

Detergents

Counting the cost of cleanliness

Cleanliness has been an important consideration for human beings since civilisation began, but few see the relationship between personal and environmental cleanliness.

According to an ancient Roman legend, soap derives its name from Mount Sapo, where animals were sacrificed to appease the gods. The mixture of melted animal fat and wood ash that ran down to the clay soil near the river was found to make washing easy for women inhabiting the area. According to the medical document *Papyrus*, soap-making dates back to about 1500 BC, when a combination of animal and vegetable oils with alkaline salts was used to form a soap-like material.¹ In ancient India too, people used soap preparations made from plant or animal fats.

Modern technology has led to the creation of synthetic detergents that have gradually replaced soaps in the laundry. The first detergents were used chiefly for hand dishwashing and fine fabric laundering. This was followed by the development of all-purpose laundry detergents introduced in the US in 1946. Today, the detergent market is a highly competitive one where a myriad brands vie with each other to get the customers' attention. Each brand claims to clean whiter, boasting of technologically dubious terms such as "fighting granules", "power pearls", etc.

As with many other countries, India too has a diverse range of detergents available off the shelf. The annual consumption of detergents in India is in the magnitude of hundreds of thousands of tonnes.² The formal sector, with its increasing ability to influence consumers through advertisements, is rapidly expanding its

market share. The introduction of small affordable sachets is further promoting the market for detergents.

What are detergents?

With detergents spreading in usage, it is imperative that we understand what they are and how they affect our environment. Detergents are household chemical cleaning compounds used for laundering and dishwashing. They contain wetting agents and emulsifiers based on non-soap synthetic surfactants. Synthetic detergent powders are made up of surface-active agents, builders and fillers. In addition, they contain additives such as anti re-deposition agents, optical fibre brighteners (whitening agents), bluing agents, bleaching agents, foam regulators, organic sequestering agents, enzymes, perfumers, and substances that regulate density and assure the crispness of the material they are used on.

Soap vs Detergents³

- Soaps are made from natural resources such as fats and oils, while detergents are

AT A GLANCE

- ❖ Detergents contain chemicals that can harm the human body as well as the natural environment
- ❖ The Indian government has not taken enough steps to address these issues
- ❖ Without mandatory legislation, industry does nothing to reduce the levels of harmful chemicals, or to inform the consumer about potential damage
- ❖ This is even true of multinational firms who are forced to follow much stricter norms in Western countries



Table 1: Detergent composition, their relative functions, environmental and health effects.

Detergent constituent	Chemicals involved	Function	Environmental effect / Biodegradability*	Health toxicity
Surfactants	Alkyl benzene sulfonates (ABS) or Linear alkyl benzene sulfonates (LAB), a cationic surfactant	Wetting, emulsifying and dispersing properties, enable removal of dirt ('soil') from fabrics and keep the soil suspended in the washing water.	Manufacturing process emits Benzene, a known carcinogen and reproductive toxin. Slow to biodegrade. ⁶	Causes slight to moderate eye and skin irritation. ⁷
Surfactants	Alkyl phenoxy polyethoxy ethanol or nonyl phenol	same as above.	Are toxic to aquatic organisms ⁸	Is a suspected endocrine toxicant. ⁹
Surfactants	Diethanolamines	same as above.	Are slow to biodegrade	Cause cancer. React with natural nitrogen oxides and sodium nitrite pollutants in the atmosphere to form nitrosamines, a family of potent carcinogens. ¹⁰
Builders	Sodium tripolyphosphate (STPP)	Removes hard water minerals like calcium and magnesium ions to increase effectiveness of detergents. Act as deflocculating agents to prevent dirt redeposition.	Contribute to eutrophication of waterways Are biodegradable	–
Builders	Ethylene-diamino-tetra-acetate (EDTA), a phosphate-alternate compound	Reduces calcium and magnesium hardness in water. Also prevents bleaching agents from becoming active before immersion in water.	–	Short term exposure can cause eye and skin irritation. ¹¹
Anti-redeposition agents	Polyethylene glycol (PEG)	Prevents dirt from settling back onto clothes.	–	Is a suspected skin or sense organ toxicant. ¹²
Optical brighteners	Chlorine bleach or sodium hypochlorite	Convert UV light wavelengths to visible light, thus making laundered clothes appear 'whiter'.		Is toxic to aquatic organisms. Can cause allergic reaction when in contact with skin, and is also an eye and lung irritant. ¹³
Artificial fragrances	Made from petroleum products	Provide a fragrant odour to clothes after washing.	Bio-accumulative ¹⁴	–

***Biodegradability** (IS:13933 – 1995) is the ability of a material to give a result of greater than 60 per cent field of carbon dioxide within 28 days.

chemical compounds made from synthetic materials.

