Reuse Initiatives Start in the Supermarket

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Reuse Initiatives Start in the Supermarket

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Abstract

The range of household products available for disposal to the sewer is uncontrolled. While stringent requirements are placed on liquid trade waste discharges, domestic discharges are immune from either monitoring or control. That there is no education of householders on the ramifications of their sewer discharges suggests that wastewater treatment is effective in subsequent dilution and treatment of the offending cocktail of chemicals. As the potential to reuse effluent is becoming more imperative under Load Based Licensing controls, the removal of chemicals at source may provide an effective means of increasing the value of the final effluent. This paper examines the contribution of some household chemicals have to the wastewater stream.

Keywords: load based licensing, phosphorus, salinity, sodicity, trade waste discharge

1 Introduction

The *Australian Guidelines for Sewerage Systems: Effluent Management* (ARMCANZ & ANZECC, 1997), the *Draft Guidelines for Sewerage Systems- Use of Reclaimed Water* (NH&MRC *et al.*, 1996) and the "*Guidelines for Sewerage Systems: Acceptance of Trade Waste (Industrial Waste)* (ARMCANZ & ANZECC, 1994) are aimed at improving the quality of water discharged from sewage treatment operations, whether that discharge be to the ocean, river systems or the land. The *NSW Protection of the Environment Operations (General) Regulation 1998* (NSW Government, 1998) and subsequent regulations replace previous legislation to continue to monitor and improve the quality of sewage effluent discharges. The Load Based Licensing (LBL) scheme is viewed by many as a means of increasing revenue collection without the tools to adequately address current treatment mechanisms. For example, the Fee Rate Threshold Factor of phosphorus is set at 0.3 mg L^{-1}, yet not even the most modern sewage treatment works can meet this level.

While trade waste discharges are coming under greater scrutiny as local government councils implement licensing and monitoring programs, the larger proportion of discharges are coming from totally uncontrolled and unmonitored approved connections to the sewer. The domestic household is able to discharge, at will, a cocktail of chemicals at varying concentrations, together with biodegradable and non-biodegradable solids without any concern as to the ramifications of those discharges. A low level education program on water conservation is one of the few strategies for involving households in their sewerage system. The NSW *Phosphorus Reduction Program* (NSW Public Works, 1984) has been given lip service by the Government even though toxic substances appear on our supermarket shelves, at the will of retailers, eventually to end in the sewer.

The availability of products in the supermarket greatly influences householder purchasing patterns. The low cost of certain products drives their demand, while overall economies of the treatment of the wastewater stream are not considered in typical household activities. At the other end of the system, the wastewater engineer is expected to maintain a plant capable of treating a wide ranging influent water quality and to deliver a more restricted discharge quality. That the supermarket should come under the scrutiny of wastewater managers is well overdue. That regulations should equally encompass domestic households as well as trade waste discharges is required as the next stage of wastewater treatment.

This paper addresses several imperfections in the current unregulated supermarket product list and the mechanisms by which we are encouraged to consume those products, without any recourse to the implications for later reuse of the effluent.

2 Trade Waste Discharges

General acceptance guidelines for trade waste discharges to sewer are given in Table 1 as taken from Armidale City Council's Liquid Trade Waste Policy (ACC, 1996). Councils are able to set their own guideline values outside these values where they have an “appropriate scientific basis to nominate alternative criteria” (ARMCANZ & ANZECC, 1994).

TABLE 1. Criteria for trade waste discharges

Parameter	***Guideline value***	***Parameter***	***Guideline value***
pH	7 - 9	Temperature	less than 38^{o}C
BOD_5	300 mg L^{-1}	COD	less than 1500 mg L^{-1}
Total suspended solids (TSS)	300 mg L^{-1}	Total Grease and Oil	up to 100 mg L^{-1}
Phosphorus	max. 20 mg L^{-1}	sulphate (as SO_4)	100 mg L^{-1}

(Source: ACC, 1996)

Monitoring requirements apply to each licensed discharge point, and non-compliance may invoke warnings and legal proceedings.

