

Use of Various Amendments to Control Methane Production during Environmental Applications

Michael Scalzi (mikescalz@iet-inc.net) and **Antonis Karachalios** (akaracha@iet-inc.net)
(Innovative Environmental Technology, Inc., Pipersville, PA, USA)

Background/Objectives. In situ reductive dehalogenation processes have been found very effective for the remediation of numerous recalcitrant and toxic compounds, including chlorinated ethenes. One seemingly universal phenomenon has been the biological production of methane, especially during the early phases of the process. Active measures to control the production of methane can offer multiple advantages in terms of cost, treatment efficiency, and safety. Production of methane is a direct indication that hydrogen generated from the electron donor amendments was used by methanogens instead of the target microbes (e.g., *Dehalococcoides* spp.), substantially reducing application efficiency.

Approach/Activities. This study presents a series of test results that were performed in order to address the effectiveness of red yeast rice (RYR) extract and various kinds of essential oils to inhibit the methane production. The RYR experiments were performed by using dosages of 20 and 40 mg/L respectively, while the essential oils were tested at dosages of 4% and 10% and included: garlic oil, cinnamon bark oil, cinnamon bark powder and lemongrass oil.

Results/Lessons Learned. During the RYR experiments and prior to the addition of the RYR extract, methane concentrations in the biogas varied from approximately 55% to 70%, which indicated an active methanogenic culture. Following the addition of RYR to 40 mg/L in Reactor 2, the methane content of produced biogas was rapidly reduced from 62% to below detection (0.05%) within 11 days and remained below detection levels until the reactors were dismantled on Day 17. Addition of RYR at 20 mg/L to Reactor 1 on Day 7 reduced the methane content of biogas from 65% to below detection (0.05%) by day 17 (i.e., after 10 days). During the Test period, the total volume of biogas produced per week in either reactor did not change appreciably, only the methane concentration. By adding RYR, fermentative gas production quickly shifted from electron donor-consuming methanogenesis to primarily fermentation by-product carbon dioxide (the bulk gas contained mostly CO₂). The essential oil laboratory tests showed that all four (4) kinds of essential oils were successful in decreasing the amount of methane produced, with the Garlic Oil appearing to be the most effective of all by gradually decreasing the methane production by 29% 7 days after the initiation of the experiments, by 60% after 11 days and 79% after 16 days.