INLAND WATERS BRANCH

DEPARTMENT OF THE ENVIRONMENT

Phosphates and the Canada Water Act

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Foreword

This report provides analytical data on the content of phosphates in detergents and shows that manufacturers are in almost all cases complying with the Nutrient Control Regulations of the Canada Water Act. It includes data on chemical analyses (particularly for phosphates) carried out on detergents manufactured before and after implementation of the regulations on August 1, 1970.

The chemical analyses were carried out in the Ottawa laboratories of the Water Quality Division, Inland Waters Branch, Department of the Environment. X-ray diffraction analyses were done by the Mineral Processing Division, Mines Branch, Department of Energy, Mines and Resources.

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INTRODUCTION

Modern societies, exploiting the natural ability of rivers and lakes to break down and carry away industrial and domestic wastes, impose a load on these waterways which frequently is grossly in excess of what can be carried without serious deterioration in water quality. Not the least serious of the effects of overloading is stimulation of cultural eutrophication, the process of overenrichment of water by nutrients which causes oxygen depletion as a result of the decay of massive growths of aquatic vegetation. Cultural eutrophication is recognized by scientists and water resource administrators in Canada, and in all developed countries, as one of the most vexing of all environmental problems.

Under natural conditions, moderate amounts of nutrient material in water and in the beds of rivers and lakes encourage the growth of aquatic vegetation which provides a food source for fish and for the small organisms on which many fish feed. Left to its own resources, nature provides a stable ecological balance which may change but little over a long period of time. The addition of even small amounts of nutrients, notably phosphorus, carbon and nitrogen, from industrial and domestic wastes, and from agricultural operations, upsets the natural ecological balance and triggers an abnormal growth of aquatic vegetation, the most troublesome form of which is algae. Abnormal algal blooms can clog water intakes and can destroy the recreational value of a lake or river. Decaying algae use up dissolved oxygen which is essential to the survival of fish and other organisms and to the growth of aerobic micro-organisms which destroy solid and liquid wastes in water. Anaerobic micro-organisms, which thrive in the absence of dissolved oxygen, then gradually become predominant, giving rise to the malodorous by-products of decomposition generally associated with gross pollution. As the process of eutrophication proceeds, lake shores and beaches become fouled by evil-smelling accumulations of decaying algae.

If the process is allowed to continue, the condition of a lake can deteriorate to the point where the quality of the water and the shore environment is virtually destroyed.

BACKGROUND

In October 1964, the Governments of Canada and the United States asked the International Joint Commission to investigate the extent and nature of pollution in Lake Erie, Lake Ontario and the International Section of the St. Lawrence River and to recommend remedial measures. The Advisory Boards established by the IJC to carry out the investigation reported their findings in 1969[1]. Notable among these were the following:

1. Nutrients, especially phosphorus, have been and are being added to the waters of reference in such quantities that Lake Erie, particularly the western basin, is in an advanced state of eutrophication. Similarly, accelerated eutrophication is occurring in Lake Ontario with the effects being carried into the St. Lawrence River.

2. The eutrophic conditions described above have caused excessive algal growths which interfere with water uses, including water supplies, aquatic life, aesthetics, industrial uses, recreation and shoreline properties.

3. Commercial fisheries statistics, while showing relatively stable catches over the last forty years in terms of weight, indicate that dramatic changes in the fish populations have occurred. The contribution to the annual catch made by once abundant and valuable species has decreased while that of less valuable species has increased. This important change, at least in part, is attributable to the effects of pollutants.

4. The major sources of pollution to the referenced waters are municipalities and industries. Municipal wastes comprise the principal sources of phosphorus to the lower lakes. Municipal and industrial wastes also contribute dissolved and suspended solids, oxygen-consuming materials, toxic substances and pathogens.

5. Nutrient runoff from agricultural lands is considered to be a source of pollution but there is limited reliable information at the present time on the magnitude of this contribution.

Among the Advisory Boards' recommendations for remedial action were the following:

1. A program of phosphorus control should be implemented in the drainage basins of Lakes Erie and Ontario to reduce the adverse effects on water quality and water use resulting from excessive biological growth. The required reduction can be achieved by:

   (a) immediate reduction to minimum practical levels of the phosphorus content of detergents and the amounts of phosphate-based detergents used; complete replacement of phosphorus compounds in detergents with environmentally less harmful substitutes as soon as possible, but not later than 1972.

   (b) implementing programs for the reduction of phosphorus from municipal and industrial waste effluents discharging directly to Lake Erie and Lake Ontario, and for the necessary treatment of waste effluents discharging to the tributaries where the influence of these on the lakes is significant.

An estimated 64% of the phosphorus loading to Lake Erie comes from municipal waste discharges; the corresponding figure for Lake Ontario is 55%. Laundry detergents are estimated to contribute about 50% of the phosphorus found in municipal discharges in Canada and 70% in the United States. This means that detergent phosphorus accounts for about 40% of the total phosphorus load to Lakes Erie and Ontario[2].

PHOSPHORUS AND DETERGENTS

Modern laundry detergents contain a variety of chemicals introduced for specific purposes. There are chemicals for brightening and whitening clothes, protecting washing machines against corrosion, stabilizing suds in top-loading machines and for suppressing suds in tumbler machines. These ingredients, however, make up only a small fraction of the packaged detergent. The two most important ingredients are the surfactant and builder.

The surfactant, usually LAS (linear alkylate sulphonate), is the suds-producing ingredient. It is soluble in both oil and water, a property which helps the water wet the individual fibres thoroughly and permits the effective removal of oil and grease. In the packaged product, the surfactant comprises up to 20% by weight of the mixture.

