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**Improving the Performance of
Septic Tank Soil Absorption Systems**

A thesis presented in partial fulfilment of the requirements for the degree of
Master of Technology at Massey University

by
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Abstract

This thesis is primarily a literature review of research and information about septic tank soil absorption systems and their combined performance as on-site sewage treatment systems. The purpose of the review is to analyse the functions of the tank and the soil absorption area and assess how aspects of their design affect their overall performance. Design variations that optimise septic tank soil absorption system performance have been determined so that they can be applied in New Zealand.

An assessment of New Zealand septic tank soil absorption systems with regard to their treatment capabilities shows that they are designed to fail. That is, the tanks are designed to produce a poor quality effluent, and the absorption areas are designed to produce saturated conditions so that contaminants in the effluent are transported to groundwater. Inadequate systems are installed and used because there has been little New Zealand research into the environmental and public health effects of their use and how these effects could be reduced, and there has been limited application of knowledge gained from overseas research.

Septic tank design features that optimise wastewater treatment are dual or multi-chambered tanks, outlet tees, outlet baffles, anaerobic filters, and large sludge storage volumes. These features improve the physical processes of sedimentation and separation, the biological process of anaerobic decomposition, and provide storage for accumulated sludge and scum. Incorporating these features can achieve consistent, significant biochemical oxygen demand and suspended solids reductions and assist in retaining pathogenic organisms and nitrogen in the sludge at the bottom of the tank. Dual or multi-chambered tanks, outlet tees, and outlet baffles are effective because wastewater short-circuiting is avoided or decreased and sludge is retained in the tank. Anaerobic filters provide effective treatment of low strength wastewater and are insensitive to variable loading rates. This makes them suitable for the types of wastewater and loading use generated by individual households. Improved septic tank effluent quality in terms of BOD and suspended solids concentrations extends the life of the soil absorption area.

Soil absorption area design features that optimise wastewater treatment are pressurised effluent distribution in all soils, effluent application at hydraulic loadings appropriate to the soil type, the presence of a biological mat, particularly in sandy soils, and passive de-nitrification components. These features ensure that effluent is applied to the entire infiltrative surface at the design hydraulic loading, assist in removing pathogenic organisms in the effluent, and avoid or decrease adverse effects on groundwater quality from nitrates.

Critical aspects of the soil absorption area design are the hydraulic loading, the method of distribution, and components that promote de-nitrification. Potential adverse effects on groundwater quality and public health are reduced by maintaining unsaturated conditions under the soil absorption areas and removing nitrates. Uniform effluent application at a rate compatible with the infiltration capacity of the soil is essential to avoid saturated conditions. Uniform application is achieved by pressure distribution.

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