Mineral Oil Biodegradation Within Permeable Pavements:

Long-Term Observations

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ABSTRACT

Initial studies on a laboratory-based permeable pavement structure (PPS) augmented with liquid fertiliser demonstrated unsustained mineral oil biodegradation. It was concluded that nutrients were rapidly leached from the structure by infiltrating rainfall. Maintained elevated metabolic indicators were observed for a period of over 400 days following the application of a nitrogen-phosphorous-potassium (NPK) water-soluble slow-release fertiliser. Biodegradation was observed to be temperature-controlled with a Q_{10} coefficient of 2.3. Increased biodegradation was facilitated by an alternative slow-release fertiliser (NPK and trace minerals). Oil and grease effluent concentrations were consistently below 20 mg/l from a surface loading of 1800 mg/l. Good correlation between COD and oil and grease concentrations was derived and used as a predictive tool in subsequent experiments. The PPS exhibited a buffering capacity, raising acidic rainwater *p*H to near neutral. Mean effluent concentrations of 1.5 mg/l total nitrogen and 1.1 mg/l phosphate were below water quality limits.

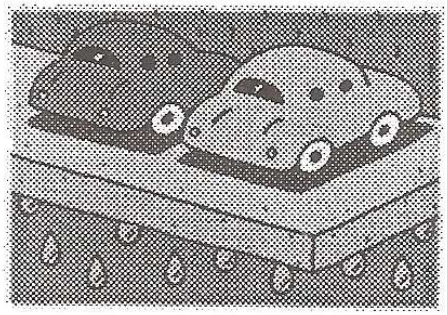
Initial potassium losses and biomass recovery occurred following road-salt addition (at 2165 g/m^2). A closed-rig-system allowed oil-degradation rates to be calculated. The slow-release fertiliser (NPK and trace-minerals) supported an oil-degradation rate of 336 g/m^2/year, a predicted half-life of 143 days and a residence-time of 208 days. The upper geotextile exhibited substantial oil retention.

Microbiological studies confirmed the presence of oil-degrading micro-organisms, demonstrated the diversity of the biomass and indicated partial self-colonisation of the structure components.

The PPS demonstrated an oil-retaining capacity of 9542 g/m^2. A concrete aggregate was recommended as an alternative construction material to increase oil retention and enhance stormwater attenuation. It was demonstrated that aerobic conditions would be preserved within the sub-base under expected long-term loadings.

It was concluded that an oil-degrading microbial population could be sustained long-term within the structure. The application of slow-release fertiliser assured the persistence of the hydrocarbonoclastic assemblage, maintaining an oil retention/ biodegradation efficiency of 98.7%. It was hoped that ultimately the structure could be used to ameliorate the input of oil into urban watercourses, from highways, car parks and oil-handling facilities.

Dedicated to Harry T. Bond without whom none of this would have been possible



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