

A Study on Chemical Contamination of Water Due to Household Laundry Detergents

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KEYWORDS Contamination. Laundry. Detergents. Eco-friendly. Pollution

ABSTRACT The present investigation entitled 'Chemical contamination of water due to household laundry detergents' was conducted to study the chemical contribution of laundry detergents to waste water. Six most commonly used laundry detergents, 4 powder and 2 liquid detergents were selected to study the chemical input of each to waste water stream from home laundry. Chemical analysis of wash water and detergent solution was done to analyse pH, total dissolved solids (TDS), chloride, sulphate, carbonate and bicarbonate alkalinity. The results indicated that with the use of powder detergents, there was a significant increase in the level of pH, TDS, chlorides, sulphate, carbonate and bicarbonate in wash water, whereas very negligible change was found in all the above chemical parameters with the use of liquid detergents. So, we should give up powder detergents and start using the eco-friendly liquid detergents to save resources, to minimize water pollution and choking of drains.

INTRODUCTION

Home laundry is one of the major household tasks in which lots of water and detergents are used. Today, many of the wonder cleaning detergents are available in the market. These washing detergents consist of different chemical components; surfactants, builders, fillers, bleaches, enzymes, optical brighteners, anti-redeposition agents, perfume and colour. These, detergents make our clothes seem whiter or brighter by absorbing ultraviolet light and remitting blue light. Foam boosters add suds but do not improve the cleaning action, enzymes attack grim, soil and stains but cause allergies (Hathi 2007). Besides, lots of fillers used in powder detergents are poured in drains causing wastage of useful products like common salt/washing soda and choking of drains/sewerage system. Powders contain more chemicals compared with liquids due to fillers. Sodium sulphate in these can wreck havoc on septic system (Frydendall 2009). Synthetic detergents and our laundry practices are contributing to our ground level water pollution (Weir 2007). Another study conducted by Kannan et al. (2005) on the physio-chemical characteristics of water samples mixed with effluent discharged from textile industries at different sites revealed the elevated levels of calcium, magnesium, sodium, chromium, potassium, nickel, copper, zinc, carbonate, sulphate, nitrate and chloride in water. The concentration of these ions exceeded the limit prescribed by Bureau of

Indian Standards (BIS). Water at these sites was found to be hard, blackish and not suitable for drinking purpose. So main environmental impact of detergents is related to their post use effect when the wash water is discharged into sewage system.

Ghai (2010) in his article, "Soap nut detergent-the best HE detergent" also mentioned that one of the major pollutant responsible for water pollution is the detergent that we use for our daily laundry. It is a well known fact that detergents are non degradable products that remain in the environment as such for years altogether. With amount of washing done every day in several hundreds of households, even in a single city, it is imaginable how much detergents go down the pipelines and into the large water bodies. The suffering aquatic life often shows signs of damage we are inflicting on it, in the form of several fishes and other aquatic creatures dying. These not only cause damage to the soil, water and aquatic life but also many times spoil our clothes and effect our skin. It should be our concern to notice the harm that chemicals are causing to our natural resources, therefore we should work towards putting our effort to conserve the environment.

Thus, there is a strong need to study which detergents add to water pollution and how much pollution is being caused by these detergents so that alternative remedial measures can be suggested for controlling chemical contamination of water. This research paper provides an

insight into various chemical inputs to waste water from home laundry through the following specific objectives.

Objectives

- ♦ To know the methods practised by homemakers for washing of clothes.
- ♦ To study the chemical profile of wash water after completion of wash cycle using different detergents.
- ♦ To know the problems experienced by the respondents while washing clothes using different detergents.
- ♦ To recommend the type of laundry detergent causing minimum chemical contamination of water.

METHODOLOGY

The present study was conducted in two parts that is, household survey and (ii) Laboratory experiments. The household survey was conducted to find out the water/detergent use pattern for washing of clothes in urban households, to gather information regarding the mode of washing and problems experienced by the respondents while washing of clothes. The household survey was conducted in all four zones of Ludhiana city. Multistage random sampling technique was followed for sample selection. From all the four zones, two localities were selected randomly. From each of the selected localities, a sample of 15 households was randomly selected, where washing of family clothes was performed by homemaker herself. Thus, the final sample, consisted of 120 homemakers. The data were collected through personal interview, informal discussions and observations using pretested interview schedule.

