

Household Greywater Treatment and Reuse Potential in Oman

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INTRODUITION

What is Greywater?

Greywater is water that has been used for washing dishes, laundering clothes, or bathing. Essentially, any water other than toilet waste (black water) drained from a household.

Differences between Greywater & Black water

- . Greywater decomposes much faster than does black water**
- . Greywater contains only one-tenth of the nitrogen contained in black water.**

Comparative Rates of Decomposition in Greywater and Blackwater.

(greywater = bath, dish and wash water; blackwater = water from flush toilets)

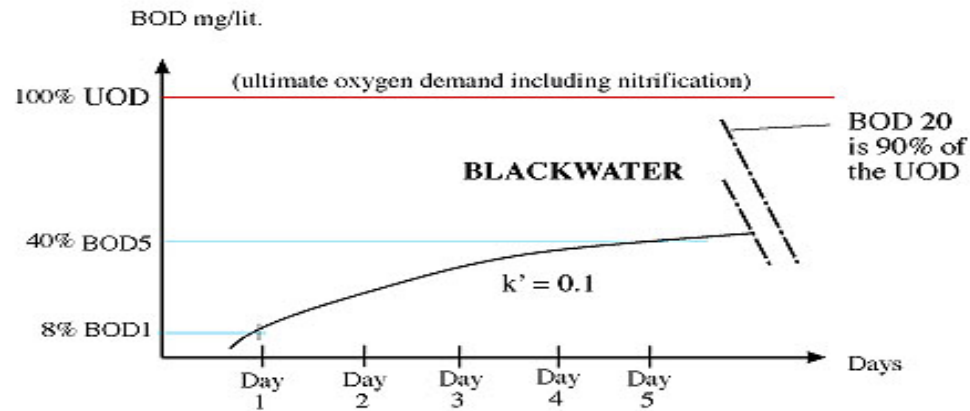


Fig. 1

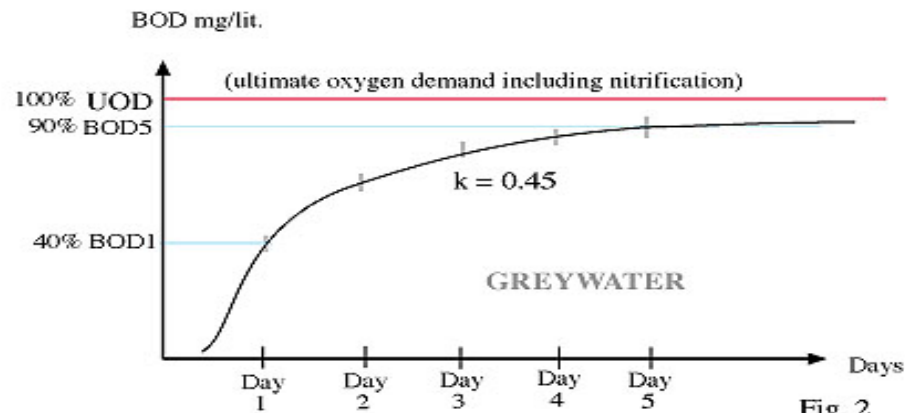


Fig. 2

Source: Olson E. et al. "Residential waste waters" - The Swedish National Institute of Building Research, 1967

The rates of decomposition in grey
& black water

Why Bother to Re-use Greywater?

Rising demand for water, particularly for domestic uses, has led to an increasing strain on water supplies in many countries (specially arid Countries).

Recent increases in environmental concerns have led to the re-use of greywater to become a more valuable alternative option to reduce the amount of contaminated wastewater discharged to the environment.

- It utilises a valuable on-site resource which is otherwise wasted.
- It conserves freshwater which can remain in natural ecosystem.
- It reduces the load on wastewater disposal systems (treatment plants & septic tanks).

OBJECTIVES

- To assess the quality of the greywater and its potential use in arid countries for irrigation and other purposes.
- To assess the variation of greywater quality and quantity on daily basis within one site & between different sites.

- To estimate the quantity of grey water produced from normal Omani house.

Experimental work

Greywater Production

- **Water meters were fixed in the kitchen and Bathroom.**
- **The total water used were recorded for one month.**
- **The average water consumption were calculated per person per day in both houses.**
- **The amount of greywater produced (in each house) were estimated.**

Sample collection & analysis

- **water samples were collected from each house as follow;**
 - **Bathroom : 1 sample from shower & 1 from hand basin.**
 - **Kitchen : 1 sample**
 - **Washing machine (laundry): 1 sample**
 - **Tab water : 1 sample**
 - **Mix of all sources : 1 sample**

- **Samples were then analyzed for water quality parameters (physical, chemical & biological). These include:**

**pH, Alkalinity, EC, TSS, TDS,
Turbidity, DO, Anions, Cations,
heavy metals, BOD & SAR.
Total Coliform & E-coli.**

Instruments used for analysis

- For the determination of major cations & trace elements ICP –OES equipped with an ultrasonic nebulizer was used. With this type of nebulizer the instrument is capable of detecting very low concentrations reaching ppb level.
- For the determination of Anions, an IC type Dionex was used.
- For BOD, a new type of equipment (OXI-TOP) was used instead of the conventional method of titration.
- This is in addition to the standard set of analytical equipments available in the SWAE lab used to measure the other parameters.

