ILLINOIS POLLUTION CONTROL BOARD
March 14, 1972

IN MATTER OF PROPOSED REGULATION )
BANNING PHOSPHATES IN DETERGENTS ) #R71-10
AND OTHER CLEANING PRODUCTS )

OPINION OF THE BOARD (BY MR. LAWTON):

Pursuant to Section 28 of the Environmental Protection Act, Earthforce, Inc. and Northwestern Students for a Better Environment submitted a proposed regulation for consideration, providing as follows:

> "No detergent or other cleaning product containing phosphorus compounds may be sold in Illinois after June 1, 1972."

The Board found that the petition satisfied the procedural requirements of Section 28, was not plainly devoid of merit and did not deal with a subject on which a hearing had been previously held. Hearings were held in Chicago and Peoria.

The presentation of the proponents consisted primarily of a statement attributed to Dr. Wesley O. Pipes, which was read into the record at the first hearing, Dr. Pipes appearing for cross-examination at a later hearing. Speaking in support of the proposal were H. W. Poston, Commissioner of Environmental Control for the City of Chicago; Lee Botts, Executive Secretary of the Lake Michigan Federation; and three witnesses on behalf of Armour-Dial, Inc. Principal opponent of the proposed regulation was The Soap and Detergent Association which presented industry witnesses and a substantial amount of written material. Mr. Ralph Evans appeared as a Board witness.

Section 27 of the Environmental Protection Act requires that in promulgating regulations, the Board shall take into account the technical feasibility and economic reasonableness of reducing the particular pollution involved. Title III, Section 11, dealing with the Board's powers with respect to prohibition of water pollution states as one of the purposes of the title the assurance that no contaminants are discharged into the waters of the State without being given the degree of treatment or control necessary to prevent pollution.

Phosphorus and phosphate discharges into the waters of Illinois have been the subject of considerable concern and action by the Board since its inception. Regulation #70-6 established water quality and effluent standards for phosphorus discharges into Lake Michigan. In adopting state-wide effluent standards, #R70-8, we limited emission of phosphorus

Regulation #71-14, Water Quality Standards, adopted March 7, 1972, provides as follows:

> "203(c) Phosphorus (STORET number - 00665): Phosphorus as P shall not exceed 0.05 mg/l in any reservoir or lake, or in any stream at the point where it enters any reservoir or lake."

Section 206 limits phosphorus in Lake Michigan to .007 milligrams per liter. The opinion in support of the regulations states as follows:

> "203(c) provides a phosphorus limit for reservoirs and lakes and for streams tributary to them. The evidence is strong that phosphorus above this level in relatively still water can give rise to obnoxious algae blooms. The evidence does not support the need for a phosphorus standard in other situations, and the proposal for such a standard is here omitted. So is the earlier proposal for an algae limit, which was too stringent to indicate the presence of a nuisance. The evidence does not support any numerical standard for algae, and we rely upon the nuisance standard of 203(a). We have not defined "reservoir" or worked out on a case-by-case basis in light of the policy here expressed. Not every navigation dam will be held to create a lake for this purpose. Despite the uncertainty, it does not seem appropriate to postpone necessary regulation for lack of a perfect definition."

The regulations promulgated by the Board manifest an intention to minimize the discharge of phosphorus and phosphates into the waters of the state where such limitation is necessary in furtherance of our statutory objectives. However, the record in the present proceeding does not support adoption of the regulation as proposed. Accordingly, the petition for adoption of the regulation must be denied at this time. In arriving at this decision, we do not foreclose further consideration of this regulation or one of similar import. Our holding today is merely a determination that on the record of the present proceeding, a state-wide phosphate ban for detergents is not justified.

The principal issues emerging from the hearings are first, whether phosphorus removal at the source is necessary in lieu of or in addition to phosphate removal at the sewage treatment plant, secondly, whether satisfactory substitutes exist for phosphate in consideration of requisite detergent capabilities, and lastly, whether such substitute materials are reasonably safe to those who use them as well as those in their proximity.