Licensed premises are required to install grease trap arresters or oil separators where required to meet wastewater stream criteria. Detergents are required to be biodegradable. Phosphate values will limit the detergents which can be used. Other restrictions apply to heavy metals and organic compounds such as pesticides, flammable substances and infectious wastes.

3 The Domestic Household

Unlike the trade waste discharger, the domestic household is not restricted in the quality of wastewater discharged to the sewer. The total range of products available through the supermarket, plant nursery retailer (pesticides), home maintenance store (household paints and chemicals), and pharmacy (medicines) is likely to enter the wastewater stream in its removal from the household. While it is not possible to relate examples from each of these sources in this document, the example of laundry and kitchen detergents provides an insight into the marketing and consumption of products by the domestic household.

3.1 Survey of household detergents

A survey of laundry and kitchen detergents was undertaken to accurately measure their contribution to the wastewater stream. A range of products was purchased from supermarkets in Armidale, products commonly chosen by consumers, from highly advertised brand names to the lesser known products. Five dish washing detergents, 40 laundry powders and 20 liquid laundry detergents were selected. Each detergent was mixed at a concentration recommended by the product manufacturer, equivalent to the full wash water volume.

There was no attempt to assess quality of the wash by its stain removing capabilities. An assumption was made that the manufacturer had determined the quantity of powder or liquid from independent testing.

The liquid sample was analysed for pH, electrical conductivity, soluble phosphorus, sulphate, and the major cations (sodium, calcium, potassium and magnesium).

3.2 Phosphorus content

Two labelling initiates have been used to market products as "low phosphorus". It is unclear as to the environmental objectives these labelling symbols attempt to address. The industry standards have no legislative support and breaches of the standards do not appear to attract any repercussions.

The symbol **NP** is used to identify products which have *no added phosphorus*, although *levels below 0.5% may be present*. It is unclear as to whether the manufacturers source ingredients based upon low levels of phosphorus or whether the phosphorus in the ingredients is irrelevant to their operation. It is clear, however, that 0.5% equates to 5000 mg kg^{-1}, not an insignificant amount. Figure 1 indicates the comparison of products labelled NP with the measured concentration of phosphorus in a full wash cycle.

