Treatment of Residential Grey Water for Recycling

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Abstract: This study is aimed to evaluate the characteristics of grey water in "Manglam City" Sirsi Road, Jaipur. The grey water was collected from different locations in the campus. The grey water sources included kitchen water, laundry water, bath water; wash basin water and composite water i.e. mixture of all kitchen, laundry, bath and wash basin water.

Looking at the depleting ground water table, there is no option left but to find out the other sources of water. Waste water reuse can find out the solution in this global problem.

Keywords: Waste Water, Grey Water, BOD, COD

I. INTRODUCTION

Amount of wastewater generated by any household will vary according to the dynamics of the household and is influenced by the factors such as no. of occupants, age of occupants, their life style and water use pattern .

For Indian Conditions IS: 1172-1957 recommends a per capita per day water consumption which is 135 litres per day per capita.

Table 1 gives the breakup of water consumption per day per capita for domestic purposes and which forms 50% of the total water requirements per head per day, for all categories of water requirements i.e. residential, domestic, institutional, public use, or civil use and water system losses (Punmia and Jain 1995)

Table 1: Breakup of water consumption per day per capita

S no	Description	Amount of water per head
1.	Bathing	55
2.	Washing of clothes	20
3.	Flushing of W.C.	30
4.	Washing house	10
5.	Washing utensils	10
6.	Cooking	5
7.	Drinking	5
	Total	135 litres

1.1 Difference between Grey water and Black water:

Grey water makes up the majority of waste water, accounting for around 65 cubic meters per person every year. Grey water is mildly polluted and simple to filter on the spot. It's great for watering plants if it's not contaminated with hazardous detergents.

The toilet flush is black water. It has a low daily capacity of roughly 50 litres. This water, which is around 1.5 litres in volume, contains human pee and faces. The majority of nutrients are found in urine (67 percent of the phosphorus, and about 90 percent on the nitrogen). We can acquire the same nutrient concentration as the benchmark in plant growth research labs by mixing urine with water in a 1:12 ratio. Pathogens (disease-causing organisms) can only be discovered in the faces.. Although the content is quite high, only 33% of the phosphorus and 10% of the nitrogen are present in the faces. When urine and faces are mixed together, the bacterial load of the faces produces a foul odour practically instantly. Grey water decomposes much faster than black water, resulting in better water pollution prevention. ODEH (Office of the Director of the Environment and Heritage. (ODEH 2003*)*

1.2 Grey water Quality:

1. The properties of Greywater produced by a household will vary depending on the number of people living there, their age, lifestyle, health state, and water usage patterns. There are three distinct types of grey water streams: 1. Bathroom Greywater contributes roughly 55% of total Greywater volume. Hair, soaps, shampoos, hair colors, toothpaste, body lipids, oils, and cleaning items can all pollute bathroom grey water. Through body washing, it has some fecal contamination (bacteria and viruses).

2. Laundry grey water accounts for approximately 34% of total grey water volume. The quality of laundry waste water ranges from wash water to rinse water to second rinse water. Fecal contamination, oils, greases, chemicals, soaps, nutrients, and other contaminants can all be found in laundry grey water.

3. Kitchen grey water accounts for roughly 11% of overall grey water volume. Food particles, cooking oils, grease, detergents, and other cleaning water, such as dishwashing powders, are all significantly polluted in kitchen grey water. Detergents and cleaning products may be alkaline, and they may contain chemicals that affect soil structure, plants, and ground water. Solid food particles and lipids can harden and be difficult for soil organisms to break down, causing a bottleneck in the land application system. It also has the potential to make the soil water-repellent. Kitchen waste water may not be suitable for reuse in all types of grey water systems as a result of this.

Table 2 - Typical Composition of waste water compared to raw sewage

Parameter	unit	Grey water		Raw sewage
		Range	Mean	
Suspended Solids	mg/l	45-330	115	100-500
Turbidity	NTU	22->200	100	NA
BODS	mg/l	90-290	160	100-500
Nitrite	mg/l	<0.1-0.8	0.3	1-10
Ammonia	mg/l	<1.0-25.4	5.3	10-30
Total Phosphorus	mg/l	0.6-27.3	12	5-30
Sulphate	mg/l	7.9-110	8	25-100
p		6.6-8.7	357.5	6.5-8.5
Conductivity	mS/cm	325-1140	600	300-800
Hardness(Ca &Mg)	mg/l	15-55	45	200-700
Sodium	mg/l	29-230	70	70-300

1.3 Use of Grey Water:

Grey water, after being properly treated, can be utilised for a variety of things, including irrigation and urinal flushing. Greywater is repurposed for two purposes:

1. Reduce the amount of freshwater required.
2. Reduce the amount of sewage produced.

Irrigation and toilet flushing are two examples of typical use.

