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Improving Wastewater Effluent of Septic Tank Using Capillarity Action

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Abstract: *This study used simple modification of septic tank using capillarity action of different fabrics such as (cotton, nonwoven polyester, non-woven polypropylene geo-textile 300gm, non- woven polypropylene geo-textile 800 gm. and filter labbad).*
Study results show that using cotton and non-woven polypropylene geo-textile 800gm improve the removal efficiency of septic tank to (97 % - 98 %) for TSS & (82%-83%)for BOD & (62% - 64%) for COD.

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I. Introduction

Many Egyptian villages lack basic sanitation services and the majority of the population in Egypt located along the Nile River banks where there is high amount of underground water and the accumulation of the sewage which is discharged into the soil harms the environment. Therefore, there is a necessity to treat wastewater to meet the standards of the water quality to be discharged to drains or to be suitable for re-use in agricultural purposes.

Septic tanks are small rectangular chambers, usually sited just below ground level. In which household wastewater is retained for 1-3 days. Most commonly they are constructed in brickwork or block work and rendered internally with cement mortar to ensure water tightness. During this time the solids settle to the bottom of the tank where they are digested an aerobically. A thick crust of scum is formed at the surface and this helps to maintain anaerobic conditions, although digestion of the settled solids is reasonably good. Some sludge accumulates and the tank must be desludged at regular intervals usually once everyone to five years. The effluent from septic tanks is disposed of either on-site n or taken off-site by settled sewerage. Although septic tanks are most commonly used to treat the sewage from individual households, they can be used as a communal facility for populations up to about 300**[1].**

Septic tank is commonly used as a primary treatment method on-site as it separate heavy impurities which settle out and the floating solids (scum) from the sewage and also works as an anaerobic chamber to break down the organic matters in the absence of oxygen.

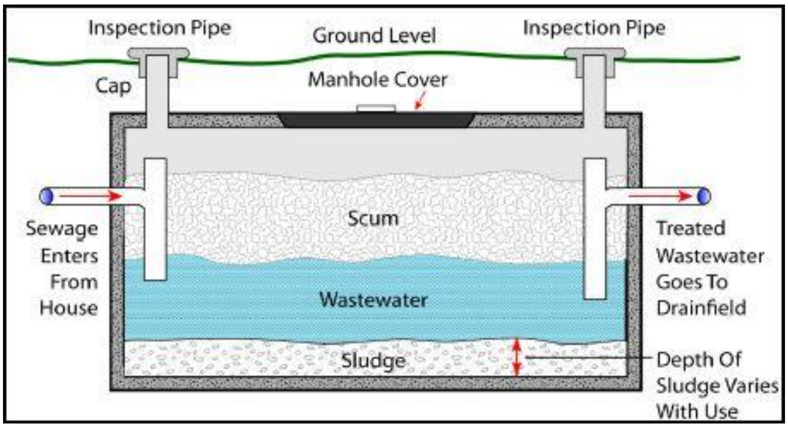

Figure (1) Typical septic tank

A septic system works by allowing waste water to separate into layers and begin the process of decomposition while being contained within the septic tank. Bacteria, which are naturally present in all septic systems, begin to digest the solids that have settled to the bottom of the tank, transforming up to 50 percent of these solids into liquids and gases. When liquids within the tank rise to the level of the outflow pipe, they enter the drainage system. This outflow, or effluent, is then distributed throughout the drain field through a series of subsurface pipes. Final treatment of the effluent occurs here as the soil absorbs and filters the liquid and microbes break down the rest of the waste

Septic tank solids include both biodegradable and non-biodegradable materials; although many of the solids will decompose, some solids will accumulate in the tank. Anaerobic and facultative biological processes in the oxygen deficient environment of the tank provide partial digestion of some of the wastewater components. These processes are slow, incomplete, and odor producing. Gases (hydrogen sulfide, methane, carbon dioxide, and others) result from the anaerobic digestion in the tank and may create safety hazards for improperly equipped service personnel [9]. Most of septic tanks achieves removal efficiency for BOD between 35 -50% and about 60% for TSS **[2].**

