Analytical Study and Survey Responses of Kitchen Waste Water of Residential Buildings in Western Pune

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Abstract- This study aims to discern the domestic grey water (GW) sources that is least polluting, at the urban households of India, by examining the GW characteristics, comparing with literature data, reuse standards and suitable treatment technologies. In view of this, the quantitative and qualitative characteristics of domestic GW originating from bath, wash basin, laundry and kitchen sources are determined and compared with established standards for reuse requirements. Quality of different grey water sources is characterized with respect to the physical, chemical, biological, nutrient, ground element and heavy metal properties. The pollutant loads indicate that the diversion techniques are not suitable for household application and, therefore, treatment is necessary prior to storage and reuse. It is observed that the total volume of GW generated exceeds the reuse requirement for suggested reuse such as for flushing and gardening/irrigation. In spite of generating less volume, the kitchen source is found to be the major contributor for most of the pollutant load and, therefore, not recommended to be considered for treatment. It is concluded that treatment of GW from bathroom source alone is sufficient to meet the onsite reuse requirements and thereby significantly reduce the potable water consumption by 28.5 %. In this report physio-chemical parameters pH, turbidity, TDS, BOD, COD, Oil and Grease Conductivity, Sulphate, Phosphorous, Nitrate, Dissolved oxygen, alkalinity, of kitchen waste water has been examined to study the scope of reuse of the same.

Keywords: - Gray water (GW), Kitchen waste, physio-chemical parameters and Analysis.

I. INTRODUCTION

One of the most pressing problems of today is water scarcity. It has been estimated that one in three persons will face water scarcity by the year 2025 in India or around 2.7 billion people worldwide by the same time. 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. In addition, GW from kitchen sources is considered to be less favorable for reuse due to its high concentration of pollutant load. This study deals with the characterization of GW to better understand the physical, chemical, microbial and nutrient composition of GW from Indian households. The study also aims to explore various cost-effective treatment options available for point source treatment and reuse. Of all sources, Kitchen GW is considered to be the most contaminated with contaminants such as food particles, oil and grease. It accounts for around 10 % of total GW and is even not considered as GW by some and should be treated using appropriate technology prior to reuse.

The grey water from kitchen and dishwasher should be excluded as they contribute nearly 50 % of its COD requirement. In addition, GW from kitchen sources is considered to be less favorable for reuse due to its high concentration of pollutant load. This study deals with the characterization of GW to better understand the physical, chemical, microbial and nutrient composition of GW from Indian households.

1.1 Need of Present Study

In general, grey water means waste water generated from domestic activities such as bath, hand basins, washing machines, dishwashing, laundry & kitchen. It does not waste water from toilet. It is considered to be the largest potential source of water reuse option at point source, accounting for around 50-80 % of the total water use. Following are the points which formulated the need of present study.

• Wastewater management is a significant and growing problem, especially in urban areas of both the developed and developing world.

• The available fresh water sources are dwindling and are getting scarce.

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• Increase in fresh water pollution due to human activities.

• Increase in health hazards and ecosystem damage due to uncontrolled discharge of wastewater into streams and oceans.

• The inefficient or ineffective system of wastewater treatment in developing countries.

II. AIM & OBJECTIVE

A. Aim: - To determine the quantitative and qualitative characteristics of Kitchen GW and to compare with established standards for reuse requirements.

B. Objectives: -

- To understand the characteristics of the grey water generated from kitchen
- To analysis the essential physical, chemical and biological properties and parameters of raw grey water and treated grey water
- To separate out solids content, oil content from kitchen GW.
- To suggest an economical treatment for kitchen waste water
- Properly treated grey water can be used potentially for irrigation, toilet flushing and various types of cleaning purpose.
- To check the usefulness of kitchen waste water.

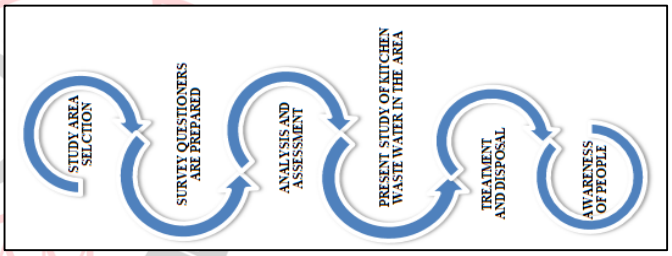
III. LITERATURE REVIEW

An extensive literature review provides background information on current knowledge related to the research topic. Prior to the study of design and development of treatment system and scope to reuse the kitchen waste water, study of various physio-chemical parameters of kitchen waste water and topics related to the kitchen waste water management technique were studied in detail. This literature review is used in support development of the research objectives and the methodologies used to test those objectives.

