ON-SITE TREATMENT AND DISPOSAL OF SEPTIC TANK EFFLUENT

by

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ABSTRACT

The effects of treating domestic wastewater in a septic tank and disposing of the effluent for absorption into surface and sub-surface soils were examined. The quality of the septic tank effluent (STE) was determined for the sodium level and sodium adsorption ratio (SAR) from 50 septic tanks of households using rainwater as the domestic source of supply. The average sodium concentration was 83 mg L^{-1} and the SAR was 3.6. The quality of STE from homes using town water was examined from the difference between the treated town water supply and the effluent outflows of sewage treatment works (STW) for that town. The increase between the town water input and the STW outflow showed a 63 mg L^{-1} increase in sodium and an increase in SAR of 2.5. The reduced sodium load and SAR result from increased dilution from a greater use of water within the home. Treated water supplies, quantified for 68 towns throughout northern NSW showed average sodium levels of 52 mg L^{-1} and SAR 2.2 for inland areas, and sodium levels of 15 mg L^{-1} and SAR 1.1 for towns along the coastal fringe.

Many of the sources of sodium in the household were found to include the clean water input, soaps and detergents in the laundry, kitchen and bathroom. Forty three brands of laundry detergents were analysed to examine the levels of sodium in domestic wastewater from the laundry. The results showed that 38% of the household's sodium budget came from that source and the sodium load could be reduced through the choice of laundry detergents.

A survey of local government councils provided data on on-site disposal for wastewater treatment and drainfield design from the regulators perspective. This survey revealed that the common length of drainfield was 20 metres, while failure in drainfield function was often a result of hydraulic overloading. A survey of 111 households provided information on wastewater production patterns, and management practices for septic tanks and traditional sub-surface drainfields. Few residents undertook any management of the wastewater system and only addressed failure of the septic tank when it occurred; they rarely saw failure of the drainfield as important.

The methods employed by councils and consultants to measure soil percolation of effluent for designing drainfields were evaluated using double ring infiltrometers, standard percolation tests and disc permeameters. An alternative method of using undisturbed soil cores wrapped in heat-shrink plastic was developed for measuring hydraulic conductivity and was tested on 10 soils. There was high variability within sample replicates for the disc permeameter with coefficients of variation (CV) up to 102%. Variability using undisturbed cores ranged from 17 to 71%. The hydraulic conductivity tests were undertaken using clean water, as is the standard practice, and with three simulated effluents (SAR 3, 8 and 15). There was a trend of decreasing saturated hydraulic conductivity (Ksat) with increasing SAR across a range of soil types and significant differences between treatments for surface and sub-surface soils of black earth, grey-brown podzolic, red-brown earth and chocolate soils. The high variability between replicates reflects the high spatial variability within the soil and the need to increase the number of samples tested to gain a reasonable degree of accuracy in evaluating Ksat. The current practice of undertaking three clean water tests per site

over short periods of time does not reflect the long term application rate (LTAR) for STE.

The results of the hydraulic conductivity measurements indicate that septic tanks effluent, with an average SAR of 3.6, will reduce soil hydraulic conductivity in many Australian soils. While amendment of the soil using gypsum is possible, reduction of the sodium load in domestic wastewater is required. The tests carried out for designing long term acceptance rates of soils must be undertaken using water of a similar quality to the effluent to be disposed of, whether by surface or sub-surface absorption. Where clean water tests are used, it is likely that the design LTAR will overestimate the long term operation of either the surface irrigation area or the sub-surface absorption trench. There is a need for tests to operate over longer periods to allow the effluent to equilibrate with the soil through which it percolates.

A laboratory and field experiment was conducted using peat to pretreat STE before disposal by surface irrigation. The results indicated that total solids, biochemical oxygen demand and faecal coliform were significantly reduced in the treated effluent . The peat bed is a low energy and low-cost alternative to aerated wastewater treatment systems (AWTS) and with chlorination of the low levels of faecal coliforms in the leachate the final effluent would be acceptable for irrigation. The field trial indicated that a 10 year life is expected from the peat bed with minimal annual maintenance. The sodium content and SAR of the treated effluent remained uncharged from the STE and amelioration of the disposal area is required, as should be undertaken for all STE and greywater disposal.

A strategy for identifying sodium concentrations in household products and reducing overall sodium loads in septic tank effluent needs to be explored. A strategy for septic tank safe products, based upon the effects of sodium on soil hydraulic conductivity is also required. It is not sufficient to remove organics and disinfect the effluent, chemical reduction or amendment is required.

A comprehensive set of guidelines is required for the maintenance of the septic tank, drainfield and irrigation area, including the requirements for pump-out cleaning of the tank. Councils should undertake the development of a data base of local soil capabilities with respect to on-site disposal requirements. Local guidelines need to be developed for percolation testing using water of a similar quality to STE and over a longer period to allow the chemistry of the effluent to equilibrate with the soil.

The effects of soil variability and effluent chemistry on saturated hydraulic conductivity require that to derive a reasonable degree of accuracy, many soil samples have to be equilibrated over periods in excess of 72 hours with water of a quality similar to the effluent. The use of undisturbed cores permitted both these conditions to be met. The results indicated a trend in decreasing Ksat with increasing SAR, thus drainfield designs must be undertaken with water of a similar quality to the STE.

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