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Research Article

DIRTY DETERGENT: A STUDY ON NORTH INDIAN DETERGENTS

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ABSTRACT

Detergents contain phosphates and have been associated with eutrophication problems. Although numerous laws and voluntary agreements exist, which either ban or restrict the use of detergent phosphate. In India hundreds of thousands of ton detergent used annually with a retail value of billions of rupees. At present, there are no rigid guidelines in India about the percentage of various constituents in a detergent formulation from the point of view of environment. An effort was made in the present investigation to characterize phosphate level in the solutions prepared by dissolving in water of 55 detergents available in North Indian market in the form of cakes, powders and liquids. Based on the analytical results their likely effects on environment were discussed. Ten percent solution of only a few detergents were found to have pH > prescribed limit of 11. Sodium tripolyphosphate (STPP) which used as a builder was found to range from 1.8% to 31.9%, a variation of above 15 fold. Higher concentration of STPP in detergent is associated with eutrophication of natural water bodies. In general, most widely used and high price range detergents were found to contain higher amount of STPP (>25%). Almost all the detergents analyzed had STPP > prescribed limit of 2.2% by weight.

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INTRODUCTION

Detergents are widely used for both household as well as industrial purposes. They consist of water soluble (hydrophilic) and water resistant (hydrophobic) organics. Detergents are usually classified by their ionic character in water such as anionic, cationic, and non-ionic. The anionic detergents one most commonly used [4]. The linear alkyl benzene sulphonate (LAS) group has the greatest use and favored over the branched chain alkyl benzene sulphonates because of more rapid biodegradation in sewage treatment plants [3]. Generally household detergent products are composed of 10-30% of a synthetic surfactant of anionic type, up to 40% of complex phosphate and of 5-10% of sodium sulphate. Most of the remainder of these products is a mixture of simple inorganic salts such as sodium sulphate and sodium chloride, which are by products of surfactant manufacture. In addition, to make the finished product, several minor ingredients like silicates, optical brighteners, dyes, and perfumes are added to impart specific performance and aesthetic properties [5].

Need of the study

Hundreds of thousands of tones of detergents is used annually with a retail value of billions of rupees. The production, use and disposal of such wide variety of chemicals and its daily

exposer to the environment may harm the consumers, water bodies and to their living organisms. Toxicity of syndets to fishes, snails and other aquatic life is well documented [7, 9]. Phosphates present as builders promote and accelerate the eutrophication of water bodies. To abate this several countries have replaced phosphates with NTA, which is not toxic to aquatic animals and completely biodegradable in concentrations generally encountered in water, but current research indicates that NTA is a carcinogenic agent.

Eco-labeling scheme for detergents - BIS requirements for Eco mark (IS: 4955)

Eco-labeling scheme refers to standard of Bureau of Indian Standard (BIS) pertaining to quality, safety and performance. BIS lays a set of general and specific requirement for Eco mark.

- According to Sec. 5.7.1.1, the product shall conform to the requirements of the quality, safety and performance prescribed by the BIS.
- As per Sec. 5.7.1.2 the manufacturer shall produce to BIS, environmental consent clearance from the concerned State Pollution Control Board.
- List of critical ingredients also shall be marked on the label of Eco mark.

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- The material shall pass the test then evaluated for skin irritant potential and skin sensitization potential.
- Sec. 5.7.2.1 says that material shall not contain any phosphate and suggest that any environmental-friendly-substance in sufficient quantity to ensure similar performance of the product as compared to that of phosphates.
- Sec. 5.7.2.1 suggested that the surfactants used in the manufacture of house hold laundry detergents shall be readily biodegradable.
- Sec. 5.7.2.1 for Eco mark, the product shall be packed in such packages, which are making from recyclable/renewable or biodegradable materials.

A green detergent

A green detergent should ideally contain only the lowest possible amount of the essential ingredients. Non-essential additives like perfumes, color and brightening agents should be omitted. Ingredients should be non-toxic to aquatic life and terrestrial animals, biodegrade quickly and be easily removed through sewage treatment. However, even the greenest detergent will also have some impact on the environment. Therefore, use of detergent can never be a totally non-polluting activity. For this reason the concerned consumer need to be informed about the possible effects of detergents and methods of using these so as to minimize their effects.

MATERIALS AND METHODS

Fifty five commercially available detergents were purchased from the markets of Roorkee (Uttaranchal), Lucknow (U.P), and Delhi. Thirty were cakes, twenty were powders and five were liquid detergents. All the chemical used in analysis of analytical grade and were procured from BDH India, Sigma and Merck.

All the detergents were dissolved in distilled water and parameters were analyzed according to standard methods for the examination of water and wastewater [1].

