

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 (K_{sat}) 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 K_{sat}. 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 unchanged 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 K_{sat} with increasing SAR, thus drainfield designs must be undertaken with water of a similar quality to the STE.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Domestic Wastewater Disposal	1
1.2	Definitions	1
1.3	Impetus for Study	3
1.4	Study Objectives	5
1.5	Thesis Outline	6
2	LITERATURE REVIEW	9
2.1	On-site Disposal of Wastewater	9
2.2	Septic Tank Operation	12
2.3	Sewage Disposal in Australia	12
2.3.1	New South Wales	12
2.3.2	Other states	13
2.3.3	Legislative and government requirements in NSW	13
2.4	Problems with Septic Tank Systems	15
2.4.1	Australian and overseas problems	15
2.4.2	Environmental problems	18
2.4.2.1	Septic tank effluent quality	18
2.4.2.2	Bacterial contamination	20
2.4.2.3	Organic contamination	22
2.4.2.4	Phosphorus pollution	24
2.4.2.5	Salinity and sodicity effects upon drainfields.	
		26
2.5	Drainfield Design	30
2.5.1	Daily domestic wastewater flows	30
2.5.2	Drainfield sizing	31
2.5.3	Hydraulic conductivity and percolation tests	33
2.5.3.1	Field assessments	33
2.5.3.2	Laboratory measurements	35
2.5.4	Soil clogging	36
2.5.4.1	Processes	36
2.5.4.2	Additives	37
2.5.5	Maintenance of septic tanks and drainfields	38
2.6	Disposal Options	39
2.6.1	Options	39
2.6.2	Re-use of septic tank effluent	42
2.7	Summary	43
3	PRELIMINARY STUDIES AND SURVEYS OF ON-SITE WASTEWATER DISPOSAL	
3.1	Introduction	45
3.2	Local Government Survey	46
3.2.1	The survey	46
3.2.2	Sphere of council influence	46
3.2.3	Septic tanks	47
3.2.4	Drainfields	48
3.2.5	Local variations to regulations	49
3.2.6	Septic tank and drainfield failures	50

3.2.7	Conclusions from survey	50
3.3	Current Status of STE Disposal	51
3.3.1	Questionnaire from wastewater course	51
3.3.2	Current attitudes	53
3.4	Preliminary Study of Failed Disposal System	53
3.4.1	Failed sub-surface drainfield	53
3.4.2	Evapotranspiration beds	56
3.5	Survey of STE Chemistry and Scum Accumulation	57
3.5.1	STE chemistry	57
3.5.2	Sodium and sodium adsorption ratios	57
3.5.3	Scum accumulation	59
3.6	Household Questionnaire	61
3.6.1	Objectives	61
3.6.2	Household size	61
3.6.3	Clean water inputs	61
3.6.4	Kitchen practices	62
3.6.5	Laundry practices	63
3.6.6	Septic tanks	63
3.6.7	Septic tank pump-outs	64
3.6.8	Drainfields	65
3.6.9	Summary	65
3.7	Conclusions	66

4 SODIUM IN DOMESTIC WATER AND WASTEWATER

4.1	Introduction	69
4.1.1	Sources of domestic water	69
4.1.2	Domestic sources of sodium	70
4.1.3	Scope of research	74
4.2	Analytical Methods	74
4.3	Sodium from Domestic Water Supplies	75
4.3.1	Introduction	75
4.3.2	Methods	76
4.3.3	Results	77
4.3.3.1	Sodium	77
4.3.3.2	Sodium adsorption ratio	80
4.3.3.3	Electrical conductivity	80
4.3.3.4	Hardness	80
4.3.3.5	Total dissolved salts and pH of water	81
4.3.3.6	Tank water	82
4.3.3.7	Groundwater	82
4.3.4	Impact of water supplies on wastewater	83
4.4	Sodium from Sewage Treatment Works	86
4.4.1	Aim of survey	86
4.4.2	Methods of sampling at sewage treatment works	87
4.4.3	Results	87
4.4.3.1	Changes in major cation concentrations	87
4.4.3.2	Change in sodium adsorption ratio	90
4.4.3.3	Change in pH and EC	90

