Analytical Study of Washing Machine Effluent for Households of Residential Building in Nasik Region

Priyanka Patekar[1], Dr. S. B. Thakare[2]

[1]M.E Student, [2]Professor

[1,2]Department of Civil Engineering, Anantrao Pawar College of Engineering & Research, Pune, Maharashtra, India

ABSTRACT

Water plays a significant role in the human and animal life; it is one of the prominent components of environment without which life is not possible in this earth but persistent glitches of today are water scarcity. In the last few decades, limitless urbanization has caused a serious pollution problem due to the disposal of sewage to the water bodies. The present study focused on the physico-chemical parameters of wastewater of washing machine for the households of residential building in Nasik. Examination have been be performed on effluent on its physical appearance such as pH, turbidity, TDS, while chemical tests should be perform for its COD, BOD, Oil & Grease, Conductivity, Total Hardness, Calcium, Magnesium, dissolved oxygen, alkalinity, Sulphate, Iron, Lead, Zinc, DO and Nitrate. The analysis shows the parameters have exceed the permissible limit of recycle/reuse of water in pH, COD, BOD, Turbidity, TDS, Total Hardness, DO so there is a need for an appropriate treatment system to reuse the washing machine effluent in the case study area.

Keywords: Washing Machine, physico-chemical, Effluent

1. INTRODUCTION

One of the water driven activity of day to day life of human being i.e. washing of clothes which requires lot of water and detergents which has chemicals has been studies in this research paper. Even more water is required for washing clothes which are stained and dirty. All this water is waste and gets mixed with other waste water. [1]

The State Pollution Control Board has, therefore, not framed standards for specific contaminant levels for the disposal of Laundry waste. No laundry industry in India needs to seek consent under existing environmental legislation. Laundry waste originates from the use of soap, soda and detergents in removing grease, dirt and starch from soiled clothing. Standard washing machine requires a lot of water to get rid of a small amount of dirt. Some of our modern appliances including those that make claims to be efficient are still based on the wasteful practices and for us to really move towards sustainability. Washing laundry is inherently wasteful, even when using water efficient machine, simply because of the nature of task. Washing machine uses a lot of water and detergent to extract small amount of dirt from fabrics, all of which is then sent down the drain together with each wash and rinse cycle, again ending up being commingled with other liquids on the way to the wastewater treatment plant. [2 & 3]

In the recent past, there is comparatively increased awareness among the governments and bodies dealing with water management to address the challenges related to water security. Measures to reduce water usage through increased awareness, installation of rainwater harvesting and grey water (GW) treatment systems are seen as promising solutions, especially in developing countries that are more vulnerable to water scarcity like India. Water is an essential part of human's life. In water shortages, three key methods: water conservation, desalination and recycling could be considered. Due to lower costs and possibility of wastewater treatment in waste production site, water recycling is much better than the other two methods. GW reuse is increasingly emerging as an integral part of water demand management. [4]

The need for increased water requirement for the growing population in the new century is generally assumed, without considering whether available water resources could meet these needs in a sustainable manner. The question about from where the extra water is to come, has led to this study. It is necessary to learn methods for the removal of the detergent from the water so that treated water will be used as the detergents possess harmful chemicals this can lead to the contamination of water. Because of which it becomes very important to study the physico-chemical properties of the effluent of washing machine.

2. AIM AND OBJECTIVE
A. Aim:
"The ultimate aim of this work is to systematically understand the physicochemical parameters of waste water generated from washing machine and its scope of reuse".

B. Objective:
The research objectives followed for this research work is as follows:
1. To study and understand wastewater parameters.