RESULTS AND DISCUSSION

Detergents raise the pH of water as at high pH the performance of surfactant is enhanced. pH of 10% solutions of fifty five different detergents were found (Fig. 1). The pH value for different detergents was found to be in the range of 8.23 to 11.40 for 10% solution. In general, pH was found in the following increasing order: Liquid detergents (range 7.42-8.24, mean 7.85), cakes (range 7.73-10.32, mean 9.61) and powders (range 9.47-10.53, mean 10.38). It is suggested [7] that pH value should not be more than 11 of a 10% detergent solution. It was found that, 10% solution of only three detergents (all cakes) had pH more than 11. Higher pH value encourages the scale formation in water heating systems and also reduces the germicidal potential of chlorine. High pH induces the formation of trihalomethanes, which is suspected to cause cancer in human beings.

Detergent builder is the main source of phosphate in the detergents. Generally sodium tripolyphosphate (STPP) is used as a builder. One percent Sample of different detergents were tested and following observations were made:

- PO_4^{3-} concentration ranged widely from 109 mg/L – 1956 mg/L
- On dry weight basis, different detergents contained 1.8% - 31.9% of STPP (Fig. 2).
- Two most widely used detergent powders in India, were found to contain very high percent of STPP i.e. 27.6% and 28.6% respectively. Both are marketed by multinational companies in India.

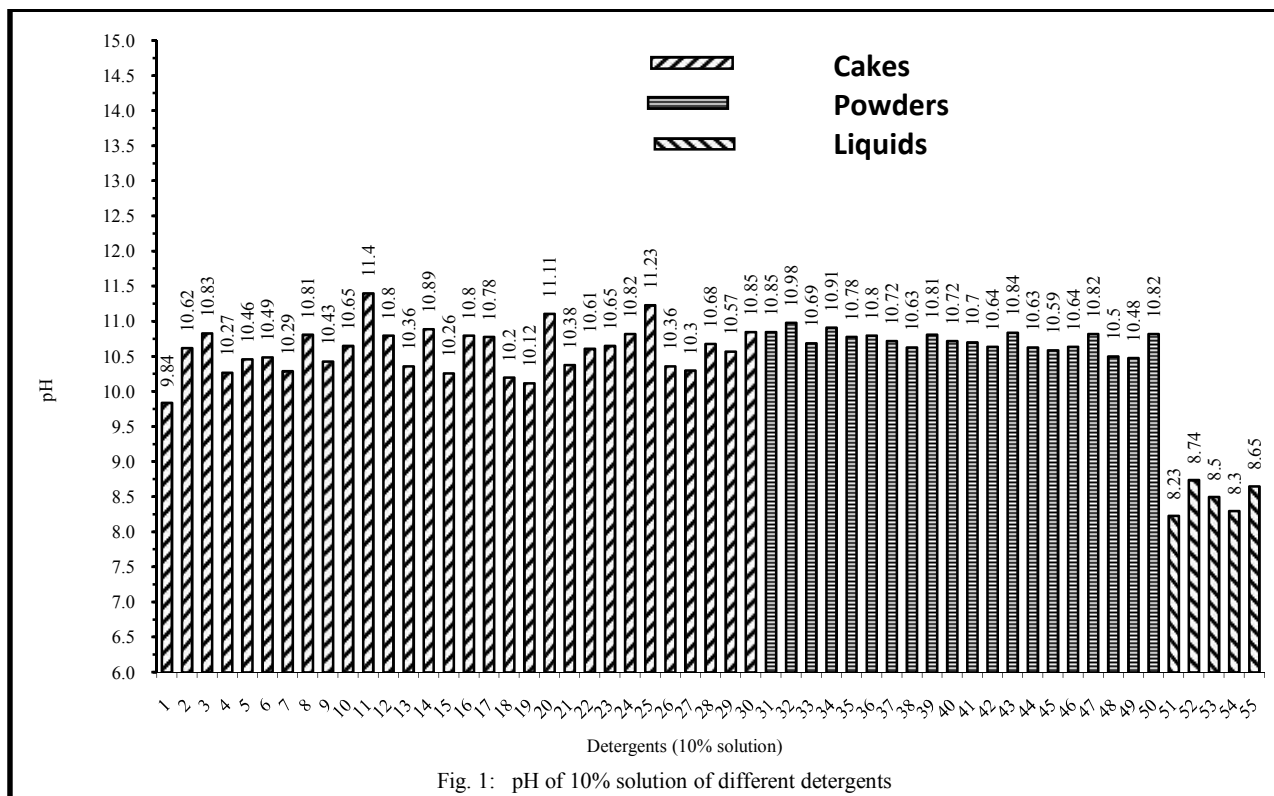


Fig. 1: pH of 10% solution of different detergents

It is reported that while marketing the same brand name in international market, much less amount of STPP is added [2].

- Detergent powder(34) contained highest concentration of PO_4^{3-} (1956 mg/L) followed by cake (12) (1795 mg/L), powder (35) (1753 mg/L), powder(46) (1690 mg/L), and powder (42) (1505 mg/L).
- Concentration wise, cake(19), (109 mg/L) and the two liquid detergents 54 (134 mg/L) and 55 (140 mg/L) ranked lowest.