Table 3: Uses of Grey water

Use of grey water	
Individual households	Toilet Flushing
School	Floor Cleaning
Government/non government office	Irrigation
Hospital	Gardening
Theatre	Car washing
Hotel	Construction
Airport	
Railway Station	
Apartment/colony	

II. MATERIALS AND METHODS

The indistinct water was gathered from private pinnacles of Mangalam city Sirsi street, Jaipur. Sand channel model was created by involving materials as follow:
Two baffle sheet 30*30 cm bowls as beading repositories, Floating ball for controlling stream, delta and outlet pipes, GI sheet Drum ,Plastic cross section, Perforated line, Sand as channel media, Gravels, M seal cement ,Sieves of size (in mm) 0.045, 0.075, 0.09. 0.15, 0.3, 0.6, 1.18, 2.36, 4.75, 20, 40, 63.

2.1 Treatment Technology Used:

Subsequent to doing the different enhancement study on concluding the profundity of channel media we picked the channel box of tallness 0.50 m and measurement 0.43 m. The determinations for the planned sand channel are:

1. Filter Unit: The channel unit was created utilizing 2mm galvanized iron sheets. The sheet was welded to frame an empty chamber with an inside width of 43 cm. M seal glue was utilized to stay away from spillages. Its aspects were 0.50 m stature and 0.43 m measurement and it was made sure that there were no holes by filling it with water.

2. Filter Media: Sand which filled in as channel media was appropriately washed and cleaned before it was placed in the channel. The sand was acquired locally and it was sieved to get a media with required sand size. The size of the sand is estimated and communicated by the term called viable size. The powerful size, for example D10 might be characterized as the size of the strainer in mm through which then percent of the example of sand by weight will pass. The consistency in size or level of varieties in sizes of particles is estimated and communicated by the term called consistency coefficient, for example (D60/D10) might be characterized as the proportion of the sifter size in mm through which 60% of the example of sand will pass, to the successful size of the said. Sand of compelling size 0.2 mm and uniform coefficient 2.5 was utilized.

3. Base Material: Gravels were utilized as base layer. The layers of sand might be upheld on rock, which allows the separated water to move unreservedly to the under channels. The supporting rock was cleaned out and set in three layers. The rock base was reviewed and laid in layers of 0.023 m with highest layer of better size and base layer of coarse size. The profundity and size conveyance of each layer is given in Table 3.2.Table

4. Base material specifications (depth and size)

Layers	Depth	Size
Topmost Layer (I)	.023 m	2 TO 4.75 mm
Intermediate Layer (II)	.023 m	4.75 to 40 mm
Bottom Layer (III)	.023 m	40 TO 63 mm

2.2 Process Description

In first taking care of supply (F1) the example was put. From this F1 tank, an outlet pipe was associated with second tank (F2) through drifting ball valve. This drifting ball was utilized to keep up with the head in F2 bowl. From F2 bowl the example was ship off channel unit (drum). On the highest point of channel Unit punctured plate was fixed so the sand layer wasn't upset with the immediate progression of water. Through this it was likewise guaranteed that the schmutzdecke was not upset by the disturbance of water. For the under waste framework, punctured line was utilized. This punctured line was associated with the power source pipe for test assortment. Tests were gathered day by day from the bay and outlet.

The line diagram of the process has been described in Figure

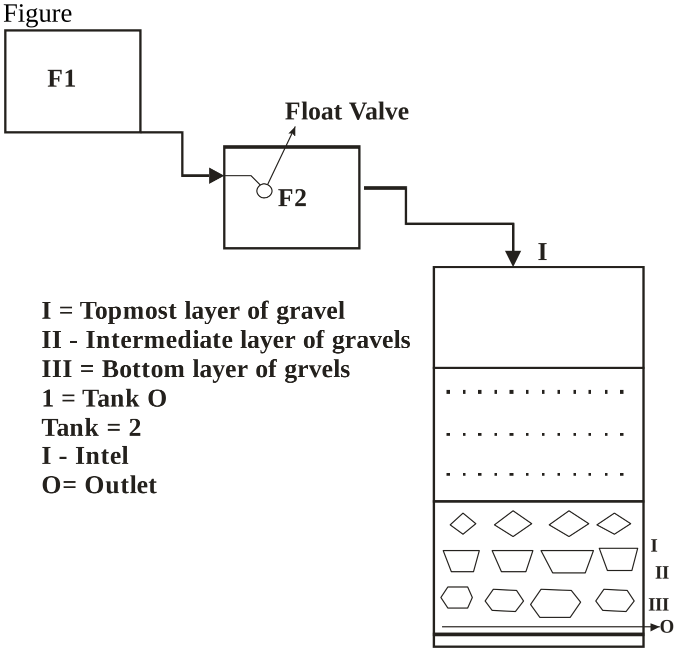

Fig 1: Line Diagram Showing Process flow

In the first place, with all the power source valves shut, the channel was accused of clean water, acquainted from the base with a degree of around 10 cm over the sand bed. This was done to drive out the air rises from the channel bed; then, at that point, the inflow was begun.

