GREYWATER REUSE - LEARN TO PROTECT THE RESOURCE

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Abstract
Greywater reuse for landscape irrigation during periods of water restrictions can be a valuable use of an otherwise wasted resource – with care it can be a social and environmental benefit. There are significant landscaping benefits from the nutrients (nitrogen, phosphorus and sulphur) in the water, but other components are detrimental to plants and soil. It is important that where greywater will be used around the home garden the residents need to be aware of domestic chemical use and its implications with water conservation. This paper addresses some issues for maximizing the benefits of greywater reuse.

INTRODUCTION

In the last few years, greywater reuse from domestic dwellings has become a household term and one that has stirred much debate. Water authorities and many politicians see it as a means of defraying real costs of infrastructure management and fail to recognise the individual's cost or the misinformation that spreads to support uneconomic outcomes. Greywater, the water generated in the bathroom and laundry, has become a useful commodity to replace potable water during drought and in its simplest form can be implemented for small financial inputs, that is, until unsubstantiated claims are made by water agencies, washing machine retailers and chemical resellers (including supermarkets). The real cost of greywater reuse needs to be closely examined in terms of Triple Bottom Line (social, environmental and economic) assessments. At the present, the individual is paying heavily for no net community benefit and no long term solution to water conservation. Meanwhile, governments sit and wait for the rains to come!

While an accepted technical term for 'reuse' is a further use of the wastewater after treatment to an appropriate quality and the term 'recycling' refers to the substitution of higher grade water with wastewater treated to an appropriate quality, the terms are often intermixed. Irrespective of the second use, there are constraints that must be applied in the home to better condition the wastewater for an appropriate level of treatment to remove the contaminants. The term 'appropriate level of treatment' requires greater care in setting policy and guidelines.

WATER CONSERVATION

Firstly, let's examine the conservation of water as a strategy for greywater resource manage-ment. When greywater has an economic benefit for its water component, which can be priced by comparing with its clean water counterpart (often as little as $0.80/kL), there must also be an economic value from the chemicals contained in the greywater. Nitrogen, phosphorus and sulphur are essential plant nutrients and can substitute for commercial chemical fertilisers, therefore, can be valued in today's currency. Sodium is detrimental to all but a few specialised plants and can lead to soil structural instability, therefore its cost is negative in that further works will be required to rectify induced problems of sodicity. When these costs exceed the value of the water and fertiliser, then greywater reuse has a net negative value, irrespective of water authorities' or politicians' views.

Recent commitment by various authorities to rebates for water efficient washing machines is one example of high individual costs for negligible community gain. Firstly, only washing machines that meet the four-star rating of the mandatory Water Efficient Labelling and Standards (WELS) Scheme meet the criteria for rebates. There are no Australian-made washing machines that meet this four-star rating, and one may ask whose measure was developed for this rating scheme? The volume of water for a 8 kg washer four-star washing machine is 82.3 litres (AS/NZS 6400:2005, p60), hardly enough to fill the wash load of a top loading washing machine. Does the rating scheme have any scientific basis or just a small group's 'feel good' number?

A recent article in *The Courier Mail,* Tuck Thompson reported that the Queensland Government had received 15,000 applications for washing machine rebates. Since only imported front loading machines can comply the rebate favours overseas manufacturers. The more important aspect of the rebate scheme is that 15,000 applications calculates into $2.25 million in rebates, $22.5 million in the cost of the new washing machines (all fully imported) for a potential saving of $0.5 million/year in water and a likely increase in $0.2 million/year in energy. Whose arithmetic shows this is a community benefit and a partial solution to the water crisis? When extrapolated out to say 25% of the Brisbane metropolitan community, the costs are enormous and the benefits negligible. This is reverse science and not very good economics.

LAUNDRY DETERGENTS

As part of my on-going research into the chemistry of greywater, 54 powder and 41 liquid laundry detergents were tested for their ability to significantly alter wastewater chemistry to such an extent that the reuse of the greywater for landscaping is seriously diminished. Therefore the results can be interpreted as "what detergents can I use?" and "what must I not use?"