The builder, the agent which works with the surfactant to give the detergent its cleaning power, is usually sodium tripolyphosphate (phosphates are compounds containing the natural element phosphorus) which helps to remove oil and dirt from cloth fibres and to hold them in suspension once they have been removed. The builder prevents the hardness constituents from interfering with the action of the surfactant by combining with these constituents to form a soluble chemical complex. It further assists the cleaning process by making the wash water alkaline.

There is considerable variation in the amount of phosphate builder used in the various detergent products. Table II shows that prior to the introduction of nutrient control legislation, the phosphate content of the laundry detergents tested varied from less than 1% to about 38% expressed as phosphorus pentoxide (P_2O_5). It shows also that after the introduction of the nutrient control legislation the phosphate content of the laundry detergents tested varied from less than 1% to about 20%.

WHY NUTRIENT CONTROL MEASURES?

Reduction in phosphorus loading to Canada's waterways requires control of the discharge of phosphorus from sources over which control can be exercised. Some of these sources are point sources, others are diffuse. A prohibition on the use of phosphates in laundry detergents would reduce significantly the phosphorus discharge from municipal outlets, but would not affect that portion of the phosphorus discharged in human wastes. Human wastes account for about 25% of the total input of phosphorus to Lakes Erie and Ontario from municipal sources. The obvious course for this source is the removal of phosphorus by sewage treatment plants specially designed for this purpose. Leaching of phosphorus from artificially-fertilized soils and surface erosion of agricultural lands are significant sources which must eventually be controlled.

An accurate assessment of the magnitude of the contribution of nutrients from agricultural sources is not yet possible, but in most cases is considered to be a minor contributor. It may be some considerable time before adequate control measures can be devised and implemented.

A comprehensive phosphorus control program must therefore include:

1. removal of phosphate from detergents, on a phased reduction basis,

2. phosphate removal at sewage treatment plants and,

3. reduction of phosphates from diffuse land sources.

There is little doubt that an important contribution to nutrient control is through removal at sewage treatment plants. But here the question of timing is involved. The time required for research, design and construction will be such that treatment plants in sufficient number cannot be expected to be in operation for some years. There is the added problem of financing. The costs of developing and building treatment facilities that will effectively remove nutrients will be high.

In the meantime, many scientists are convinced that in some of Canada's lakes the rate of deterioration will increase rapidly unless even partial remedial measures are instituted without delay. It is essential therefore that, as design and construction of treatment facilities go ahead, a start must be made on reducing the phosphorus loading without waiting for treatment facilities to become available, and the obvious way to do this is to reduce the phosphate content of detergents.

Research in nutrient removal methods at treatment plants indicates that, while it is difficult to assess the extent of the cost saving involved, there is, nevertheless, a relationship between cost and the quantity of nutrients removed. Hence a reduction in the amount of nutrients fed to a treatment plant can be expected to lead to a decrease in operational costs. There is also the fact that there are sources of nutrients which will remain indefinitely beyond the reach of nutrient removal facilities. These include intermittent overflows from combined storm and sanitary sewer systems of Canada's older cities, small municipalities where it would be uneconomical to provide facilities, and resort areas where sewage and waste treatment facilities would be prohibitively expensive.

The replacement of phosphate in detergents in Canada would not of course be sufficient to meet the phosphorus reduction goals recommended for Lake Erie since the major phosphate discharges are from sources in the United States. However, further deterioration would be arrested and some improvement in water quality may result. The effect of phosphate replacement on Lake Ontario, on the other hand, is much more promising. The reduction in phosphorus loading could arrest the worsening condition of Lake Ontario and hold the water in its present state until longer-range additional measures can reverse the process and hopefully return Lake Ontario to better conditions.

The effect of detergent phosphate replacement on other lakes and rivers in Canada would be generally beneficial and would vary according to the existing extent of enrichment. In the worst cases, the process of accelerating eutrophication could be halted and even reversed, in others the quality of the water could be restored, and in those cases where eutrophication is not yet a problem, control measures would ensure that deterioration does not take place.

REPLACEMENTS FOR PHOSPHATES

A growing awareness of the relationship between phosphate in municipal and industrial wastes and the accelerated eutrophication of lakes and rivers led to a search for phosphate replacements that would offer the advantages of phosphate in the cleaning process without the undesirable environmental effects. The most promising replacement for phosphate was nitrilotriacetic acid (NTA), which had been used for several years in the United States and Sweden. After the introduction of the nutrient control regulations in August 1970, small quantities of NTA were used in some Canadian detergents.

The Government of Canada, recognizing its responsibility to ensure that substances used to replace phosphate do not themselves present environmental hazards, took part in a three-nation study with the United States and Sweden to determine the potential environmental and health impact of NTA in lakes and rivers. There is no evidence that NTA in the small quantities used poses any threat to human health nor are biotic toxicity problems involved. The only cautionary note struck so far was in connection with U.S. experiments which showed that large doses of NTA administered with large doses of toxic mercury and cadmium tended to make the mercury and cadmium more damaging. However, it is generally recognized that more research on potential health hazards is needed before NTA is used extensively in high concentrations. The use of NTA in detergents has recently been approved in Sweden[3].

Research is continuing on the physiological effects of NTA and on seeking other possible replacements for phosphate. Regulatory action to reduce phosphate levels does not depend upon the availability of satisfactory substitutes. The goal of phosphate reduction, because of its importance in environmental protection, must be approached independently.

To determine other constituents that might be present either as full or partial replacements for phosphates (or for other purposes) that could create new problems in the environment, many detergents were analysed by X-ray diffraction; Table II lists the constituents found in the detergents using this technique. Table I is the code listing for the constituents.