Literature suggests that the detergents should not contain phosphate (STPP) more than 2.2% by weight but results show that most of the detergents had phosphate (STPP) more than 5%. Total phosphorus concentration in excess of 0.1mg/L is believed to provide sufficient nutrient enrichment in lakes to be eutrophic. The EPA has made the following recommendations to control the phosphate in water bodies (a) Total phosphate concentration should not exceed 0.05 mg/L (as PO_4^{3-}) in a stream at a point where it enters to a lake or reservoir, and (b) Should not exceed 0.1 mg/L in a stream that do not discharge directly into lake or reservoir [6]. Phosphate level greater than 1.0 mg/L, may interfere with coagulation in water treatment plants. As a result, organic particle that harbor microorganisms may not be completely removed before distribution.

variation of above 15 fold. Higher concentration of STPP in detergent is associated with eutrophication of natural water.

- In general, most widely used and high price range detergents were found to higher amount of STPP (>25%).
- Almost all the detergents analyzed had STPP > prescribed limit of 2.2% by weight.
- Ten percent solution of only a few detergents were found to have pH > prescribed limit of 11.
- BIS (IS:4955) has prescribed a detailed method of writing various constituents on the packet. However, it was observed that no industry follows these guidelines.
- At present, there are no rigid guidelines in India about the percentage of various constituents in a detergent formulation from the point of view of environment.
- Constituents in detergents available in North Indian market vary widely and are likely to have widely varying impacts.

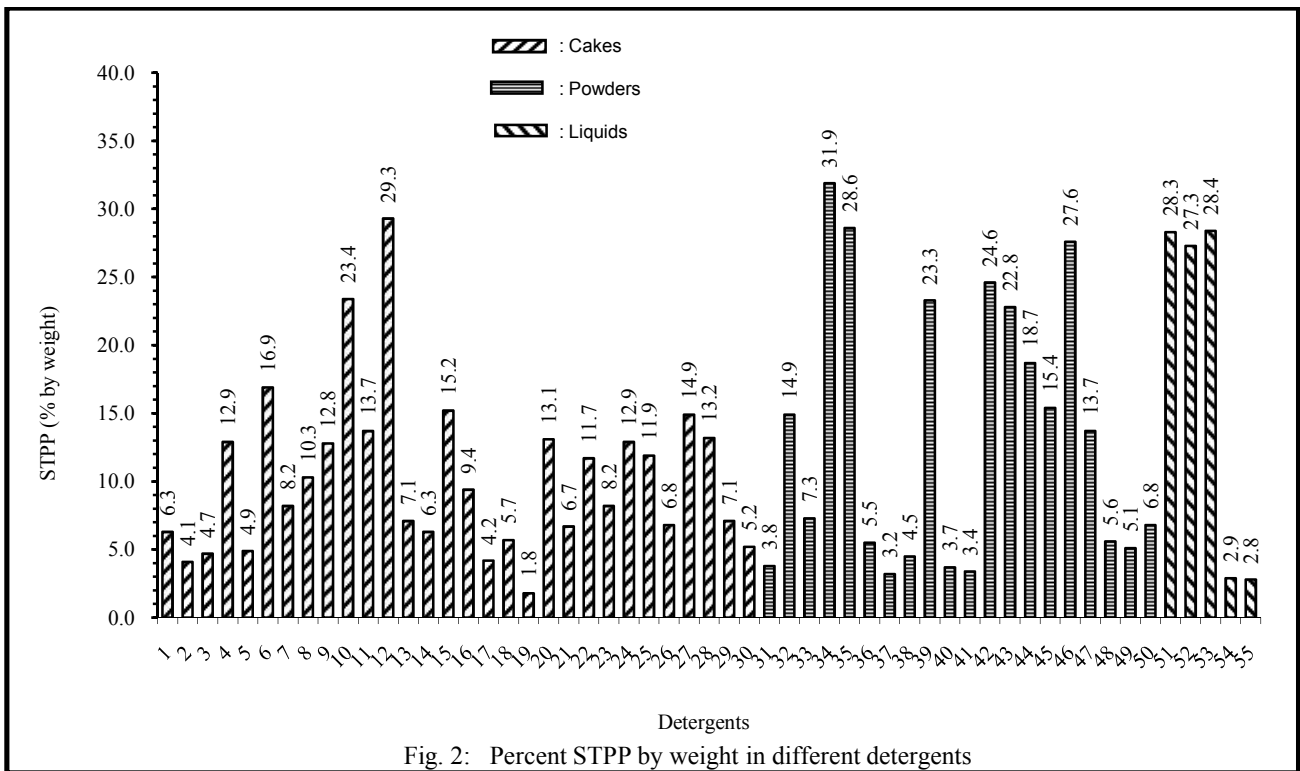


Fig. 2: Percent STPP by weight in different detergents

CONCLUSIONS

An effort was made in the present investigation to characterize the solutions prepared by dissolving in water 55 detergents available in North Indian market in the form of cakes, powders and liquids. Based on the analytical results their likely effects on environment were discussed. Following conclusions were drawn:

- Sodium tripolyphosphate (STPP) which used as a builder was found to range from 1.8% to 31.9%, a

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