AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Public Works

# Effect of Media Properties on Performance of Sand Filtration for Drain Water Treatment

A Thesis submitted in partial fulfilment of the requirements of the degree of
Master of Science in Civil Engineering
( Public Works )

by

**Khaled Abd El Naser Ismail Fathi**
Bachelor of Science in Civil Engineering
( Public Works )
Higher Institute of Engineering, El Shorouk Academy, 2013

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A Thesis For

## The M. Sc. Degree in Civil Engineering (Sanitary and Environmental)

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**Khaled Abd El Naser Ismail Fathi**
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## THESIS APPOVAL

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Date: ----/----/2020

# Statement

This thesis is submitted as a partial fulfilment of Master of Science Degree in Civil Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

**Khaled Abd El Naser Ismail Fathi**

Signature

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# Researcher Data

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# Thesis Summary

**Thesis titles:**

## Effect of Media Properties on Performance of Sand Filtration for Drain Water Treatment

**Prepared by:**

**Khaled Abd El Naser Ismail Fathi**

**Summary:**

Open drains in Egypt are currently suffering from increased pollution loads caused by discharge of untreated domestic and industrial wastewater. Untreated effluents adversely affect agriculture drains water quality and limit their potential for reuse. Belbies drain, which originates North of Cairo, is considered one of the most polluted agriculture drains in Egypt.

The research focuses on the efficiency of the sand filtration unit mixed with different media in drain water treatment, in which the analysis of variable parameters will be conducted, to optimize the design of the unit & investigate the most efficient configuration for the filtration unit to be operated with. Three media have been tested with the sand filter which are: perforated Ceramic cylinders, Sponge and 2 commercial activated carbon (Jacobi and A.C-LN).

The experiments were conducted in six experimental runs. The first run was conducted to determine the optimum depth of filtration for each type of filtration medium. It was observed that the best removal results have been obtained at filtration media depth of 120 cm. Also, sand mixed with other media such as Sponge and Activated Carbon has the better result than that of sand alone at depth 120cm with respect to total chemical oxygen demand removal, total suspended solids removal which were 75%, 58% respectively.

The second run of the experiment was conducted to study the performance of three filtration medium. It was noticed that the Activated carbon (Jacobi) has the best removal efficiency with respect to $COD_{tot}$, T.S.S which were 79%, 94% respectively. The Sand medium mixed with Sponge had nearly the same results as sand mixed with A.C-LN.

The third run was conducted to study the effect of mixing ratio of Activated carbon Jacobi mixing with sand on the performance of the filter. It was noticed that, the removal efficiencies were increased as the weight of Activated carbon Jacobi in the mixing ratio were increased as well with respect to $COD_{tot}$, T.S.S which were 88%, 99% respectively.

The fourth run was conducted to study the effect of mixing ratio of sponge medium mixing with sand on the performance of the filter. It was found that all chosen mixed ratio have effluent quality that are complied with law 48, year 82 with respect to

$COD_{tot}$ &T.S.S. However the removal efficiencies were increased as the sponge in the mixing ratio were increased as well and the best mixing that gave the best efficiency was at the mixing ratio Sand: Sponge was 1:0.85 with respect to $COD_{tot}$, T.S.S which were 70%, 89% respectively.

Fifth run was conducted to study the effect of Rate of filtration on the performance of the filtration process using the optimum mixing ratio of Sponge and Sand from previous run. It was found that the optimum infiltration rate was IR=2 m3/m2/d at the mixing ratio Sand: Sponge (1:0.35) with respect to $COD_{tot}$, T.S.S which were 64%, 75% respectively.

The sixth run was purposed to test the use of ceramic cylinders for improving the performance of the filtration and removal of pollutants from drain water. It was noticed that the removal efficiencies were increased as the ceramic cylinders in the mixing ratio were increased as well. The best mixing that gave the best efficiency was at the mixing ratio of Sand: ceramic cylinders of 1:0.27 with respect to $COD_{tot}$, T.S.S which were 77%, 79% respectively.

From the research work it was found that ceramic cylinders considered as the most feasible media that can mixed with sand as it is locally produced and its price is low.

Key words:

Drain water treatment, Belbies drain, ceramic Cylinders, rural communities, sand filter, and packing material.

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Thank you

Date:

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# CHAPTER 1

# INTRODUCTION

## GENERAL

Management of water resources can define as a good balance between the supply and demand that helps to keep the good water quality. In Egypt, The major source of water comes at most from the River Nile. The quantity of water is not sufficient all cultivated lands which suffer from decrease in irrigation water .Also there are short and long term programs of land expansion and reclamation depended on two main schemes. [45]

Firstly: the increasing of the productivity and the size of the cultivated areas

Secondly: the increasing the area of reclaimed soils, Egypt efforts to increase the agricultural industries to increasing the farming input in the old Valley and Delta lands. Also to increase the cultivated area outside them in the newly reclaimed desert lands. [45]

Agriculture is a very important sector in Egypt. Irrigation of the fields extracting and distributing the water from the Nile River is a critical activity on which large parts of the country's economy rely.

Egypt has made significant strides in the water sector and sanitation ahead of the 2015 target, with 98% of the population having access to drinking water on premises in urban areas and 95% in rural areas .However, Egypt is dependent on the Nile River for water and its annual quota is fixed and insufficient to meet the growing needs of the population. The country is facing an annual water deficit of about 13.5 BCM/year and is among the ten countries threatened by water scarcity by 2025. On the other end, drains collect the remaining water coming out from the fields, which was not used for irrigation. It is considered to be "less clean" water drain water to be discharged back to the Nile. [46].

Presently the vast majority of existing wastewater treatment plants (WWTP) in Egypt discharge into drains, because the quality of treated wastewater does not allow to discharge into canals. This implies that the treated water (and the eventual nutrients included in it) are lost for reuse in the agriculture.

Due to limited resources and capacities, not all WWTP comply with the standards (law 48) for discharging into the drains. Also non-point source of pollution coming from untreated sewage from village. [1]