Phosphate is used in detergents to increase efficiency of the surface active agent, to keep dirt particles suspended in wash water, to furnish necessary alkalinity for proper cleaning, to provide resistance against

criteria for phosphorus without phosphate removal processes at treatment plants. The technical feasibility and economic reasonableness of phosphate removal at waste water treatment plants is conceded. However, if detergent phosphate is banned, it is contended that substantial savings will be effected in the treatment plant operation resulting from the decreased use of chemicals and decreased costs of sludge disposal. Also, with a detergent ban, petitioners contend that in some instances, phosphate removal processes would not be necessary at all in order to meet water quality effluent standards. The decrease in chemicals needed for treatment would save much-needed resources (R.39,) and at the same time lessen the dissolved solids entering the receiving waters.

Petitioner concludes as follows: 1. That installation of phosphate removal processes at municipal waste water plants is technically feasible and economically reasonable; 2. That phosphate removal would still be required in many instances, even if phosphates are banned from detergents; 3. That in flowing streams which provide adequate dilution, water quality protection will be assured even without the employment of phosphate removal processes if a phosphate detergent ban is invoked; 4. The banning of phosphates from detergents is an attractive alternative to the installation of phosphate removal processes at all municipal waste water treatment plants because the money saved by not installing phosphate removal equipment can be used to solve other water pollution problems, because phosphate removal processes will consume resources and energy, because some phosphate removal processes add to the chloride and sulphide content of the effluent and because all phosphate removal processes increase the problem of sludge disposal. (R.41).

Dr. Pipes next considers the sources of phosphorus in surface waters considering the relative contribution of storm water and land run-off and observing that efforts to control agricultural run-off as well as urban storm drainage and effluent control are necessary to resolve the phosphorus problem. As stated in the testimony, "The banning of phosphorus detergents will not solve the entire problem of phosphorus in the surface waters. We realize the control of dispersed sources of pollutants is more difficult than the control of identifiable discharges. We believe that the limitation of phosphorus content in effluents is an essential step in arriving at the solution to the phosphorus problem. We also support the Board in their attempts to take the necessary steps to solve the other parts of the problem." (R.44)

Dr. Pipes next discusses phosphorus as a pollutant, observing that phosphates discharged into municipal and industrial effluent serve as nutrients for algae and other aquatic vegetation. While the effect of excessive algal growth in lakes has not been disputed, the point of controversy has been whether the phosphates or other nutrients such as carbon or nitrogen are the controlling factors which limits excessive algal growth. Publication entitled "The Effect of Carbon on Algal Growth - Its Relationship to Eutrophication" is referred to, in which

and by using pickling liquor, a steel waste product, "one pollutant can be used to get rid of two". (Exhibit 12A and B).

Three witnesses from Armour-Dial, Inc. testified in support of the proposed regulation, addressing themselves principally to a non-phosphate detergent called 'Triumph' in which the phosphate builder is replaced by sodium carbonate. The product is manufactured by DeSoto, Inc. and is identical to products distributed by Sears, Roebuck & Company and Whirlpool Corporation under other brand names. The substance of their testimony was that the sodium carbonate-based detergent they have been working with is ecologically preferable to a phosphate-based detergent, that it does not possess attributes of toxicity or corrosiveness exceeding most phosphate-based detergents, that phosphate-based detergents are as hazardous and that the dangers resulting from non-phosphate detergents have been over-dramatized. Lastly, the Armour-Dial, Inc. witnesses contend that its product is as good a detergent as the best-selling phosphate product and superior to a considerable number of others in terms of soil removal, performance on fabrics, water softening, absence of film and other considerations by which the effectiveness of detergents are judged. (R.60 to 84).

With respect to the possible reduction of flame-retarding finishes, the witness observed that such fabrics presently in use have been designed for use with phosphate-based detergents and that other resins used for flame retardation could be employed that would not be affected by sodium carbonate based detergents (R.83).

A witness for DeSoto, Inc. supporting the testimony of the Armour-Dial, Inc. witnesses discussed the subject of precautionary labeling, observing that no detergent, phosphate or non-phosphate, is safe to eat, put in the eye, or leave on the skin for long periods of time and that all detergents should have precautionary labels with first-aid instructions. (R.85). He concluded that it is not fair to say that there is no safe and effective substitute for phosphate detergents and that the DeSoto product cleans as well and is as safe as phosphate-based detergents in use for many years (R.95).

