Removing of fat residues from domestic kitchen wastewater by synthetic filter of saw dust

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Abstract. Domestic kitchen wastewater contains significant quantities of fat residues that may insist in blocking home and municipal sewers. This work was designed to remove fat residues from domestic kitchen wastewater using synthetic sawdust filter. Five samples were examined, where the first one was a control. Synthetic filter contained sawdust was used as a removal of fat residues from four different samples of domestic kitchen wastewater. The obtained results showed that the synthetic sawdust filter could remove highest quantities of fat residues having removing capacity ranging from 80.7 ± 5.6 % in sample 1 to 88.5 ± 5.8 % in sample 4. Also, it was found that the mean value of pH, Electric conductivity (EC) and Total dissolved solid (TDS) of domestic kitchen wastewater were significantly affected by filtration process compared with those of control sample. The mean value of pH ranged from 6.61 ± 0.32 in sample 4 to 6.9 ± 0.54 in sample 2. E.C. mean value was varied from 1400.2 ± 262.8 μS/cm in sample 4 to 2100.4 ± 426.5μS/cm in sample 2 while mean value of T.D.S. was lying between 1123.0 ± 142.3 mg/L in sample 4 and 1347.0 ± 210.6 mg/L in sample 2. It seems clearly that sawdust synthetic filter was not affected when it was used for several times with different kitchen wastewater samples and this finding would suggest that this synthetic filter may work efficiently and subsequently may have no significant effects on sewer obstruction phenomena. In addition, all examined wastewater variables (pH, EC, and TDS) in all sample were significantly declined.

Keywords: Kitchen wastewater, Fat residues, Sawdust filter, Removing capacity, sewer

1. Introduction

It is well known that domestic kitchen wastewater contains elevated fat residues that apparently causes obstruction of both home and municipal sewers which needs to be frequently cleaned that impose economic and labor costs. Much attention was made domestic kitchen wastewater in terms of treatment and fat resides removing [1,2,3,4]. Several removing techniques were examined such as coagulation and magnetic separation [5], composite flocculants of polysilicat e ferro-aluminum sulfate – rectorite [6,7], electro-coagulation [8], Application of Peat Filter Media [9], Constructed Wetland [10] and phytoremediation [11] by using different biological species and waste materials such as mixed bacterial consortium [12], mixed micro algal culture and an aerobic bacterial culture [13], symbiotic co-culture of microalgae and bacteria [14] and immobilized photosynthetic bacteria [15].

It is well documented that sawdust was successfully used in biosorption of several heavy metal ions from industrial wastewater [16,17] such as copper [18], lead, cadmium and nickel [19], chromium [20] and lead [21]. Also, sawdust was used in the treatment of textile wastewater [22] and other organic pollutants [23].
The current was designed to examine the capacity of a sawdust synthetic filter in removing fat residues from domestic kitchen wastewater for several times; and test other water variables such as pH, E.C. and TDS in samples collected from cleaning cocking pans in particular being contain significant quantities of fat residues.

2. Material and Methods.
The studied filter was synthesized from only sawdust placed in cylindrical plastic container with two upper and lower ends where the upper end was to receive wastewater and the lower end was to discharge the filtered water (diagram 1).

![Diagram 1: Synthetic sawdust filter.](image)

Five samples of domestic kitchen wastewater were collected in one-liter plastic bottle after washing and cleaning cooking wares containing various quantities of fat residues where the first one represents a raw wastewater called control sample. The test was carried out in three replications for each sample having a total of 12 experimental unites. Each sample was divided into two parts where the first part was examined for pH, EC and TDS content and then filtered directly using whatman filter paper to record fat residues content while the second part was placed in the synthetic filter and left until all wastewater being filtered. This filtered wastewater was examined for pH, EC and TDS content and re-filtered using again whatman filter paper to assess fat residues quantity. The quantity of fat residues was determined using the following the procedures used in case of measuring of various examined variables such as soil organic content and others which calculates the filter paper before and after filtration as explained in following formula:

\[
\text{Weight of fat residues} = \text{weight of filter paper after filtering} - \text{weight of Filter paper before filtering}
\]

Wastewater pH, EC and TDS values were recorded using portable lab devices.