The results of the X-ray diffraction tests showed that most of the phosphate-based detergents had one or both of the tripolyphosphates, i.e., sodium tripolyphosphate hexahydrate and sodium tripolyphosphate, as a major constituent; sodium sulphate and sodium chloride were present in varying amounts. In the case of the non-phosphate or low-phosphate detergents, silicates and carbonates were the major constituents in the majority of cases, most had sodium sulphate, and a large number had (at the date of testing) greater or lesser amounts of NTA. No distinguishable patterns were observed for tartrates and citrates.

THE CANADA WATER ACT

The Governments of Canada and of Ontario, after a study of the recommendations of the Advisory Boards, agreed that the Federal Government should introduce legislation to control the use of nutrients in cleaning products. A suitable vehicle for this legislation already existed in the form of the Canada Water Act, then under consideration in Parliament. A clause covering nutrient control was incorporated in the proposed Canada Water Act. The Act became law in mid-1970 and the first regulations under the nutrient control clause went into effect on August 1, 1970.

The nutrient clause is essentially permissive in nature and does not specify any particular limitation on the chemical composition of cleaning products. It does, however, give the Government authority to regulate the amounts of nutrients used in cleaning products.

Under the Act, the Governor in Council may make regulations prescribing nutrients and the maximum permissible concentration of any prescribed nutrient in a cleaning agent or water conditioner, and the manner in which the concentration of any prescribed nutrient shall be determined. He is empowered also to require that persons who manufacture cleaning agents in Canada, or who import these products into Canada, shall maintain books and records necessary for the proper enforcement of these regulations and shall submit samples of their products for analysis. The Act also provides for seizure of cleaning agents or water conditioners believed to have been manufactured in Canada or imported into Canada in violation of the regulations.

The first application of the regulations, and the one currently in effect, limits the amount of phosphate in laundry detergents to 20% expressed as phosphorus pentoxide (P_2O_5). It is estimated that this limitation has reduced the amount of detergent phosphates entering Canadian lakes and rivers by between 25% and 30%.

Table II, which shows the P_2O_5 content of detergents tested after August 1, 1970, indicates that the nutrient control regulations are being followed. In isolated cases where the phosphate content slightly exceeds the 20% limit, additional samples are being analysed to determine whether action is required to have the phosphate content reduced.

As indicated earlier, the maximum permissible level for phosphate concentration in detergent products is 20%, expressed as P_2O_5. This is the level prescribed by the control regulations which went into effect on August 1, 1970. In a press release, dated April 8, 1971, the Honorable Jack Davis, Minister of the Environment, indicated that the next step in the Government's program to control nutrient levels would be a further reduction in the phosphate content of detergent products to 5% (expressed as P_2O_5), the reduction to be in effect by December 31, 1972.

SUMMARY

Cultural eutrophication is the process of over-enrichment of water by nutrients and results in oxygen depletion caused by the decay of massive growths of aquatic vegetation. Of the many substances which contribute to the process, phosphorus is most frequently the limiting factor; it is also the substance which can be most readily controlled.

The major source of phosphorus in municipal and industrial wastes discharged to lakes and rivers is the phosphate-based laundry detergent and control of phosphates in cleaning products was considered to be the logical first step in a program of nutrient control. A nutrient control clause was written into the Canada Water Act and the first regulations under this clause became effective in August 1970. The regulations limit the allowable phosphate concentration in laundry detergents to 20%, expressed as phosphorus pentoxide (P_2O_5). The next step in the phosphate control program is expected to be a reduction in the maximum allowable phosphate content from 20% to 5%, the reduction to be effective by the end of 1972.

The purpose of making available the results of the phosphate content tests on washing products carried out in the Branch Laboratories is to emphasize that the phosphate contents listed are at present, in almost all cases, meeting the interim maximum level of 20% P_2O_5 that the Government has established as the first stage of control.

To guard against the possibility that other substances introduced into detergent formulations, either as replacements for phosphate or for other purposes, may themselves be environmentally harmful, detergent samples are analyzed by X-ray diffraction to determine other constituents in the product. By this process, substances which may be environmentally harmful can be detected and action taken to control their use.

REFERENCES

1. Report to the International Joint Commission on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River, 1969.

2. Prince, A.T. and J.P. Bruce, 1971. *Development of Nutrient Control Policies in Canada.* Symposium on "Nutrients in Natural Waters", 161st National American Chemical Society Meeting, Los Angeles, California.

3. National Swedish Health and Welfare Board, 1971. *Communique re NTA.*

TABLE I

X-Ray Diffraction Constituents in Table II

A:	Sodium tripolyphosphate hexahydrate	$Na_5P_3O_{10}.6H_2O$
B:	Sodium tripolyphosphate	$Na_5P_3O_{10}$
C:	Sodium pyrophosphate	$Na_4P_2O_7$
D:	Sodium pyrophosphate hexahydrate	$Na_4P_2O_7.6H_2O$
E:	Sodium pyrophosphate decahydrate	$Na_4P_2O_7.10H_2O$
F:	Sodium sulphate	Na_2SO_4
G:	Sodium chloride	NaCl
H:	Sodium calcium orthophosphate	$NaCaPO_4$
I:	Sodium tetraborate pentahydrate	$Na_2B_4O_7.5H_2O$
J:	Sodium metasilicate	Na_2SiO_3
K:	Sodium metasilicate pentahydrate	$Na_2SiO_3.5H_2O$
L:	Sodium metasilicate hydrate	$Na_2SiO_3.9H_2O$
M:	Sodium silicate hydrate	$Na_6Si_2O_7.11H_2O$
N:	Sodium carbonate	Na_2CO_3
O:	Sodium carbonate hydrate	$Na_2CO_3.H_2O$
P:	Sodium sesquicarbonate	$Na_3H(CO_3)_2.2H_2O$
Q:	Nitrilotriacetic acid (sodium salt)	" NTA "
R:	Sodium calcium borate hydrate	$NaCaB_5O_9.8H_2O$
S:	Unidentifiable constituents	

FOOTNOTES FOR TABLE II

(a) Obtained from packaged product or recorded by inspector collecting samples under Canada Water Act.

