Improvement in denitrification efficiency at low temperature with addition of redox mediators

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ABSTRACT

The efficiency of wastewater denitrification was determined in batch cultures at low temperatures (10°C and 15°C) by adding different redox mediators (RMs; anthraquinone-2,6-disulphonate [AQDS], 2-hydroxy-1,4-naphthoquinone [LAW] and 1,2-naphthoquinone-4-sulphonate [NQS]). The denitrification rate and nitrogen removal efficiency were found to increase with the addition of RMs at low temperatures compared with the control. At 10°C, the highest nitrogen removal efficiency was 11% (control: 5%) and maximum denitrification rate of 2.06 mgNO$_3^-$–N/g volatile suspended solid [VSS]·h was achieved with addition of NQS (control: 1.15 mgNO$_3^-$–N/g VSS·h). At 15°C, the maximum denitrification efficiency increased to 18.7% with addition of LAW (control: 10.7%) and the denitrification rate improved to 5.63 mgNO$_3^-$–N/g VSS·h with addition of NQS (control: 3.53 mgNO$_3^-$–N/g VSS·h). Investigation of the underlying mechanism revealed a typical redox reaction. Addition of different RMs improved the oxidation-reduction potential, sludge dehydrogenase activity, and electron transport system to some extent compared with the control. Furthermore, the high-throughput sequencing revealed the presence of denitrifying bacteria such as *Thauera* spp., *Pseudomonas* spp., and *Dechloromonas* spp. in the acclimated sludge.

Keywords: Low temperature; Redox mediator; Denitrification rate; Efficiency

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