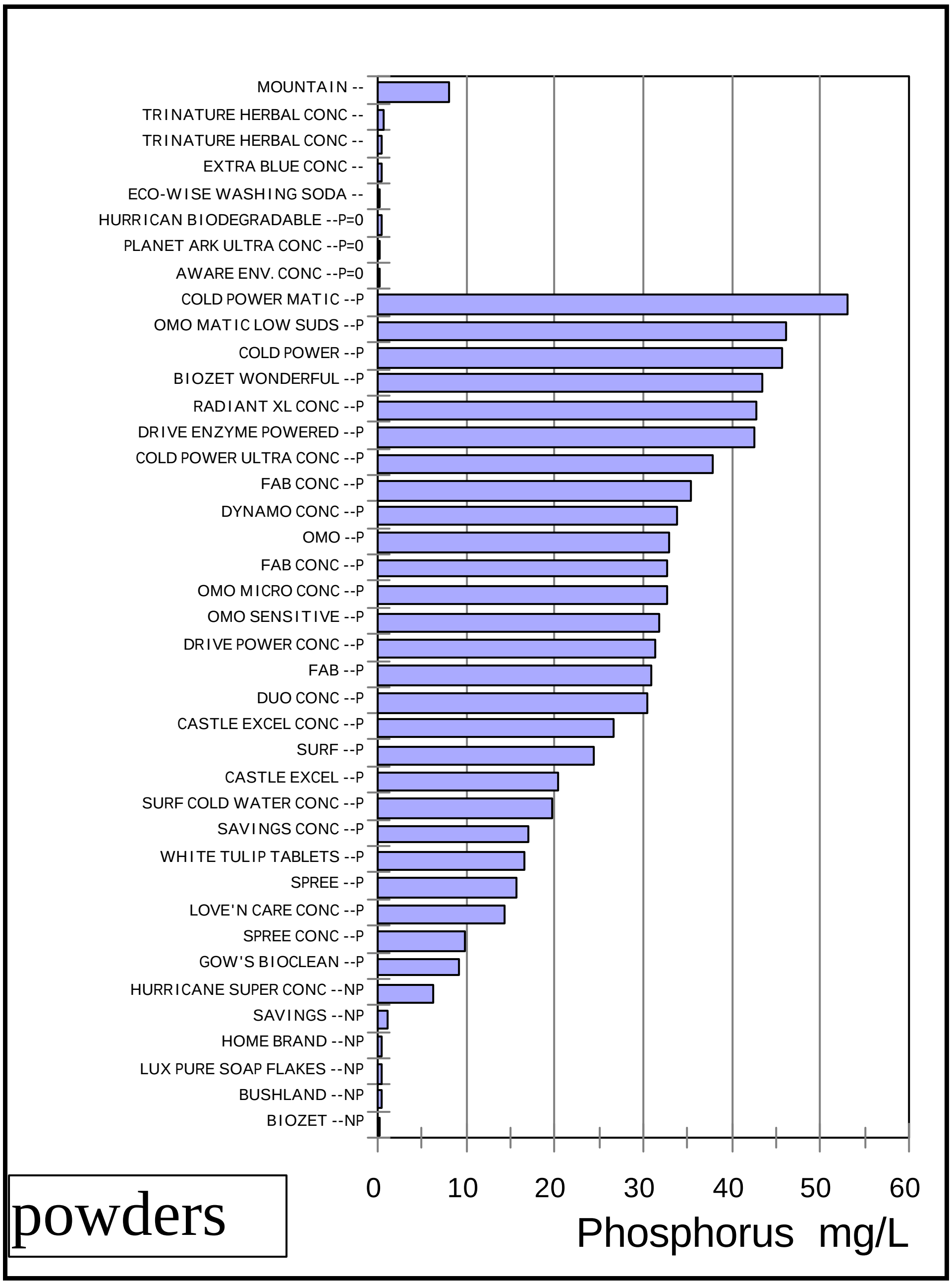

Figure 1 Concentration of phosphorus in powder laundry detergents

The Symbol **P** denotes "*the product complies with agreed industry standards on phosphorus which impose a maximum content of 7.8 g per wash*". Figure 1 denotes the laundry powders and their variable phosphorus content under this symbol. A phosphorus content of 7.8 g P per wash is equivalent to a concentration in the full wash load of 50 mg L^{-1}.

A third group consists of products which either stated that their products contain "no phosphorus" or were "phosphorus free". The measured concentration of phosphorus for these products is shown in Figure 1.

Liquid Laundry Products

Similar labelling applies to the liquid laundry detergents. Figure 2 indicates the concentrations measured in those products when mixed at concentrations equivalent to a full washing load.