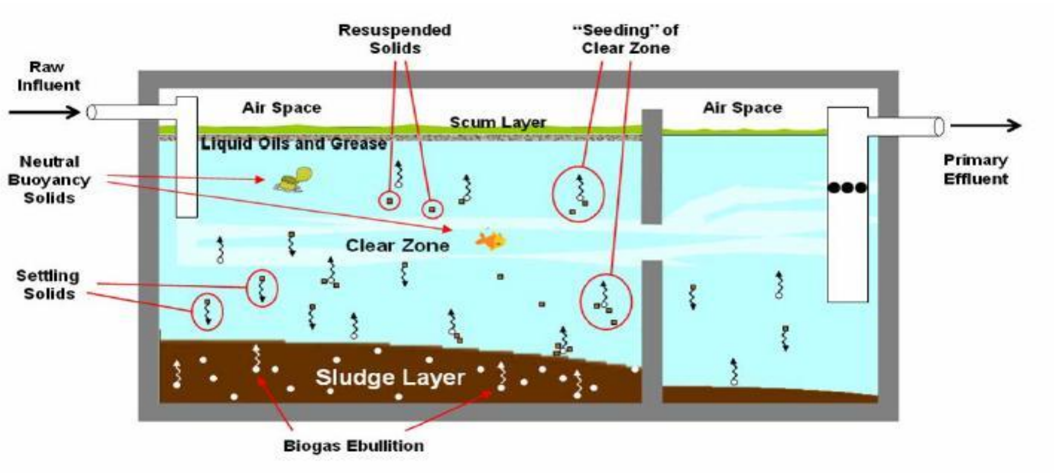

Figure (2) Septic tank processes

II. Research Significance And Previous Work

The simplicity of its operation and the low cost of construction and the ease of maintenance rise the depending on the septic tanks in rural areas. But its low efficiency was the main difficulty against the environmental aspects that raise the needs for simple modifications that increase the removal efficiency without complication of its construction or operation.

In the south east of Asia septic tank was used with bamboo stalk as biological filter behind the tank increased the efficiency to 75 % **[3].**

Using the unsubmerged plastic media (aerobic reaction) by el Nadi, M. H. behind the tank increased the efficiency of it to 80% in Aswan villages at year 2000 **[4].**

Using the gravel then crushed stone then sand as a physical filter behind the tank increased the efficiency to 75% in Aswan and Edfo villages at year 1999 **[5].**

Upflow Septic tank compartment and anaerobic Baffled Reactor compartment (USBR) was developed as described in figure (3) and tested at pilot scale for 6 months at Iowa State University by Dr. T. Sabry and Dr. S. Sung [14] and for one year at Oseem village, Giza then a full-scale system was constructed in Abo-Khalifa village in El Tel El Keeber district, Ismailia governorate. During almost one year of continuous operation and monitoring, the average results were 84% for the COD removal, 81% for the BOD removal, and 89% for the TSS removal **[6].**

Up flow filter the effluent enters at the base Flows upwards through a layer of coarse aggregate about 0.5 m deep and is discharged over a weir at the top Field studies in India have shown that these filters can effect a 70 per cent reduction in BOD and change a malodorous, highly turbid, and grey to yellow influent to an odorless, clear, yellow effluent **[7].**

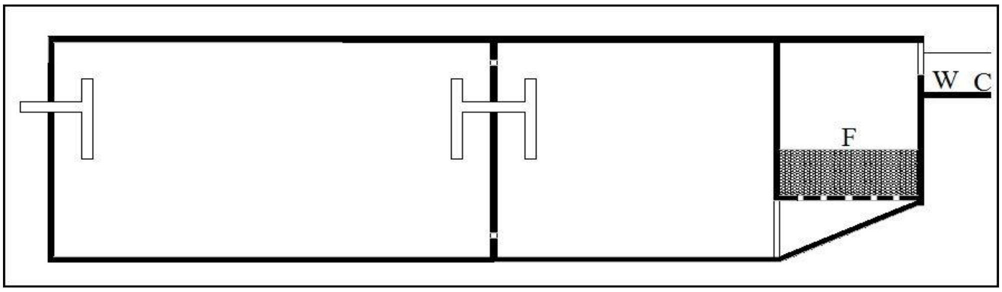

Figure (3) Septic Tank with Up Flow Filter

This study applied on a septic tank erected in Nawa Village Qalubiya Governorate, Egypt, which served 10 houses with volume 10m3 enough for 2 days retention time divided by two plastic sheets partitions to three compartments as illustrated in figure (4).