Little, if any, nitrogen is present in laundry detergents, most of the nitrogen in greywater derived from body proteins. Liquid detergents may have more nitrogen (from ammonia derivatives) than powders, but the amounts are insignificant in relation to plant requirements or potential for nitrate leaching from greywater application areas.

Detergents that have high phosphorus levels may be beneficial because phosphorus is an essential plant and microbial nutrient, but may be hazardous when greywater discharges influence phosphorus levels in nearby waterways. On the other hand, sodium is always a problem for most of our common garden plants, can seriously affect soil stability and permeability (drainage); and may lead to soil sodicity. The household must recognise the need to limit its use of products that have high range sodium and/or phosphorus and water conservation may not be advantageous in this quest. The same quantity of chemicals with reduce water is an increase in environmental hazard, irrespective of the savings in water. Less water also makes it more difficult to irrigate the greywater over larger areas to minimise adverse impacts. Bucketing water from the washing machine is likely to lead to the most severe consequences because of small areas to which the greywater is applied.

Laundry detergents are available in liquid and powder form, standard formulations (with bulking agents) or concentrates (less bulking agent). Their three-fold purpose is to overcome the hardness of the water (caused by calcium and magnesium); lift dirt and stains from clothes; and maintain these contaminants in the water to prevent re-contamination so they can be rinsed from the clothes during a rinse cycle. Thus, a concoction of chemicals is required to meet the task with additional aesthetic properties such as disinfectants, deodorizers, perfumes, whitening agents and colour-fastness. Whether the chemicals, or chemical cocktail is beneficial or detrimental as a greywater resource is mostly immaterial to the detergent or the washing machine manufacturers. Until recently, the efficacy of the rinse cycle was not assessed as important, irrespective of the potential harmful effects on human skin. Today AS/NZS 2040 goes part of the way to addressing rinse quality but how do the detergents match the pseudo-detergent used for the Standard test? And how well do the various washing machines rinse with the standard detergents? Unfortunately, there are no documented data available at the moment because the rinse quality standard only came into action on 1st July 2006. How much chemical is left in the clothes after rinsing may be more important, from a health perspective, than the greywater quality from the rinse water.

SODIUM IN DETERGENTS

The major difference between the liquids and the powders is the lower sodium in the liquids, although some liquids are nothing more than suspensions – perhaps the reason for opaque containers! Figure 1 indicates the frequency distribution of sodium in powder and liquid detergents when mixed for front loading washing machines.

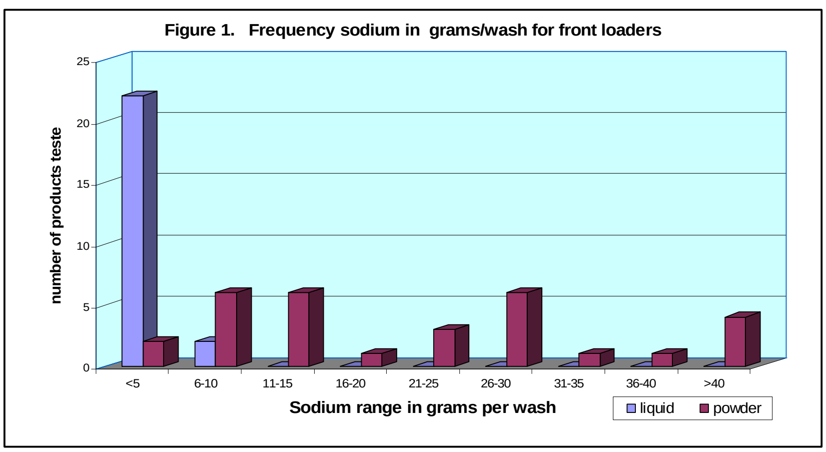

Figure 1 Sodium in liquid and powder detergents

While the difference between powders shows that where sodium is likely to be a problem for either plants or soil, it is possible to choose liquids with low range sodium. However, when examining the powders, it is clear that many products have excessive amounts of sodium salts that may render the greywater harmful to susceptible soils. The term 'susceptible soil' is important because some soils will respond negatively to small amounts of sodium, where sands and some loams may be unaffected by sodium. However, some plants can tolerate high sodium without effect and may dominate in areas where greywater is spread.