RESULTS & DISCUSSIONS

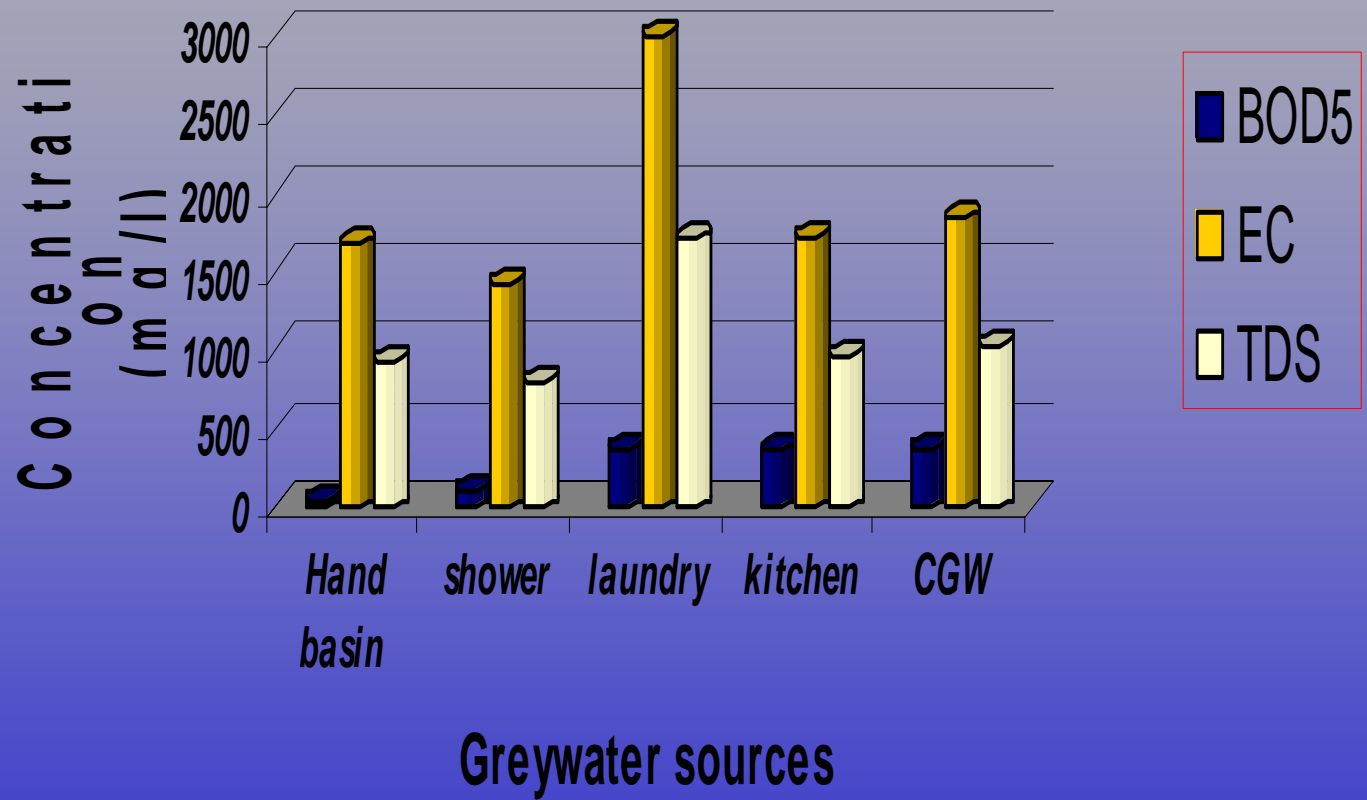
Greywater production from site one & site two.

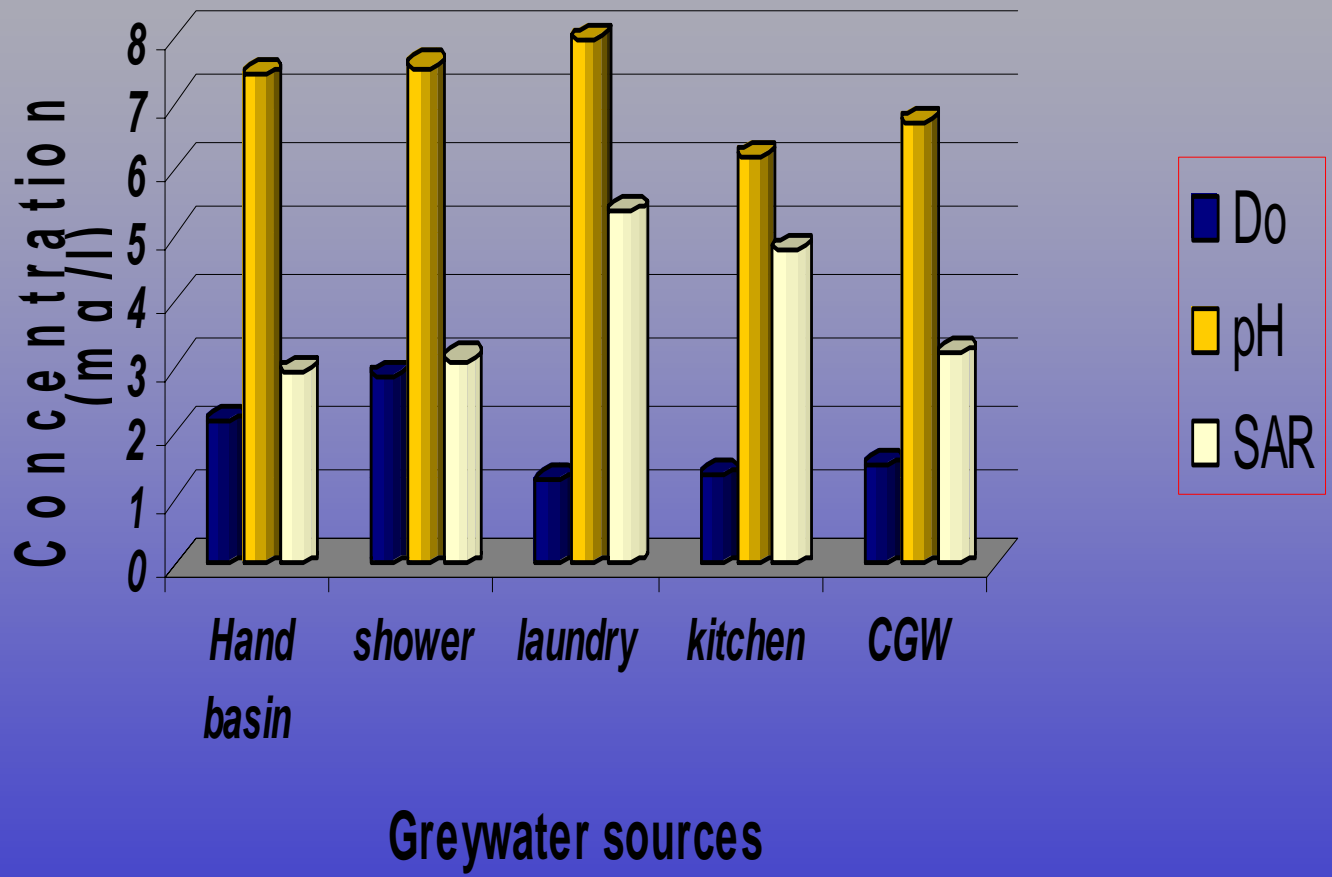
SITE	Total water used (g/p/d)	Kitchen (g/d)	Bathroom (g/d)	Total GW used (g/d)	GW (g/p/d)
BARKA	42.9	40	103	143	23.8 (55.5%)
MAWALEH	44.4	38.7	75.4	114.1	19.02 (42.8%)

