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Effect of various filtration media on grey water

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Abstract
The use of domestic grey water for irrigation, gardening, etc. is becoming more useful in the world to cope with the scarcity of water. The present study was carried out on the grey water of Jayaprabha girl's hostel of DBSKKV, Dapoli. In this study, various chemical and physical properties of grey water were calculated and then which were compared to standard characteristics of irrigation water. Grey water sample filtered through various filtration media which were easily available such as gravel, grit, sand and crushed brick at various depths such as 45cm, 30cm and 15 cm. Then results were analysed for each filtration media with depth of 45 cm, 30 cm and 15 cm for estimation of efficient filtration media and its efficient depth. Thus, study shows that for all filtration media the effective depth of layer was found as 45 cm.

Keywords: Greywater, filtration media, effective depth, chemical properties, water scarcity

Introduction
Water is important resources of a living object. The quantity and quality of water supplies pose a serious problem today in many regions of the world. The deterioration of water quality due to urbanization, land cover changes and contamination are also increasing water scarcity. India by 2025 it estimated that India will be face severe water scarcity, thus it faces a water crisis. According to Qureshi and Hanjra 2010, recently about 800 million people live under water stress and this no. will be reach 3 billion in 2025. Only 3.29 million km^2 occupies geographical area of India which forms 2.4 % of world's area [1]. Fresh water is the natural resource on which human activities, food security depends with its availability on the earth is only 3%.
Thus, by increasing demand of water there will be need to adoption of alternative and cost effective water resources such as reuse of grey water. Greywater is wastewater without any contributions from toilet water [2, 3]. It includes high potential for reuse and application with high volume. Thus the appropriate use of grey water from domestic sources can help in increasing demand of water for crop production, for garden washing and flushing purposes etc. In last 20 years mainly in arid and semi-arid regions observed that increase interest in use of these wastewaters in irrigation [4]. Thus the awareness about limitations of natural water resources, reuse of water is assumed to be great significance. In Israel, about 70 % of treated wastewater is reused for agriculture irrigation [5].
Grey water includes high variability in their chemical and physical quality estimated form household. It also consisting oils, fats, greases, salt and other products depends on used products of household. Thus it required to greywater treatment to reuse it. Filtration plays an important role in greywater treatment. So, in this investigation various filtration media with their effective depth was studied.

Materials and Method
The experiment was carried out on the grey water of Jayprabha girl's hostel of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Daily average grey water generation of hostel accommodating 350 girls was estimated to be 10000 litre per day. The locally available low cost filtration media used for study were gravel (10 – 30 mm), grit (6 – 8 mm), sand (4 – 6 mm) and crushed brick (10 – 20 mm).

Determination of the parameters of domestic grey water
Different parameters of grey water were calculated such as pH, Electrical conductivity (EC), Total Dissolved Solids (TDS), Potassium, Bicarbonate and carbonate, Calcium, Physical properties using standard procedures and compared with standard characteristics of irrigation water [6].

Results and discussions

Determination of properties of grey water

The analysis of grey water was done at the laboratory of department of Agriculture Chemistry and Soil Science, College of Agriculture and College of Forestry, Dapoli. The standard methods of determination of chemical properties of water were used. These properties are reported in the following table.

Table 1: Determination of pH before and after filtration of grey water

Filtration Media	pH		
	Depth of layer		
	45 (cm)	30 (cm)	15 (cm)
Gravel	6.14	6.26	6.34
Grit	6.32	6.42	6.53
Sand	7.10	7.16	7.23
Brick	6.20	6.31	6.51
Inlet Sample		6.27	
Permissible range for irrigation		1-14	

From Table 1 it observed that the values of all filtration media were within the permissible range of standard irrigation water quality. The maximum permissible value of pH obtained from sand filtration media i. e. 7.23 at 15 cm depth of layer. Also minimum value of pH obtained from gravel filtration media i. e. 6.14 at 45 cm depth of layer. In case of gravel and grit observed values were at 45 cm depth which near to the neutral values.

Greywater has potential to increase soil alkalinity if which used in garden for long period of time. If pH value of greywater higher than 8 can lead to increase soil pH and increase in pH reduce available micronutrients for plants [7]. Also when pH is above 9 it reduces the transpiration rate [8].

Table 2: Determination of EC before and after filtration of grey water

Filtration Media	EC (µS ppm^{-1})		
	Depth of layer		
	45 (cm)	30 (cm)	15 (cm)
Gravel	88.58	121.83	164.80
Grit	64.0	104.3	166.56
Sand	151.66	205.40	209.7
Brick	99.5	116.93	148.30
Inlet Sample		298.0	
Permissible range for irrigation		0-3000	

From Table 2 we observed that the values that the values of all filtration media were within the permissible range of standard irrigation water quality. The maximum value of EC obtained from sand filtration media i. e. 209.7µS cm^{-1} at 15 cm depth of layer. Also minimum permissible value of EC obtained from grit filtration media i. e. 64.0 7µS cm^{-1} at 45 cm depth of layer. In case of gravel and brick observed values at 45 cm depth which near to the permissible values.

