Eutrophication, Impacts of detergent phosphates

Lee and Jones-Lee have published an update of an earlier paper assessing the possible environmental consequences of a detergent phosphate ban. This follows work by Maki et al. in the 1980's concluding that detergent phosphate bans in the USA have not led to improvements in water quality. The reason is that this action does not result in a sufficient reduction in phosphate inputs to water to have a measurable effect.

The updated paper is based on application of the Vollenweider-OECD model which links phosphorus loads to eutrophication. This model data base has been expanded to 750 lakes, reservoirs and estuaries. From this model, the authors derive a graph showing situations where a phosphate ban can be expected to have detectable impacts, as a function of the % of P input to the surface water coming from domestic sewage (as opposed to industry, agriculture, land run-off, …), and as a function of the % of P in domestic sewage coming from detergents.

This shows that, where phosphates are used in modern detergents and the proportion of phosphate in sewage coming from detergent will be below 30% for example, then a detergent P ban will only have a detectable impact if more than half of P input to the water body is from sewage.

Sewage works phosphorus removal

The authors emphasize that about 90% of the phosphorus in domestic wastewaters can be removed from sewage in treatment works at a cost of <4 cents per person per day for populations over 10,000 and that this is the most effective way to control eutrophication in waters receiving sewage discharges.

Where some sewage is not treated (households not connected, overflows, …) then a detergent phosphate ban will only be effective if such untreated sewage contributes more than 20% of total P input to the surface water. The authors also note that septic tank wastewater systems do not contribute significant amounts of phosphate to surface waters.

The authors conclude that although detergent phosphate bans will not generally result in an overall improvement to water quality, "there may be some situations in which eutrophication-related water quality would be improved by a ban." The results are also applicable to evaluating other questions regarding impacts of changing phosphate loadings to surface waters.

The key information in this updated paper is that it is possible to predict, with a high degree of reliability, the impact of a detergent phosphate ban on eutrophication-related water quality as measured by planktonic algal chlorophyll and the diagram explained above which shows the issues to be considered in order to make this evaluation.

This review references previous papers by the authors which present in detail the OECD phosphorus loading – eutrophication response models, based on both data from water bodies comparing phosphorus loading with chlorophyll concentration, and also from a number of cases looking at water quality response to reductions in phosphorus loadings following the introduction of sewage works phosphorus removal. These models show log-

log relations between phosphorus loading and chlorophyll concentration, Secchi depth and hypolimnetic oxygen depletion. This information is presented at *http://www.gfredlee.com/pexfert2.htm* .

These papers already suggested that whereas phosphorus removal in sewage works or significant reductions in non-point phosphorus loadings (agriculture) would result in reductions in chlorophyll concentrations perceptible by the public as water quality improvements, the P load reduction resulting from a detergent ban would not result in a perceptible change in the eutrophication-related water quality.

The authors emphasized both the simple but effective predictive capability of the OECD phosphorus loading – eutrophication response models, and the need to develop significantly more "before and after" data sets for water bodies where significant phosphorus loading reductions have been implemented.

"Detergent phosphate bans and eutrophication," G. Fred Lee, A. Jones-Lee, 2007. Available at www.gfredlee.com. *Based on (updated) "Detergent Phosphate Bans and Eutrophication," Environ. Sci. Technol. 20(4): 330-331 (1986).*
http://www.gfredlee.com/Nutrients/DetergentPBan.pdf