DETERGENTS, PHOSPHATES, AND ENVIRONMENTAL CONTROL[1]

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ABSTRACT

Eutrophication and its relationship to the detergent industry is analyzed. The role of phosphorus in accelerated or "cultural" eutrophication is discussed and the different uses of phosphorus by all industry are presented. The detergent industry is broken into its different sectors of marketing, and the distinction is made between household laundry detergent products and that of the specialty detergent and sanitizer products. Application of specialty detergents and sanitizers is discussed and their role in maintaining public health and safety standards is related. Remedial steps being taken to reduce "cultural" eutrophication are discussed and a request is stated that, if legislative or judicial actions are deemed necessary in the problem of "cultural" eutrophication, reasonable thought be given to the effect those actions may have in the critical area of product application of the specialty detergents and sanitizers.

Today there is much discussion and confusion on the subject of the environment and its attendant problems. Foremost among the areas of concern is the question of the alleged diminishing quality of water in our environment. The phenomenon of "eutrophication" and the relationship of the detergent industry is one of the current most popular issues.

What is the environmental problem of "eutrophication?" How is the detergent industry involved in this issue? What are some of the remedial steps being taken to solve the problem? These are questions we would like to address ourselves to in this article.

EUTROPHICATION

Eutrophication can be regarded as the progressive increase in biological productivity in a body of water, supported by the input of nutrients (fertilizing elements) which stimulate the growth of algae and other aquatic vegetation. Many other factors are also involved which contribute to aquatic plant growth, such as availability of carbon dioxide for photosynthesis, abundant sunlight, clarity of water for light penetration, warm temperatures, and presence of "trace nutrients" such as molybdenum, copper, etc.

Eutrophication is a natural phenomenon and occurs at slow rates in the "natural aging" of lakes. Accelerated eutrophication, on the other hand, is caused by man through his pollution of waters with sewage, industrial wastes, agricultural runoff, etc. Prominent among the nutrients discharged is phosphorus. "Cultural eutrophication" or accelerated eutrophication caused by human influence is really the assault on the environment.

PHOSPHOROUS: THE LINK BETWEEN EUTROPHICATION AND THE DETERGENT INDUSTRY

Most discussions of accelerated eutrophication and the causative factors center around the chemical elements of carbon, oxygen, nitrogen, and phosphorus, but nuisance algae require from 15 to 20 different nutrient elements for growth. Phosphorus in the form of sodium tripolyphosphate is the link between cultural eutrophication and the detergent industry. The detergent industry is a large volume user of phosphorus with > a million tons (expressed as sodium tripolyphosphate) used per year. In most instances, the detergent phosphates end up in waste water. Ordinary biological sewage treatment only removes a small fraction of the phosphate.

No one will argue that phosphorus is not essential for nuisance algae growth. The question is, is it the controlling factor? Generalities on phosphorus as the limiting nutrient (controlling factor) in cultural eutrophication should not be overdone. What is true for one region is not necessarily true for another region. Phosphorus is recognized as a limiting nutrient for algae growth in some areas, while other elements, such as carbon and nitrogen are limiting nutrients in other regions.

Since phosphorus is implicated in cultural eutrophication, is the detergent industry the only source of phosphorus for the environment? The answer is no. The detergent industry consumes between 13%-14% of the yearly phosphorus production, whereas over 70% goes to the fertilizer and animal feed industries. A small percentage also goes into foods and pharmaceuticals. If the detergent industry removed all the phosphates from detergents, would this alleviate man-accelerated eutrophication? Material balances have been conducted on some bodies of water

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to establish what contributions of phosphates arrive from what sources. In general, for an urban center adjacent to a body of water, the sources of entering phosphorus break down as follows:

Municipal sources	
Human and vegetative sources	27%
Detergents	28%
Inflowing waters	13%
Rural run-off	11%
Urban run-off	6%
Industrial	4%
Other	11%

Even though detergents contribute about 50% of the phosphorus in municipal sewage, the detergent contribution is down to 25%-30% of the total phosphorus entering the receiving waters because of the other contributing sources. If it were possible to remove phosphorus completely from detergents, we would be limiting only 25%-30% of the phosphorus contribution to the lakes in an urban setting. In a rural setting, the contribution from detergents is less and in some instances nonexistent. Since algae require very little phosphorus for growth (as little as 0.5 lb, or less, per 100 lb. of dry algae), the remaining phosphorus entering from the other sources is sufficient to maintain accelerated eutrophication provided other essential nutrients are present. Man-accelerated eutrophication is really more complex to solve than merely removing phosphorus from detergents.

Dr. Daniel A. Okun, professor of environmental engineering and head, Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina, Chapel Hill testified at recent FTC hearings:

> "I would recommend strongly against a decision to remove phosphates from detergents as a solution of the eutrophication problem for two reasons: *(a)* the benefits of removal of phosphates from detergents are questionable at best, and *(b)* the alternatives to phosphates pose unknown dangers directly to man that may be far more serious than the problems of phosphates themselves."
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> "The phosphates present in detergents used by approximately 87% of the total population of the United States cannot be claimed to have any effect whatsoever on the waters into which wastewaters containing these detergents are discharged. For example, all of the rural population and the population in unsewered communities, approximately 30% of the total population . . . discharges its wastewaters to the ground, where the phosphate concentration is of no consequence. About 55% of the population . . . reside in cities whose municipal wastewaters discharge into rivers or the ocean, where there is no danger of eutrophication. In this latter category are New York, Pittsburgh, St. Louis, Chicago, Los Angeles, and many other large and moderate-sized cities."

