Human & Environmental Risk Assessment on ingredients of European household cleaning products

STPP and Eutrophication / The Risk Assessment of Sodium Tripolyphosphate (STPP)

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STPP and Eutrophication

This targeted environmental risk assessment of STPP addresses the issues of toxic effects to biota in the environmental compartments. An additional environmental issue concerning phosphates in general, and therefore also STPP, is their role in the nutrient enrichment of surface waters (eutrophication).

As shown in this report, STPP is hydrolysed ultimately to soluble inorganic phosphate (orthophosphate PO_4^-) or transformed to insoluble inorganic forms. These are the same phosphates as those formed by natural hydrolysis of human urine and faeces, animal wastes, food and organic wastes, mineral fertilisers, bacterial recycling of organic materials in ecosystems, etc.

Factors involved in Eutrophication

Phosphates are an essential nutrient (food element) for plants, and stimulate the growth of water plants (macrophytes) and/or algae (phytoplankton) if they represent the growth-limiting factor. In some cases, nutrient enrichment (fertilisation) of surface waters will be absorbed by the food chain (grazing by zooplankton, which are in turn consumed by fish), leading to increased fish catches. The ecosystem effect is thus dependent on factors such as zooplankton grazer population and distribution, or toxicants which might affect these populations. In other cases, nutrient enrichment of a given ecosystem will have no apparent effect, because algal development is limited by other factors. However, in certain circumstances, nutrient enrichment can lead to negative effects, ranging from ecosystem modifications, through algal blooms, to in extreme cases (through decomposition of plant biomass) oxygen depletion and collapse of the biocenosis in a surface water.

A large proportion of Europe's surface waters are currently subject to anthropogenic nutrient enrichment, with the largest fluxes of both phosphates and nitrates coming from agriculture (animal wastes, fertilisers, soil erosion) and human sewage. This is a serious environmental issue. Requirements to reduce phosphate and nutrient fluxes from sewage (of which, detergents, where phosphates are used, are a minority proportion of phosphates) are directly addressed by the EU Urban Wastewater Treatment Directive 91/271/EEC.

The contribution of detergent phosphates (STPP) to the environmental effects of nutrient enrichment cannot be addressed by a risk assessment type approach for the reasons outlined below, and is therefore not addressed by this report.

In many cases, the main cause of nutrient enrichment of surface waters is agriculture and soil run-off. In those cases where agricultural and other inputs of phosphates into surface waters are low, and sewage inputs are significant, then sewage collection and treatment including phosphorus removal will in any case be necessary, irrespective of whether or not STPP is used in detergents. No cases have been documented where a reduction only in detergent phosphate use, without introducing sewage nutrient removal to address other sewage phosphate sources, has resulted in identifiable environmental improvements.

Why a risk assessment methodology is not applicable to nutrient enrichment

The risk assessment methodology is based on a comparison between PEC (predicted environmental concentration) and PNEC (predicted no effect concentration).

However, a PNEC cannot be defined for nutrient enrichment, and in particular for phosphates. The ecosystem reaction to increased phosphate concentrations depends on many factors which vary spatially and temporally. A water body will react to additional phosphate input only if it is the growth-determining factor, which depends on other factors such as temperature, light, low water-flow, concentrations of other nutrients (nitrogen, iron, oligo-elements) and ecosystem balance (grazer populations). Equally however, the ecosystem will not react to addition of phosphate if it is already at concentrations higher than plant needs, as is often the case.

"No effect" or "effect" of an increase in phosphate loadings to a given part of a water body is thus dependent on a number of other factors: is plant/algal development being limited in the present circumstances by phosphate availability in the water? or is it being limited by other nutrients or by other factors?

A "No effect concentration" thus cannot be defined, neither in theory, nor by any form of practical or field "assay" or test. The results will in each case depend directly on the other parameters set for the test: concentrations of other nutrients, light, temperature, algal and grazer species and density. It is therefore not possible to derive a PNEC in terms of eutrophication.