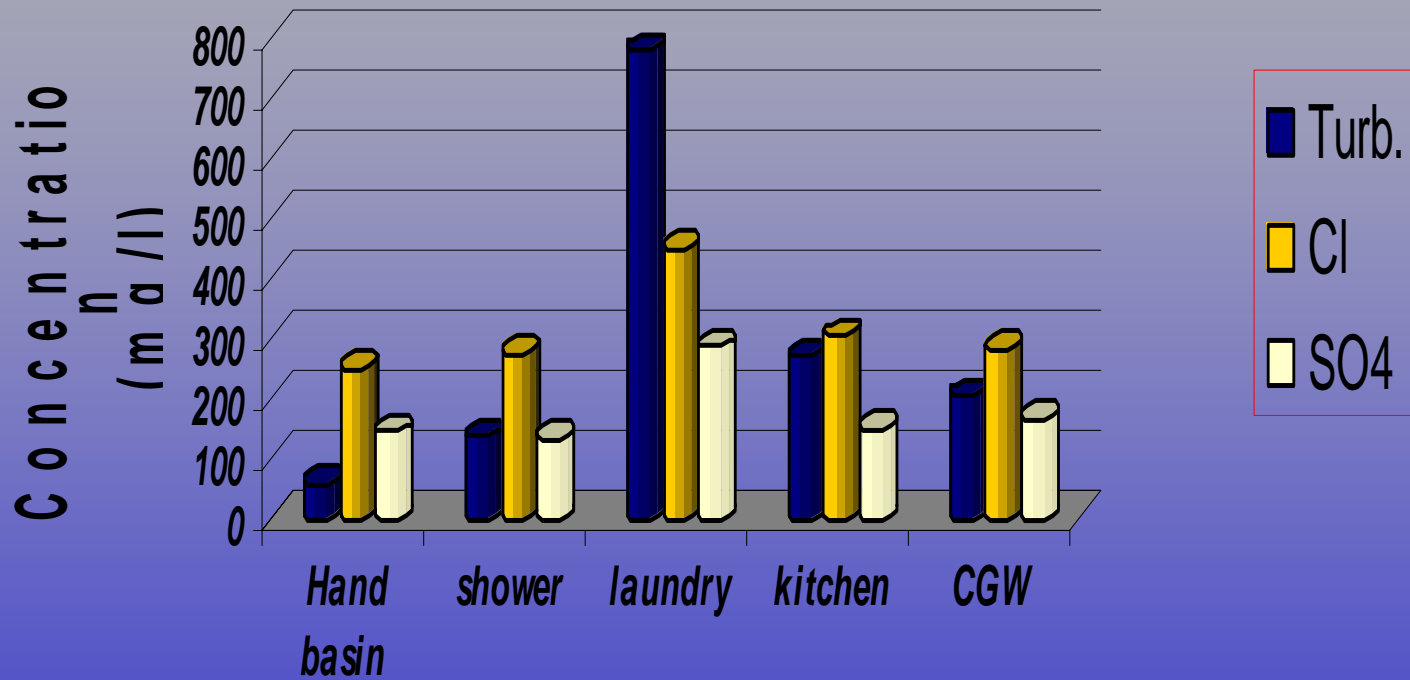
SITE ONE

“BARKA”

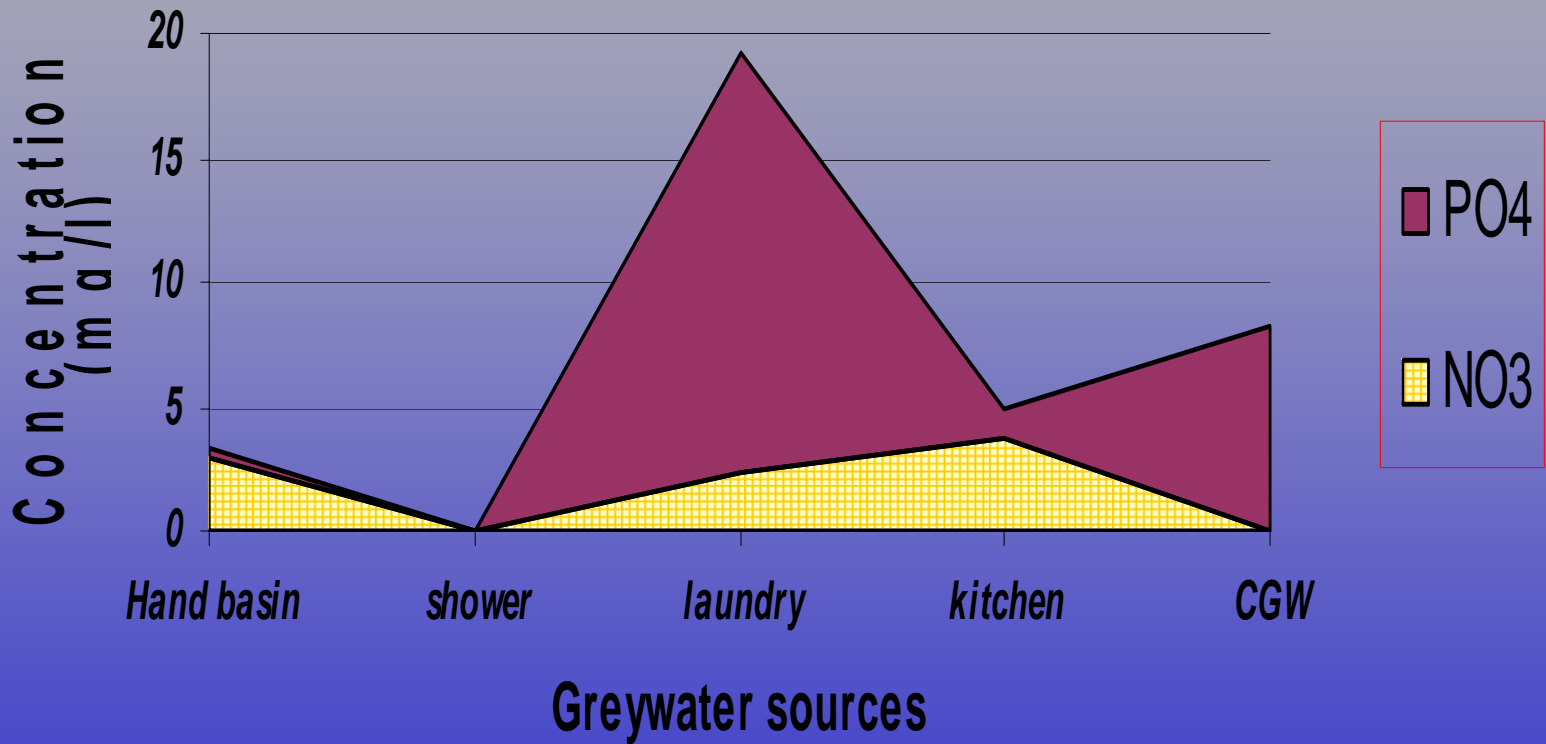
Greywater Physical, Chemical & Biological parameters