Laboratory Experiments

Laboratory experiments were conducted in the laundry laboratory of Department of Clothing and Textile, College of Home Science and Science Laboratory of Civil Engineering, Punjab Agricultural University, Ludhiana to study the various chemical inputs to the waste water stream from home laundry. On the basis of the results of household survey, six most commonly used detergents, four powder detergents that is, D1; D2; D3 and D4 and two liquid detergents

that is, D5 and D6, each having different active ingredients were selected for the experiments. White cotton fabric, which was soiled in the laboratory using soiling mixture recipe given in ISI specification (IS : 5785, part IIV, 1977) was used for washing in different detergent solutions (5 gm of powder or 5 gm/of liquid detergent in one litre of water). The artificially soiled samples were washed in laundrometer at 50°C for 45 minutes. After that samples were taken out and wash water was collected in sterilized bottles. Then chemical analysis of wash water and different detergent solutions was done for pH, TDS, chloride, sulphate, carbonate and bicarbonate alkalinity using APHA standards. The data were analyzed using percentage and Anova.

RESULTS AND DISCUSSION

Methods Practised by the Homemakers for Washing of Clothes

Washing methods included mode of washing, types of washing machine and detergent being used for washing of clothes. The results of the study indicated that majority of the respondents (71.67 per cent) were using washing machine, while 28.33 cent preferred hand washing for washing of clothes (Table 1).

Table 1: Mode of washing and type of machine used by respondents for washing clothes

S. No.	Parameters	Number of households	Percentage
I.	<i>Mode of Washing (n=120)</i>		
	Hand washing	34	28.33
	Machine washing	86	71.67
II.	<i>Type of Machine Used (n=86)</i>		
	Fully automatic	26	30.23
	Semi automatic	60	69.77

These results are in contradiction with results of study conducted by Kaur (2007) who had reported that hand washing of household articles was more popular in comparison to machine washing. This indicates that machine washing is less preferred in rural areas. The data further indicate that out of the total respondents using washing machine, 69.77 per cent were using semiautomatic washing machine and 30.23 per cent were using fully automatic machine for washing of family clothes.

Type of Detergents Being Used for Washing of Clothes

The data in Table 2 and Figure 1 provide information regarding the type of detergent being used by the respondents. The data reveal that a large number of the respondents that is, 84.00 per cent were using powder detergents whereas as small as 16.00 per cent were using liquid detergents for washing of clothes. Kaur (2007) also revealed that detergent powders were most popularly used cleansing agents and formed the largest share of total detergents purchased. The results in Table 2 reveal that majority (23.76 per cent) of the respondents were using Wheel Active powder for washing of clothes followed by Surf Excelmatic (19.80 per cent), Ariel (17.82 per cent), Tide (15.84 per cent), Nirma (9.90 per cent), Henko and Rin Supreme 4.95 per cent each, Saheli (1.98 per cent) and Ghari (0.99 per cent). The data in Table 2 also highlight that among those using liquid detergent (16.00 per cent), majority of the respondents (57.89 per cent) had preference for Sa8 (Gelzyme) liquid detergent followed by Home liver (36.84 per cent) and Safe Wash (5.27 per cent).

Table 2: Distribution of respondents according to detergent use pattern for washing of clothes

S. No.	Parameters	Number of households	Percentage
1.	Type of Detergent Used (n=120)		
	Powder	101	84.17
	Liquid	19	15.83
2a.	Preferred Powder Detergent (n=101)		
	Wheel Active	24	23.76
	Surf Excelmatic	20	19.80
	Ariel	18	17.82
	Tide	16	15.84
	Nirma	10	9.90
	Henko	5	4.95
	Rin Supreme	5	4.95
	Saheli	2	1.98
	Ghari	1	0.99
2b.	Preferred Liquid Detergent (n=19)		
	Sa8 (Gelzyme)	11	57.89
	Lever Home	7	36.84
	Safe Wash	1	5.26

Problems Experienced by Respondents during Washing of Clothes

Problems experienced by respondents during washing of clothes included unsatisfactory

rinsing, skin problems, machine and drain blockage.

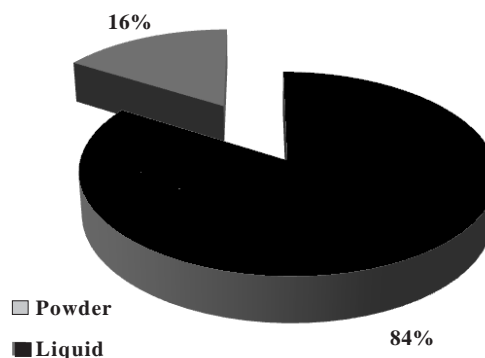


Fig. 1. Distribution of respondents according to the type of detergent used for washing of clothes

A perusal of data in Table 3 reveal that majority of the respondents (74.42 per cent) were of the view that machine did not rinse the clothes satisfactorily and felt the need for rinsing it again after completion of wash cycle in washing machine. However, 25.58 per cent respondents did not feel the need of rinsing clothes again after completion of wash cycle in fully automatic washing machine.

