Making every drop count: the bioremediation of produced water

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Background

Climate change and increasing population continue to threaten the global availability of freshwater, as demand continues to exceed supply[1]. Produced water (PW) is one of the largest waste products of the oil industry, with over 21 billion barrels produced annually in the United States alone[2]. Bioremediation provides an environmental-friendly and sustainable way for the cleanup and reuse of PW for industrial and agricultural purposes. However, most PW are highly saline and contain a diverse range of hydrocarbons and heavy metals which prevent the growth of many conventional microorganisms[3].

Objective

To investigate the ability of a previously isolated hydrocarbon-degrading bacteria, *Modicisisalibacter* sp. strain Wilcox, to degrade selected hydrocarbons at high salinity and in the presence of different heavy metals.

Methodology

- Set up microcosms containing mineral salts medium with 2.5M NaCl (14.5% salinity) and varying concentrations of heavy metals.
- The microcosms were sealed with Teflon-coated septa and aluminum crimps.
- 3 microliters of undiluted Benzene, Toluene, Ethylbenzene and Xylene mixture (BTEX) was injected into autoclaved microcosms.
- The concentration of BTEX in the microcosms was monitored weekly, up to 5 weeks using a Gas Chromatograph.

Results

Heavy Metal	Highest Concentration Tolerated (mM)	Concentation in mg/L	Degradation Time (Weeks)
Arsenic	100*	31,200.00	2
Manganese	100*	16,902.00	2
Cadmium	12.5	2,291.25	2
Zinc	7	953.96	4
Lead	3	993.60	4
Selenium	3	789.09	3
Chromium	2	532.90	3
Cobalt	0.5	118.97	2
Nickel	0.5	118.85	4
Copper	0.25	42.62	5

Table 1: Metal tolerance limit of *Modicisisalibacter* sp. strain Wilcox expressed in different concentration parameters and time taken to achieve complete degradation of BTEX in the presence of metals
***** Experiment testing higher concentrations in progress

Conclusions

- *Modicisisalibacter* sp. strain Wilcox can tolerate a wide range of heavy metals, some at level higher than have been reported in literature for an isolated microorganism.
- *Modicisisalibacter* sp. strain Wilcox can degrade BTEX at high salinity and in the presence of of heavy metals commonly found in PW.

Significance

- The ability of this bacteria strain to thrive at high salinity, breakdown a variety of hydrocarbons, and tolerate different heavy metals makes it a promising candidate for the cleanup of PW.
- The cleanup and reuse of PW for agricultural and industrial purposes can prove critical for Oklahoma and other oil-producing states that are increasingly experiencing droughts and water scarcity.

References

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