Trends in the Soap and Detergent Industry in Japan

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Japan's 1985 sales of household products, which comprise washing and cleaning products, laundry aids, toiletries, insecticides, disposable diapers and napkins, deodorants, and cosmetics, are estimated to be about 2.0 trillion yen (about $12.5 billion at 160 yen/U.S. dollar). The sales of washing and cleaning products and laundry aids were 297 billion yen and 83 billion yen, respectively (Table 1). Although the market growth of washing and cleaning products and laundry aids was not expected to be so much, the total of 380 billion yen nearly equalled the 409 billion yen from toiletries and the 408 billion yen from paper products such as facial tissues, disposable diapers and napkins, all of which are growing.

The growth of detergents and cleaners in Japan and other countries was interrupted by the oil crises in 1975 and 1980, as shown in the trends over the past 15 years (Fig. 1) (1). Total production of heavy duty powders and liquids, dishwashing liquids, and liquid cleaners in 1985 [968,000 metric tons (MT)] shows recovery from the two recessions. However, the growth rate of production decreased, crisis by crisis, due mainly to the declining growth rate of heavy duty powders, namely 10.6% between 1976 and 1979 and 3.8% between 1981 and 1985. The rate may approach 0.7% of the average annual population growth for this decade.

HEAVY DUTY DETERGENTS

The Japanese soap and detergent industry succeeded in the voluntary substitution of biodegradable soft alkylbenzene for hard and branched homologues about 15 years ago. This time, as a second environmental issue, the industry faced arguments about the role of phosphates in eutrophication. Although not regulated by the government, the industry voluntarily regulates the phosphate content in detergents; the upper limit was fixed at 15% as P_2O_5 in 1975, and then further lowered to less than 12% in 1976 (2). But after phosphate detergents were banned in 1980 in Shiga prefecture where Lake Biwa, Japan's largest lake, is located, the issue focused on complete elimination of phosphate from detergents. Responding to this requirement, major detergent manufacturers voluntarily introduced non-phosphate heavy duty powders in 1981. Ninety-four percent of heavy duty powders were changed to nonphosphate formulations within only four years, as shown in Figure 2 (1). Because of this quick response, there was no need to enact legislative restrictions on phosphates in Japan, except for a few local cases.

Biodegradability of synthetic detergents also was argued, as well as eutrophication. Initially, use of powdered laundry soaps rather than non-phosphate detergents was promoted. But such soaps did not do well because of their poor solubility under characteristic Japanese washing conditions, particularly low washing temperatures. Even in Shiga prefecture, of the total laundry products used, 30% are soaps and 70% non-phosphate detergents. As shown in Figures 1 and 2, laundry soap production remained static for 15 years.

TABLE 1

Household Cleaning Product Sales in Japan, 1985

	1000 MT (1)[a]	Billion Yen
Products for washing and cleaning		297
Laundry soaps (bars and powders)	57	12
Heavy duty powders	607	145
Heavy and light duty liquids	56	21
Dishwashing liquids	237	62
Scouring powders and liquids	45	7
Household cleaners		50
Acid and base cleaners	24	6
Hard surface cleaners	68	22
Laundry aids		83
Bleaches	115	24
Liquids	95	14
Powders	20	10
Softeners	260	49
Starches		10
Toiletries		409
Bar soaps	106	73
Shampoos	88	83
Hair rinses	52	48
Hair treatments	8	26

[a]MT, Metric tons.

Non-phosphate detergents in the U.S. are not in a state of flux. Usage ratios of non-phosphate detergents stay around 20% of total heavy duty powders. The partial replacement of phosphates by zeolites (sodium aluminosilicates) was discontinued, probably because of the poorer performance-by-cost of zeolites under U.S. washing conditions compared to phosphates. In Europe, of course, the step by step reduction of phosphates in detergents is proceeding. Yet, there are few countries like Japan where so many drastic changes have occurred.