The foregoing constituted the principal testimony in support of the proposed regulation.

Mr. Ralph Evans (R.126), Head of the Water Quality Section of the Illinois State Water Survey, appeared as a Board witness. He testified that there is no question that phosphorus is a major algal nutrient and the most controllable of many nutrients required for algal productivity, which alone makes it attractive for control purposes. Phosphorus, on the other hand, is not toxic, does not directly degrade water quality and serves usefully in detergent formulations for cleaning purposes. He observed that the current controversy regarding phosphorus has developed from its association with the term "eutrophication", which, in essence, is the process by which a body of water becomes over-nourished from

James N. Carlisle, Manager of the Great Peoria Sanitary District, testified that even with removal of phosphates from detergents, the final effluent from the treatment facility would contain 3 or 4 milligrams per liter of phosphorus, which would require phosphorus removal at the plant in order to meet the 1 milligram per liter proposed for certain streams. If pickle liquor is employed, the two major costs would be for chemical and sludge removal. In his judgment, the ava ability of chemicals locally would reduce chemical costs and sludge remc costs would remain essentially the same. He believes that the benefit of a phosphate ban would not be considerable because treatment at the plant would still be necessary. In his view, "at the present time, there are too many conflicting opinions, unsupported by proven data which make the benefits derived (from a phosphate ban) questionable." (R.136.)

Keith A. Booman, Technical Director of the Soap and Detergent Association, testified in opposition to the proposed regulation (R.144). He summarized the uses of phosphate in detergents, including water softening, dirt suspension, alkalinity and emulsification of oil and grease, stressing the safety of the phosphates to humans, aquatic life, fabrics and machinery. Also emphasized was the use of specialty detergents used in hospitals, restaurants, dairies, food processing plants and meat and poultry plants.

The statement of Dr. Steinfeld, Surgeon General of the United States was read into the record in part:

> "...I am concerned...with another danger which deserves our attention, danger that the national outcry over the levels of phosphates in detergents will become so great as to obscure the health or environmental impact of alternatives to phosphates..."

Lew Theoharous, Associate Director of Research for Proctor & Gamble Company reviewed the relation between phosphates in detergents and eutrophication. His review of statements made by scientists to the Federal Trade Commission during April and June of 1971 lead to the following conclusions: that accelerated eutrophication is limited to a small portion of the country and does not create a public health problem, that where eutrophication is a problem, removal of phosphates from detergents will have little or no effect on the growth of algae and that the consensus of opinion was that replacement for phosphates should be authorized only when such replacements have been adequately tested for environmental safety. Simulated experiments conducted in apartment house complexes where phosphate detergents were not used, suggested that the waste water without phosphate detergent would have the same algal-producing characteristics as waste water in which phosphate detergent was present and that treatment by precipitation of sewage containing phosphate detergent would eliminate algal growth (R.165).

The use of soap in place of phosphate detergents was considered. In the judgment of this witness, soap is a suitable cleaning material

Analysis of several dozen non-phosphate laundry detergents represented a distinct hazard in the home because of the high alkalinity of these products. Toxic household products can express their toxicity when they are used without adequate precautions for their intended use or when grossly misused. The usual victim of episodes of misuse is the young child between one and four whose natural curiosity often leads him to put into his mouth materials that no adult would consider palatable. Accidental poisoning is conceded to be the leading cause of death of young children in this age group and, of course, non-fatal injuries are far more common than fatal ones. Both liquid and granular household detergents are involved frequently in such accidental ingestions. According to 1969 statistics, approximately 15% of all inquiries at poison centers in the United States concerned the accidental ingestion of household cleaning and polishing agents of children under five years of age. In 1969, this amount consisted of 10,978 reports of which about one-third involved detergents and chemicals. Often, the results are nothing more than mild sore throat without permanent injury and rarely lead to clinically significant illnesses, which only require mild measures of first-aid. Such reassurances cannot be extended to cases involving high alkalinity detergents which are presently appearing on the American market and alerting to the dangerous consequences of these materials cannot be expected to prevent injury. In the words of Dr. Gosselin:

> "There is nothing about the appearance or packaging of the newer products that would in any way discourage the young child from mouthing them, in the same way that his older brothers and sisters may have sampled the phosphate detergents when they were toddlers. Accordingly, we must expect that ingestion episodes involving non-phosphate detergents will soon accumulate in substantial numbers. It is my expectation, based on considerations to be presented in a few moments, that many of these exposures will result in serious and even permanent injuries. These injuries are expected to take the form of chemical burns in the mouth, esophagus and eyes.
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> "Certainly, no toddler will be dissuaded by a warning label on the package. In any case, many of these containers bear no warning. Among others one sometimes finds nothing more than the bland statement: 'Keep out of reach of children'. Thus, even the intelligent and alert mother may have little basis today for recognizing that most of the new non-phosphate detergents have significantly higher toxicity potential than the phosphate preparations with which she has had long experience. In March, 1971, the Food and Drug Administration seized two highly alkaline laundry detergent products, because of inadequate cautionary labelling, and in June they acted to require such labelling on 25 additional products. Since then, several manufacturers of similar products have added warning statements on the package, but the practice is still far from general.

predictions are based on experimental studies in dogs and rabbits and on at least one clinical episode involving an automatic dishwasher preparation no more alkaline than several phosphate-free products that are now being promoted as home laundry detergents.

4. Thesepredictions are supported by recent scattered reports of personal injuries from the use and misuse of these phosphate substitutes. The recent death of an infant in Connecticut has been ascribed to mouthing and then inhaling the powder of one such product.

5. In my opinion these products should carry a warning label of the type prescribed under the Federal Hazardous Substances Act. However, I do not expect such cautionary labeling to prevent a considerable number of serious personal injuries if these products gain general consumer acceptance.

6. In my opinion the use of phosphate detergents should not be discouraged until there is available at least one alternative product that is established to be safe as well as effective. The home is still an important part of our environment, and ecological principles should apply inside as well as outside the home."

John C. Livengood, Product Manager of Monsanto Industrial Chemical Company testified that the evaluation of forty-six non-phosphate detergents show a substantial amount of sodium carbonate and a higher alkalinity than phosphate-based products (R.205).

Dr. Louis P. Scharpf, also of Monsanto, testified that on the basis of experiments conducted on the eyes of rabbits, using both phosphate and non-phosphate detergents (R.206) irritation was found to be far more severe, long-lasting and deteriorating when caused by high alkalinity non-phosphate detergents than by using phosphate detergents. Where high alkali detergent was used, not only was the initial injury more severe, but the period of healing far longer. Experiments conducted on the stomachs of dogs again showed a more severe and longer impact where carbonate-based detergents were utilized.

Dr. Edwin R. Loder, from DuBois Chemicals Division, CHEMED Corporation, testified on the subject of institutional and industrial detergent products (R.222). It is his view that the composition of detergents presently containing phosphate should not be altered until the use of substitutes for hospital, restaurant and food processing uses could be ascertained. Detergents are needed for removal of food pathogens and spoilage microorganisms for restaurants, hospitals and institutional sanitation and forced modification of present industrial and institutional detergents could have a devastating effect on the public health aspects of cleaning and sanitizing. Approximately twenty

Dr. Paul F. Derr appeared on behalf of FMC's Inorganic Chemicals Division. He testified to the principal causes of eutrophication stating that in his judgement, detergent phosphates "are not and never have been a cause of eutrophication." (R.256). It was his belief that excessive discharges of carbon-containing organic wastes have caused both the increase in algal growth and simultaneously, an increase contained in phosphate found in solution. Thus, increased phosphate concentration is a result of organic pollution and eutrophication, not a cause. In his judgement, although phosphorus is one of some 15 to 20 nutrients required for growth of all plants, including algae, any attempt to control eutrophication by limiting the input of phosphorus to a lake is doomed to failure; first, because of the relatively small amount of phosphorus needed for growth, secondly, that there are such large uncontrollable natural supplies of phosphorus that it will never be feasible to control phosphate input to a lake at extremely low levels which would be required to inhibit algae growth. All lakes contain excessive amounts of phosphates, most of which is found in the bottom sediments. In contrast, other important inorganic nutrients such as carbon, nitrogen and potassium remain totally undissolved in the lake water. If phosphate input to a lake were completely stopped, phosphates in bottom sediments would merely redissolve to maintain essentially a constant concentration of phosphate in the lake waters for many years. Thus, an increase or decrease of phosphate added to a lake has little or not effect on the growth of algae. The primary nutrient required by algae is carbon in the form of carbon dioxide. Algae is composed of between 50% to 75% carbon. Bacterial decay of organic matter supplies the large amount of carbon dioxide essential to support algae growth. Bacterial decay of sewage leads to depletion of dissolved oxygens creating the death of fish and aquatic animal life and also major chemical changes which greatly increase the release of nutrients, including phosphorus from the sedimentation. In his judgement, the answer to all these problems was adequate sewage treatment, including adequate chemical processes. Secondary sewage treatment permits natural biological processes to convert carbon in both the dissolved and suspended organic matter into carbon dioxide gas which is expelled into the atmosphere. In summary, this witness stated that "No one has ever shown that removal of phosphates from detergents will have any effect whatsoever on excessive growth of algae in lakes. Good sewage treatment is the only method for correcting the problem." Incorporation of chemical precipitation processes removing carbon-containing organic wastes greatly increases the removal of all nutrients.