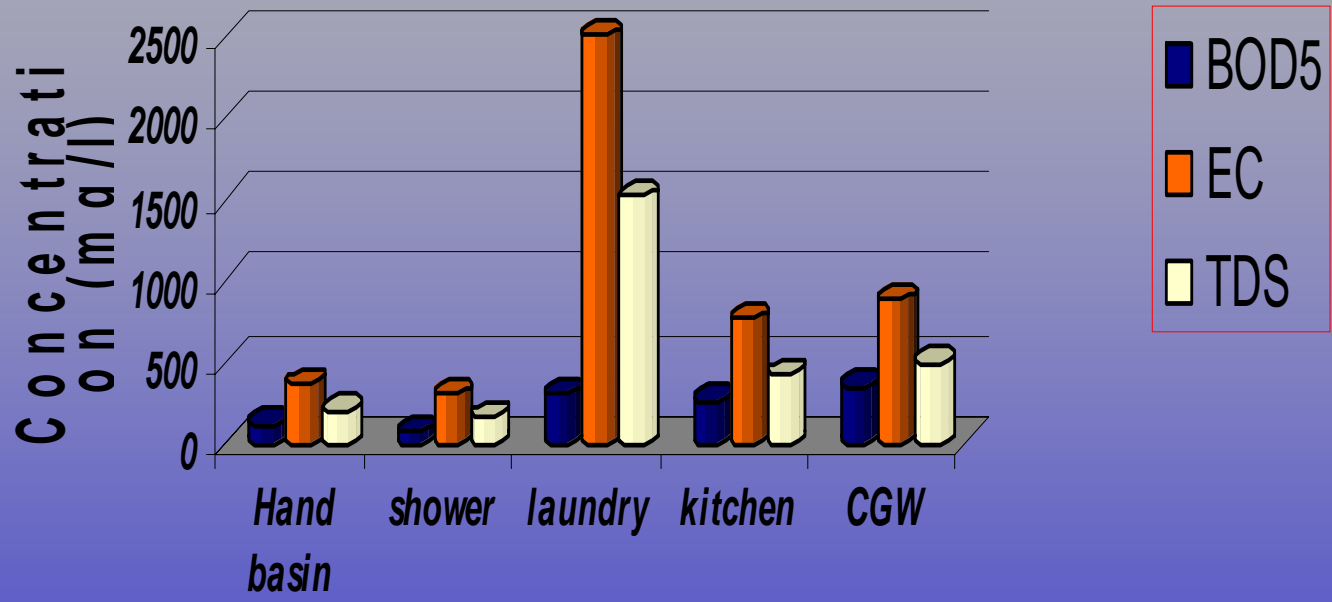


Greywater sources

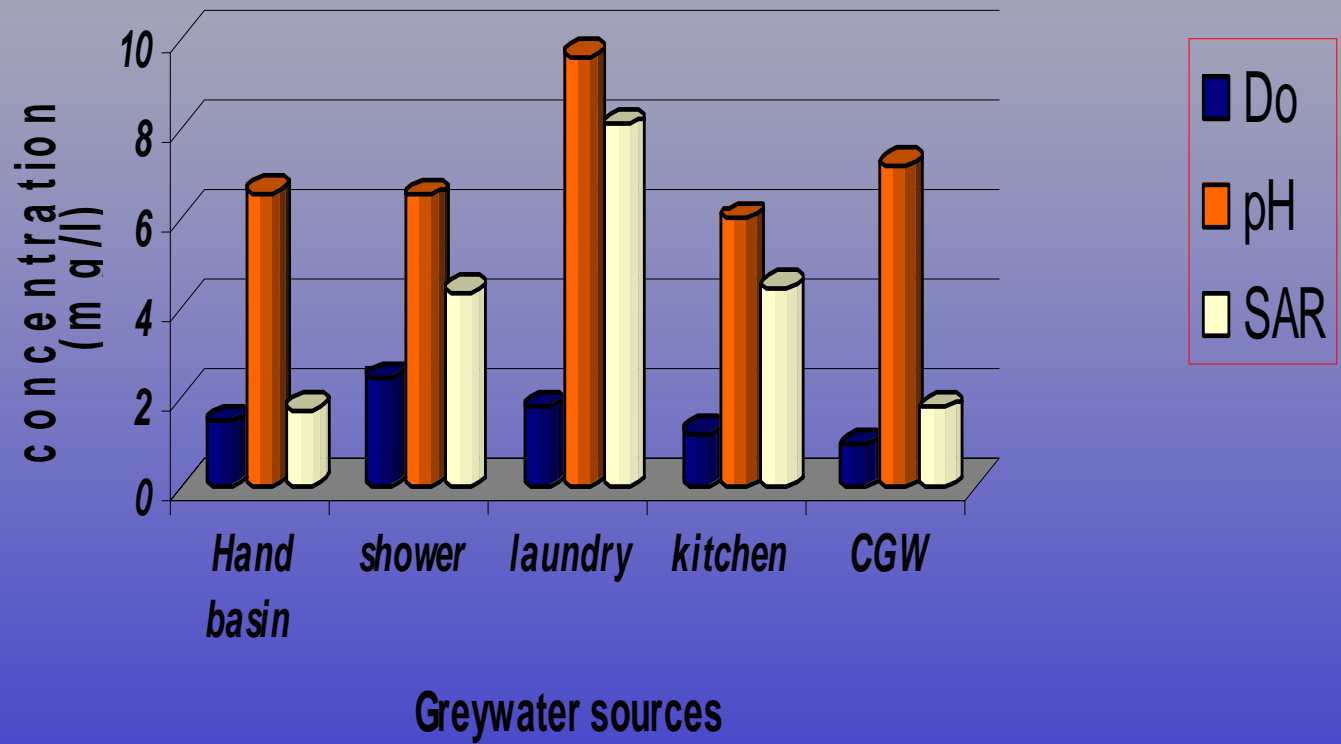


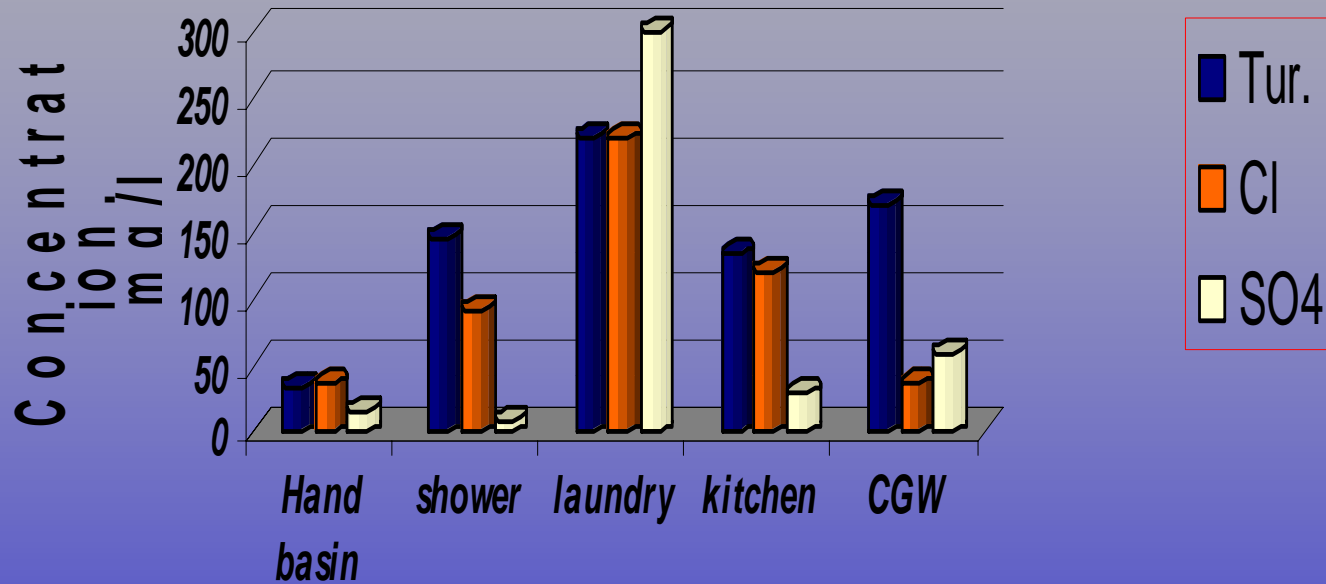
SITE TWO

“MAWALEH”