(b) For the purpose of this report manufacturer will denote:
1. the manufacturer's or distributor's name, as obtained from the packaged product at a retail outlet, or
2. the point of sampling, for products analyzed under the regulations of the Canada Water Act.

(c) NTA content expressed as per cent nitrilotriacetic acid (% H_3NTA)

(d) See Table I for explanation of symbols A,B,C etc. If detergent contained two or more crystal types of different composition, separate analyses are given for the crystal types.

(e) Date of manufacture if manufactured in Canada, or date of import if imported. If date of manufacture was not available, date of sampling at manufacturer's or distributor's plant is given in brackets.

(f) Results for two different boxes of Super Solo which were received for analysis at the same time. Other results in the table are averages of two or more boxes which were close in phosphate content.

(g) Manufactured before August 1, 1970.

(h) Bestline B7 has since been withdrawn and replaced by B70.

TABLE II - DETERGENT ANALYSES

Brand Name (a)	Manufacturer (b)	Before Canada Water Act				After Canada Water Act				
		Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)	Date of Manufacture (e)	Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)
ABC Heavy Duty Laundry Detergent	Colgate-Palmolive	-	-	-	-	April/71	June 24/71	16.0	-	-
Ajax 2	Colgate-Palmolive	Dec. 12/69	24.1	-	Major: A,B,F	-	-	-	-	-
Ajax Laundry Detergent	Colgate-Palmolive	-	-	-	-	June/71	June 24/71	15.7	-	-
All, New Improved	Lever Bros.	Dec. 17/69	28.7	<0.1	Major: A,F Possible B	September/70	Oct. 1/70	18.9	8.5	Major: A,B,F Trace: Q
All, Concentrated for Automatic Washing Machines	Lever Bros.	-	-	-	-	May/71	June 2/71	18.1	-	-
Amaze, Enzyme Power	Lever Bros.	Jan. 6/70	21.3	-	-	April/71	June 2/71	18.6	-	-
Amway LOC High Suds	Amway	-	-	-	-	November/70 March/71	Dec. 4/70 Apr. 29/71	<1 <1	-	-
Amway LOC Regular	Amway	-	-	-	-	November/70 January/71	Dec. 4/70 April 29/71	<1 <1	-	-
Amway SA 8 Plus	Amway	Dec. 12/69	26.7	<0.1	-	October/70 January/71 January/71	Dec. 4/70 April 29/71 Sept. 8/71	19.7 21.6 19.9	6.3 -	Major: B,F,K,N,Q -
Amway Tri-Zyme	Amway	-	-	-	-	November/70 March/71	Dec. 4/70 April 29/71	19.7 20.1	<0.1 -	Major: A,B,F -
Apache	Wyandotte	-	-	-	-	September/70 (June 24/71)	Nov. 26/70 July 19/71	6.9 7.7	<0.1 -	- -
Arctic Power, New Cold Water	Colgate-Palmolive	Dec. 16/69	24.1	<0.1	Major: A,F,G Minor: C	September/70	Oct. 2/70	17.3	2.7	Major: A,B,F Trace: H, Possible J
Arctic Power with Powerful Cold Water Brighteners	Colgate-Palmolive	-	-	-	-	May/71	June 24/71	18.5	-	-
Arctic Syntex HD	Wyante & Co. Ltd.	-	-	-	-	May/71	July 16/71	20.1	-	-
Arlac	Wyandotte	-	-	-	-	September/70 (June 24/71)	Nov. 25/70 July 19/71	3.5 <1	<0.1 -	Major: N Minor: G -
Arodet	Rowe, Robt. Co.	-	-	-	-	December 11/70	Jan. 13/71	2.1	-	-
Atlantic Power Low Suds Detergent for Automatic Washers	Demotex Inc.	-	-	-	-	June/71	Aug. 11 & 17/71	22.0	-	-
Becker's Detergent	Witco Chemical Co.	-	-	-	-	November/70	Dec. 8/70	16.0	<0.1	Major: A,F,G Minor: H
Bestline B 7	Bestline Products of Canada	-	-	-	-	(November 4/70)	Nov. 13 & 25/70	21.0(h)	<0.1	Major: B,F,K,N,O Trace: Possible P
Bestline B70	Bestline Products of Canada	-	-	-	-	December/70	Mar. 30/71	<1	-	-
Biltrite	Canada Packers	-	-	-	-	December/70	Jan. 5/71	6.0	<0.1	Major: B,N,S Trace: G
Bio-Ad, Enzyme Active	Colgate-Palmolive	Dec. 11/69	38.3	-	-	-	-	-	-	-
Blue ABC	Colgate-Palmolive	Dec. 11/69	23.9	<0.1	-	September/70	Oct. 2/70	16.9	2.8	Major: A,B,F Trace: H, Possible J
Blue Bird	London Soap Co.	-	-	-	-	(June 22/71)	July 13/71	19.0	-	-
Blue Detergent	Aero Chemical Co.	-	-	-	-	(June 9/71)	July 8/71	15.8	-	-
Blue Detergent	F.D. Miller Co.	-	-	-	-	(July 7/71)	July 28/71	13.8	-	-
Bold, New Bolder	Proctor & Gamble	Dec. 16/69	27.7	<0.1	white: Major: A,B Minor: F blue: Major: A,B green: Major: A Minor: B	September/70	Oct. 23/70	19.7	<0.1	Major: A,F Minor: B
Bold, New Enzyme	Proctor & Gamble	-	-	-	-	March/71	May 27/71	18.2	-	-
Breeze with Borax	Lever Bros.	Jan. 28/70	25.1	-	Major: A,B	September/70 May/71	Oct. 8/70 May 31/71	18.7 18.3	3.3 -	Major: A Trace: B,F -
Bright Monday Laundry Detergent, Heavy Duty	Mandate Manufacturing	-	-	-	-	November/70 (February 10/71)	Dec. 16/70 Feb. 22/71	8.6 8.6	<0.1 -	Major: F,G Trace: A,B -
Byisol, Heavy Duty Blue	Canada Packers	-	-	-	-	(December 16/70) (March 22/71)	Jan. 5/71 Mar. 30/71	19.9 16.0	<0.1 -	Major: A,F Trace: N -
Byisol, Heavy Duty White	Canada Packers	-	-	-	-	(December 16/70) (March 22/71)	Jan. 5/71 Mar. 30/71	18.6 15.9	2.4 -	Major: A,F -
Byisol, Light Duty	Canada Packers	-	-	-	-	(December/70)	Jan. 5/71	<1	<0.1	Major: F,G,S
Chambers Powdered Detergent	Canada Packers	-	-	-	-	November/70	Dec. 30/70	13.1	4.4	Major: A,B,H,F Trace: Q
Cheer, All Temperature	Proctor & Gamble	Dec. 12/69	30.1	<0.1	-	-	-	-	-	-
Cheer, New All Temperature Detergent	Proctor & Gamble	-	-	-	-	October/70 March/71	Oct. 23/70 May 27/71	18.6 17.6	<0.1 -	Major: A,F Trace: Possible C -