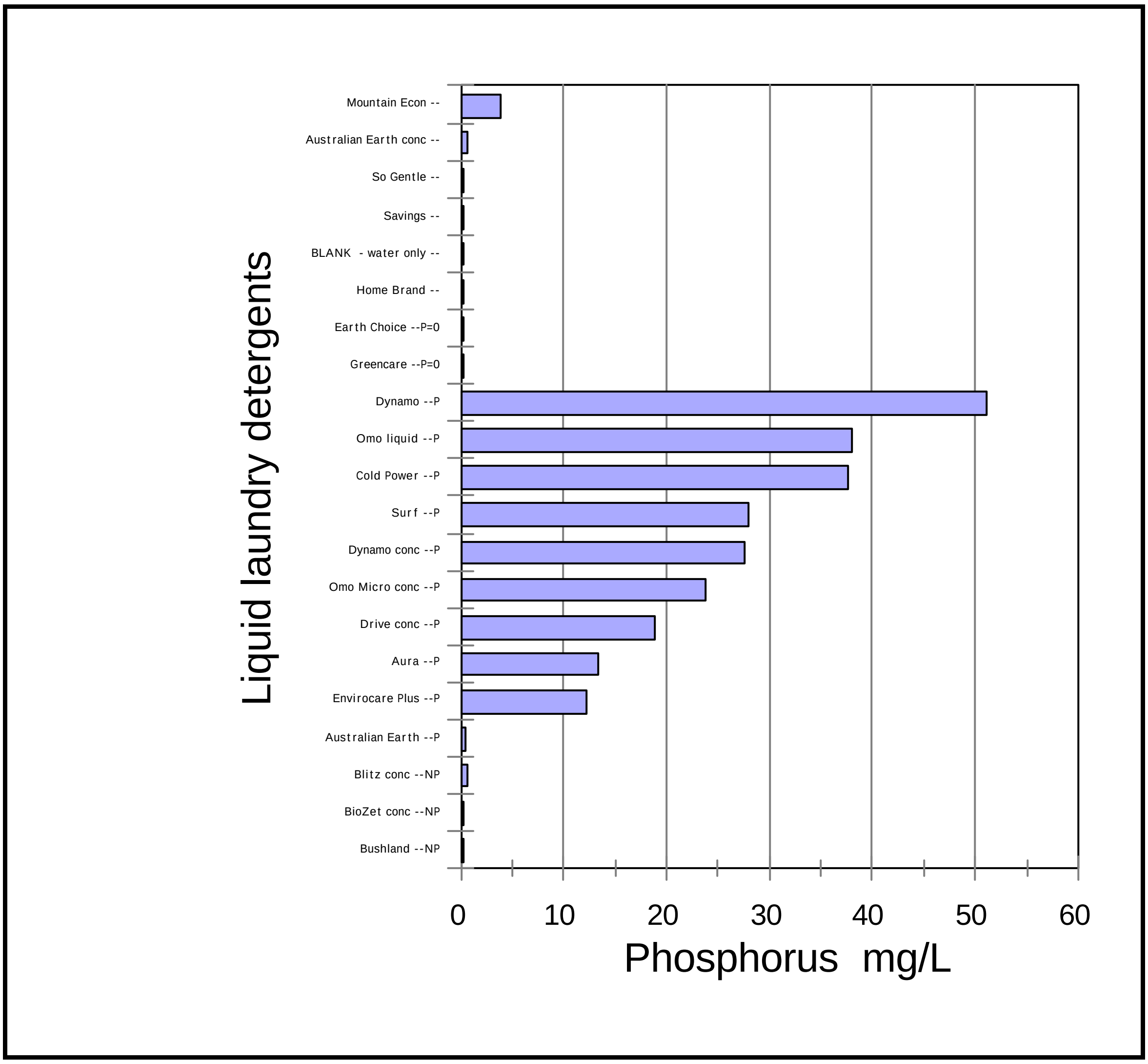

Figure 2 Concentration of phosphorus in liquid laundry detergents

The dishwashing detergents were measured at 5 mg P L^{-1} (Sunlight liquid) use for hand dishwashing and 18-26 mg P L^{-1} for the machine dishwashing detergents.

3.3 Sodium concentrations

That phosphorus is a plant macro-nutrient and has an economic benefit in reuse, sodium is detrimental to plant metabolism, soil structure and soil hydraulic conductivity. Sodium salts present a significantly different problem in that they are always soluble and cannot be removed except by reverse osmosis.

Sodium salts are used in laundry powder detergents as a "manufacturing agent", or in simple terms "filler". While sodium sulphate assists the manufacturer in processing operations, its function ceases from that point.

Many other components of laundry products use sodium as the cation because of the benefits of solubility. However, the contribution of sodium to the wastewater stream is generally not reported. It is uncommon for sewage plant operators to monitor sodium and often reuse options place considerable emphasis on BOD_5 , total suspended solids (TSS), nitrogen, phosphorus and total salts while ignoring the effects of sodium.

The laundry products were measured for their contribution to sodium in the wastewater. Significant quantities of sodium are discharged with the wastewater. What is not generally known is that by selection, low sodium products are available. There is no packaging information provided on the relative proportions of the elements contained in the laundry products. The consumer cannot make an informed choice.