The differences in sodium can be seen in Figure 2 when powders are mixed in front loaders or top loaders. There is sufficient product choice for those using either front loaders or top loaders to not be concerned about the type of washing machine they use. However, that some brands are exceedingly high in sodium represents a disregard for environmental consequences of those products when greywater is used for landscaping.

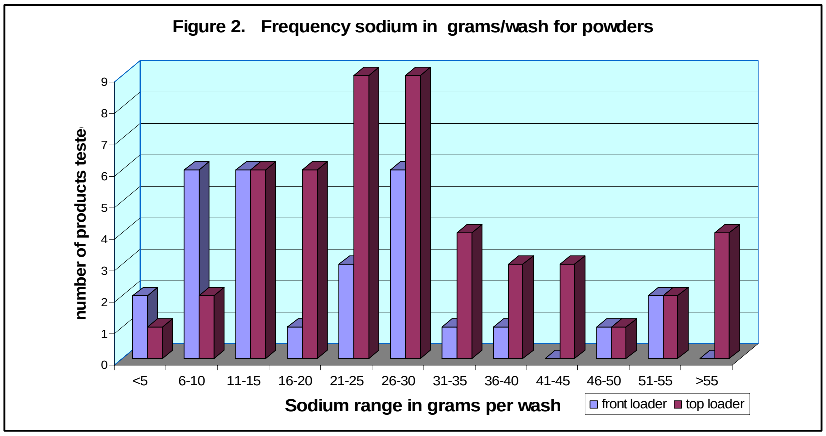

Figure 2 Sodium in powders for front and top loaders

PHOSPHORUS IN DETERGENTS

Perhaps of more prominence has been the high publicity given to phosphorus in laundry detergents and the link (irrespective of how tenuous) between sewage effluent and *Cyanobacteria* blooms in river systems. That many soils have high phosphorus sorption; that phosphorus is an essential plant nutrient; and that phosphorus is an excellent detergent builder are often ignored. Whether the manufacturers' voluntary standard of 7.8 g P/wash has any validity has not been disputed even though it equates to 100 mg P/L in an average front loader and 50 g P/L in an average top loader. That legislation places an onus on sewage treatment plant operators of 0.3 g P/L, then much is expected of dilution with other wastewaters. So, from where did the 7.8 g P/wash arise as a standard for the 'P' symbol and the belief that this level was environmentally acceptable for all cases.

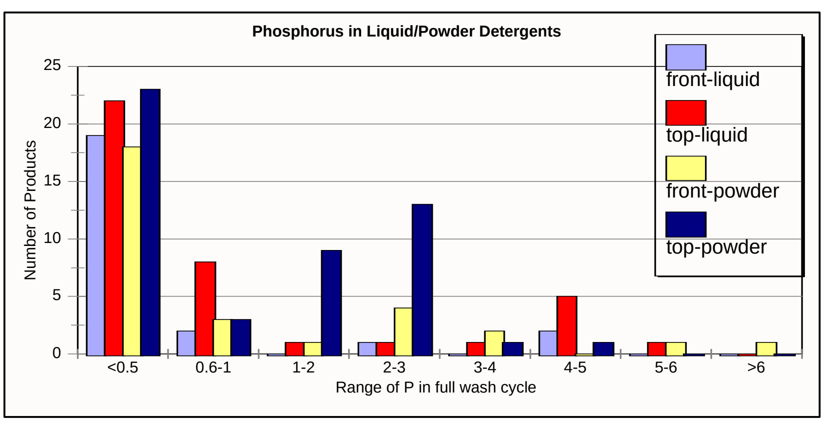

Figure 3 Phosphorus in detergents when mixed for front or top loader

When phosphorus in liquid and powder detergents is compared for each washing machine type, there are many choices of low phosphorus products to avoid negative environmental consequences. Products labeled 'NP' have little or no phosphorus, while those labeled 'P' comply with the artificial ceiling of 7.8 g P/wash. However, the specialised products for front loaders (termed ***matic) have a higher phosphorus load than the large number of other liquids and powders.