2. To study scope of reuse of waste water.

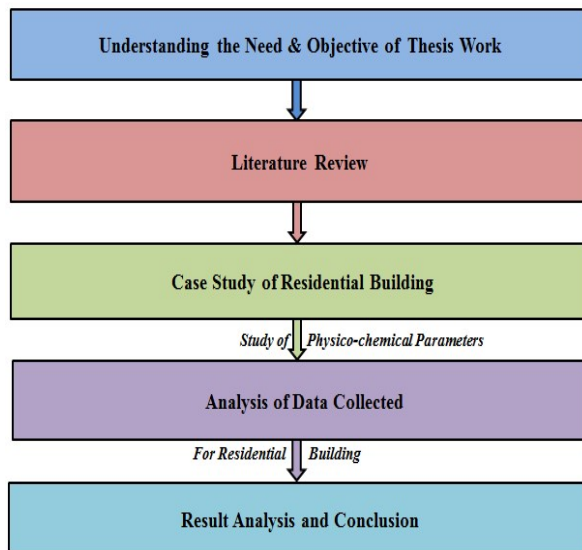## 3. LITERTURE REVIEW

A literature review of scholarly articles, books, dissertations, conference proceedings and other resources which are relevant to the study of Laundry effluent, carried out to set the background on what has been explored on the topic so far.

Table No.1: Characteristics of Laundry effluent from Various Research Paper

Sr. No.	Tittle	Year of Publication	Remarks	
			Characteristics of Laundry Effluent	Value
1.	Commercial Laundry Water Characterization by J. K. Braga and M. B. A. Varesche	2014	pH	5.6
			Total Alkalinity	25.9
			COD	1710
			TSS	80
			Nitrate	8.4
			Nitrite	2.1
			Sulphate	21.1
			Sulphide	0.2
2.	Characterization of domestic gray water from point source to determine the potential for urban residential reuse by Golda A. Edwin Et. al	2014	pH	9.1
			EC	641.6
			Hardness	721
			BOD_5	186.5
			COD	1545.8
			DO	N.D
			TS	586
			TSS	141.2
			Nitrate	0.3
			Nitrite	0.2
3.	Study of physico-chemical characteristics of domestic Wastewater in Vishnupuri, Nanded, India by Sonune NA Et. al	2015	pH	7 – 8
			BOD	56 – 96
			COD	180 – 300
			Ammonical Nitrogen	129 – 146
			Nitrate	74 – 181
			Phosphate	0.4 – 2.1
			TDS	1228 – 1440
			TSS	43 – 65.43
4.	A Study on Characterization & Treatment of Laundry Effluent By Prof Dr K N Sheth Mittal Patel	2017	Temperature	30 – 34
			pH	7.88 – 10.32
			COD	376 – 910
			BOD	230 – 625
			SS	445 – 1550
			TDS	640 - 1455
			Oil & Grease	3 - 6

4. METHODOLOGY

Figure No. 1: Overall Methodology Process

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5. PHYSICO-CHEMICAL PARAMETERS OF WASHING MACHINE EFFLUENT

A. Case Study Details

Building Name	Akshar Estate
Address	Kathe Lane, Dwarka, Nasik
Total No of flats	16
Number of Flats Taken for Study	10
Data Collection Period	March – April 2019