Figure 3 indicates the range of sodium loading from a full wash load for the products measured. A

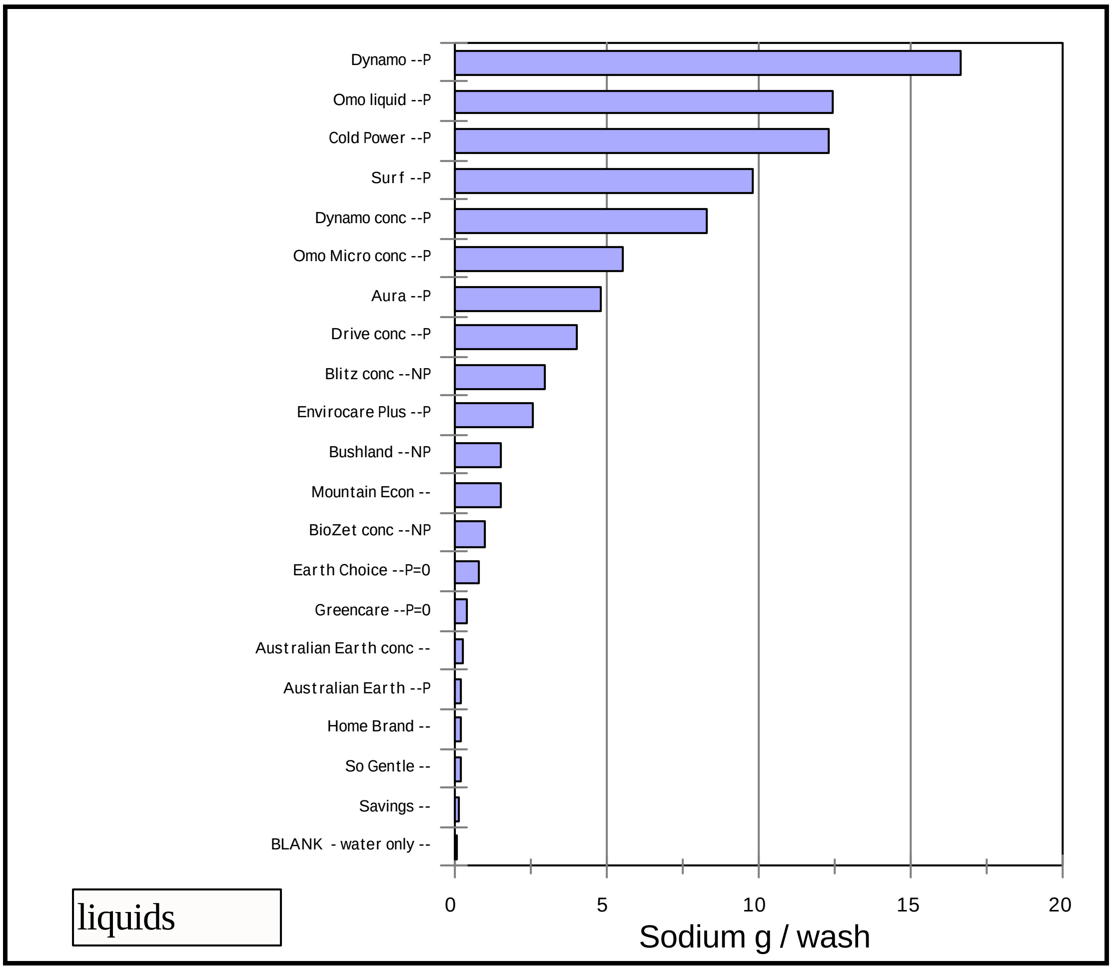

Figure 3 Contribution of sodium from a single full washing load (150 L)

volume of 150 litres of water has been assumed for the total wash volume (Patterson, 1999).
Figure 4 indicates the contribution from powder laundry detergents from a single full wash. The phosphorus symbols are shown for each detergent.

