Investigation of the behavior of ammonia-oxidizing microorganisms in water purification processes

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1 INTRODUCTION

A decline of biological activity at low water temperatures causes ammonia leakage through BAC (biological activated carbon) adsorbing basins, which leads to the production of trichloramine in WPPs (water purification plants). Although there have been many studies on the nitrification activity of BAC, many aspects remain unknown regarding ammonia-oxidizing archaea (AOA) and bacteria (AOB), which play a role in nitrification. Therefore, we established a method for the measurement of AOA and AOB, and investigated their behavior in water purification processes.

2 INVESTIGATION

A) Establishment of pretreatment and measurement methods for AOA and AOB

Referring to the method adapted by Tokyo University[1)], we studied the pretreatment and measurement methods for AOA and AOB by real-time polymerase chain reaction (qPCR).

B) Investigation of the amounts of AOA and AOB in BAC and pre-filtration basins in WPPs

Investigations on AOA and AOB were conducted during the stationary and two-step chlorination phases, and after BAC renewal in WPPs. We also explored the possibility that the amounts of AOA and AOB, the viable cell count, and the ATP luminescence in BAC-treated water might be surrogate indicators of the amounts of AOA and AOB in BAC. Based on the results, we attempted to determine the relationship between the amounts of AOA and AOB and the nitrification activity.

3 RESULTS

A) The amounts of AOA and AOB in BAC and water were measurable by qPCR.

B) The AOA and AOB promptly fixed to the BAC after BAC renewal, and their amounts remained stable during the stationary phase. During the two-step chlorination phase, their amounts in BAC did not change drastically in WPPs employing a pre-filtration process while they decreased in the pre-filtration

basin. However, we could not confirm whether the amounts of AOA and AOB, the viable cell count, and the ATP luminescence in BAC-treated water could act as surrogate indicators of the AOA and AOB in BAC. The threshold levels of AOA and AOB related to nitrification activity remain unclear.

4 CONCLUSIONS

The amounts of AOA and AOB were measurable by qPCR, and we could determine some of the basic behaviors of AOA and AOB. Further studies on AOA and AOB are needed to clarify the relationship between the amounts of AOA and AOB and the nitrification activity.

1) Kasuga I et al ., Predominance of ammonia-oxidizing archaea on granular activated carbon used in a ful l -scale advanced drinking water treatment plant. WATER RESEARCH vol .44 No17, pp5039-5049, 2010