Table 3: Problems experienced by respondents while washing of clothes

S. No.	Parameters	Number of households	Percentage
1.	Rinsing Required After Completion of Wash Cycle (n=86)		
	Yes	64	74.42
	No	22	25.58
2.	Skin Problems (n=120)		
	Dryness	36	30.00
	Itching	27	22.50
	Rashes	18	15.00
	None	39	32.50
3.	Blockage Problem		
	a) Machine Blockage (n=86)		
	Rarely	22	25.58
	Never	64	74.42
	b) Drain Blockage (n=120)		
	Rarely	43	35.83
	Never	77	64.17

The data in Table 3 further reveal that 30.00 per cent of the respondents complained about dryness of skin of hands, 22.50 per cent of the respondents reported the problem of itching in

Table 4: Comparison of various detergents on the basis of their contribution in chemical contamination of water

Detergents	Chemical profile of water											
	pH		TDS(mg/l)		Chloride (mg/l)		Sulphate(mg/l)		Carbonate (mg/l)		Bicarbonate (mg/l)	
	DS	WW	DS	WW	DS	WW	DS	WW	DS	WW	DS	WW
D ₁	2.64	2.24	3110.00	2596.67	344.00	294.00	276.14	236.24	555.00	535.00	356.67	33.33
D ₂	2.79	2.49	2676.67	2240.00	84.00	60.67	328.21	280.76	581.67	565.00	436.67	410.00
D ₃	2.53	2.31	3853.33	3220.00	980.67	940.67	83.45	71.29	331.67	308.33	306.67	290.00
D ₄	2.62	2.22	1456.67	1183.33	114.00	90.67	50.85	37.27	895.00	878.33	446.67	410.00
D ₅	0.52	0.22	270.00	156.67	34.00	20.67	3.16	-	175.00	145.00	-	-
D ₆	0.23	0.87	210.00	130.00	24.00	14.00	20.92	14.35	138.33	121.67	-	-
CD	0.108	0.150	71.71	67.35	16.27	21.32	1.99	1.32	25.43	19.97	27.50	35.09

5%

DS – Detergent solution

WW – Wash water

hands, whereas 15.00 per cent of the respondents complained of rashes after washing of clothes with the detergent used.

As far as problem blockage is concerned 74.42 per cent of respondents had never faced the problem of blockage in machine itself whereas 64.14 per cent of respondents had never faced the problem of blockage of drain.

Chemical Contamination of Waste Water Stream through Selected Detergents

The results of chemical analysis of wash water revealed that the level of pH, total dissolved solids (TDS), chloride, sulphate, carbonate and bicarbonate had significantly increased in wash water with the use of powder detergents. Whereas with the use of liquid detergents very nominal increase was observed in pH, TDS, chloride, sulphate, carbonate and bicarbonate content of wash water over tap water (Table 4). These findings are in tune with the findings of research study conducted by Patterson (2004), who had tested 40 powder and 21 liquid detergents and reported that liquid detergents have the lower salinity and sodicity as compared to powder detergents.

The reason for higher concentration of TDS, chloride, carbonate and bicarbonate in wash water containing powder detergents may be the excessive use of filler and builders in preparation of these detergents.

Xul (1996) also revealed from his study that every year more than 2000 metric tonnes of washing powders are poured into Dianchi lake along

with urban sewage causing damage to the environment. The findings of the present study reconfirm the fact that the filler/builders are used in powder detergents which play a major role in chemical contamination of water and choking of drains.

CONCLUSION

From the results of present study it is concluded that majority of homemakers are using powder detergents for washing of clothes, which adds more to the chemical contamination of water as compared to liquid detergents. Besides, powder detergents are harsh on skin and fillers used in powder detergents add lots of salts in drainage system causing its choking and changing chemical nature of effluents. So we should stop use of powder detergents and start using liquid detergents to save resources, minimize water pollution, to protect our health and already sick drainage system from overloading.

RECOMMENDATIONS

On the basis of above findings it is recommended that as far as possible we should restrict the use of powder detergents and start using liquid detergents, as powder detergents add to chemical contamination of water.

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