Greywater sources



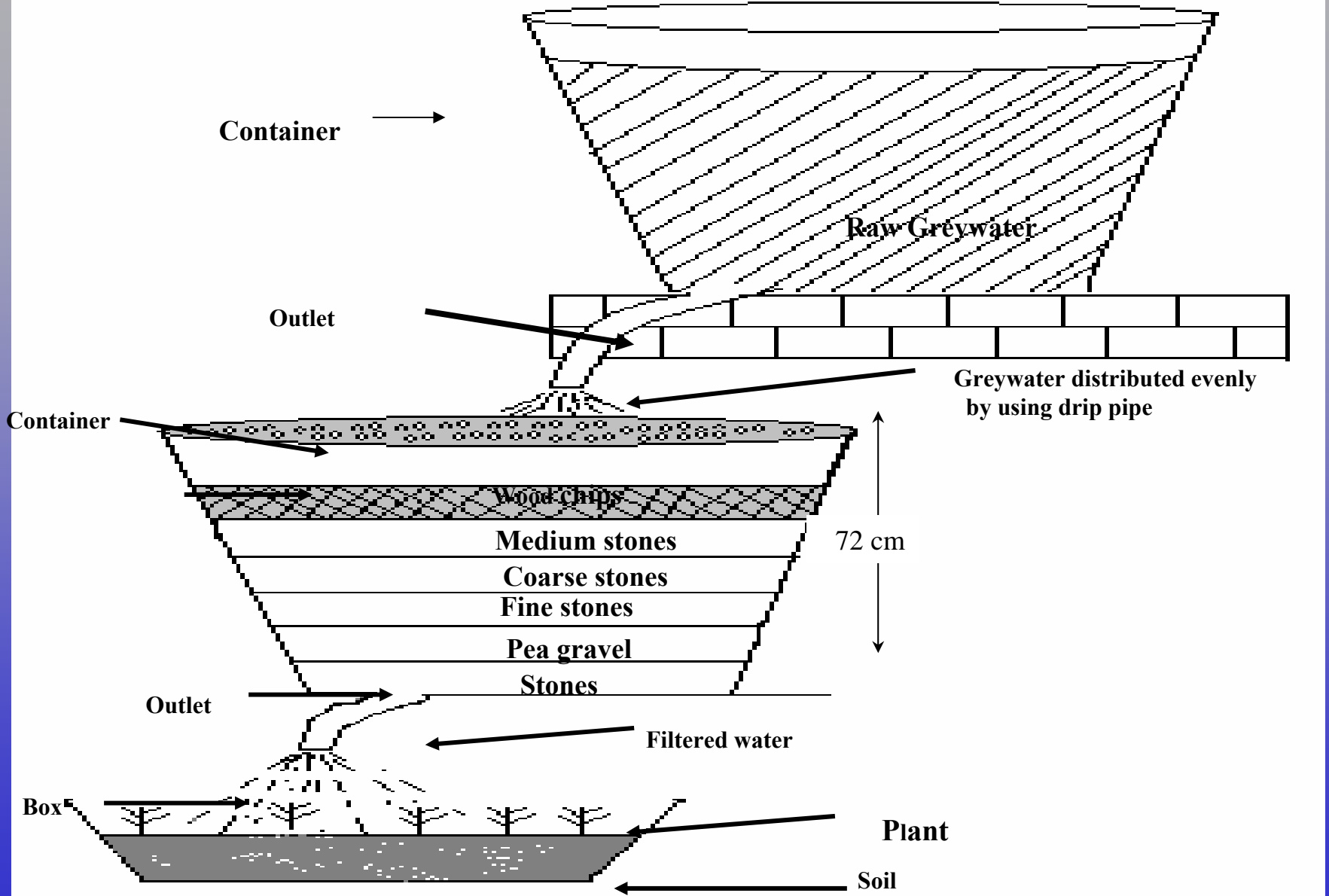


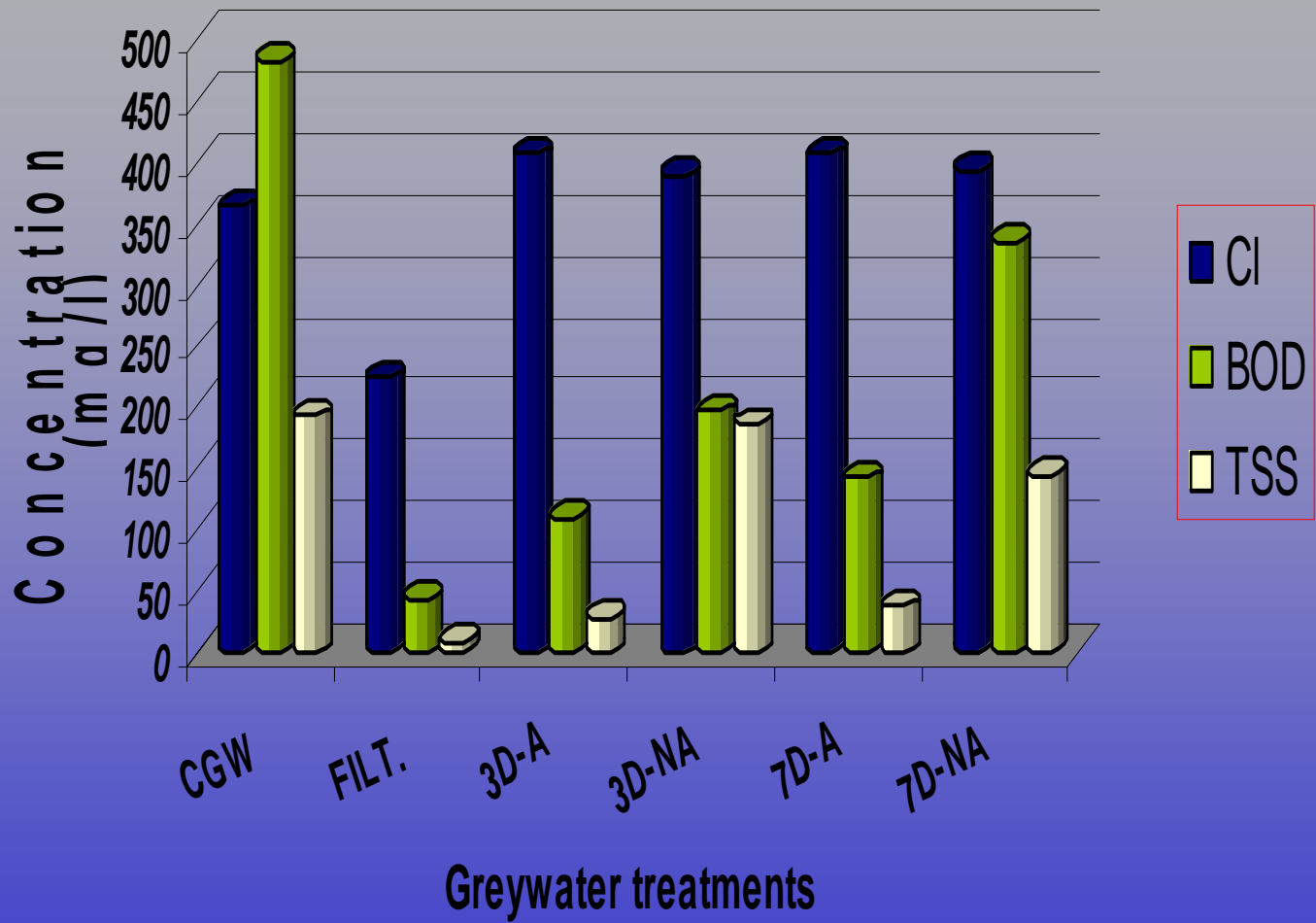
Greywater sources