Other factors influence the acceptability of laundry water as a landscape resource irrespective of whether other water restrictions are in place or not. Greywater that may be harmful to plants and/or soils may be difficult to remedy when rain is more frequent or when irrigation with potable water can be alternated.

LABELLING

Many households purchase laundry powders on price and supermarkets use 'Specials" to turn over stock or as loss leaders because laundry detergents are usually expensive. Detergents can cost a household up to $250 per year. The correlation with price and performance is one that comes from previous experience with the product, or through publications such as Choice (Australian Consumer Association).

Misleading information on packets of powder detergent mask the purchaser's ability to calculate the price per wash. Since powders are sold by weight and dosed by volume, unless one knows the bulk density of the powder, the calculation of cost per wash cannot be made. The simple question "How many cups (or scoops) in a 1 kg packet of detergent?" cannot be answered. Products that are sold with a scoop often do not make the task of calculating cost per wash any easier – for example, one scoop may be 30 mL, 90 or 125 mL Sometimes the size of the scoop is not known until the packet is opened. These problems do not arise with liquids because they are sold by volume and dispensed by volume.

In this day of litigation and the obligations under health and safety legislation, Material Safety Data Sheets (MSDS) are an obligatory requirement for all chemicals. When did you ever see, or ask for, or be given an MSDS for the products you purchase in a supermarket for use in a home. Any business operator could be fined for not having an MSDS for every chemical (solid, liquid or gas) in the workplace. How nasty are these products? Is it correct to say a laundry detergent is environmentally friendly when it produces a pH of 10? We know that skin dissolves in pH 10 and higher. Isn't it irrelevant that "no petrochemicals" have been used when the only biodegradable material is the perfume and the cardboard box? We need labelling that reflects the hazardous nature of the chemicals we add to our wastewater to produce the greywater we think is such a valuable resource.

CONCLUSION

Greywater from the bathroom and laundry can be a reliable and valuable resource in maintaining the aesthetic and social value of a landscaped area around the home, not just during drought, but all the time. The nutrient value of the greywater may only be low, but the beneficial use of nitrogen, phosphorus and sulphur is positive compared with the loss of these nutrients in municipal sewage treatment systems or in drainfield disposal of septic tank effluent.

What is not known in this greywater scenario is the constituents of the chemicals we use in the bathroom and laundry and how these impinge upon the environmental effects of the greywater on our landscaped areas. Manufacturers' voluntary standards do not appear to be in keeping with the regulators desires to keep phosphorus out of domestic wastewater and failure to adequately state the contents of laundry detergents only adds to the surprise that sodium may actually be back for the environment. Why do regulators not consider sodium an issue when so much hype is made about salinity generally? The term "environmentally friendly" is applied to products that load sodium into the environment and have pH values above that which are considered acceptable for living systems. Further complicate the terminology with "biodegradable" and the consumer is coaxed into a sense of acceptability.

Whether we discharge greywater to sewer or use it for its attractive beneficial use, we must be conscious of the implications of chemical use in the home. Without positive labelling laws, the consumer will always be kept in the dark.

Greywater is a valuable resource but reduction of the chemical load in the first instance is better defence than trying to ameliorate the landscaped area after the damage has been done. All this can be achieved at no additional cost, for no loss of lifestyle or convenience, to the benefit of our garden and the wider environment.

References

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Note: In the original paper printed in the Symposium Handbook, Figures 1 and 2 were reversed during the collating process and the Titles left off the figures.