B. Case Study Location

Nashik (formerly Gulshanabad) is an ancient holy city in the northwest region of Maharashtra in India. Situated on the banks of Godavari River (Ganges of the South) and located about 190 km north of state capital Mumbai. The latitude and longitude of study area is 19°80'69" and 73°77 '69 ".
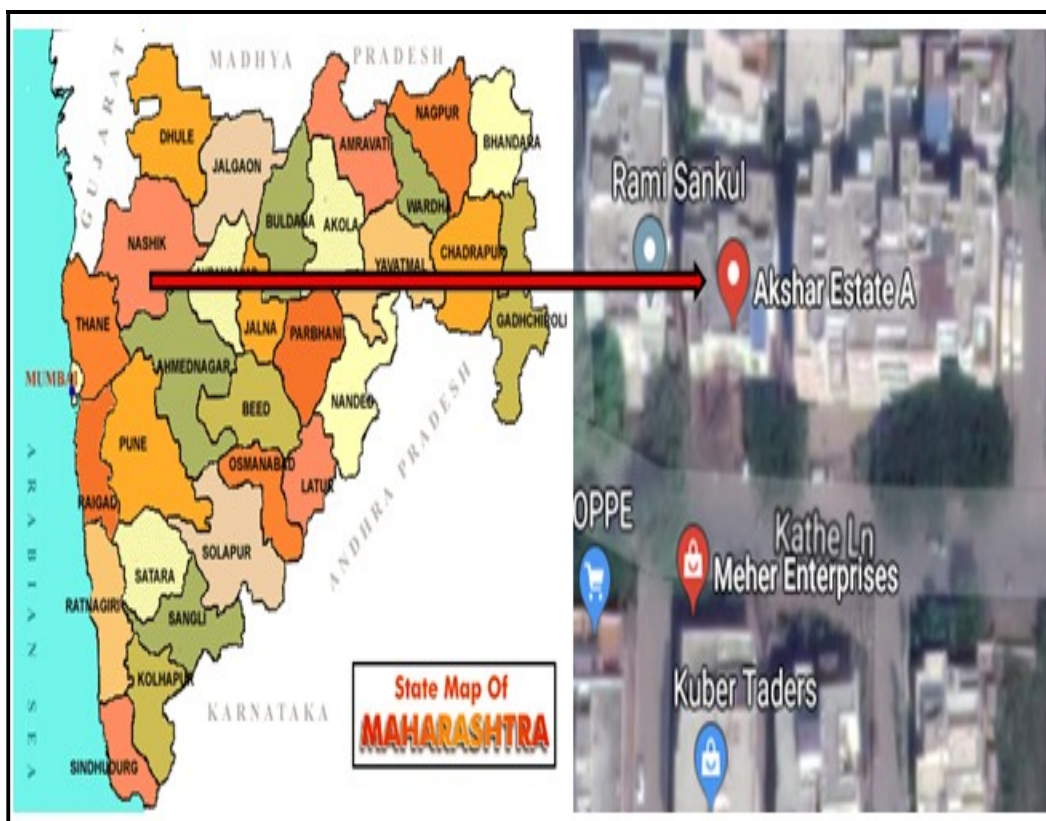

Figure No. 2: Showing Map of Maharashtra & Study Area

C. Case Study Survey

Table No. 2: Data Collected from Survey

Sr. No.	Type of Washing Machine	Capacity	Approximate Water Required	Process of Cleaning
1.	Fully Automatic	11	130	Wash + Rinse + Power Spin
2.	Fully Automatic Fuzzy Logic	6.5	80	Air dry + Inlets + Temp.+ Water + Wash + Rinse + Spin + Delay
3.	Semi-Automatic	7	90	Wash + Rinse + Spin
4.	Semi-Automatic	6	75	Wash + Rinse + Spin
5.	Fully Automatic	6.5	80	Wash + Rinse + Spin + Air Dry + Program
6.	Fully Automatic	7.5	100	Active Wash + Wash + Rinse + Power Spin
7.	Fully Automatic	6.5	80	Soak + Wash + Rinse + Spin
8.	Fully Automatic	6.2	80	Water + Wash + Rinse + Spin + Air Dry + Program
9.	Fully Automatic	6	85	Soak + Wash + Rinse + Spin
10.	Semi-Automatic	8.5	110	Wash + Rinse + Spin

Figure No. 3: Photos While Carrying Out the Survey

D. Method Adopted for Analysis

All the water quality parameters studied in the project are specified with the method used to determine the parameters are mentioned in below Table.