TABLE II - DETERGENT ANALYSES (Cont.)

Brand Name (a)	Manufacturer (b)	Before Canada Water Act				After Canada Water Act				
		Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)	Date of Manufacture (e)	Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)
Clairix	Wyandotte	-	-	-	-	(June 24/71)	July 20/71	<1	-	-
Compo HDB	Majestic Soap Co.	-	-	-	-	December/70	Jan. 8/71	13.3	<0.1	Major: A,F Minor: H
Control Laundry Detergent	Diversey	-	-	-	-	October/70	Nov. 27/70	20.2	<0.1	Major: A,B,F,K,N,P Trace: O
						May/71	July 8/71	19.5	-	-
Co-op Blue Detergent	Witco Chemical Co.	-	-	-	-	October/70	Dec. 8/70	16.4	<0.1	Major: B,F Trace: G
Crown Detergent No Phosphate	Crown Chemicals	-	-	-	-	September & October/70	Nov. 13/70	<1	<0.1	Major: F,K,P Trace: Possible G
						June 22/71	July 13/71	<1	-	-
Crystal Laundry Compound	Crystal Chemicals	-	-	-	-	November/70	Nov. 25/70	6.1	<0.1	Major: G,K,M,N,O,S Trace: Possible F
						(June 23/71)	July 16/71	9.8	-	-
Dairi-Brite	Purity Dairy	-	-	-	-	June/71	July 13/71	<1	-	-
Dash, Controlled-Sudsing	Proctor & Gamble	Jan. 6/70	36.6	-	-	-	-	-	-	-
Demotex Low Suds Detergent for Automatic Washers	Demotex	-	-	-	-	June/71	July 28/71	19.7	-	-
Detergent, Heavy Duty	Witco	-	-	-	-	October/70	Dec. 11/70	5.6	<0.1	Major: F,G Minor: B
Diaper Pure	Boyle-Midway	-	-	-	-	September/70	Nov. 27/70	3.8	<0.1	Major: I,P Trace: S, Possible F
						(June 24/71)	July 20/71	5.7	-	-
Domino Blue	Lever Bros.	Jan. 6/70	23.6	<0.1	-	September/70	Oct. 16/70	20.0	<0.1	Major: A,H Trace: Possible F
						May/71	May 31/71	18.3	-	-
New Nylon Dreft	Proctor & Gamble	-	-	-	-	October/70	Oct. 23/70	19.1	<0.1	Major: A,B,F,S
Nylon Dreft	Proctor & Gamble	-	-	-	-	January/71	May 27/71	16.6	-	-
Drive with En-zolve	Lever Bros.	Dec. 12/69	27.9	<0.1	-	May/71	May 31/71	16.5	-	-
Duz	Proctor & Gamble	Dec. 16/69	25.9	<0.1	Major: A Minor: F,B	September/70	Oct. 23/70	18.0	<0.1	Major: A,F Trace: B
						April/71	May 27/71	17.1	-	-
Economical Blue Detergent (Jesta 100)	Majestic Soap Co.	-	-	-	-	(July 6/71)	July 28/71	16.1	-	-
Economical Blue Detergent (Compo 120)	Majestic Soap Co.	-	-	-	-	June/71	July 28/71	13.3	-	-
Engrime, Phosphate-Free	Witco Chemical Co.	-	-	-	-	November/70	Dec. 8/70	<1	1.5	Major: F,N Trace: G
Explore	Witco Chemical Co.	Jan. 28/70	18.0	<0.1	-	November/70	Dec. 8/70	17.5	<0.1	Major: A,F,G Trace: B, Possible C
						1971	Apr. 29/71	15.0	-	-
Fab, with Active Enzymes	Colgate-Palmolive	Jan. 6/70	23.9	-	-	September/70	Oct. 8/70	18.3	2.8	Major: A,B,F Trace: H, Possible J
						May/71	June 24/71	16.9	-	-
Fame	Wyandotte	-	-	-	-	(June 24/71)	July 20/71	5.5	-	-
Favori Blue Detergent	Majestic Soap Co.	-	-	-	-	December/70	Jan. 8/71	15.6	<0.1	Major: A,F,S Trace: J
Foisy	F.D. Miller Co.	-	-	-	-	November/70	Jan. 13/71	<1	-	-
French Maid	Witco Chemical Co.	-	-	-	-	September/70	Dec. 11/70	15.4	<0.1	Major: A,B,F Trace: G
French Maid, No Phosphate	Mandate Manufacturing	-	-	-	-	November/70	Dec. 16/70	<1	6.7	Major: F,Q
						(February 10/71)	Feb. 22/71	<1	-	-
General Purpose Blue Detergent (Compo R-GLO)	Majestic Soap Co.	-	-	-	-	December/70	Jan. 8/71	12.5	-	-
						June/71	July 28/71	10.4	-	-
Golden Laundry Compound	Diversey (Canada) Ltd.	-	-	-	-	(November 9/70)	Nov. 25/70	20.0	<0.1	Major: B,F,K,P Trace: Possible G
Hep Controlled Suds Laundry Detergent	Handy Chemicals	-	-	-	-	January/71	Feb. 9/71	11.9	<0.1	Major: B,F,K,P Trace: O
						April & June/71	July 8/71	13.4	-	-
HI3	United Chemicals	-	-	-	-	December/70	Jan. 13/71	15.9	<0.1	Major: B,F,J Possible G Trace: Possible Q,R,S
						(July 7/71)	July 28/71	14.0	-	-
Hi-Top Blue Detergent	Majestic Soap Co.	-	-	-	-	December/70	Jan. 5/71	11.4	<0.1	Major: A,F Trace: S
HLD	Galt Chemicals	-	-	-	-	June/71	July 13/71	<1	-	-

