution to completely cover the **Zeobrite®** media.
4. Allow the salt solution to stand in the media bed for a minimum of four hours
5. Backwash the salt solution out the discharge drain with a backwash cycle
6. Resume the normal filtration of pool water

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