- The calcium and magnesium salts of soap are insoluble in water, unlike detergents.
- Soaps are not as readily soluble in hard water as detergents. This property of soaps is due to the fact that soaps react with minerals present in the water leading to the formation of curdles, or scum, that makes them insoluble in water.

How are detergents related to our health?

A study undertaken to understand the Indian consumer's knowledge of the harmful effects of detergents on the health and environment showed that 77.6 per cent of respondents had experienced some kind of skin irritation due to the use of detergents. Of these, the majority were *dhobis* and rural women.⁴

Conventional laundry detergents leave chemical residues on clothes. These enter our bodies either through the skin or lungs. They cause many health problems, including allergies, skin infections and, in rare cases, cancer. The fragrances used in laundry detergents can prove allergic and be highly irritating to the lungs, causing serious health effects on people with asthma or chronic heart problems.

Table 2: A typical phosphate-based detergent formulation

Components	Conventional Powders (%)	Compact Powders (%)
Sodium tripolyphosphate (STPP)	20-25	50
Organic phosphonates	0 to 0.2	0
Sodium silicate	6	5
Sodium carbonate	5	4
Surfactants	12	14
Sodium perborate	14	10
Activator	0 to 2	3
Sodium sulphate	1-24	4
Enzymes	1	0.8
Anti-redeposition agents	0.2	1
Optical brightening agents	0.2	0.3
Perfume	10	0.2
Water	0	8

Source: Consumer Voice, Mar-Apr 2001

Continuous and excessive exposure of the skin to detergents leads to drying, fissuring and dotting of the keratin layer. This results in increased permeability, which causes sensitisation, which with time may develop into dermatitis⁵. The elderly are more susceptible to infections that may lead to developing eczema.

Eutrophication or Nutrient pollution is normally a natural a process by which water bodies gradually age and become more productive. In nature, the process might take thousands of years to progress but human activities accelerate this process tremendously. The presence of excessive plant nutrients causes pollution of water bodies. These plant nutrients are supplied primarily in the form of phosphorus, nitrogen and carbon to water bodies in various ways. Sewage perhaps is a particular source of phosphorus when detergents containing large amounts of phosphates are drained into water bodies. The algal boom leads to consumption of the oxygen dissolved in water, creating a hypoxic, and at times, a near anoxic situation. This can lead to excessive eutrophication that kills the fish, causes odour and increases pathogenic animals.

Detergents and water pollution¹⁵

Phosphates are a major source of water pollution which, in turn, accounts directly for 42 per cent of human and animal diseases. According to Prof Narinder K. Kauschik, Professor Emeritus for environmental biology at the Canadian University of Guelph, "the main problem with phosphate-based detergents is that they promote the eutrophication of aquatic environments".

Prof Kauschik reveals that in Canada and in many states of USA public pressure has led to the regulation of phosphates in detergents since the early 1970s. According to him, these countries have spent \$8.5 billion in the 1970s to upgrade sewage treatment plants to remove excessive phosphates. Canada successfully implemented appropriate regulation to control phosphate emission into water systems by limiting the amount of phosphates in laundry detergents to 0.5 per cent.

India and phosphate control

The Law of **Environment Protection in India (1989)** recognises phosphorus as a pollutant chemical. Despite that, its usage is on the rise. In India, per capita consumption of detergents in 1994 was 2.8 kg per annum. This

is projected to rise to over 4 kg/capita by 2005. In rural areas the use of detergent bars is expected to grow 7-8 per cent annually. The figures are of concern because high-quality detergents have as much as 35 per cent STPP in them (see Table 1 for harmful effects of STTP). In fact, most laundry detergents in India are phosphate-based, but there is no control or regulation for phosphate use in detergents¹⁶. The fact that the phosphates in these detergents can cause eutrophication of waterways portends a grim situation, since these water bodies are the primary sources of water for a large section of the population.

So far, India's action towards controlling advanced eutrophication has been addressed and dealt with only through sewage treatment plants (STPs). Despite several action plans, the issue remains largely ignored. The ever-increasing demand of phosphate-laden detergents in rural areas is sure to escalate eutrophication of local water bodies that serve as the primary water resource. Even metropolitan cities like Delhi, Calcutta, Mumbai and Chennai are only partially sewered. More specifically, only 43 per cent of class I cities and 12 per cent of class II cities are sewered, of which only 37 per cent of sewage is partially treated in class I cities and 5 per cent in class II cities.