TABLE II - DETERGENT ANALYSES (Cont.)

Brand Name (a)	Manufacturer (b)	Before Canada Water Act				After Canada Water Act				
		Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)	Date of Manufacture (e)	Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)
Impact-NTA, Phosphate Free	Copeland Laboratories	Apr. 6/70	<1	12.7	Major: Q,J,F	(Nov. 9/70)	Nov. 20/70	<1	13.2	Major: J,N,Q Trace: Possible G
Instant Fels	Purex	-	-	-	-	October/70	Nov. 27/70	6.0	<0.1	Major: C,S Trace: Possible O
						April/71	July 20/71	<1	-	-
Ivory Beads	Swano Soap Co.	-	-	-	-	(February 10/71)	Feb. 22/71	<1	-	-
Jesta H.D.B.	Majestic Soap Co.	-	-	-	-	December/70	Jan. 8/71	13.7	<0.1	-
Jet Blue with Borax	Majestic Soap Co.	-	-	-	-	December/70	Jan. 8/71	14.2	0.2	Major: A,F,S Trace: J
						June/71	July 28/71	18.0	-	-
Joyeux Lundi	Majestic Soap Co.	-	-	-	-	November/70	Jan. 8/71	12.5	<0.1	Major: A,H,F
Ker-Cell	Wyandotte	-	-	-	-	September/70	Nov. 26/70	7.2	<0.1	Major: J,N Minor: B
						(June 24/71)	July 20/71	3.3	-	-
Kik	Par-All	-	-	-	-	January/71	Feb. 9/71	6.7	-	-
Lasco Built Laundry Soap	S.F. Lawrason & Co.	-	-	-	-	March/71	July 13/71	<1	-	-
Laud	Wyandotte	-	-	-	-	November/70	Nov. 26/70	11.3	<0.1	Major: B,J,N Minor: C,G
						(June 24/71)	July 19/71	11.0	-	-
Laundrex Low Suds Detergent	Canada Packers	Dec. 30/70 (g)	29.6	-	-	December/70 March/71	Jan. 5/71 Mar. 30/71	21.5 12.9	<0.1 -	Major: B,G,J,N -
Laundrex Heavy Duty Low Suds Detergent Phosphate Free	Canada Packers	Dec. 30/70 (g)	<1	-	-	-	-	-	-	-
Laundry Compound DHF	Copeland	-	-	-	-	March/71	Apr. 29/71	7.3	-	-
Laundry Compound	Purssell	-	-	-	-	January/71 May/71	Feb. 9/71 July 8/71	7.8 8.5	<0.1 -	- -
Laundry Detergent D-230	Copeland	-	-	-	-	February/71	Apr. 29/71	17.8	-	-
Low Foam Detergent	Wyante & Co. Ltd.	-	-	-	-	January/71	July 16/71	19.5	-	-
Low Suds Detergent	Produit Net-O	-	-	-	-	(April 21/71)	Apr. 29/71	19.8	-	-
Mac's Fresh Laundry Detergent	Crown Chemicals	-	-	-	-	Sept. & Oct./70 June/71	Nov. 25/70 July 16/71	2.3 <1	<0.1 -	Major: F,G,K,N,P -
Mac's Laundry Detergent No Phosphate	Crown Chemicals	Apr. 6/70	<1	-	Major: F,P,N Trace: M	-	-	-	-	-
Majestic Blue Detergent	Majestic Soap Co.	-	-	-	-	December/70	Jan. 5 & 8/71	16.7	<0.1	Major: A,F Minor: H
M-40 Laundry Detergent	Ostrem Chemical Ltd.	-	-	-	-	December/70	Dec. 16/70	<1	17.7	Major: F,G,K,P,Q
ML Heavy Duty Powdered Detergent	Canada Packers	-	-	-	-	December/70	Dec. 30/70	15.8	3.0	Major: A,B,F
Nelco 56L	S.F. Lawrason & Co.	-	-	-	-	April/71	July 13/71	11.6	-	-
Net-O Low Suds Detergent for Automatic Washers	Produit Net-O	-	-	-	-	(December 18/70)	Jan. 13/71	21.8	-	-
Neutrex	Majestic Soap Co.	-	-	-	-	(July 6/71)	July 28/71	6.0	-	-
Omo, Blue Charged	Lever Bros.	Dec. 17/69	25.8	<0.1	white: Major: A,B,F blue: Major: A,F	August/70 April/71	Oct. 6 & 8/70 May 31/71	18.6 18.3	2.5 -	Major: A,B,F -
Oxydol Plus	Proctor & Gamble	Dec. 11/69	31.4	<0.1	-	October/70 November/70	Oct. 23/70 May 27/71	19.2 18.7	<0.1 -	Major: A,F -
Plaza, All Purpose Blue	Majestic Soap Co.	-	-	-	-	December/70	Jan. 5/71	12.3	0.6	Major: A,F Trace: S
Polo Blue Detergent	Swano	-	-	-	-	February/71	Feb. 22/71	18.6	-	-
Polo Low Foam	Swano	-	-	-	-		Feb. 22/71	29.8(g)	-	-
Polo White Detergent	Swano	-	-	-	-	February/71	Feb. 22/71	17.7	-	-
Princess Commercial Laundry Bleach	F.D. Miller	-	-	-	-	May/71	July 28/71	15.4	-	-
Provigo Blue Detergent All Purpose	Majestic Soap Co.	-	-	-	-	July/71	July 28/71	15.4	-	-
Punch	Colgate-Palmolive	-	-	-	-	August/70	Oct. 16/70	18.4	5.6	Major: A,B Minor: F Trace: Q,H
						Jan. & Apr./71	June 24/71	18.4	-	-
Quality Blue Detergent	Produit Net-O	-	-	-	-	(April 21/71)	Apr. 29/71	12.2	-	-
Riddax	Wyandotte	-	-	-	-	(June 24/71)	July 16/71	<1	-	-
Rintex	Wyandotte	-	-	-	-	(June 24/71)	July 20/71	<1	-	-
Sail, New Blue Beads	Witco Chemical Co.	Jan. 28/70	16.7	<0.1	-	November/70	Dec. 11/70	17.6	<0.1	Major: B,F Trace: A,G
						April/71	Apr. 29/71	14.8	-	-
Sail, New Improved Formula	Witco Chemical Co.	Jan. 28/70	17.3	-	-	November/70 November/70	Dec. 11/70 Apr. 29/71	17.6 19.0	<0.1 -	Major: A,B,F,G -

