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Methanogenic biodegradation of crude oil storage tank sludge enhances bio-corrosion of mild steel

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Methanogenic biodegradation of crude oil sludge was investigated using chemical and molecular approaches. 16S rRNA gene sequences recovered from the samples revealed significant presence of *Marinobacterium* (63%), *Pseudomonas* (3%) alongside with acetotrophic *Methanosaeta* (16%) and hydrogenotrophic Methanobacterium (5%). The resident microbial community was able to reduce the gravimetric weight of residual oil by 65.5% (with complete degradation of C5-C17 nAlkane fractions) in non-amended samples and 94.13% (with complete degradation of C5-C25 nAlkane fractions) in substrate amended samples during the 60-day incubation period. As biodegradation progressed, acetotrophs consume acetate at the rate of 0.41mM/day-1 while hydrogenotrophs consume hydrogen at the rate of 0.59mM/day-1. The Respective volume of methane produced and corrosion rates observed were higher in highly biodegraded samples (3.60mmol/0.084 mm/yr) than lesser biodegraded samples (1.64 mmol/0.018 mm/yr). Our results showed that the resident methanogenic archaea were largely responsible for the anaerobic biodegradation of hydrocarbons in crude oil sludge and biodegradation were enhanced with substrate amendment which further accelerated the corrosion rates of mild steel coupons. Considering the relatively high number of facultatively anaerobic *Marinobacterium* and significant presence of *Pseudomonas* in the sequenced data, we speculate that the bacteria were at least partially responsible for biodegradation of crude oil components potentially acting as syntotrophic organisms with methanogens to convert crude oil to methane and subsequently enhance corrosion rates of mild steel coupons.

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