Table 3: Determination of TDS before and after filtration of grey water

Filtration Media	TDS (mg l^{-1})		
	Depth of layer		
	45 (cm)	30 (cm)	15 (cm)
Gravel	56.69	77.97	105.47
Grit	40.96	66.75	105.53
Sand	109.86	131.30	134.2
Brick	63.67	74.84	94.92
Inlet Sample		190.80	
Permissible range for irrigation		0-2000	

From table 3 we observed that the values of all filtration media were within the permissible range of standard irrigation water quality. The maximum value of TDS obtained from sand filtration media i. e. 134.2 mg l^{-1} at 15 cm depth of layer. Also minimum permissible value of TDS obtained from grit filtration media i. e. 40.96 mg l^{-1} at 45 cm depth of layer. In gravel and brick observed values at 45 cm depth which near to the permissible range.

Table 4: Determination of Ca before and after filtration of grey water

Filtration Media	Ca (me l^{-1})		
	Depth of layer		
	45 (cm)	30 (cm)	15 (cm)
Gravel	1.1	1.2	1.3
Grit	0.8	0.8	0.8
Sand	0.9	0.9	1.0
Brick	0.8	1.0	1.0
Inlet Sample		1.3	
Permissible range for irrigation		0-20	

From table 4 we observed that the values of all filtration media were within the permissible range of standard irrigation water quality. The maximum value of Ca obtained from gravel filtration media i. e. 1.3 me l^{-1} at 15 cm depth of layer. Also minimum value of Ca obtained from grit filtration media i. e. 0.8 me l^{-1} at all depth of layer.

Table 5: Determination of Bicarbonate before and after filtration of grey water

Filtration Media	Bicarbonate(me l^{-1})		
	Depth of layer		
	45 (cm)	30 (cm)	15 (cm)
Gravel	1.1	1.1	1.4
Grit	0.9	1.3	2.4
Sand	1.3	1.4	1.55
Brick	0.9	1.0	1.0
Inlet Sample		1.1	
Permissible range for irrigation		0-20	

From table 5 we observed that the values of all filtration media were within the permissible range of standard irrigation water quality. The maximum permissible value of bicarbonate obtained from grit filtration media i. e. 2.4 me l^{-1} at 15 cm depth of layer. Also minimum value of bicarbonate obtained from grit and also brick filtration media i. e. 0.9 me/l at 45 cm depth of layer.

Table 6: Determination of K before and after filtration of grey water

Filtration Media	K (mg l^{-1})		
	Depth of layer		
	45 (cm)	30 (cm)	15 (cm)
Gravel	0.8	1.4	1.9
Grit	0.8	0.8	0.9
Sand	3.55	4.1	4.15
Brick	1.05	1.3	1.65
Inlet Sample		6.2	
Permissible range for irrigation		0-2	

From table 6 we observed that the values of all filtration media were within the permissible range of standard irrigation water quality. The maximum permissible value of potassium obtained from sand filtration media i. e. 4.15 mg l^{-1} at 45 cm depth of layer. Also minimum value of potassium obtained from grit filtration media at 45 and 15 cm and also gravels

filtration media at 45 cm i. e. 0.8 mg l^{-1}. In case of brick observed value at 45 cm depth which near to the permissible range.

Physical properties of grey water were removed after filtration. The milky white colour of grey water changes to colourless. Suspended particles were removed after filtration. And also odour was reduced after filtration.

Misra *et al*., 2010 [9] reported that laundry greywater has a good potential for reuse as irrigation water to grow tomato crop, greywater irrigated plants substantially uptake greater quantity of Na (83%) and Fe (86%). In laundry detergents having large proportion of ingredients, some of them can be helpful to plants, especially nutrients which balanced concentration is required to avoid the deficiency of nutrients in plants (Misra *et al*., 2010) [9]. Thus use of filtered greywater which saves the water and ultimately resulting environmental benefits.

Conclusions

The field study was done regarding the effect of various filtration media of grey water quality. The study shows that, all the parameters determined were range of irrigation water quality. The study concludes with the most effective depth of media.

The maximum permissible value of pH obtained from sand filtration media at 30 cm and minimum value from brick filtration media at 45 cm depth of layer. The maximum value of EC obtained from sand filtration media at 45 cm and minimum permissible value from grit filtration media at 15 cm depth of layer. The maximum value of TDS obtained from sand filtration media at 45 cm and minimum permissible value from grit filtration media at 15 cm depth of layer. The maximum value of Ca obtained from gravel filtration media at 15 cm and minimum value from grit filtration media at all depth of layer. The maximum permissible value of bicarbonate obtained from grit filtration media at 45 cm and minimum obtained from grit and also brick filtration media at 15 cm depth of layer. The maximum permissible value of potassium obtained from sand filtration media 45 cm and minimum value of from grit filtration media at 45 and 15 cm and also gravels filtration media at 45 cm. Thus study concluded that for all media that are gravel, grit, sand and crushed brick the effective layer was found as 45 cm.

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