In order to make it clear why phosphates could be eliminated from powdered detergents in Japan in such a short time, characteristic washing conditions and detergent formulations in Japan have to be taken into consideration. So far, changes in social trends have not brought about significant changes in washing conditions and habits in Japan between the previous presentation (1977) (2) and this one. Namely, washed items are agitated in relatively large amounts of washing liquid and then rinsed with a continuous supply of fresh water. After rinsing, the items are spin drained. Finally, they are line dried. Details are shown in Table 2 (3). Top-loading pulsator type washing machines already had found their way into almost all homes a long time ago. The most popular type of washing machine has a separate washing tub and spin drainer. Automatics have only one tub, which serves both as a washing tub and a spinner. 1-2 Kg of items are washed for 8-10 min in 30-40 l of tap water whose hardness is 54 ppm $CaCO_3$ (3°DH), with 40-50 g of detergent. Because no heating equipment is fitted to the washing machine, washing is usually done at the temperature of tap water. It is possible to wash at around 5 C in winter, but many housewives often use warm water from the previous night's bath. The practice of multi-load washing (4) is still continued, with the washing liquid used twice, on average. After lightly soiled items are washed in the fresh washing liquid, heavily soiled ones are washed in the same liquid. The washed items are rinsed for about 8 minutes with overflowing, continuously supplied fresh tap water in the machines. Japanese housewives wash at home six days a week, and more than two times a day. Such frequent washings may be due to the following: many items cannot be washed at one time and people change their clothes almost every day. Thus, washing conditions such as soft water and light soil act together to replace phosphates; on the other hand, low temperature, short washing times and multi-load washing handicap this substitution.

Zeolite A has emerged the substitute for phosphates from among the various candidates, such as sodium nitrilotriacetate (NTA), sodium citrate and polyelectrolytes, from the viewpoints of the balance of effects on eutrophication, biodegradability, safety to human health, and performance-by-cost. As concerns the performance of zeolites, typical test results were shown in the reports at the Japan Oil Chemists' Society in regard to the method of reducing phosphates in detergents entrusted by the Ministry of International Trade and Industry. It was concluded that certain amounts of zeolites may be used as a substitute to reduce the total amount of phosphates (5). Present

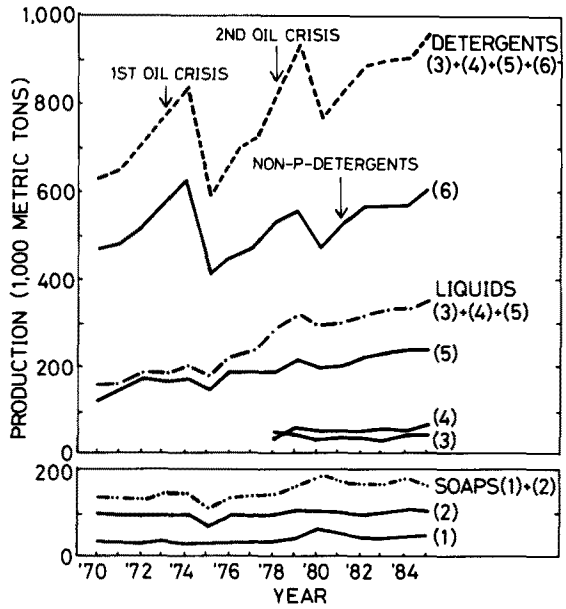

FIG. 1. Changes in production of soaps and detergents in Japan (Ref. 1). (1) Laundry soaps; (2) bar soaps; (3) heavy duty liquids; (4) hard surface cleaners; (5) dishwashing liquids; (6) heavy duty powders.

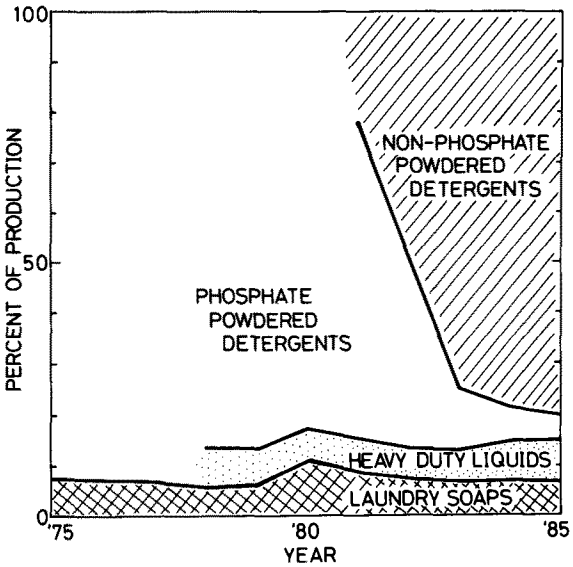

FIG. 2. Percent of production of non-phosphate detergents among laundry soaps and detergents in Japan (1).