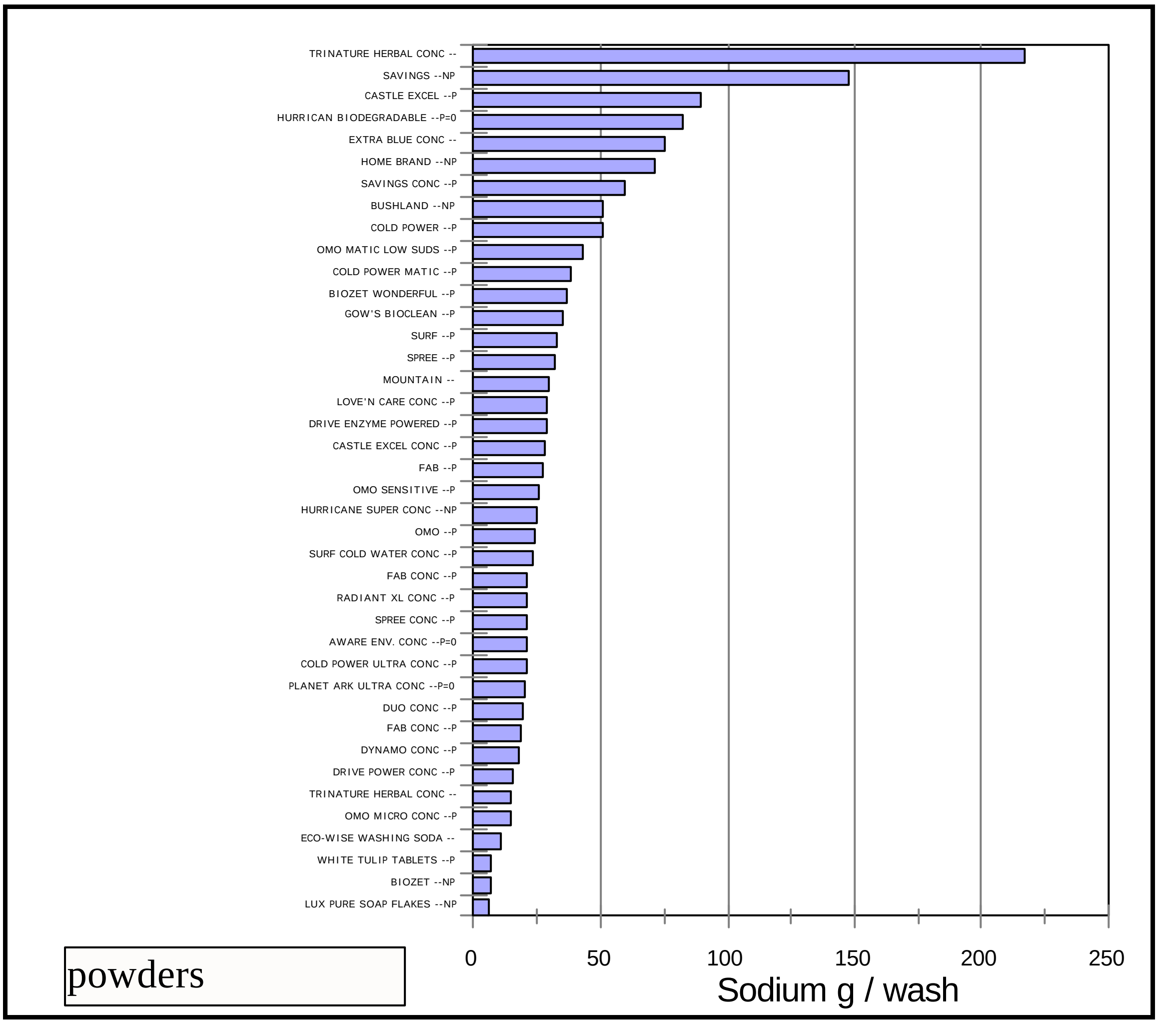

Figure 4. Sodium contribution to wastewater from one full washing load

3.5 Changes to wash water pH

Significant increases in pH of the wash water are partly due to the impact that high pH has on the ability of the detergent to remove stains. Soil and grease are more easily removed at high pH The problem with high pH is the effect that any residuals may have on the person wearing the garment and the deterioration in cloth life with washing in higher pH liquids.

Many products make the consumer aware of the need for "caution" and "keep out of reach of children". However, advertising that a product which increases pH above 10.7 as "for sensitive skin" is blatant misrepresentation of the effects that such elevated pH has on any human skin.

