The Removal of Residual Chlorine from Tap Water that is to be Used in Aquaria

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Most municipal water supplies are treated with chlorine to control disease-producing organisms. Chlorine may be added as gaseous chlorine or as chloramine, which is a combination of chlorine and ammonia. Gaseous chlorine is more frequently used. Water treated with chlorine retains as tap water a high enough concentration of chlorine to be lethal to aquatic organisms. Even after the water has been placed in an aquarium and aerated several days, it may still retain enough chlorine to be lethal.

Many laboratories that utilize aquatic forms for teaching or experimental work must utilize municipal water for aquaria. The present paper reviews several methods for dechlorinating tap water for use in aquaria.

Laboratory tests (Wilhelmi, 1922) have indicated that chloramine has a more effective germicidal action than gaseous chlorine and is also more toxic to aquatic animals. Coventry, Shelford and Miller (1935) found that 0.3 to 0.4 ppm. of chloramine killed trout fry instantly and 0.06 ppm. killed trout fry in 48 hours. It was also found that 0.4 ppm. killed sunfish and bullheads, 0.7 ppm. killed hardy species of minnows, and 1.2 ppm. caused mortality to large carp and bullheads. These authors pointed out that chloramine does not decompose spontaneously and is not removed from the water by three to four hours of boiling.

Determining the toxicity of gaseous chlorine, Adams (1927) found that 2.0 ppm. of chlorine killed cladocerans. Davis (1934) reported that 1.0 ppm. was toxic to coarse fish. Ellis (1937) reported that 1.0 ppm. killed goldfish in 96 hours.

The more common means of eliminating residual chlorine from tap water used in aquaria are aging, aeration, filtration through various materials, and use of sodium thiosulfate. In our study each of these methods was investigated as a means of eliminating gaseous chlorine and the chemical method was also tested on chloramine.

Aging of water in a 20-gallon aquarium without aeration required a minimum of four days to reduce the chlorine content of 3.1 ppm. to a safe level for aquatic organisms. Larger volumes of water required only slightly longer periods of time to detoxify. Vigorous aeration in other tests reduced the time period for the same chlorine level by only one day.

The use of aquarium filters (Lewis and

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Cole, 1957) with a purely mechanical medium consisting of short pieces of glass tubing proved to be more effective than aeration. Chlorine concentrations up to 2.5 ppm. were reduced to safe levels in 20-gallon aquaria in slightly over 24 hours. The greater efficiency of this mechanical medium over aeration is probably due to the greater surface area afforded by the medium. Filters containing activated charcoal were very effective in reducing even high concentrations of chlorine. A pint of activated charcoal for a 20-gallon aquarium with a chlorine level of 3.1 ppm. reduced the chlorine content to a safe level for fish in about 8 hours and completely eliminated the chlorine in less than 12 hours.

Tap water containing chlorine can immediately be used for holding aquatic animals by the addition of sodium thiosulfate. On the basis of the reaction, it was calculated that 2 ppm. of thiosulfate would be required for each part per million of chlorine. Several tests of thiosulfate in the laboratory resulted in a factor of .008 grams per ppm. chlorine per gallon. Since the thiosulfate is not very toxic, overtreatment would not be dangerous. To test the effectiveness of the treatment with thiosulfate, fish were added to the aquaria immediately after the chemical was used. These fish survived for the entire test period of two weeks with no visible damage.

In order to test the use of thiosulfate on chloramine-treated water, ammonium hydroxide was added to an aquarium at a rate that was calculated to unite with most of the chlorine present producing a concentration of approximately 2.0 ppm. of chloramine. These tests indicated that thiosulfate was effective in detoxifying chloramine-treated water when used at the same rate as for water treated with gaseous chlorine. Fish added to this tank following treament for chloramine survived for the test period of two weeks in good condition.

To obtain some understanding of the variation of the chlorine content of the tap water, the content at the tap was periodically sampled in our aquarium room which is supplied by Carbondale city water. It was found that the chlorine content varied from day to day and increased in concentration when the water was permitted to run for 45 minutes. In the first few minutes the chlorine level varied from 0.0 ppm. to 0.5 ppm. by the end of 20 minutes had risen to an average of 1.0 ppm. and by 45 minutes was stabilized at a maximum of 2.0 to 3.1 ppm. The average daily chlorine content was found to be approximately 2.1 ppm. ranging from 1.2 to 3.1 ppm. Due to this variation in concentrations it was felt that direct treatment of the tap water would be more difficult than treatment of the water in the aquaria.

Discussion:

Aging and aeration of tap water was found to be effective in the removal of chlorine but required a considerable period of time. Filtration of the aquarium water was also found to reduce chlorine concentration but still required 8 hours or more for a 20-gallon aquarium.

Sodium thiosulfate proved to be effective in reducing toxic levels of chlorine or chloramine in aquaria very rapidly. The level of treatment required was .008 grams per ppm. of chlorine per gallon. When it is impossible to determine chlorine levels by analysis, the amount of thiosulfate can be determined by assuming a chlorine maximum of 5.0 ppm. At this level a 10-gallon aquarium would be treated by a crystal of thiosulfate the size of a kernel of corn. Any overtreatment of thiosulfate at this level will not be harmful to aquatic organisms. Where aquarium water is to be analyzed for dissolved oxygen, sodium thiosulfate should not be used.

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