typical formulations of heavy duty powders containing zeolites as calcium ion sequestering agents are shown in Table 3 in comparison with previous formulations containing phosphates. To boost zeolites, the present powders contain larger amounts of surfactants and alkaline builders than previous powders. The present powders are sometimes reinforced by a small amount of polyacrylates to prevent iron compound deposition onto clothes, or a small amount of proteases. Proteases are penetrating Japanese heavy duty detergents significantly. More than 50% of heavy duty detergents now contain proteases. These improvements must have augmented the building actions of zeolites.

The outstanding effects of non-phosphate detergents

TABLE 2

General Laundry Conditions and Washing Habits in Japan, 1985 (3)

Home washing machines	
Degree of penetration	98%
Popular type	76%
Automatic type	24%
Laundry conditions	
Detergent concentrations	
Powders	0.133%
Liquids	0.133%
Water temperature	5-25 C
Water hardness	54 ppm $CaCO_3$ (3 DH)
Bath ratio	1-2 Kg/30-40 l
Washing time	8-10 min
Presoaking	50%
Frequency of repeated usage of used washing liquor	2 times
Rinsing conditions	
Overflow with continuous supply of fresh water (rinsing time, 8 min)	79%
Batch-wise	21%
Frequency of home washing	
days/week	6
times/day	2.5

TABLE 3

Typical Heavy Duty Detergent Formulations

	Powders (%)		
	Previous formulations	Present formulations	Liquids (%)
Anionic surfactants (LAS, AS, AES, AOS, soap)	15-23	17-25	25-35
Nonionic surfactants			5-15
Phosphates (Sodium tripolyphosphate, sodium pyrophosphate)	14-20		
Sodium aluminosilicates		15-22	
Ca^{++} sequestering agents (Sodium citrate, sodium polyacrylate)		0-2	0-5
Alkaline builders	5-15	10-20	

Standard amount 40 g (40-45 ml)/30 l water.
Total amounts of surfactants in liquids 35-45%.

on the consumption of major raw materials for detergents, including heavy and light duty, dishwashing detergents, and household cleaners, are shown in Figure 3 where only established values were plotted (1). Consumption of phosphates (A) + (B), which is the sum of sodium tripolyphosphates (A) and sodium pyrophosphates (B), was quickly reduced to 8,000 MT a year in 1985. Conversely, consumption of zeolites was 84,000 MT in 1985 (1) and seems to be saturated. Anionic surfactants are still major raw materials both in heavy duty powders and liquids, because high-foaming types are preferred in Japan. Linear alkylbenzene sulfonates (LAS), alkyl sulfates (AS), alkyl ethersulfates (AES) and alpha-olefinsulfonates (AOS), are predominant. Two components, at least, are mixed into the formulations of heavy duty detergents. The consumption of linear alkylbenzenes (LAB) is regaining its pre-1978 position. The difference between consumption around 1978 and that in post-1982, the enormous consumption around the oil crisis being ingnred, is about 10,000 MT, probably due to the decrease of LAS-based dishwashing detergents. LAS is still a stong workhorse as a main surfactant in heavy duty detergents. The consumption of higher alcohol which is used for AS and AES in heavy duty powders and liquids and in dishwashing liquids was almost static during this decade, because the change in consumption of AS and AES in these three detergents compensated each other. Nonionic surfactants are scarcely used in heavy duty powders and dishwashing liquids, but are used more in heavy duty liquids. Almost all nonionics used in household detergents are soft types. Many surfactants with a

variety of properties can be derived from alcohol with the selection of alkyl chains, molar number of additions of ethylene oxides, sulfonation, and counter ions of sulfonates. Usage of alcohol-based surfactants will be continued in the future, because of such usefulness. Another interesting surfactant, AOS, can be estimated to be consumed at a rate of 20,000–25,000 MT a year.

