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Bioremediation of hydrocarbon water pollution by bioaugmentation using Southern African bacterial isolates

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ABSTRACT

A new, non-pathogenic bioaugmentation product was formulated specifically for underground use in South African mines, using local bacterial isolates. This was designed for the remediation of various hydrocarbons via biochemical breakdown by sub-surface microorganisms. The active microorganisms were isolated from hydrocarbon-polluted areas of a gold mine. Many commercially available bioaugmentation products are already in existence however, all, to our knowledge, have been developed and tested primarily for use in the northern hemisphere. None have been formulated and tested in Africa. Our series of bacterial isolates are the first to be isolated from mine soils for hydrocarbon biodegradation purposes. Such isolates have further, not previously been tested on sub-surface contamination. The safety associated with the use of such a product in a closed mine-environment is of paramount importance.

Initial batch-flask experiments were conducted using a readily-available commercial bioremediation product. This was tested on simple surfactant molecules and compared to the biodegradation observed under standard waste water treatment plant conditions. The bioremediation product increased biodegradation by 6% on average. Bacteria in the product were identified by 16S rDNA gene sequence analysis and found to be homologous to potentially pathogenic *Bacillus cereus*, known especially to effect immunocompromised individuals, this was of particular concern in the closed mine system.

South African isolates were sourced from various hydrocarbon-polluted sources, with six bacteria ultimately being selected from deep sub-surface mine soil and water samples. The ability of these isolates to biodegrade waterborne monograde engine oil was assessed via GC-FID. The isolate showing average percentage growth increase, homologous to *Pseudomonas pseudoalcaligenes*, was found to degrade the motor oil by 98%. The new isolates were, on average, 16% more efficient at biodegrading petroleum hydrocarbons than the commercial bioremediation product isolates. Formulation of these isolates into the first commercially-available South African developed and tested bioaugmentation product will prove a successful conclusion to this study.