

Online Toxicity Monitoring System using Sulfur Oxidizing Bacteria (OTMS-2013)



Patent

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England : GB2466974

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Japan : JP2011-94839

EU : EP11163029.9

China : CN201110100395.9

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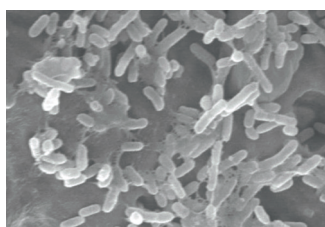
Online Toxicity Monitoring System using Sulfur Oxidizing Bacteria

OTMS-2013 is an online biological toxicity early-warning system which employs sulfur oxidizing bacteria (SOB) and can monitor remote locations in real time and produce an alarm when toxic substances are detected. The system offers simple and reproducible tests that can be automated.

>>> Principle



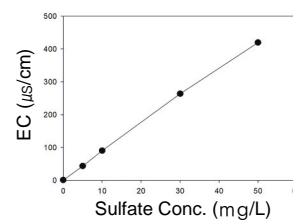
Sulfur particles



Sulfur oxidizing bacteria



Biosensor



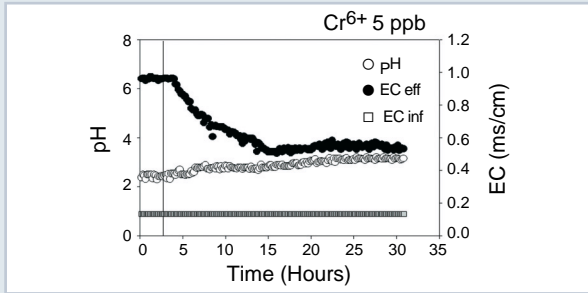
Sulfate concentration vs EC

- Our online toxicity monitoring system using sulfur oxidizing bacteria (SOB) relies on the production of hydrogen ions (H^+) which lowers the medium pH, and SO_4^{2-} which increases the electrical conductivity (EC) of the medium.
- The increase in EC and the decrease in pH indicate that SOB attached to the S° particles and oxidized the S° to H_2SO_4 using O_2 provided as the electron acceptor.
- In the presence of toxic chemicals, the activity of SOB will be inhibited, which will cause an increase in pH and a decrease in EC.
- Thus, toxicity can be detected using simple EC and pH meters.

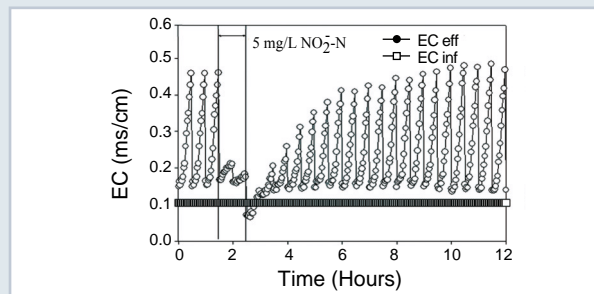
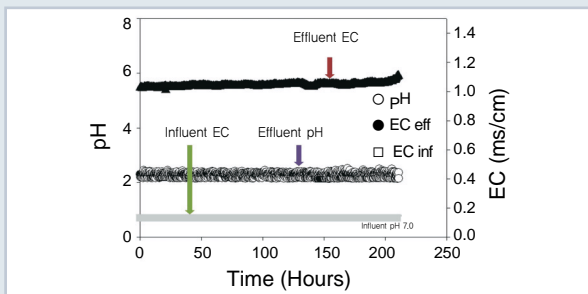
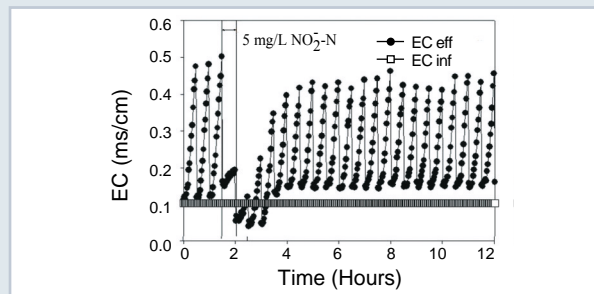
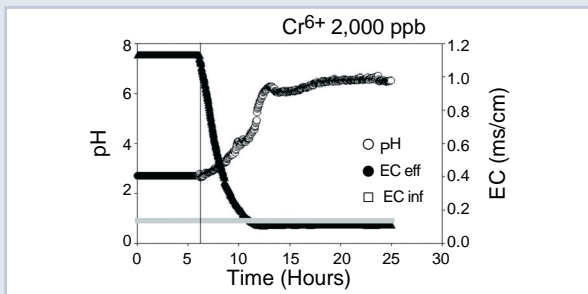
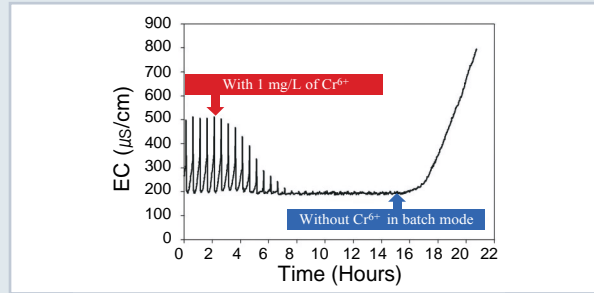
Comparison of different biological species for toxicity monitoring.