III. RESULTS AND DISCUSSION

Location : 1 Tower First (A)
Location : 2 Tower First (B)
Location : 3 Tower First (C)

From the previously mentioned areas tests of kitchen water, clothing water, shower water, wash bowl water and composite water were investigated. Table 5 to Table 9 records out the qualities of various wellsprings of dark water. Table 10 shows the research center investigation of various boundaries complete alkalinity, chloride, hardness, turbidity, nitrate, BOD, COD, TSS, TDS, pH for influent and gushing examples.

3.1 Characteristics of Grey Water

The indistinct water from kitchen, clothing, shower, wash bowl and composite for example containing combination of kitchen water, clothing water, shower water and wash bowl water were subjectively dissected for various physical and compound boundaries like alkalinity, chloride, hardness, turbidity, nitrate, BOD, COD, TSS, TDS and pH. The aftereffects of the investigation are given in Table10

Table 5: Characteristics of Kitchen Water

Parameters (mg/I)	S1	S2	S3	S4	S5	S6	S7
Alkalinity	248	192	250	252	182	185	220
Chloride	27.99	29.69	30.59	32.39	25.69	27.9	28.84
hardness	196	200	210	220	190	182	198
Turbidity	27	25	21	24	20	18	26
Nitrate	31.33	30.33	35.33	35.23	29.9	38.7	30.83
BOD	200	190	220	230	225	180	195
COD	266.1	262.15	260.1	259.2	269.7	265.3	264.2
TDS	540	440	445	450	460	510	490

TSS	2.22	1.8	1.2	1.5	2.1	1.3	2.01
pH	7.6	7.9	7.8	7.9	7.8	7.6	7.7

The alkalinity in the kitchen water range from 180 to 255 mg/1 and might be available because of the utilization of various cleansers and cleaning items. Kitchen water is principally dirtied by the suspended solids which are contributed by the presence of food particles. These strong food particles must be screened out prior to utilizing the treatment cycle.

Table 6: Characteristics of Laundry Water

Parameters (mg/I)	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
Alkalinity	952	672	892	670	652	750	812
Chloride	39.69	26.99	29.90	27.9	35.4	30.39	33.34
hardness	400	320	350	320	360	410	360
Turbidity	54	53	50	54	56	59	53
Nitrate	63.5	70.33	69.93	60.3	65.3	70.6	66.9
BOD	310	320	290	300	330	300	315
COD	555.4	575.2	515.2	525.9	495.8	560.2	565.3
TDS	4260	4290	4340	4341	4239	4210	4275
TSS	2.17	3.5	3.9	3.2	3.6	2.9	2.835
pH	8.1	7.9	7.8	8.2	7.9	7.6	8.0

The alkalinity in the laundry water showed high variations from sample to sample because the wastewater from the laundry varies in quality from wash water to rinse water to second rinse water. The values ranged from 650 to 9555 mg/1. It is also found that the nitrate concentration and hardness are also high in laundry water due to the use of detergents. The nitrate values ranged from 60 to 71 mg/1 whereas hardness values ranged from 300 to 410 mg/1. The turbidity values ranged from 50 to 60 ppm. There was also a sharp increase in the values of dissolved solids. the values ranged from 4210 to 4340 ppm

Table 7 : Characteristics of Bath Water

Parameters (mg/I)	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
Alkalinity	300	260	272	250	255.4	262	280
Chloride	61.82	67.90	61.82	69.3	52.3	49.9	64.86
hardness	176	190	175	176	192	188	183
Turbidity	48	35	42	45	49	47	42
Nitrate	59.30	60.30	59.30	51.4	50.8	61.7	59.8
BOD	210	230	250	200	240	200	220
COD	301.1	290.1	300.19	299.4	295.76	310.65	295.6
TDS	354	320	335	350	365	355	337
TSS	1.1	3.45	1.15	1.12	2.13	2.15	2.275
pH	8.2	8.1	7.9	8.1	8.1	7.9	8.1

Bath water is mainly contaminated by suspended particles due to the presence of skin, lint or other similar particles. The nitrate values ranged from 50 to 62 mg/1. Soap and detergents residue were also found in the bath water. There was a sharp increase in the pH value of bath water. It ranged from 7.9 to 8.2. The COD values ranged from 290 to 310 mg/1 whereas the BOD values ranged from 200 to 250 mg/1.