Research conducted by Raka Sharan of IIT Kanpur on the "Socio-demographic context of detergent consumers: A case of Kanpur (India)" found an increase in detergents being used throughout India. *Dhobis*, and rural as well as urban women extensively use phosphate-containing detergents. There are various rules and regulations like the law of Environmental Protection in India (1989), and the Hazardous Waste Rules, which categorise phosphine and phosphorus and its compounds as toxic chemicals. Such regulations, however, are not applied to household detergents.

Labelling requirements laid down by BIS

The Bureau of Indian Standards (BIS) has laid down the standards for eco-labelling of detergents in India. Based on the quality, safety and performance of these detergents, a set of general and specific requirements for an **Ecomark** have been established. The standards suggest replacing phosphates with any other environment-friendly substance. They also stress that the surfactants used in the manufacture of household laundry detergent powders should be readily biodegradable and the products be packed in packages made of recyclable or biodegradable materials.

Despite the laying down of this Ecomark plan which encourages phosphate-free environ-

STANDARDS

Despite the laying down of an Ecomark plan by BIS, which encourages phosphate-free environment-friendly detergents, not a single compliant product has made its way to the consumer

1 www.chemistry.co.nz/deterghistory.htm

2 Consumer Voice, Mar-Apr 2001

3 Soaps are sodium salts of long chain carboxylic acids while detergents are salts of long chain alkyl benzene sulphonic acid (Source: <http://www.citycollegiate.com/industry2.htm>.)

4 Detergents and the environment – The Canadian Experience and the Indian Scenario, by Clive Southey et al., 2001, Tata McGraw Hill Publishing Company Limited

5 <http://telemedicine.org/soaps.htm>

6 www.healthy-communications.com

7 www.epa.gov

8 ICSC - April 2000

9 www.scorecard.org

10 www.healthy-communications.com

11 ICSC - April 1997

12 www.scorecard.org

13 ICSC - Oct 1999

14 www.foe.co.uk

15 Detergents and the environment – The Canadian Experience and the Indian Scenario, by Clive Southey et al., 2001, Tata McGraw Hill Publishing Company Limited

16 Prof. Narinder Kaushick,

Detergents damage your washing machines as well¹⁸. Harsh abrasives in the detergents leave a residue that slowly builds up in the machine and corrodes machine parts and water pipes.

Packaging

Detergents are mostly packaged in plastic bags or containers. This poses significant environmental impact from raw material extraction to disposal. The packaging industry is one of the largest end-users of commodity plastics¹⁹. Detergents that were earlier available in large packs are now also being marketed in small plastic sachets, adding to waste generation. Also, packaging has now become multi-layered that can often not be recycled and ends up in landfills.



A voluntary initiative of the detergents industry in Europe

The *Association Internationale de la Savonnerie, de la Détergence et des Produits d'Entretien* (A.I.S.E.) is a voluntary initiative that represents more than 1200 companies in Europe, covering approximately 90 per cent of the market. It represents the soap, detergent and maintenance industry with European and other international organisations. This covers household laundry powder and liquid, heavy- and light-duty detergents.

This voluntary scheme is open to all manufacturers, importers, or other persons (subsequently referred to as 'the manufacturer') whether or not affiliated to A.I.S.E. national associations, placing household detergents on the market. To comply with this code, a manufacturer must commit to:

1. Design composition and packaging of his products taking into account their impact on the environment identified by acknowledged scientific criteria.
2. Provide consumer information designed to encourage the correct use of products.
3. Fully comply with all relevant environmental and consumer protection legislation, including the European Union Directives on biodegradability of surfactants classification, safety labelling provisions including dosage instructions covering different soils, loads and water hardness.
5. Ensure that the environmental advertising claims for the products are truthful, supported by factual data and designed to inform the consumer.
6. Provide to A.I.S.E a written declaration on commitment to this code, signed by the manufacturer's legal representative.

These targets may need to be adjusted for individual countries depending on ongoing environmental progress, washing habits and consumer choices. Established for the past five years, there is a need for a similar initiative in India.

Source: <http://www.aise-net.org>

ment-friendly detergents, not a single compliant product has made its way to the consumer. According to Professor Kauschik, the industry has simply sabotaged the plan.

According to the labelling requirements laid down by BIS, each packet of detergent powder should carry information on the name/grade of the material used, the source of manufacture, and a caution statement which reads: *Detergent solutions can be skin irritants. Avoid prolonged contact. Rinse garments and hands thoroughly.* The label should also carry information about the critical ingredients used in the formulations.

