

NITRIFICATION INHIBITION ASSAY BASED ON MICROBIAL SENSORS

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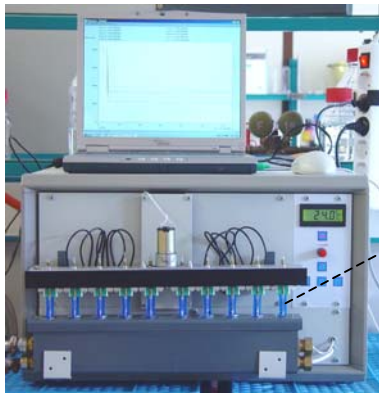
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INTRODUCTION

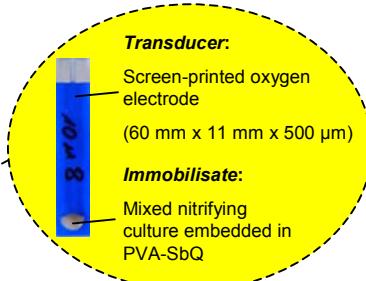
Due to their slow growth autotrophic nitrifying bacteria are among the most sensitive purifiers in waste water treatment plants. Organic matter, high concentrations of ammonium and toxic compounds from various industrial sources can disturb the purification process and inhibit the nitrification step. Therefore a biosensor system based on miniaturised microbial sensors was developed for the screening of inhibiting effects on nitrifying microorganisms. These biosensors are composed of an enriched mixed nitrifying culture immobilised onto low cost screen-printed oxygen electrodes and are integrated in a multichannel device. In this array, data from up to ten sensors can be simultaneously recorded, thus allowing the quantification of inhibiting and toxic effects between 10 to 30 minutes. In these studies environmental chemicals and waste water samples were investigated and compared to the standardised test system EN ISO 9509 (inoculum: suspended activated sludge, incubation time: 4 hours) for evaluation of the newly developed nitrification inhibition test.

MATERIAL & METHODS

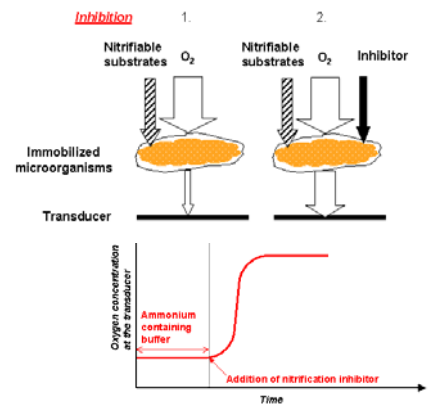
Multichannel device



Disposable nitrification biosensors



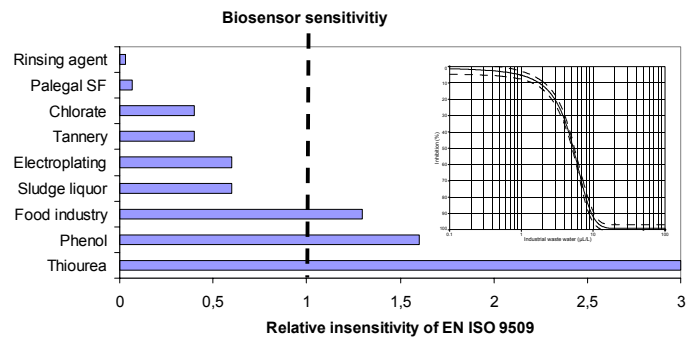
Principle of detection



RESULTS

Nitrification inhibition of chemicals and waste water samples. Quantification of the inhibitory effect determined by biosensors and EN ISO 9509.

Sample	IC ₅₀	
	Biosensor system	EN ISO 9509
Palegal SF	1,5 mL/L	0,1 mL/L
Commercial rinsing agent	1,6 mL/L	0,05 mL/L
Potassium chlorate	1,2 g/L (IC ₇₅)	0,5 g/L (IC ₇₅)
Phenol	1,2 mg/L	2,8 mg/L
Thiourea	32 µg/L	96 µg/L
Penicillin G	no inhibition up to 1 g/L	-
Oxytetracycline	no inhibition up to 1 g/L	-
Sulfamethoxazole	no inhibition up to 1 g/L	-
Tannery waste water	100 mL/L (IC ₅₀)	40 mL/L (IC ₅₀)
Electroplating industry	5,3 µL/L	3,4 µL/L
Sludge liquor	432 mL/L	273 mL/L
Food industry (alcohol mixture)	1,2 mL/L	1,6 mL/L



Comparison of biosensors sensitivity with EN ISO 9509. The quantified inhibitory effect (e.g. IC₅₀) of samples is related to the biosensors (< 1 ISO-method is more sensitive; > 1 ISO-method is less sensitive than biosensors). The figure inside shows the sigmoidal concentration dependency on the biosensors to the waste water sample from electroplating industry.

Although the biosensors and EN ISO 9509 are characterised by different exposure times, both systems are comparable in regard to sensitivity (maximum difference: factor 3). Only when surfactants are investigated are the biosensors less sensitive than EN ISO 9509 due to the diffusion barrier of the immobilisate to substances with high molecular weights.

CONCLUSIONS

A test system has been developed enabling the fast, reliable and reproducible determination of nitrification inhibiting effects and has been successfully implemented in contract investigations.

