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Uptake by Algae of Dissolved Organic Nitrogen from BNR Treatment Plant Effluents

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UPTAKE BY ALGAE OF DISSOLVED ORGANIC NITROGEN FROM BNR TREATMENT PLANT EFFLUENTS

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ABSTRACT AND BENEFITS

Abstract:

The importance of dissolved organic nitrogen (DON) in wastewater treatment effluent has dramatically increased. This is because permitted effluent total nitrogen (TN) concentrations have been decreased to very low levels in response to problems with impaired surface water quality from eutrophication. For conventional secondary treatment, DON typically accounts for less than 10% of the effluent TN. However, it can be a major component (>50%) in effluents from advanced biological nutrient removal (BNR) treatment plants, for which most of the inorganic nitrogen species and effluent suspended solids are removed. DON persists in effluents from BNR systems, yet little is known about the potential impact it has on surface water quality. Of particular interest is what portion of DON is readily available for algae consumption or can be converted to forms to support algal growth, and what types of substances compose DON.

To develop a better understanding of the occurrence and bioavailability of DON in effluents from advanced BNR systems, a new protocol was developed for measuring the readily bioavailable DON and forms of DON that are not readily taken up by algae (recalcitrant DON). An anion exchange resin was used to remove nitrate while an XAD-8 resin was used to remove hydrophobic forms of DON. To assess the bioavailability of wastewater-derived DON, algal growth assays were performed in the presence of bacteria in effluents from 10 municipal BNR wastewater treatment plants.

The results showed, after nitrate removal, only minor and statistically insignificant differences in algal growth and DON consumption between untreated samples and samples from which the hydrophilic forms of DON were removed. Growth of algae and DON consumption were not observed in the hydrophobic fraction from XAD-8 resin separation, despite the fact that this fraction contained up to approximately 30% of the DON. These findings indicate that the hydrophobic DON retained on the XAD-8 resin is not readily taken up by algae over periods of several weeks. They also indicate that the XAD-8 treatment combined with an anion exchange resin can be used to quantify and separate this recalcitrant form of DON from bioavailable DON and nitrate.

Benefits:

- Provides an improved protocol for making low-level measurements of dissolved organic nitrogen (DON) in effluent from BNR wastewater treatment plants.
- Provides further evidence that BNR wastewater treatment plant effluent contains forms of DON that are not readily available to algae. That evidence provides a basis for more efficient control of nutrient pollution and a more scientific basis for evaluating the impact of effluent DON on surface waters.
- Provides a simpler, faster, and robust protocol without extensive bioassay for separating and quantifying readily bioavailable DON from recalcitrant DON in BNR effluents.

Keywords: Dissolved organic nitrogen, algae, eutrophication, humic substance.

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