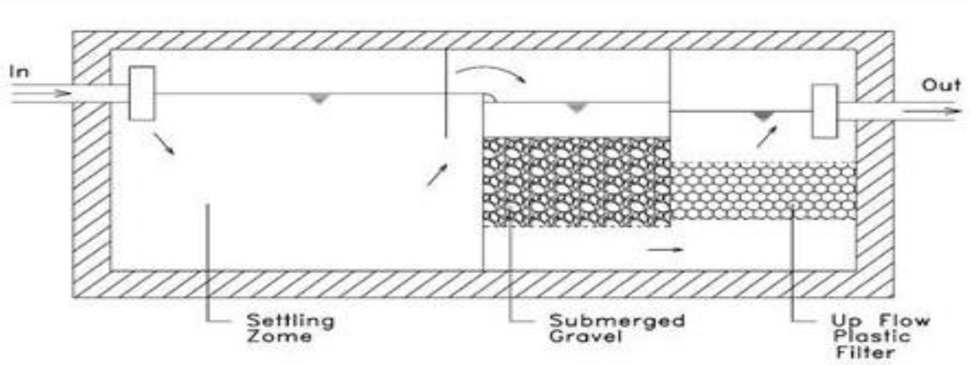

Figure (4) Simple modification for septic tank

From three months operation for domestic sewage The study resulted the suitability of the modification to improve the removal efficiency of the septic tank from 50% for BOD & 60% for TSS to become 83.66% for BOD & 86.91% for TSS which are promising removal efficiencies for such simple system that raise the possibility to depend on it as one of the low cost treatment procedures for sewage treatment in rural areas **[8].**

III. Materials & Methods

The set up for the modified septic tank reactor was as follows:

1- Holding tank
2- mixer
3- Lab scale model of septic tank

The examined materials were cotton, nonwoven polyester, non-woven polypropylene geo-textile 300gm, non-woven polypropylene geo-textile 800 gm. and filter labbad. These materials were used for filtration in the bench scale reactor.

Filter labbad

Non-woven geo-textile 300 gm

Non-woven geo-textile 800 gm

Non-woven polyester

Figure (5) Examined materials

IV. Inoculation And Start Up

The lab set up was properly saturated with real wastewater for maximum 72 hours. The wastewater was seeded to a holding tank and fed afterwards to the lab scale model of septic tank. In the start-up phase, a constant influent flow rate of 2.5 lit/d was fed into the system. This phase continued for 60 days. During this phase, pH, COD, BOD and TSS were analysed in the influent and effluent of the reactor to follow up its stability.