Heavy duty liquids in Japan entered the market around 1975 and are still at almost the same level. The market share of heavy duty liquid laundry detergents is less than 10% (Figs. 1 and 2). It is difficult to determine the reason. If it were because of the detergent qualities of heavy duty liquids, the performance shown using 20 g, which is half that for heavy duty powders, would not be supported by a majority of consumers. Currently, major manufacturers have introduced a new type of liquid which uses about 40 ml (g) per wash load, equal to that of heavy duty powders. The fact that this new type of heavy duty liquid, which has excellent detergent qualities, is convenient to use, is more expensive for the consumer is interesting.

Heavy duty powders containing softening agents, so called softergents, are now few in Japan. Consumers may not be satisfied with the softness of clothes washed with softergents and may have to treat the clothes with softeners again, after washing. Consequently, the growth of softergents cannot be expected in the future in Japan.

DISHWASHING DETERGENTS

237,000 MT of dishwashing detergents were consumed in 1985 (1), with growth approaching that of the population (Table 1). Thus, the dishwashing detergent market in Japan has continued static for the past four years as a weight consumption base (Fig. 1) (1). However, a change in sales took place; the growth in sales was much larger than growth in tonnage. Between 1979 and 1980 clear dishwashing liquids were introduced into the market. These, though more expensive, were less irritating to the hands than traditional turbid liquids. By 1985, about 60% of dishwashing detergents were the clear type. The clear liquid formulations are based on AES and alkylaminoxide while turbid liquids are based on LAS. It was seen that the mixed micelle of AES and alkylaminoxide contributed to less skin irritation (6). Over the past few years, the skin troubles of housewives have tended to decrease with increases in the clear liquids. However, efforts to further reduce skin irritation will be an eternal problem. The introduction of new dishwashing liquids containing abrasives to combat stiff soil deposits on glasses and cups in 1983 did not necessarily lead to an extension of total consumption.

Almost all dishwashing detergents in Japan are liquids designed for hand washing. It is rare to find automatic dishwashers in Japanese homes. It is interesting that major electrical manufacturers are introducing small automatic dishwashers into the market.

LAUNDRY AIDS

Sales of laundry aids (fabric softeners, bleaches and starches) amount to 83 billion yen (about $0.5 billion) a year (1). Fabric softeners, the market leader among laundry aids, are used in about 70% of all Japanese households. Their production has increased rapidly through this decade, amounting to 260,000 MT in 1985. Their market growth, however, is slowly slackening as is that of household detergents. The active ingredients in fabric softeners are mainly di(hydrogenated tallow) dimethyl ammonium compounds. Cationic amide compounds and imidazolinium compounds are used in some private label brands. In Japan, liquid softeners used in the rinse cycle are dominant. Because only 9% of Japanese households have automatic dryers, dryer cycle softeners are still minor products. Automatic dryers tend to be used only as a replacement for line drying, as when it rains, or snows, or at night. Believing in the disinfectant effects of sunlight as well as in saving energy costs, people prefer outdoor line drying.

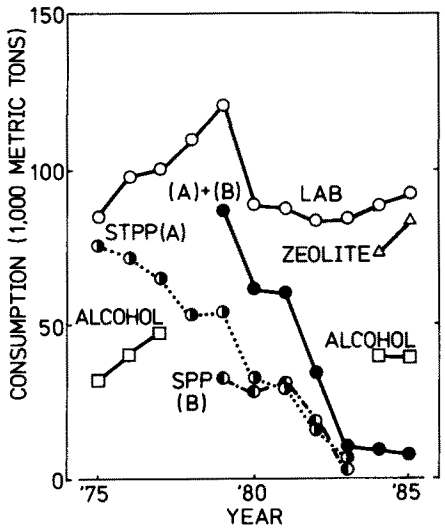

FIG. 3. Changes in consumption of major raw materials for detergents in Japan (1).

Laundry bleaches amount to 24 billion yen a year in sales. This category comprises liquid chlorine bleaches and powdered oxygen bleaches. Sodium percarbonates, which possess good solubility even in cold water, are used as active ingredients in powdered bleaches.

Starch sales account for 10 billion yen a year. Liquid starches comprising as a main component a polyvinyl acetate (PVAc) emulsion constitute a major portion of this market. Various chemical modifications have been made to PVAc emulsions to enable starching in washing machines and to eliminate starch build-up on fabrics. Spray starches currently are increasing.

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