	4.4.3.4 Total dissolved solids	90
	4.4.4 Discussion	91
4.5	Sodium and Laundry Detergents	94
	4.5.1 Aim of investigation	94
	4.5.2 Methods and materials	95
	4.5.3 Results	97
	4.5.3.1 General properties and costs	97
	4.5.3.2 Sodium in laundry products	99
	4.5.3.3 Sodium adsorption ratios	100
	4.5.3.4 pH and EC changes caused by addition of detergents	101
	4.5.3.5 Phosphate determinations	101
	4.5.3.6 Manufacturer's information to consumers	101
	4.5.4 Discussion	102
	4.6.1 Sodium in domestic wastewater	104
	4.6.2 Education and information	105
5	MEASURING SOIL HYDRAULIC CONDUCTIVITY FOR EFFLUENT DISPOSAL	
5.1	Introduction	107
5.2	Double Ring Infiltration Tests	109
	5.2.1 Field measurements	109
	5.2.2 Results	109
	5.2.3 Discussion	111
5.3	Standard Soil Percolation Test	112
	5.3.1 Introduction	112
	5.3.2 Method	113
	5.3.3 Results	115
	5.3.4 Discussion	116
5.4	Disc Permeameter Measurements	119
	5.4.1 Methods	119
	5.4.1.1 Field measurements	119
	5.4.1.2 Simulated effluent	121
	5.4.2 Results	122
	5.4.2.1 Pore volume replacement	122
	5.4.2.2 Ksat values	124
	5.4.2.3 Black earth	124
	5.4.2.4 Chocolate	125
	5.4.2.5 Grey-brown podzolic	126
	5.4.2.6 Yellow podzolic	127
	5.4.2.7 Krasnozem	127
	5.4.3 Discussion	128
5.5	Development of a Laboratory Method of Determining Ksat	130
	5.5.1 Introduction	130
	5.5.2 Development of soil sampler for undisturbed cores	131
	5.5.3 Evaluation of the soil sampler	135
	5.5.4 Collection and preparation of cores	136
	5.5.5 Laboratory procedure	139
5.6	Hydraulic Conductivity Measurements on Undisturbed Cores.....	140

5.6.1	Introduction	140
5.6.2	Methods	140
5.6.3	Results	142
5.6.3.1	Black earth	143
5.6.3.2	Grey-brown podzolic	145
5.6.3.3	Red-Brown Earth	145
5.6.3.4	Yellow solodic	146
5.6.3.5	Chocolate Soil	147
5.6.3.6	Yellow podzolic	147
5.6.3.7	Phosphate effect	147
5.6.4	Discussion	147
6	PRE-TREATMENT OF SEPTIC TANK EFFLUENT	
6.1	Introduction	152
6.1.1	Pre-treatment of STE	152
6.1.2	Peat As Pre-Treatment Medium	153
6.1.3	Peat availability	155
6.2	Laboratory Evaluation of Peat for Pre-treatment of STE	155
6.2.1	Methods	155
6.2.2	Results	159
6.2.2.1	Peat Quality	159
6.2.2.2	pH of leachate	159
6.2.2.3	Changes to Column EC	160
6.2.2.4	Cations	161
6.2.2.5	Faecal coliforms	163
6.2.2.6	Colour, turbidity and odour	164
6.2.2.7	Phosphates and nitrates.	164
6.2.3	Discussion	165
6.3	Field Evaluation of a Peat Bed.	167
6.3.1	Introduction	167
6.3.2	Methods	168
6.3.2.1	Peat bed construction	168
6.3.2.2	Peat Bed Loading	171
6.3.2.3	Installation costs	171
6.3.3	Monitoring of the system	172
6.3.3.1	Operation	172
6.3.3.2	Faecal Coliforms	173
6.3.3.3	Phosphate	174
6.3.3.4	Sodium	174
6.3.3.5	pH	174
6.3.3.6	Biochemical Oxygen Demand	175
6.3.4	Evaluation of the system	175
6.3.4.1	Re-use of domestic wastewater	175
6.3.5	Further development	177
6.3.5.1	Additional system in operation	177
6.3.5.2	Disinfection	179
6.3.6	Conclusions	180

7	GENERAL DISCUSSION	
7.1	On-site disposal systems	182
7.1.1	Septic tank operation	184
7.1.2	Drainfield operation	186
7.1.3	Future role of on-site disposal	187
7.2	Major on-site disposal problems	189
7.2.1	Household Chemicals	189
7.2.2	Water quality	191
7.3	Soil hydraulic conductivity and drainfield design	192
7.4	Effluent disposal options	193
8	RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH	
8.1	Disposal Strategy	195
8.2	Education program	196
8.3	Further research required	196