Effects of biogenetic reactive oxygen species on organic pollutant degradation in the presence of visible light and natural biofilms

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Introduction and Method

Diurnal rhythm has significant effects on geochemical characteristics of natural waters and behavior of trace metals in the waters [1]. However, few studies have reported its effects on behavior of organic pollutants. We tried to figure this out by investigating the behavior of a typical non-persistent organic pollutant (n-dodecyl benzene sulfonate, DBS) in natural biofilm-water systems under periodic visible light illumination [2]. Unexpected rapid degradation of DBS was observed with the presence of both intact biofilms and light. This was supposed to be caused by biogenetic reactive oxygen species (ROS) produced by photosynthesis [3]. To prove this, we measured the content of a typical ROS, H_2O_2, in the systems, and investigated the roles of some ROS in DBS degradation using corresponding *quenching reagents*.

Results and Discussion

In the system with most significant DBS degradation (both intact biofilms and light), H_2O_2 concentration was much higher than that in the other systems, and the concentration increased with illumination time. While in systems with organism inhibitors (DCMU and azide), H_2O_2 was negligible, indicating the ROS were mainly biogenetic. Concentration of H_2O_2 in systems with different amount of biofilms was proportional to degradation rate of DBS in these systems. The application of *quenching reagents, which decreased the DBS degradation remarkably,* confirmed *the presence of* $\cdot OH$ *and* $^1O_2$ *and their roles in DBS degradation. With the presence of Fe minerals in the biofilms and the* H_2O_2 *produced,* Fenton-like effect was observed. Indirect measurement showed the presence of $\cdot O_2^-$ and its generation rate was faster than that of H_2O_2, which imply that $\cdot O_2^-$, produced mainly by photosynthesis process, was the origin of the other ROS. This study preliminarily confirmed the presence and the roles of the biogenetic ROS in aquatic environment.

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[1] Nimick *et al.* (2011) *Chem. Geol.* **283**, 3-17. [2] Hua *et al.* (2012) *J. Hazard. Mater.* **229-230**, 450-454. [3] Kim *et al.* (2004) *Aquat. Microb. Ecol.* **35**, 57-64.