Stacey L. Daniels appeared on behalf of Dow Chemical Company and discussed the technology available for removal of phosphorus from sewage and waste water (R.275). He stated that 30% to 70% of the phosphorus present in sewage is contributed by detergents. The process of phosphorus removal must be practiced at waste water treatment plants even if there is no detergent phosphorus contribution to

she has regarded as hazardous and which she has tried to keep out of reach of children. Rather suddenly, as one result of growing alarm over eutrophication problems (which alarm the Department of Health, Education and Welfare shares) and consequent moves to limit or ban phosphates in or from detergents, many producers turned to alternative builders and some marketed products which were highly alkaline and highly caustic. Some of these products were capable of inflicting harm on the unwary housewife and her children, but the hazard had not been adequately drawn to her attention before the press conference of September 15, 1971. Admittedly, some manufacturers of detergents had complied with the law. But some had not. And, although the Food and Drug Administration will continue to test detergent products, the frequent changes of product composition for the 200 or so detergents now marketed will tax the testing capacity of this Agency.

Dr. Mitchell then considers the consequence of ingestion of phosphate-containing detergents as contrasted with those of highly caustic content and concludes that change in labelling alone would not be a sufficient protection, particularly among children who are incapable of understanding them.

"The causticity of a product varies directly as the pH differs from neutrality, which is to say, the more alkaline (or the more acid) the material, the stronger will be its corrosive properties. An important factor in determining the ultimate effect is the reserve alkalinity which is an indication of the ability of the offending material to preserve its highly alkaline state while reacting with tissue.

"The physical state of the product may be either liquid or solid. Liquids, while more readily swallowed and more capable of reaching the stomach, may be somewhat more readily diluted, neutralized and flushed away from a surface, such as the mouth and eye, than is a particulate matter."

He discusses the detrimental consequences of contact of highly caustic alkaline material on the skin, eye, mouth, larynx, esophagus, stomach and tracia, noting that a child would not have the ability to neutralize the effect of such contact. He notes that it is too soon to enumerate the accidents which have occurred since the first of the many alkali products in detergents began but there have been accidents from some of these products. Citing the death of a fifteen-month-old child who aspirated one of these products and a St. Louis child who suffered mouth burns, he discounts the effects of cautionary labeling in furnishing suitable protection to those using or coming in contact with the product. He states:

"To my knowledge, there has been very little public outcry against the hazardous nature of some of the highly alkaline laundry products. Attention has been focused on the hazard posed by phosphates in respect to waters. There has been