Table No.1: Characteristics of Kitchen waste water from Literature

Sr. No.	Title of paper and name of author	Year of Publication	Remarks	
			Characteristics of laundry effluent	Value
1.	Commercial Laundry Water Charaterization by J.K.Braga and M.B.A.Varesha	2014	pH	5.6
			Total Alkalinity	25.9
			COD	1710
			TSS	80
			Nitrate	8.4
			Nitrite	2.1
			Sulphade	21.1
			Sulphide	0.2
2.	Characterization of domestic grey 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
			BOD5	186.5
			COD	1545.8
			DO	N.D
			TS	586
			TSS	141.2
			Nitrate	0.3
			Nitrite	0.2
3.	Study of physio-chemical characteristics of domestic waste water in Vishnupuri, Nanded, India by Sonune NA et. al	2015	pH	7-8
			COD	180-300
			BOD	56-96
			Nitrate	74-181
			Phosphate	0.4-2.1
			TDS	1228-1440
			TSS	43-65.43
			Temperature	30-34
4.	Assessment of kitchen wastewater quality for irrigation by, Rijwana Parwin et.al	2020	pH	6.43
			TSS	2353
			TDS	3652
			Electrical Conductivity	5450.75
			Sulfate	1245.59
			DO	3.31
			BOD	698.46
			Phosphate	1.29

IV. METHODOLOGY



A. Parameters to be considered from KWW

It is very essential and important to test the effluent of kitchen waste water to decide the best suitable approach for the treatment of waste water from kitchen before it is reused for gardening, car washing, flushing of toilet purpose.
Water must be tested with different physio- chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we are going to use that water and what extent we need its quality and purity.

The characteristics indicate high variability in the physical, chemical, biological parameters among the different sources. The GW from kitchen sources contribute to over half of all pollutant load.

B. Case Study Survey

1. Objective of Survey:

The main purpose of this survey is to study the average water consumed by persons daily in kitchen, Types of food they consume, No. of persons in family, type of dishwashing

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detergent they use, kitchen effluent collection and its analysis.

2. **Parameters of physio-chemical assessment:**
   - Physical test of Temperature, TDS.
   - Chemical tests of pH, DO BOD, COD, Oil and Grease, Electrical conductivity, Total alkalinity, Sulphate, Phosphorous, Nitrate etc.
3. **Type of survey:** Open ended Questions.
4. **Participants in Survey:**
   Participants from different area of Pune are allowed for this survey.
5. **Framework for survey:**
   - To carry out the assessment in smooth and effective way the questionnaire is divided into technical specification about kitchen water and waste water.
   - In no case more than one participant are surveyed at the time to reduce the possibility of influencing the response.
   - Prior appointment has been taken from respective participants.

C. Survey Questionnaire: -

We prepared a survey questionnaire related to our topic kitchen grey water and took responses from almost 200+ people. The questions are as followed:

Q.1) Area.

Purpose: To select the area for sample collection.

Q.2) Select Food Category.

Purpose: To know the quality parameters from food waste.

Q.3) If Non-vegetarian, select frequency.

Purpose: To know the quantity and quality parameters from food waste.

Q.4) Select Frequency for Outdoor Food parcel at home.

Purpose: To know the quantity of water for daily consumption in kitchen.

Q.5) Outdoor Hoteling frequency for food.

Q.6) Select Breakfast Frequency.

Q.7) Mention your type of Breakfast.

Q.8) How do you clean your utensils after use?

Q.9) Mention which type of detergent or soap you use.

Purpose: To know the surfactants present in detergent.

Q.10) Location to clean utensils.

Q.11) No. of times you clean the utensils in a day.

Purpose: To know the quantity of water for daily consumption in kitchen for reuse purpose.

Q.12) Where do you dump your kitchen waste.