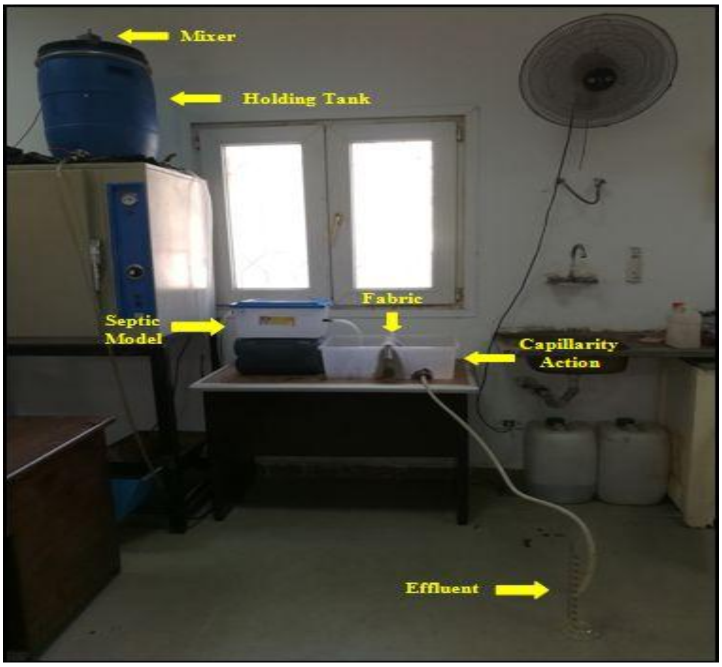

Figure (6) Lab scale model

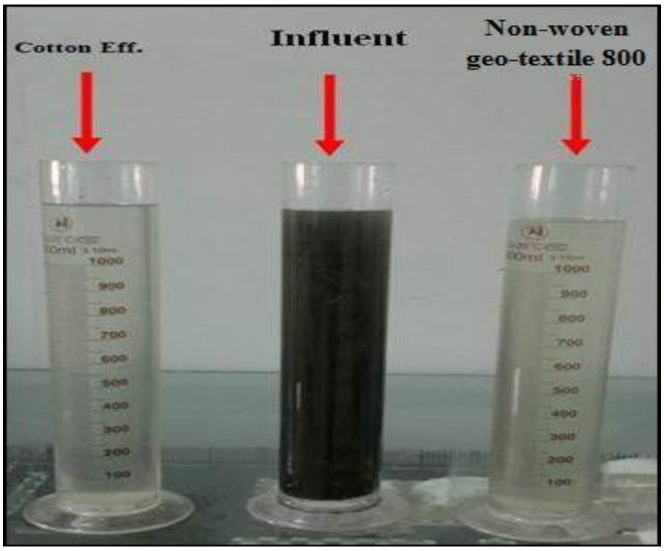

Figure (7) wastewater effluent

V. Experimental Results

The results of removal efficiency percent of used fabrics for TSS, BOD and COD where the PH value have no effect of removal efficiencies in gravity filter after 72 hrs. Are shown below:-

Table (1) removal efficiency of capillarity action

Fabric / Parameter	Non Woven Polyester	Cotton	Filter lebbad	Non woven polypropylene Geo-textile (300 gm)	Non woven polypropylene Geo-textile (800 gm
TSS	95.78%	98.27 %	92.70%	96.165%	97.49%
BOD	73.17%	82.39 %	71.65%	71.75%	83.28%
COD	62.08%	64.07 %	57.25%	60.32%	62.41%