Dr. William J. Oswald, professor of Public Health and Sanitary Engineering, University of California, Berkeley, in a letter to FTC, stated:

> "The fact is that the principle of source control does not apply, because even elimination of all phosphates from the detergent source will have no detectable effect except possibly in the most pristine environment. Each human each day excretes about 1.5 g of phosphorus, and each kilogram of ordinary soil or silt contains 1 g of phosphorus. Independent of any detergent source, the average domestic sewage contains sufficient phosphorus from uncontrollable origins to support the growth of 1,000 mg per liter of blue-green algae. Such an algal concentration is 50 times that ever found in Clear Lake, California, 100 times that found in Lake Erie, and 1,000 times that found in the oceans."

SPECIALTY PRODUCTS

Since the detergent industry is involved in cultural eutrophication because of the phosphorus we use in our products, what are we doing about this environmental problem? Before discussing some of the remedial steps being taken by the detergent industry in general, we would like to describe a sector of the detergent industry not generally recognized as being part of the detergent market place. This sector of the detergent industry is known as the specialty detergent and sanitizer market. The Soap and Detergent Association uses the designation of Industrial & Institutional (I & I) detergents to define this category. To put the specialty detergents and sanitizer products in the right perspective as compared to the other sectors of the detergent industry, one can use the volume of the detergent phosphorus as an indicator of comparison. Since phosphorus is implicated in cultural eutrophication, it is interesting to note that only approximately 28% of the total phosphorus currently used by the detergent industry in one calendar year finds its way into the specialty detergent and sanitizer field, and the remaining 72% of the phosphorus used by the detergent industry goes to other sectors of the industry, the all-purpose household laundry detergents being the biggest user.

All too often, detergents are considered as one large family without the distinction being made as to the application of the detergent. As the name signifies, cleaning formulations in the specialty detergent and sanitizer markets are designed for special use. Not all specialty detergents contain phosphorus, but those that have phosphorus in their formulations do so to function effectively on a special cleaning job. These specialty detergent and sanitizer formulations are used in institutional and home dishwashing machines; hospital and health care facilities; cleaned-in-place (CIP) equipment for the dairy and food industry; the transportation industry to aid in cleaning and overhauling of carrier vehicles such as airplanes, ships, truck transports, buses, and

diesel locomotives. These are the market places of the specialty detergent and sanitizer products. The markets themselves demand a special type of detergent or detergent sanitizer to function under a special set of conditions to do a special job of cleaning. It may be possible to bring about a formula change quickly in a general household laundry detergent, but specialty detergents and sanitizers were designed for special uses and a change in formula (phosphate reduction or removal) may render them ineffective. The criterion for cleanliness in a specialty detergent and sanitizer application is different from the "whiter than white" concept for household clothes washing. We speak in terms of microbial cleanliness, reduction of bacterial count, quality of bulk milk for Grade A use, etc.

Composition of many of these specialty type products is presently regulated by federal, state, and local requirements. Licensing and special labeling may be required by such agencies as the Food and Drug Administration, Consumer and Marketing Service (USDA), and the Environmental Protection Agency (EPA), and any change in formula would require time-consuming re-approvals. To treat specialty detergent products used in essential sanitary steps in food or beverage service or in the mass transportation industry on the same basis as general household cleaning products seems to disregard an important element of public health protection and public safety.

REMEDIAL MEASURES

The above discussion has been presented to distinguish between general household detergents and specialty detergents and sanitizers. This market of the specialty detergents and sanitizers is the market place of Economics Laboratory, Inc. We at Economics Laboratory have accepted this challenge to "do business in an age of constant change," and are continuing to search for phosphate replacements and to test formulation changes to bring about effective cleaning and sanitizing agents for the markets we serve. However, we feel it would be a great disservice to put into the market place something which would reduce the levels of cleanliness and sanitation we now maintain and possibly create an even greater environmental problem. The large number of product types and the various uses and methods of application of specialty detergents and sanitizers point to the extreme complexity of finding phosphate substitutes to fit this market place.

We are pleased to note that legislative and judicial bodies are now giving special consideration to specialty detergents and sanitizers and their role in American life. We appreciate the understanding of these officials that it is very risky from the standpoint of public health and safety to remove some specialized detergents and sanitizers from use. It is hoped that if legislation is deemed necessary, it will be written with intelligent timetables for phosphate removal in these critical product types of the specialty detergent and sanitizer markets.

It would seem that several other courses of action are open to help in the problem of cultural eutrophication. When feasible, all wastes should be diverted from lakes. Where diversion of waste water is not possible, improved waste treatment technology can be applied. Physical-chemical processes have been developed to effect high removal of *all* nutrients. The city of Detroit is completing the construction of a 1 billon gal/day sewage treatment plant which is unique because the waste pickle liquor from nearby steel mills will be used as a precipitating chemical for phosphates. The city of Rochester,, New York has moved aggressively to provide treatment facilities which will effect high removal of nutrients from waste water. The total treatment costs are above the conventional primary-secondary systems currently being used, but their overall efficiency in terms of organic and inorganic waste removal is dramatically superior. No doubt we will be seeing more and more plants of this type, simply because of increasing population densities, regardless of what happens to detergent phosphate input levels in the future. We look at proper waste handling and modern effective sewage treatment as a more comprehensive and reasonable solution to cultural eutrophication than the removal of phosphate from detergents.