Table No. 3: Physico-chemical Parameters and Methods Adopted for the Analysis

Sr. No.	Analysis Parameters	Method used
01	pH	pH meter, IS: 3025 (part – 11 – 2): Reaff. 2012
02	COD	IS: 3025 (part – 58): Reaff. 2014
03	BOD	IS: 3025 (part – 44): Reaff. 2014
04	Oil and Grease	IS: 3025 (part – 39- 5): Reaff. 2014
05	Turbidity	Nephelometer, IS: 3025 (part – 10): Reaff. 2012
06	Conductivity	Conductivity meter IS: 3025 (part – 14): Reaff. 2013
07	Total Dissolved Solids	Gravimetric Metrhod, IS: 3025 (part – 16): Reaff. 2012
08	Total Hardness	Titrimetric Method, IS: 3025 (part – 21- 2): Reaff. 2014
09	Calcium	Titrimetric Method, IS: 3025 (part – 40- 5): Reaff. 2014
10	Magnesium	Titrimetric Method, IS: 3025 (part – 46- 6): Reaff. 2014
11	Total Alkalinity	Titrimetric Method IS: 3025 (part – 23): Reaff. 2014
12	Sulphate	Spectrometer IS: 3025 (part – 24- 4): Reaff. 2014
13	Iron	Spectrometer IS: 3025 (part – 53- 6): Reaff. 2014
14	Lead	Atomic Absorption, APHA 3111 - D
15	Zinc	Atomic Absorption, APHA 3111 - D
16	Dissolved Oxygen	Atomic Absorption IS: 3025 (part – 44): Reaff. 2003
17	Nitrate	IS 3025 (Part 34): Reaff. 2014

E. Analysis of Physico-chemical Parameters

The sample analyses of the collected effluent from the ten households are represented in to the tabular form in following section.

Table No. 4: Physico-chemical analysis of Effluent of Case Study Area

Sr. No.	Analysis Parameters	Mean
1	pH	9.1
2	COD	1543.0
3	BOD	183.1
4	Oil and Grease	2.5
5	Turbidity	107.5
6	Conductivity	640.4
7	TDS	708.5
8	Total Hardness	612.0
9	Calcium	4.1
10	Magnesium	1.3
11	Total Alkalinity	37.1
12	Sulphate	25.7
13	Iron	0.8
14	Lead	<0.003
15	Zinc	<0.01
16	Dissolved Oxygen	ND
17	Nitrate	0.2

F. Physicochemical Parameters Compared with the Standards

The physicochemical composition of washing machine effluent samples was statistically analysed between march 2019 to April 2019 and the results are presented in the form of acceptability or class of the parameter based on Water recycle/reuse standards based on protection of human health and the environment and suitability for the intended reuse application in below section.

Table No. 5: Washing machine Quality Classification based on Recycle/Reuse Standards

Sr. No.	Analysis Parameters	Mean Value	Acceptability
01	pH	9.1	Above the permissible limit
02	COD	1543.0	Above the permissible limit
03	BOD	183.1	Above the permissible limit
04	Oil and Grease	2.5	Doubtful
05	Turbidity	107.5	Above the permissible limit
06	Conductivity	640.4	Doubtful
07	TDS	708.5	Within Permissible limit
08	Total Hardness	612.0	Above the permissible limit
09	Calcium	4.1	Within Permissible limit
10	Magnesium	1.3	Within Permissible limit
11	Total Alkalinity	37.1	Doubtful
12	Sulphate	25.7	Within Permissible limit
13	Iron	0.8	Within Permissible limit
14	Lead	<0.003	Within Permissible limit
15	Zinc	<0.01	Within Permissible limit
16	Dissolved Oxygen	ND	Insufficient to be in permissible limit
17	Nitrate	0.2	Within Permissible limit

6. CONCLUSION

The characteristics of domestic washing machine wastewater were evaluated using wastewater samples from ten selected households of study area. The samples were analysed for the physical and chemical characteristics of the water. The parameters examined were: pH, Turbidity, TDS, COD, BOD, Oil & Grease, Conductivity, Total Hardness, Calcium, Magnesium, Alkanity, Sulphate, Iron, Lead, Zinc, DO and Nitrate.

The research showed that the quality of grey water with respect to COD, BOD, TDS, turbidity and total hardness requires adequate treatment prior to household reuse. With regard to the trace and heavy metal contents, no further treatment is required.

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