A recent test done by *Consumer Voice* on detergents showed that of the 14 brands selected, only one complied with the BIS standards for detergent labelling.

The Indian detergent industry – washing its hands of its responsibilities

The issues of environmental protection and a regulatory policy on the use of detergents need to be addressed by the Indian detergent industry. As a proactive approach to reduce the environmental risks, the industry needs to reduce the perilously high phosphate levels from 30 per cent to 5 per cent. Industry representatives have declined to do so on grounds that the amount of phosphate used in northern countries is higher as compared to that in India¹⁷. What this ignores is that India relies only on sewage treatment plants (STPs) which are not fully functional even in metropolitan cities, whereas in the northern countries, STPs are installed for every few households.

Industry also needs to voluntarily label its products regarding phosphate content, so that it can be left to the consumer to decide the merits of the product. But as there are no mandatory legislations, the detergent industry refuses to take any action in this respect.

The vast run-off of phosphates into water streams is due to fertilisers and manure as well as detergents. Findings show that, during the dry seasons, when the run-off from agriculture is virtually zero, and manure run-off is down to one-fifth of the total annual rate, detergents are responsible for additional loading of rivers by about 7.3 per cent. Owing to the low flow rates of rivers during dry seasons, eutrophication can have a severe toxic impact.

FACTFILE²⁰

- Experts suggest that as much as 70 per cent of the 'target' population is using detergents in India.
- India has perhaps the most diverse product range of detergents.
- The total annual consumption of detergents in India holds a retail value of billions of rupees.
- The specific and general requirements laid down by BIS for ecomarking of detergents states that they should not contain any phosphate.

Personal Communication

17 Interaction Workshop "Environment and Detergents: Global Scenario and Indian Perspective", reported in *Down to Earth*.

18 www.wash4less.com

19 <http://www.tradeport.org/ts/countries/india/isa/isar0035.html>

20 *Consumer Voice*, Mar-Apr 2001

21 www.Laundry-detergent.com

According to Prof Kaushick, strict regulations in North America and Europe make it mandatory for the multinational detergent industry to produce detergents with nominal phosphate content (or even phosphate-free detergent). The same businesses absolve themselves of this responsibility in India, where they manufacture detergents with a high phosphate content. The industry vehemently opposes any regulation of phosphate use in detergents.

An environment-friendly household cleaning powder

An environmentally superior detergent is one that uses fewer chemical ingredients. The toxicity of detergents decreases if you remove additives like perfumes, colour and brightening agents. Minimal packaging can also reduce environmental harm substantially. Synthetic surfactants may be replaced by non-petrochemical surfactants or vegetable oil soaps; builders like phosphates can be replaced by sodium citrate and sodium bicarbonate; dyes and fragrances can be eliminated or minimised. One of the traditional alternatives to detergents is *reetha*, which is known for its washing properties and is used in a number of shampoo preparations as well.

Detergents can be made using soap and other household cleaning products. Soap, unlike detergents, is made from animal fat and is an excellent cleanser because of its ability to act as an emulsifying agent. Being salts of weak acids, soaps get converted by mineral acids into free fatty acids. These fatty acids, having a lower solubility, form a precipitate or soap scum, rendering them ineffective in acidic water. The formation of these insoluble salts in hard water can be overcome by mixing in such household chemicals as borax or washing soda that can help get better results.

AWARENESS

Detergent use can never be a totally non-polluting activity. The consumer needs to be informed that the smaller detergent products can also be the least polluting ones

HANDS-ON

Make your own detergent²¹

Laundry Detergent: Basic Mix

- 1 cup soap flakes
- 1/2 cup washing soda
- 1/2 cup borax

Laundry Detergent: Soft Water Mix

- 1 cup soap flakes
- 1/4 cup washing soda
- 1/2 cup borax

Laundry Detergent: Hard Water Mix

- 1 cup soap flakes
- 1 cup washing soda
- 1 cup borax

Liquid Laundry Detergent

- 1 cup of any of the above mixes
- 2 tablespoons glycerin
- 2 cups warm water

Mix ingredients and store in a sealed glass container which has already been used for storing detergents. To use, measure ½ to ¾ cup of the mix and wash your clothing in warm or cold water. Use cold water for the rinse cycle.

Detergent use can never be a totally non-polluting activity. The consumer needs to be informed that the smaller detergent products can also be the least polluting ones. By using 'green detergents' that do not contain non-essential additives like perfumes, colour and brightening agents and minimal packaging we can ensure a cleaner environment.

If you have any suggestions or require more information, please visit our website at www.toxicslink.org or contact:

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