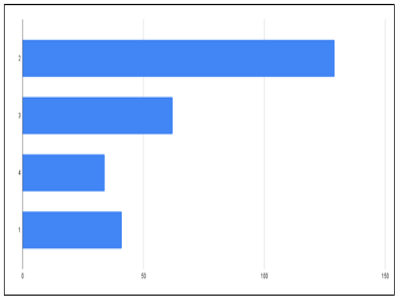
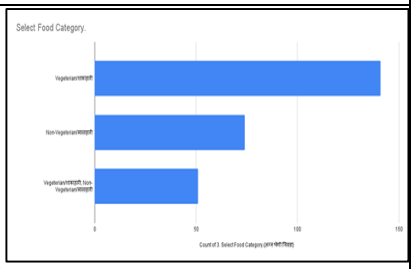
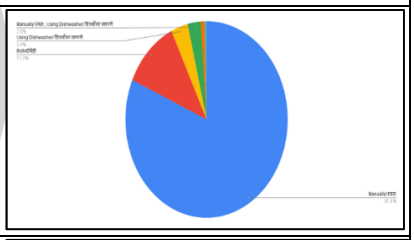
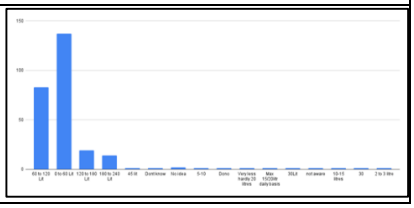
Q.13) What do you use to clean up your drain pipe & frequency of cleaning.

Q.14) How much water you daily flush in kitchen sink.

Purpose: To know the quantity of water for daily consumption in kitchen for reuse purpose.

Q.15) What is the disposal system.

D. Analysis and Assessment

Sr. No.	Assessment parameter	Collected Responses
1	No. of times you clean the utensils in a day.	
2	Food Category	
3	How do you clean your utensils after use?	
4	How much water you daily flush in kitchen sink?	

E. METHOD

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

Table N0.3: Physio-chemical Parameters & Methods to be used for the Analysis: -

Sr. No.	Analysis Parameter	Method Used
1	pH	pH meter, IS:3025 (part-11-2): Reaff.2012
2	COD	IS:3025 (part-58): Reaff.2014
3	BOD	IS3025 (part-44): Reaff.2014

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4	Oil and Grease	IS:3025 (part-39-5): Reaff.2014
5	Surfactant	APHA 23rd Edition,5540 C
6	Conductivity	Conductivity meter IS:3025 (part-14): Reaff.2013
7	Total Dissolved Solids	Gravimetric Method, IS:3025 (part-16): Reaff.2012
8	Total Suspended Solids	IS 3025(part17)
9	Total Alkalinity	Titrimetric method, IS:3025 (part-23): Reaff.2014
10	Sulphate	Spectrometer IS:3025 (part-24-4): Reaff.2014
11	Dissolved Oxygen	Atomic Absorption IS:3025 (part-44): Reaff.2003
12	Total Nitrogen	APHA 23rd Edition,4500-N A
13	Phosphorous	APHA 23rd Edition,4500-P D

[1] Sampling

Waste water samples were collected from three different households of case study area in Pune. Kitchen waste water collected from kitchen sink in the month of March to April 2021 according to standard procedures. A composite sample from kitchen sink were collected at 3 different timings, after breakfast, lunch & dinner. Approximately 1.5ltr of composite sample was collected in an airtight plastic bottle as shown in picture.

[2] Analysis of Physio-chemical Parameters

The physio-chemical composition of kitchen waste water was statistically analyzed & presented in below section.

Sample collection from case study location

Table No.4: Physio-chemical analysis of effluent from case study Area.

Sr No.	Analysis Parameters	Unit	Samples			Mean
			S-1	S-2	S-3	
1	pH	mg/l	6.8	6.4	5.1	**6.1**
2	Total Suspended solids	mg/l	1900	1630	172	**1234**
3	Total Dissolved Solids	mg/l	484	1364	326	**724.66**
4	Dissolved Oxygen	mg/l	0	0	2.7	**0.9**
5	BOD_3 at 27^0C	mg/l	2100	3360	375	**1945**
6	COD	mg/l	5304	10404	856.8	**5521.6**
7	Total Alkalinity (as $CaCO_3$)	mg/l	19.2	0.3	38.4	**19.3**
8	Total Nitrogen (as N)	mg/l	30.61	18.37	14.18	**21.05**
9	Phosphorous (as P)	mg/l	8.7	5.31	0.30	**4.77**
10	Sulphates (as SO_4)	mg/l	4.6	2.42	2.04	**3.02**
11	Electrical Conductivity	µmhos/cm	786	2080	470	**1112**
12	Oil & Grease	mg/l	422	464	76	**320.66**
13	Surfactants	mg/l	5.3	11.96	10.87	**9.37**

[3] Physio-Chemical Parameters of kitchen waste water compared with the Standards

The physio-chemical composition of kitchen waste water sample was statistically analyzed in May 2021 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 environment and suitability for the intended reuse application in below section.