Of the products tested, a dishwashing powder resulted in a pH of 11.55, while only 11 of the 65 products had a pH less than 9, the limit set by Armidale City Council for trade waste discharges.

4 Discussion

The reuse of effluent requires that long term sustainability of the land application area is not diminished.

While nitrogen and phosphorus products have an economic value as fertilisers, and can be managed by crop selection, crop rotations and crop removals, no similar option is available for sodium. Salinity issues can be treated with leaching fractions and amelioration of the soil profile with either gypsum or lime. However, such amelioration is a short term solution as the leachable cations will enter the groundwater system. Without amelioration, increases in soil salinity and sodicity, and loss of hydraulic conductivity will follow.

The removal of phosphorus from the wastewater stream benefits systems which discharge effluent to river systems. What is unclear is the effect that replacement chemicals will have on the environment. The reduction of phosphorus is beneficial to effluent reuse since at 5-7 mg P L^{-1} in sewage treatment works effluent there is an oversupply of P on an annual basis. At an estimated 6 ML ha^{-1} for irrigation requirements, about 50% more P is provided than can be removed with cropping.

The use of P and NP symbols to generate an awareness of phosphorus problems in wastewater is welcomed. However, it appears from the data presented above that the “industry standard” allows a wide range of products to comply with that standard. When the load base licence goal is for 0.3 mg P L^{-1} in the final effluent, acceptable P levels of up to 50 mg L^{-1} in an average wash seem luxuriously excessive.

Advertising on laundry products is extremely subjective and instructions are just as obscure. Laundry powders are sold by weight yet most of the instructions recommended volumetric measure of the powder required. The majority of products do not indicate the number of washes per packet, making it almost impossible for the consumer to estimate the cost per wash.

Labelling of components in the various products does not allow the environmentally conscious consumer to make an informed choice based upon likely impact to the wastewater stream. Of the products surveyed in this research, not one provided a clear breakdown of chemicals.

That sodium is of vital concern to the reuse operation cannot be ignored, more appropriate labelling is required. However, the removal of fillers and other sodium products is the most efficient strategy available for greater sustainability of land application.

5 Conclusion

Domestic households currently enjoy unrestricted access to the sewer for the disposal of all manner of substances, a privilege not afforded the liquid trade waste licensee. That household should have access to a range of chemicals which significantly impinge upon wastewater quality is in need of review. It is clear that if the requirements of Table 1 were applied to domestic discharges, significant changes to the supermarket shelves would follow. Removal of chemicals at source is the most effective method of reducing sodium in wastewater. Large quantities of sodium enter the wastewater unnecessarily through “fillers” in laundry detergents.

The results of this research indicate that current labelling practices are less than informative, and in some cases blatantly deceptive. Through better access to product content, similar to that on food items, communities can make informed decisions which can be beneficial to its efforts to undertake sustainable reuse options.

References

ACC. 1996. *Liquid Trade Waste Policy*. Armidale City Council. Armidale

ARMCANZ and ANZECC, 1997. *Australian Guidelines for Sewerage Systems. Effluent Management*. AGPS. Canberra,

ARMCANZ & ANZECC (1994) *Guidelines for Sewerage Systems: Acceptance of Trade Waste (Industrial Waste).* Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council. Commonwealth of Australia.

NH&MRC, ARMCANZ & ANZECC (1996) *Draft Guidelines for Sewerage Systems - Use of Reclaimed Water*. National Health and Medical Research Council, Agriculture and Resource Management Council of Australia and New Zealand, and Australian and New Zealand Environment and Conservation Council. Commonwealth of Australia.

NSW Public Works (1984). *NSW Local Government Phosphorus Action Plan.* NSW Public Works and Water Resources. Sydney

NSW Government. 1998. *Protection of the Environment Operations (General) Regulation 1998*. Government Information Service. Sydney

Patterson, R.A. 1999. *Modifying Wastewater Inputs to On-site Systems.* in R.A. Patterson (ed) Proceeding of On-site '99 Conference: Making on-site wastewater systems work. Armidale 13-15th July 1999. Lanfax Laboratories. Armidale.