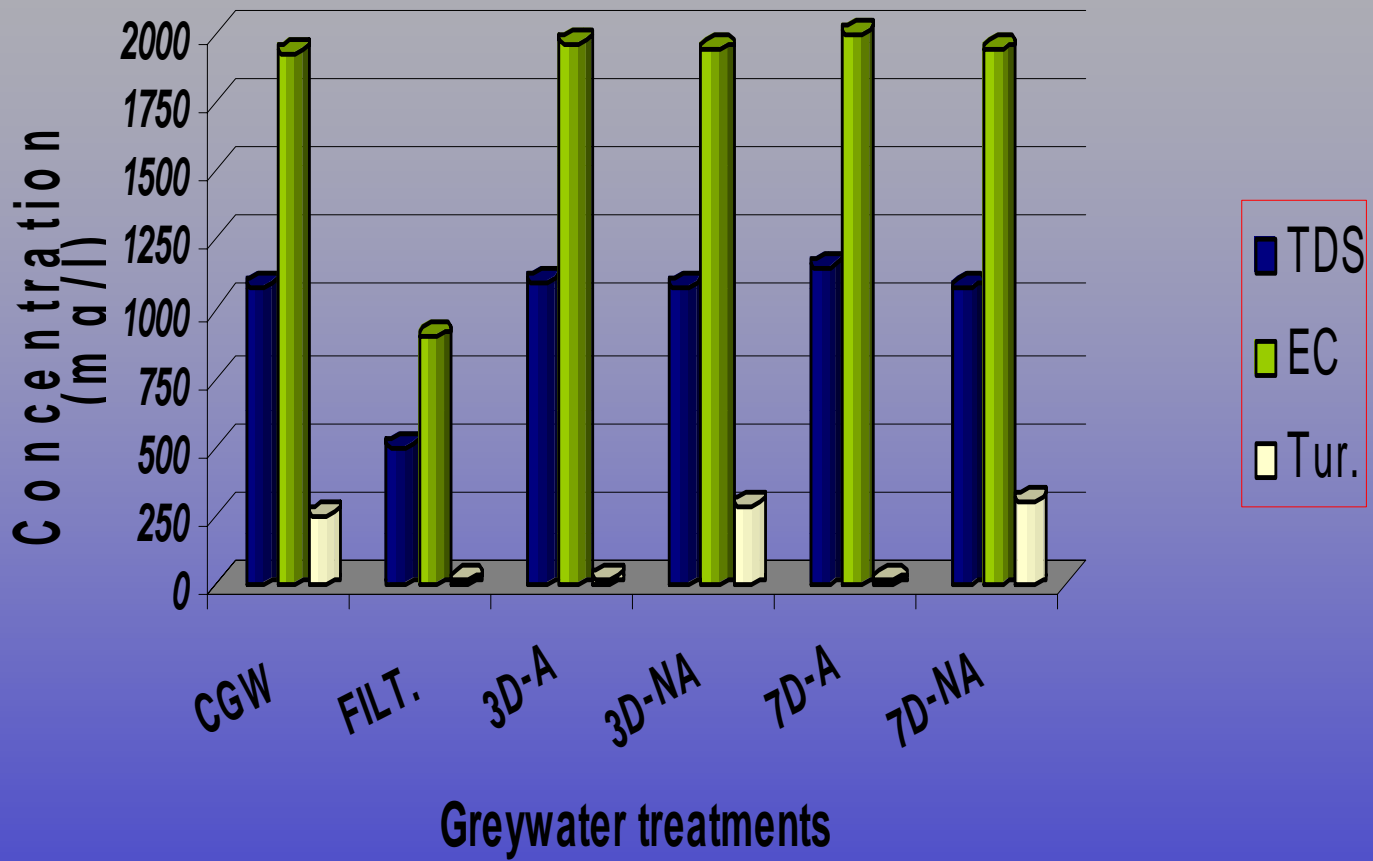
Greywater Treatments

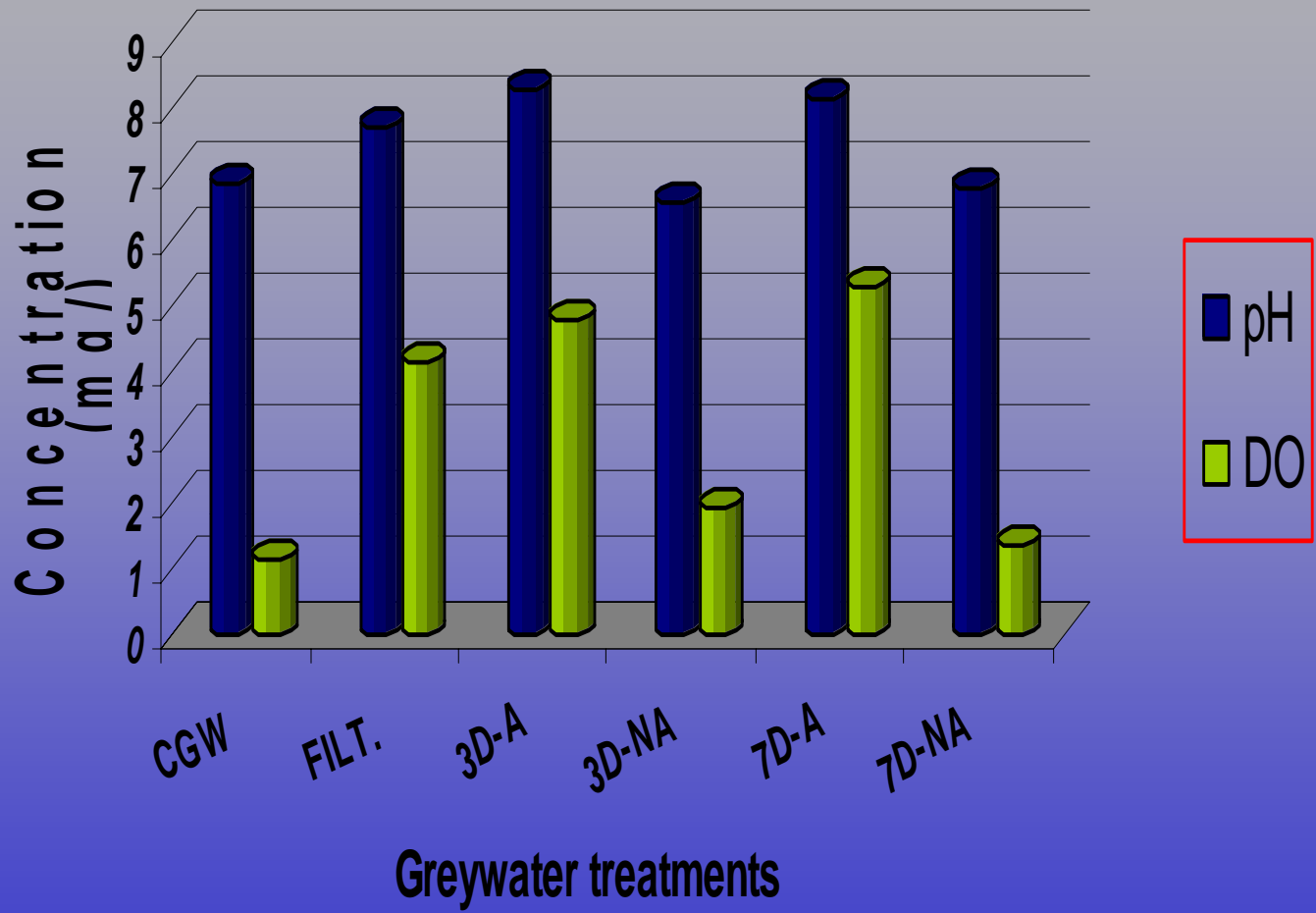
- * Filtration (Filt.)
- * Three days aeration (3D-A)
- * Three days non-aeration (3D-NA)
- * Seven days aeration (7D-A)
- * Seven days non-aeration (7D-NA)