3. Results and Discussion
Mean value of pH, EC and TDS in domestic kitchen wastewater of raw wastewater (control) and filtered samples are given in table 1. It seems clearly that the mean value of all examined variables of domestic kitchen wastewater was affected significantly by the sawdust filter.

For wastewater pH, it was found that control sample had the highest mean value (9.22 ± 0.82) while examined samples gave much significantly (P≤0.001) lower pH values which varied from 6.61 ± 0.32 in sample 4 to 6.9 ± 0.54 in sample 2 (Figure 1). The least significant difference (LSD) value (1.147) shows that mean values of filtered samples were significantly (P≤0.05) different from that of control unfiltered sample.
Table 1: Mean value of pH, EC and TDS in domestic kitchen wastewater of control and filtered samples.

| Wastewater sample | Mean value ± SD          |
|-------------------|--------------------------|
|                   | pH          | E.C. (μS/cm) | TDS (mg/L) |
| Control           | 9.22 ± 0.82 | 2430.8 ± 680.3| 1559.0 ± 246.5 |
| Sample 1          | 6.78 ± 0.48 | 1930.1 ± 398.6| 1307.0 ± 186.3 |
| Sample 2          | 6.9 ± 0.54  | 2100.4 ± 426.5| 1347.0 ± 210.6 |
| Sample 3          | 6.68 ±0.51  | 1620.7 ± 312.8| 1301.0 ± 178.9 |
| Sample 4          | 6.61 ± 0.32 | 1400.2 ± 262.8| 1123.0 ±142.3 |

Figure 1: Mean pH values in control and filtered domestic kitchen wastewater.

In case of wastewater E.C., the mean values of treated samples were significantly (P≤0.001) decreased and found to vary from 1400.2 ± 262.8 μS/cm in sample 4 to 2100.4 ± 426.5 μS/cm in sample 2 (Figure 2). In addition, LSD value of these data (21.83 μS/cm) shows that mean values of examined wastewater samples were significantly (P≤0.001) lower than that of control domestic kitchen wastewater sample and also, it differs from each other.

Figure 2: Mean EC (μS/cm) values in control and filtered domestic kitchen wastewater.

Regarding wastewater TSS, again the mean values of these filtered wastewater samples were significantly (P≤0.001) declined compared with that of control unfiltered sample and recorded to vary from 1123.0 ±142.3 mg/l in sample 4 to 1347.0 ± 210.6 mg/l in sample 2 (Figure 3). However, LSD value (18.26
mg/l) shows clearly that the mean values of TSS in filtered wastewater samples were significantly (P≤0.05) lower than that of control sample and also differed from each other.

![Mean TSS (mg/l) values in control and filtered domestic kitchen wastewater.

Figure 3: Mean TSS (mg/l) values in control and filtered domestic kitchen wastewater.

Table 2 shows the mean removal of fat residues from examined domestic kitchen wastewater samples. It seems very obvious that the used sawdust filter has given higher fat residues removal percentages.

**Table 2. mean removal of fat residues from examined domestic kitchen wastewater**

| Wastewater sample | Mean fat removal % |
|-------------------|--------------------|
| Sample1           | 80.7 ± 5.6         |
| Sample2           | 86.7 ± 6.2         |
| Sample 3          | 88.4 ± 7.1         |
| Sample 4          | 88.5 ± 5.8         |

However, it was found that capacity of sawdust filter in removing fat residues from examined kitchen wastewater samples was almost very high and found to range from 80.7 ± 5.6 % to 88.5 ± 5.8 % for samples 1 and 4 respectively (Figure 4).

![Mean fat removing percentage (%) in filtered domestic kitchen wastewater samples.

Figure 4: Mean fat removing percentage (%) in filtered domestic kitchen wastewater samples.

Statistically, the mean values of removing capacity were found insignificantly (P>0.05) different from each other apart from that of sample 1 where LSD value (5.09 %) emphasis such finding.
Apparently, certain physical and chemical properties of saw dust such as water drainage, porosity and specific gravity may play significant role in removing fat residues from domestic wastewater since it was used in various applications such as artificial soil [24], heavy metal biosorbent [25, 26], dye removal [27], crude oil [28] and any unwanted materials [29]. However, sawdust seems to have a porosity 84% and water drainage of $40.0 \times 10^{-3} \text{sm}^{-1}$ [30] and these physical properties have resulted in clear and high capacity of sawdust in terms of removing all material from wastewater.

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