a matter of interest and concern, it cannot be the controlling element in imposing a state-wide ban on a household product. It appears undisputed that approximately 50% of the phosphate content in municipal sewage is contributed by phosphate detergents and proponents suggest that the banning of phosphate detergents may enable some small and middle-sized communities to meet Board effluent standards without undertaking the additional cost of phosphate removal. This conclusion, at least with regard to middle-sized communities is refuted by testimony regarding Peoria which would need phosphate removal facilities even if phosphate detergents were banned. In any event, it would appear that operational cost for phosphate removal would be reduced by no more than 30% if phosphate detergent is prohibited. Economic savings alone to the extent shown do not justify the adoption of a ban on phosphate detergents. We are mandated to control pollution. Economic reasonableness must be considered when a particular pollution control measure is proposed. However, we do not believe the statute envisions our imposing a product ban for purposes of affecting economies on the local level. Likewise, considerations of safety are such that we do not feel justified in imposing the ban at this time until we are satisfied that replacements for phosphate do not possess toxic or caustic propensities creating substantial dangers to those using or in the vicinity of the product involved. By this holding, we are making no judgment that all phosphate products are good and all sodium carbonate products are evil. The record demonstrates that it is the alkalinity and not the element that determines the danger. The evidence demonstrates that some phosphate-based detergents have high alkalinity with attributes of danger while some sodium carbonate products appear reasonably safe. However, we cannot conclude that on the basis of the limited testimony in this respect that an outright phosphate ban would be in the best interests of the public health, safety and general welfare. The record demonstrates that many sodium carbonate detergents do have high alkalinity with resulting dangers from causticity.

While some evidence was introduced on both the safety and effectiveness of a particular non-phosphate detergent, these findings cannot be extrapolated to all non-phosphate detergents. The critical consideration in determining causticity is the percentage of alkalinity in a particular product and not the phosphate or sodium carbonate character of its base. The record is devoid of evidence demonstrating the comparative safety of non-phosphate cleaning products as a class. Opposition witnesses did offer evidence that on the average, non-phosphate products did contain a higher degree of alkalinity and, therefore, causticity, than phosphate-based products. The evidence did demonstrate that non-phosphate detergents with alkaline content on the order of 40% exerted disruptive effects in mucous membranes in the stomach of dogs, rabbits and monkeys (R.202). Other studies evaluating forty-six non-phosphate detergents demonstrated

casually proceed on a dearth of information. The record does not adequately show the technical feasibility of the proposed ban.

Petitioner offered as additional areas of problem algae growth, the Illinois River in certain sectors, the Skokie Lagoons (R.49, 370), certain sections of the banks of the Mississippi River, certain shallow, low-flow areas of the Kankakee River (R.327), and the North Branch of the Chicago River (R.370). No water quality data and no evidence of pollution problems in these areas due to algae growth were offered in support of these conclusions. Absent supporting evidence or a showing of first-hand knowledge of the water quality of these areas, the mere conclusion that they suffer from nuisance algae growth is legally insufficient to persuade us on this issue. The proponent failed to establish that phosphorus poses a pollution problem in any flowing stream in Illinois. Beyond our previous decisions affecting the Fox River and Lake Michigan, we remain open to future evidence of nuisance algae blooms in other waters of the state. At present, the limited evidence of phosphorus pollution does not warrant a remedy of the magnitude of a state-wide prohibition on phosphate detergents.

Nothing we do today restricts those Illinois communities along the Fox River or which discharge sewage effluent to Lake Michigan or other municipalities which may be faced with nuisance algae growth in their reservoirs or lakes from acting to reduce their local pollution problems and to deal with their need to cut sewage treatment costs. Indeed, the ability to impress upon housekeepers the need to use discretion in purchasing detergents would seem considerably easier in a local area when undertaken by a local governing body than would be the case if a statewide ban of phosphate detergents were imposed. We do not rule out a reopening of this issue before the Board when clearer evidence exists of a threat of degradation of the waters of Illinois from phosphorus effluent.

Nor do we restrict the possibility of holding rule-making hearings on a proposal to ban the sale of phosphate detergents on a regional basis in those areas affected by eutrophication, when the evidence of adequate available substitutes for phosphate detergents is more convincing. The record in this case demonstrates that a phosphate detergent ban would result in a further reduction of the total pounds of phosphorus discharged to a receiving body of water even when phosphorus is removed at the sewage treatment plant in order to meet an effluent standard (R.132). Given the threat that bottom deposits may pose a considerable long-term eutrophication problem (R.128, 129), even if an effluent standard is being enforced in an area suffering from nuisance algae blooms, such a regional ban on phosphate detergents could, in the future, be a necessary step to reducing the total amount of phosphorus discharged to an over-enriched body of water. By our existing regulations, we have endeavored to