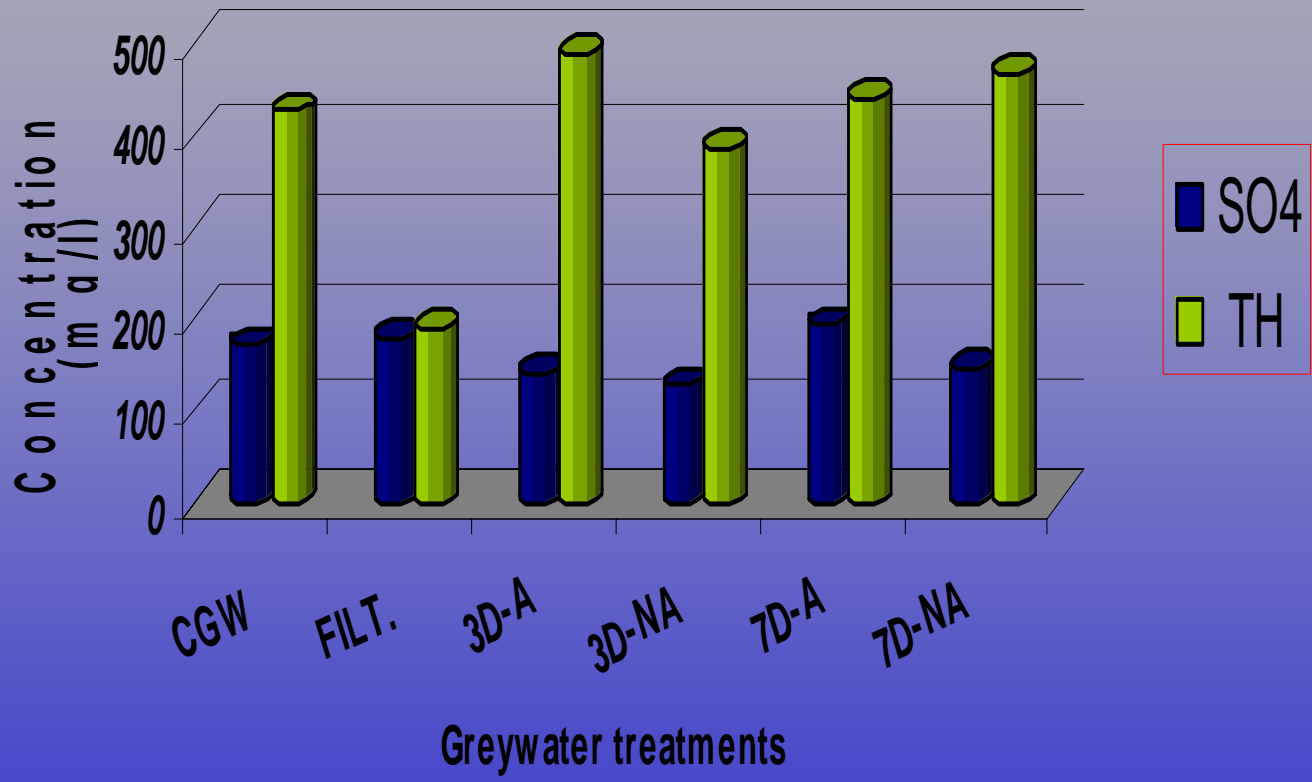
General Structure of the Multi-media filter System for Greywater Treatment











CONCLUSIONS

- * About 50% of domestic wastewater is greywater.
- * Generally, greywater from Laundry & Kitchen were the most contaminated compared to other sources.
- * Filtration treatment is very effective on (improving) all tested quality parameters.
- * Aeration treatment improved BOD, Turb., TSS & DO parameters.
- * Non –aeration treatment has the least improvement on the greywater quality.
- * There is no significant differences between storage of greywater for 3 days & 7 days on all quality parameters.

Comparing this result with literature, it can be concluded that:

- * Using greywater will reduce the demand for water of potable quality.**
 - * WC flushing and irrigation are the two common uses, but nearly any non-contact use is a possibility.**
- * The re-use of greywater should be considered as management practice.**
- * Water conservation and recycling is therefore a timely area of research.**

Recommendations for Greywater reuse

- Greywater contains large numbers of bacteria that may include disease-causing organisms therefore, chlorination is a vital process in this case.
- Care should be taken to ensure there is no direct contact between people and greywater.
- WC flushing and irrigation are the two common uses, but nearly any non-contact use is a possibility.

Continued..

- Developing legal guidelines for greywater disposal & reuse for Oman is essential.
- Greywater & Black water separation in houses should be encouraged by government housing agencies.

THANK YOU



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IMPERIAL GALLONS



