ALUM APPLICATION TO LAKE ELSINORE, CALIFORNIA: QUESTIONNAIRE UPDATE

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1. DOES THE WATER CHEMISTRY AND SHALLOWNESS OF LAKE ELSINORE MEET THE CRITERIA FOR AN ALUM TREATMENT?

The water chemistry of Lake Elsinore is not suitable for an alum application because of the lake's high pH and alkalinity. Anderson (December, 2001) found that lake water alkalinity was not 200mg CaCO3/L (as reported by Black and Veatch, 1994, p.4-9), but 500 mg CaCO3/L. I have no doubts regarding the quality of Anderson's work.

The high pH -alkalinity of the lake means that unless pH can be permanently lowered to the pH 8 or less level, high amounts of toxic dissolved aluminate are likely to appear following an alum application. The high alkalinity will buffer the lake water, meaning that either high concentrations of alum will be needed and/or that the alum will have to be acidified in order to drive the pH down to the pH 8 or less level. There is no assurance that lake pH would remain at that level after treatment.

2. WHAT WILL BE THE CHANGE IN ALKALINITY FOLLOWING THE ALUM TREATMENT?

Anderson (December, 2001) carried out experiments to determine the responses of Lake Elsinore water to higher alum and acidified alum applications. It was found that only at the highest dose (100 grams Al per square meter; 18 mg Al/L) and highest additional acidification (20% sulfuric acid added) did alkalinity fall to a level that could maintain a lower pH. Lake water alkalinity is strongly influenced by runoff chemistry and by the chemistry of lake soils. It is likely that alkalinity will return to pre-treatment levels at some point.

3. WHAT WILL BE THE CHANGE IN pH FOLLOWING THE ALUM TREATMENT?

pH can be expected to fall in Lake Elsinore when acidified alum is used, but Anderson (December, 2001) demonstrated that an equilibrium pH which is significantly higher than immediate post-application pH could develop over the hours after treatment. If this occurs in Lake Elsinore, there is likely to be significantly increased levels of toxic aluminate ions formed.

9. ACCORDING TO THE SCIENTIFIC LITERATURE THE UPPER CONCENTRATION LIMIT FOR TOXIC DISSOLVED ALUMINUM IS 50 MICROGRAMS PER LITER. WILL THE ALUM DOSE PROPOSED FOR LAKE ELSINORE INDEFINITELY REMAIN UNDER THIS LIMIT?

Anderson's experiments (Anderson, December, 2001) support the conclusion that it is unlikely that dissolved and total aluminum concentrations in Lake Elsinore will be less that the USEPA limits for chronic and possibly acute toxicity. For this reason, Lake Elsinore is not a suitable candidate for an alum application.

Anderson showed that even at the highest alum and acid dose, dissolved aluminum (USEPA toxicity limits are based on total Al) was about 0.2 mg Al/L after 3 days, a value more than twice the USEPA chronic exposure limit of 0.087 mg Al/L. Further, his experiments show that as pH increases after application (as expected in this high alkalinity lake), dissolved aluminum increased as well. pH increased rapidly when water samples were bubbled (as would occur with artificial circulation). This increased pH would also provide ideal growth conditions for blue-green algae and lead to phosphorus release from any iron complexes. Dissolved aluminum increased rapidly with pH increase during slow and fast mixing. Thus normal wind mixing or mixing provided by any artificial mixing system may drive pH up and high levels of dissolved aluminum can then be expected. If artificial mixing is used with an alum application, his experiments indicate that high dissolved aluminum can be expected.

Anderson suggested that a calcium addition with the alum application would remove some of the alkalinity and shift the lake to a more desirable pH. This work has provided a new and better understanding of the alkalinity-pH-dissolved aluminum relationship. However, even with a calcium addition as part of an alum application, the margin of error appears to be slim. Laboratory-based jar tests are a useful and often accurate guide to lake water responses to additions of various compounds. But tests of this nature may not provide sufficient information about biological responses.

CONCLUSIONS

Anderson's experiments (Anderson, December, 2001) strongly indicate that there will be high dissolved and total aluminum concentrations in Lake Elsinore after an alum application, even with large doses of high acid alum. While calcium addition may partially or completely solve this water chemistry problem, lakes are biotic systems and I believe a wide margin of safety must be evident before treatment. The Precautionary Principle should be applied to the Lake Elsinore Project. Convincing evidence regarding safety to the biological community of Lake Elsinore after an alum-acid-calcium treatment is needed.

Based on the evidence to date, I do not support an alum treatment of Lake Elsinore.

REFERENCE

Anderson, M.A. 2001. Impacts of alum addition on water quality in Lake Elsinore. Unpublished report to LESJWA.