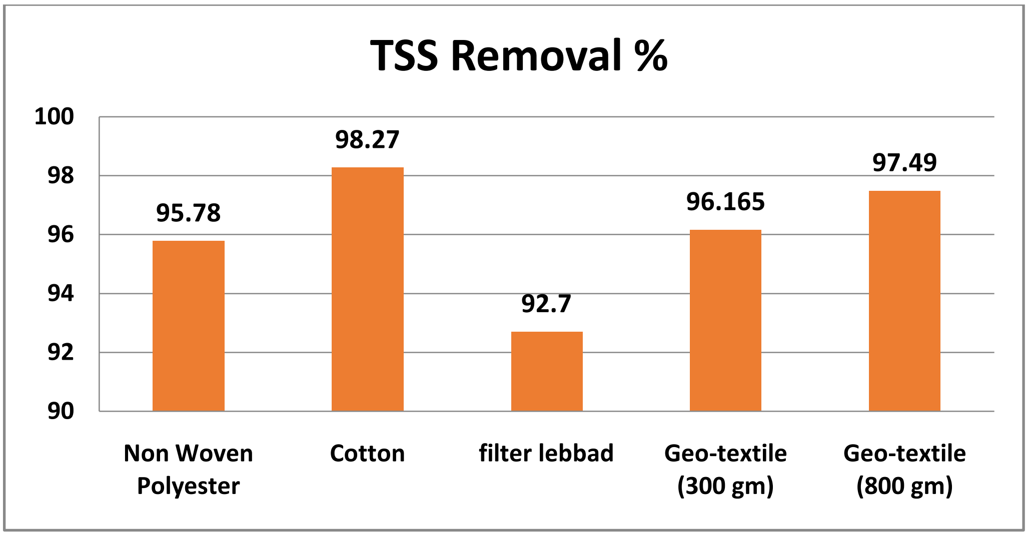

Figure (8) TSS Removal efficiency of Capillarity action

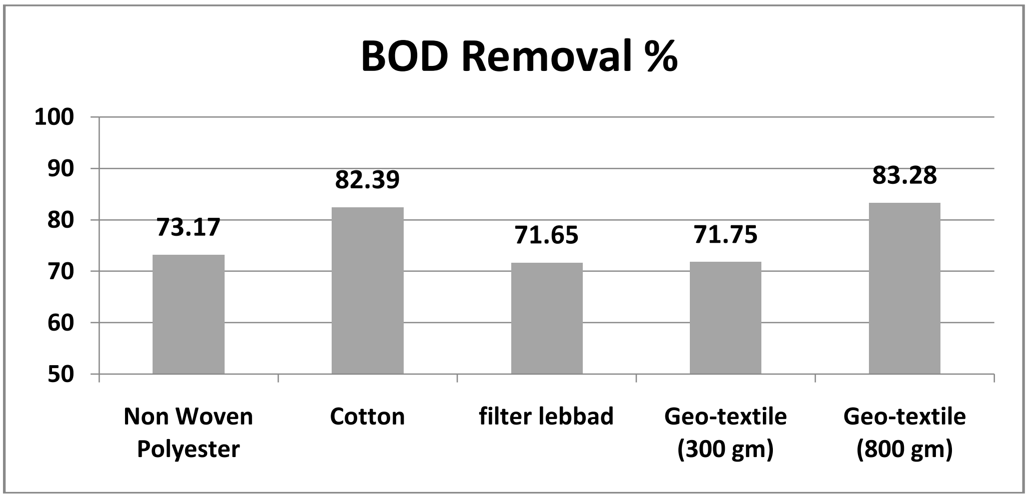

Figure (9) BOD Removal efficiency of Capillarity action

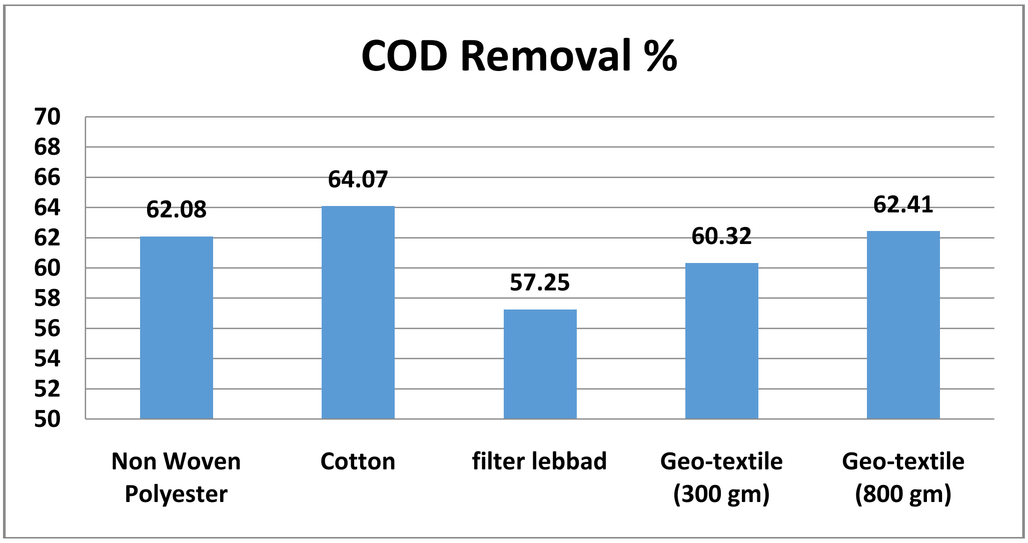

Figure (10) COD Removal efficiency of Capillarity action

Table (2) Used fabric comparison

cirbaF fo epyT	ecruoS	thgieW (gm/m2)	ssenkcihT (mm)	ezis eroP (norcim)	ytilibaemreP (m/sec)	yticapac wolf retaW (L/hour/m2)	gnihsaw	Cost / m2 EP
nottoC	derutcafunam yllacoL	500	30	70	0.040	2.0	oN	5.0
Non Woven Polyester	derutcafunam yllacoL	160	10	100	0.085	3.0	seY	6.0
dabbel retliF	derutcafunam yllacoL	200	8	95	0.100	3.0	oN	7.0
Non woven polypropylene (800 gm)	derutcafunam yllacoL	800	15	80	0.030	5.0	seY	12.0
Non woven polypropylene (300 gm)	derutcafunam yllacoL	300	6	80	0.060	2.0	seY	9.0

According to table (1) it can be seen that using of fabrics as a filter media after conventional septic tank improve the removal efficiency for TSS, BOD and COD. Cotton and non woven polypropylene geo-textile 800 gm gives high removal efficiency than the other fabrics In spite of the variation in removal efficiency of fabrics are in a small range. But according to table (2) cotton and non woven polypropylene geo-textile 800 gm are low cost and more efficient than the other fabrics.

VI. Conclusions

The study analyzed several wastewater samples as mentioned in the experimental work to identify the efficiency of used fabrics. Conclusions are drawn from the results carried out from the bench scale reactor. The results can be interpreted into the following points:-

1- The use of fabrics as a modification of septic tank enhancement of wastewater effluent.
2- Both Cotton and non-woven geo textile (800 gm) are more efficient than the other fabrics used in gravity filter.
3- Study results show that using cotton and non-woven polypropylene geo-textile 800gm improve the removal efficiency of septic tank to (97 % - 98 %) for TSS & (82%-83%) for BOD & (62% - 64%) for COD.
4- The system stability and easy operation and maintenance needs raise the possibility of its application in future.

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