	Sulfur Oxidizing Bacteria (EC50)	<i>Vibrio fischeri</i> (EC50)	Fish, 96-h (LC50)	Daphnia, 48-h (EC50)	Ostracod (EC50)	Algae (EC50)
Zn ²⁺	0.05	0.5-55	0.55-7.2	0.76-8.1	3.4	0.06
Cd ²⁺	0.01	0.015-3.7	1.0-100	0.035-1.9	3.2	0.04
Pb ²⁺	0.05	2.56	1.4-8.0	3.6	-	-
Cr ⁶⁺	0.01	-	11.2-133	0.26-1.8	20.1	-
Hg ²⁺	0.005	0.064	0.01-0.9	0.03-0.05	0.37	-
Benzene	0.005	2.0	-	-	-	-
Phenol	0.005	-	-	3.1	-	-

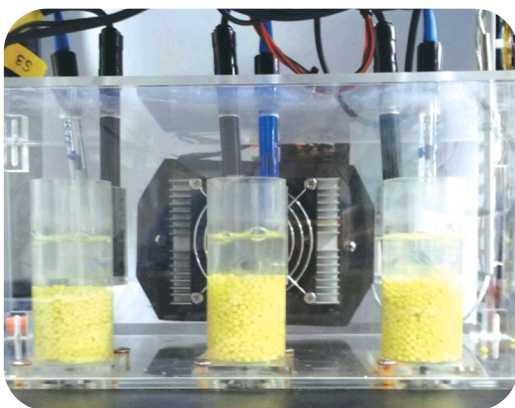
● Continuous operation



● Semi-continuous operation



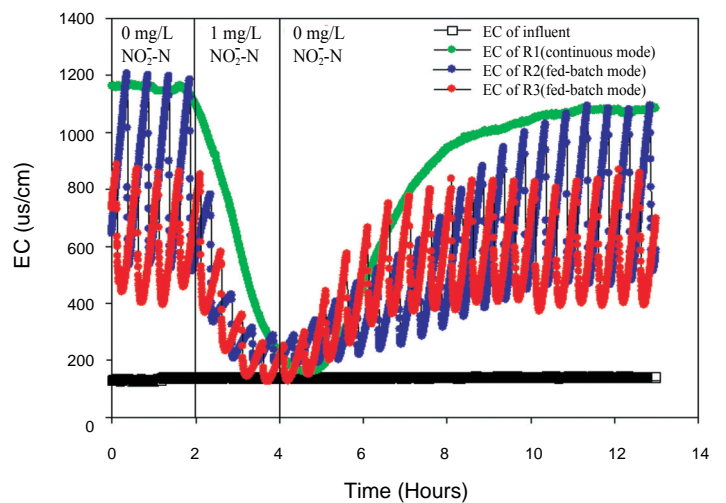
● Biosensors (R1, R2, and R3) with sulfur in the system



R1

R2

R3



Advantages

- It is simple, uses little energy, and its sensitivity is not reduced by turbid waters.
- Long term operation (months) compared to other sensors that have to be maintained for feeding every week
- Periodic calibration of pH and EC meters is not needed.
- No toxic byproducts are produced – the total mass of sulfate produced is low.
- High sensitivity – contaminants are detected in the low ppb range due to the low operating pH.
- High accuracy and stability since three different sensors are simultaneously operated.
- Since the SOB biosensor gives a biological response to toxicity, the response is to the additive and synergistic effects of multiple contaminants which is likely a better predictor of overall toxicity than the measurement of individual chemicals.

Application of our system

- Drinking water intake
- Monitoring of rivers, lakes, reservoirs
- Monitoring of industrial effluents and influents
- Monitoring of ground water
- Monitoring of the influent and effluent of wastewater treatment plants
- Sediment and soil testing

◆ Specification

Model	OTMS-2013
Test Organism	Sulfur oxidizing bacteria (SOB)
Detection time	2-30 minutes
Measurement	pH and EC
End point	Decrease in EC due to inhibition of SOB
Detection range	0.005~10 ppm depending on toxic substances
Operating Temp	30-40°C
Operating mode	R1 : continuous mode; R2, R3 : semi-continuous mode
Electrical power	1 kW
Size dimension	50 cm (W) x 66 cm (D) X 115 cm (H)
Weight	60 kg
Output	TCP/IP, 4-20 mA, RS-232
Display	LCD touch sensitive