Table 8: Characteristics of Wash Basin Water

Parameters (mg/I)	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
Alkalinity	260	250	210	215.5	262	202	255
Chloride	31.99	27.99	32.99	35.7	37.8	42.9	29.99
hardness	196	180	190	182	195.4	186	188
Turbidity	35	35	39	30	30	40	35
Nitrate	40.33	35.33	29.43	25	27.6	39.32	37.83
BOD	290	300	300	310	305	315	295
COD	501.8	515.1	525.17	500.15	530.9	545.45	508.4
TDS	540	540	525	545	550	563	575

TSS	2.8	2.9	3.1	3.2	2.9	2.9	2.85
pH	7.5	7.4	7.5	7.6	7.6	7.5	7.4

The alkalinity values in the wash basin ranged from 200 to 262 mg/1 whereas the chloride values ranged from 27 to 43 mg/1. Wash basin water was found to be mainly contaminated by toothpastes, cleaning products, lint, and soaps. The dissolved solids ranged from 525 to 575 ppm and the suspended solids ranged from 2.8 to 3.1 ppm.

Table 9: Characteristics of Composite Water

Parameters (mg/I)	S1	S2	S3	S4	S5	S6	S7
Alkalinity	332	295	335	280	285	282	313.5
Chloride	47.32	51.46	41.35	40.3	37.9	42.3	49.41
hardness	188	180	175	175	190	210	184
Turbidity	75	82	74	70	69	80	79
Nitrate	59.84	52.24	48.45	50.1	54.8	60.2	56.34
BOD	190	175	210	195	200	190	182.5
COD	382.6	412.3	391.4	401.54	400.54	420.75	397.45
TDS	720	690	790	790	785	764	705
TSS	.89	1.2	.95	1.3	1.32	1.42	1.045
Ph	7.8	7.8	8.1	8.1	8.1	8.2	7.8

Composite sample was prepared by mixing different components of grey water like kitchen water, laundry water, bath water and wash basin water. The pH values in the composite water ranged from 7.8 to 8.2. The high variability of the composite grey water quality is due to factors such as water use efficiencies of appliances, individual habits, products used (soaps, shampoos, detergents) and other site specific characteristics.

3.2 SAND FILTER PERFORMANCE

The influent and the effluent samples from the sand filter were analyzed for different physical and chemical parameters like alkalinity, chloride, hardness, nitrate, turbidity, TSS, TDS, pH, BOD and COD. The results of the analysis are described in the following tables Table 10 shows the test results of laboratory analysis for total alkalinity for influent and effluent samples.

Table 10: Influent and Effluent Values for Total Alkalinity (mg/1)

Sample	Kitchen Water		laundry Water		Bath Water		Wash Basin Water		Composite Sample	
	Influent	Effluent	influent	Effluent	influent	effluent	Influent	effluent	influent	effluent
S1	248	198.4	952	522.56	300	246	260	219.72	332	289
S2	192	131.90	672	311.18	260	233.22	250	180.5	295	243.23
S3	250	160.25	892	489	272	219.77	210	170.1	335	269.9
S4	252	165.5	670	315.2	250	220.1	215.5	169	280	260
S5	182	129	652	305.2	255.4	218	262	215	285	259.4
S6	185	130.5	750	420	262	211.2	202	165.3	282	260
S7	220	165.15	812	416.87	280	239.61	255	200	313.5	266.1

IV. CONCLUSION

The exploratory work was completed effectively by gathering the examples from different areas of Mangalam City, Sirsi Road, Jaipur. Following are the different ends drawn from the review:

1. The creation of the sand model was one effectively and the spillages were checked by filling water.
2. Samples of kitchen water ,shower water, clothing water ,wash bowl water were gathered from various destinations from Mangalam City, Sirsi Road, Jaipur and were subjectively broke down for physical and compound boundaries. There was high variety in the nature of dark water because of elements, for example, water use efficiencies of machines, individual propensities, items utilized (cleanser, cleanser, cleansers) and other site explicit qualities.
3. It was observed that normal foreign substances in the kitchen water were suspended solids which are added because of the presence of food particles in the water. They must be

screened out before treatment to stay away from any blockage.

4. There was a high variety in convergence of alkalinity in clothing water on the grounds that the waste water from the clothing shifts in quality from wash water to flush water to second wash water. The nitrate fixation and broke down solids was additionally observed to be high in the clothing water.

5. Bath water and bowl water was chiefly polluted by suspended particles like soil, build up and hair. There was a sharp expansion in the pH esteem.

6. During the fundamental runs the filtrate got showed the irrelevant rate expulsion in toxins. This was because of the explanation that the channel was loaded up with the newly cleaned sand and consequently there was no organic layer created on the sand bed.

7. Turbidity, one of the main boundary to screen the presentation of the channel showed the most elevated level of evacuation in profluent. The expulsion rate went from 65-90 percent. There was a sharp expansion in expulsion percent as the hour of run of channel expanded.

It is observed that there is a little diminishing in the pH in the filtrate. This is presumably because of disintegration of Co2 because of natural movement in the top layer (schmutzdecke).

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