Table No. 5: Kitchen waste water Quality classification based on recycle / Reuse Standards

Sr. No.	Analysis Parameters	Reuse Range	Mean Value	Acceptability
1	pH	6.5-8.4	**6.1**	Within permissible Limit
2	Total Suspended solids	NA	**1234**	Doubtful
3	Total Dissolved Solids	450-2000	**724.66**	Within permissible Limit
4	Dissolved Oxygen	> 0.5	**0.9**	Within permissible Limit
5	BOD_3 at 27^0C	30	**1945**	Above permissible Limit
6	COD	200	**5521.6**	Above permissible Limit
7	Total Alkalinity (as $CaCO_3$)	NS	**19.3**	Doubtful
8	Total Nitrogen (as N)	NA	**21.05**	Doubtful
9	Phosphorous (as P)	NA	**4.77**	Doubtful
10	Sulphates (as SO_4)	500-1000	**3.02**	Within permissible Limit
11	Electrical Conductivity	700-3000	**1112**	Within permissible Limit
12	Oil & Grease	NS	**320.66**	Insufficient to be in permissible Limit
13	Surfactants	NA	**9.37**	Doubtful

#Reuse:- with special reference to irrigation purpose only.

V. AWARENESS OF PEOPLE

While we are washing our hands regularly to stay safe from the coronavirus pandemic, we cannot afford to take water for granted by leaving taps on for the 20-seconds cleansing routine. And since you are now spending a lot more time indoors, how about looking at setting up a grey water system at home? Approximately 50-70% of the water used in your house results in grey water generation and not even 5% of this is recycled in urban households. This water is suitable

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for in recycling using simple low-cost technologies and it is rather unfortunate that the concept is not commonplace in a water starved country like India. During the last few years, the awareness about the importance of kitchen waste management has grown substantially. Commercial kitchens in particular are expected to play a significant role in this regard as they produce a large volume of waste and by-products, many of which are not biodegradable. That's why systematic planning and management of Kitchen waste along with their recycling and reuse is a burning topic among environmentalists. In this post, we highlight some of the key areas related to waste management and recycling in commercial kitchens such as in hotels and restaurants.

VI. CONCLUSION

From this study, it can be concluded that there is an urgent need for more information about characteristics of kitchen wastewater. The main focus of this project is on characterization of kitchen waste water, the harmful impact of KWW on the environment, and its applications in different areas. The results obtained after analytical methods will be compared within higher or lower values. The characteristics of domestic kitchen waste water were evaluated using kitchen sink water from different household of study area. The samples were analyzed for physio-chemical characteristics of water. The parameters examined were pH, TSS, TDS, DO, BOD, COD, Total alkalinity, Total Nitrogen, Phosphorous, Sulphates, Electrical conductivity, Total Oil and grease and surfactants, The research showed that the quality of grey water with respect to BOD, COD, Oil and grease, surfactants require adequate treatment prior to household reuse. With regard to pH, TDS, DO, Sulphates and electrical conductivity, no further treatment is required. Kitchen waste water (KWW) a type of grey wastewater has garnered significant attention because of organic pollutants and oil and grease. It has hazardous effects on the environment, such as eutrophication in water bodies and choking of pipes in the sewer system. Stagnant kitchen waste water invites serious diseases like malaria, filarial, and dengue. So, the point source treatment and reuse are considered favorable as it not only enables the treatment of KWW as soon as it is generated, but also it reduces the load on the centralized treatment facility supported by the local municipalities. The present water crisis demands the reuse of KWW for non-potable purposes. Reuse of KWW will be helpful for integrated water management. Also reuse of KWW in various fields helps to convert its zero value to a valuable resource. Further exploration of KWW is required for determining its sustainable uses.

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