TABLE II - DETERGENT ANALYSES (Cont.)

Brand Name (a)	Manufacturer (b)	Before Canada Water Act				After Canada Water Act				
		Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)	Date of Manufacture (e)	Date of Analysis	% P_2O_5	% NTA (c)	X-ray Diffraction (d)
Savon Superbe for Automatic Washers	Sany Products	-	-	-	-	January/71	Feb. 9/71	19.4	<0.1	Major: A,B,K,N,P Minor: F
						(July 7/71)	July 28/71	18.6	-	-
Scala Blue Detergent	Witco Chemical Co.	-	-	-	-	October/70	Dec. 8/70	17.7	<0.1	Major: A,F,G Trace: H
						February/71	Apr. 29/71	18.4	-	-
Sears Kenmore Super Concentrated	Simpsons-Sears	Jan. 6/70	23.9	-	-	-	-	-	-	-
Sears Laundry Detergent	Simpsons-Sears	Jan. 28/70	23.6	<0.1	-	-	-	-	-	-
Sears Laundry Detergent Phosphate Free Formula	Simpsons-Sears	-	-	-	-	(January 22/71)	Jan. 26/71	<1	<0.1	Major: N,O
Servo-Mousse for Automatic Washers	Majestic Soap Co.	-	-	-	-	December/70	Jan. 8/71	18.9	-	Major: A,F Minor: I
						June/71	July 28/71	17.4	-	-
Silverwood's Lo-Suds	Crown Chemicals	-	-	-	-	June/71	July 13/71	<1	-	-
Skortex	Wyandotte	-	-	-	-	September/70	Nov. 26/70	3.5	<0.1	Major: F,G,N Minor: B,O Trace: P
						(June 24/71)	July 19/71	5.2	-	-
Starlene	Wyandotte	-	-	-	-	(June 24/71)	July 16/71	<1	-	-
Steinberg All Purpose Heavy Duty Blue	Witco Chemical Co.	-	-	-	-	November/70	Dec. 8/70	17.5	<0.1	Major: A,F,G Trace: Possible C
Steinberg All Purpose Heavy Duty White	Witco Chemical Co.	Jan. 28/70	16.7	<0.1	-	September/70	Dec. 8/70	16.6	<0.1	Major: A,F,G
Steinberg Blue No Phosphate	Witco Chemical Co.	-	-	-	-	October/70	Dec. 15/70	<1	10.8	Major: F,Q
						October/70	Apr. 29/71	<1	-	-
Steinberg Low Suds Neopone	Witco Chemical Co.	Jan. 13/70	30.3	-	-	November/70	Dec. 11/70	16.3	-	Major: A,H,S
Steinberg New Blue Regular	Witco Chemical Co.	Jan. 28/70	17.8	<0.1	-	November/70	Dec. 4/70	17.9	<0.1	Major: A,B,F,G
						January/71	Apr. 29/71	13.3	-	-
Steinberg Phosphate Free with Borax	Witco Chemical Co.	-	-	-	-	November/70	Dec. 11/70	1.4	2.0	Major: F,G,N
Steinberg White No Phosphate	Witco Chemical Co.	-	-	-	-	October/70	Dec. 15/70	<1	10.9	Major: F,G,Q Trace: O
Steinberg with Borax, All Purpose Heavy Duty	Witco Chemical Co.	Jan. 28/70	19.1	<0.1	-	November/70	Dec. 8/70	16.2	-	-
Stream Fresh	Formpal Ltd.	-	-	-	-	November/70	Nov. 13/70	<1	<0.1	Major: I,J,K,N,O
						June/70	July 16/70	<1	-	-
Sunlight Laundry Detergent	Lever Bros.	Dec. 17/69	26.7	<0.1	-	-	-	-	-	-
Sunlight Laundry Detergent No Phosphate	Lever Bros.	-	-	-	-	October/70	Oct. 16/70	<1	18.7	Major: F,Q Trace: N
Super Solo	S.F. Lawrason & Co.	-	-	-	-	April/71	Apr. 29/71	18.6	-	-
						June/71	July 13/71	(a) 13.9 (f)	-	-
								(b) 20.2	-	-
Surf Heavy Duty Detergent	Lever Bros.	Dec. 11/69	24.8	-	-	September/70	Oct. 1/70	18.4	0.4	Major: A,B,H Trace: F,S
						March/71	June 2/71	17.2	-	-
Swipe, Liquid	Swipe	-	-	-	-	January/71	March 30/71	<1	-	-
Talla Low Foam	Copeland	-	-	-	-	March/71	Apr. 29/71	16.5	-	-
Thames Valley	S.F. Lawrason & Co.	-	-	-	-	(June 22/71)	July 13/71	<1	-	-
