Removal of Algal Toxins from Drinking Water Using Ozone and GAC
[Project #446]

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OBJECTIVES:
The goal of this project was to provide water utilities with guidance regarding the application of ozone and GAC for the removal of a range of natural toxic algal metabolites.

BACKGROUND:
Toxic cyanobacteria (blue-green algae) have now been reported in 27 countries and are found on all continents, including Antarctica. Drinking water authorities worldwide are faced with the challenge of treating contaminated water, or the possibility of a toxic bloom occurring sometime in the future. The international water industry must obtain knowledge of reliable treatment options that are applicable in a range of conditions, for the cells themselves and the toxins they produce.

HIGHLIGHTS:
The following are highlights from the project:

- Ozone is an efficient treatment for anatoxin-a and microcystins.
- Saxitoxins are not readily destroyed under the same conditions.
- GAC adsorption alone cannot be recommended for the removal of microcystin toxins; however, when the filter functions in biological mode, removal is excellent.
- Effective removal of toxicity is found with GAC for the saxitoxins. This is due to the good adsorbability of the most toxic variants.

APPROACH:
Laboratory scale ozonation experiments were undertaken in four waters for microcystin LR, microcystin LA, anatoxin-a, and the saxitoxin class of cyanotoxins. The toxicity of the product water was also investigated. Laboratory GAC experiments were carried out over a six month period for saxitoxin removal. The experiment was undertaken in two waters. Pilot trials were undertaken at two water treatment plants in order to compare the removal of the two microcystins by GAC when preceded and not proceeded by ozone.

RESULTS/FINDINGS:
The main findings of the research are summarized below:

**Microcystin LR**
- Ozone—recommended
- Ozone/GAC—recommended
- GAC (adsorption)—not recommended
- GAC (biological)—potentially, requires much more research to achieve full implementation

**Microcystin LA**
- Ozone—recommended
- Ozone/GAC—recommended
- GAC (adsorption)—not effective at all
- GAC (biological)—potentially, requires much more research to achieve full implementation

**Saxitoxins**
- Ozone—not recommended
- Ozone/GAC—recommended
- GAC (adsorption)—recommended
- GAC (biological)—not recommended

**Anatoxin-a**
- Ozone—recommended
- Ozone/GAC—recommended

IMPACT:
Water utilities now have sufficient information to make informed decisions regarding water treatment options for the toxins studied. In the application of the suggested treatment methods, utilities can have the confidence to treat water affected with these algal toxins and distribute to consumers.

PARTICIPANTS:
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• Thames Water, United Kingdom
• South Australian Water Corporation

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