Tide XK	Proctor & Gamble	Dec. 16/69	29.4	<0.1	Major: A,B	October/70	Oct. 23/70	18.8	9.5	Major: A,B Minor: Q Trace: F,S
Tide XK New Miracle Cleaner	Proctor & Gamble	-	-	-	-	April/71	May 31/71	19.0	-	-
Top Valu New Blue Detergent	Witco Chemical Co.	Dec. 31/69	16.5	<0.1	Major: A,E,F,G	November/70	Dec. 11/70	15.7	<0.1	Major: A,B,F Trace: G
Treasure	Witco Chemical Co.	-	-	-	-	November/70	Dec. 11/70	15.5	<0.1	Major: A,F Trace: G
Val-U Laundry Compound	Canada Packers	-	-	-	-	October/70	Jan. 5/71	22.1	<0.1	Major: B,G,K,N
						February/71	Mar. 30/71	18.0	-	-
Vancouver Only	Savo-Lile Soap Co.	-	-	-	-	November/70	Dec. 16/70	<1	<0.1	Major: K,S Minor: N
White Detergent	Produit Net-O	-	-	-	-	(April 21/71)	Apr. 29/71	16.1	-	-
Willex This Stuff	Willex	-	-	-	-	(June 21/71)	July 13/71	19.0	-	-
Woolite Cold Water Wash	Boyle-Midway	-	-	-	-	November/70	Nov. 20/70	17.8	<0.1	Major: A,B,F,G
						(June 24/71)	July 20/71	19.4	-	-
Zero Cold Water Wash	Boyle-Midway	Jan. 6/70	6.5	-	-	November/70	Nov. 20/70	6.0	<0.1	Major: F,G Trace: Possible S
						(June 24/71)	July 20/71	9.2	-	-

APPENDIX

EXPERIMENTAL PROCEDURES

Phosphate. The analyses tabulated in this report were carried out in the Ottawa laboratories of the Water Quality Division using procedures that will be described in Technical Bulletin No. 45, The Determination of Phosphorus Content of Detergents, by P.D. Goulden, W.J. Traversy, and M. Comba, now in preparation. A manual method, as published by the American Society for Testing and Materials, modified to overcome the interference from borates, is used to analyse samples that have a phosphorus concentration close to the 20% P_2O_5 maximum permissible under the Canada Water Act. An automated method has been developed, using Technicon Auto-Analyzer equipment, which enables detergent samples to be screened for phosphorus content at a rate of 20 samples per hour after sample preparation.

NTA. The NTA analyses shown in Table II were carried out in the Ottawa laboratories of the Water Quality Division using the procedure "Determination of Trace Quantities of Nitrilotriacetic Acid by Differential Cathode Ray Polarograph", by B.K. Afghan and P.D. Goulden. This method is described in Environmental Science and Technology Journal, Volume 5, Number 7, July 1971.

X-Ray Diffraction. X-ray diffraction analyses were carried out at the Mines Branch, Department of Energy, Mines and Resources by Mr. C.H.J. Childe under the direction of Mr. R.M. Buchanan. Samples were analysed using a quadruple Grunier camera. If two or more types of material were distinguished under a stereomicroscope, these were analysed separately. Constituents were identified by direct comparison with verified standard XRD patterns and with interplanar spacings listed in the ASTM index to X-Ray Diffraction File 1970. The X-ray diffraction analyses report stated that in some cases, where many constituents were found, identification was difficult and the results should be used judiciously.