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Stabilization Tank with Respect to Detention Time for Grey Water Treatment

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Abstract: Characterization and treatment of grey water; options for (re)use. PhD thesis, Wageningen University, The Netherlands. Addressing the issues of water shortage and appropriate sanitation in Jordan, domestic grey water treatment receives growing interest. Grey water comprises the domestic wastewater flows excluding waters associated with the toilet. The topics of concern for grey water are its characteristics, treatment and potentials for use after treatment. The target of this thesis is to develop a concept for treating grey water on-site for agricultural usage, thus sustaining a recycling process of grey water in Jordan. A review was made regarding the currently available grey water treatment technologies. In addition, grey water was quantitatively and qualitatively characterized, and then grey water reuse requirements including treatment, were analyzed. Biodegradability and biodegradation rates of the grey water were investigated for selecting appropriate design and operation criteria of the treatment technology to be developed. A low-tech semi-technical scale treatment system was tested to treat grey water discharges from a dormitory at the Jordan University campus. The treatment system was evaluated on obtained removal efficiencies and conformity of the effluent to the guidelines for the use of reclaimed water for irrigation in Jordan. Finally, the objectives, approaches and the results of each chapter are summarized, and then both the results and the potential of applying decentralized sanitation and reuse (DeSaR) concepts in Jordan are discussed. Results show that storage and treatment are prerequisites for any type of grey water use. Grey water is aerobically and anaerobically biodegradable but the conversion rates are low. The core of the treatment concept consists of an integrated storage and anaerobic treatment unit, fed with a natural influent flow pattern, in a down-flow mode, up to a one day operational cycle, i.e. a variable HRT ≤ 24 hours. The second step consists of an aerobic post-treatment, mechanically aerated in a down-flow mode and a one day operational cycle, i.e. 24 hours HRT. Both units need insulation in the winter period. The final effluent, stable in winter and summer, meets the Jordanian standard, except for the pathogens, for usage in restricted irrigation.

I. INTRODUCTION

This review aims to discern a treatment for grey water by examining grey water characteristics, reuse standards, technology performance and costs. The review reveals that the systems for treating grey water, whatever its quality, should consist of processes that are able to trap pollutants with a small particle size and convert organic matter to mineralized compounds. For efficient, simple and affordable treatment of grey water with safe effluent reuse, a combined anaerobic-aerobic process is recommended, with disinfection being an optional step. The removal and subsequent conversion of suspended and colloidal particles in the anaerobic process need further improvement. Furthermore, the reuse standards should be revised and classified considering the reuse options and requirements. Raw grey water treatment is a prerequisite for storage and use. The aim of treatment is to overcome esthetic, health and technical problems, which are caused by organic matter, pathogens and solids, and to meet reuse standards. Raw grey water pollutants, measured as COD, have an anaerobic and aerobic biodegradability of respectively 72-74% (Elmitwalli and Otterpohl, 2007; Zeeman et al., 2008) and 84±5% (Zeeman et al., 2008). Furthermore, 27-54% is dissolved, 16-23% colloidal, and 2850% suspended.

II. METHEODOLOGY

The source of the grey water used for this study was the waste streams of shower, laundry and washbasins discharged into a single outlet pipe of a 150-female dormitory at the jordan university campus. The outlet pipe was retrofitted so that it discharged the wastewater, 7 m3, directly into the pilot plant. An auto-sampler collected daily composite samples from the inlet pipe of the pilot plant. The autosampler (isco, 6712), consisting of 24 1 l bottles, was programmed to withdraw every 15 minutes 250 ml of grey water. For analysis a daily composite sample was prepared on-site, by mixing the content of the 24 bottles in one container of which 3 litres was taken for analysis, performed on the same day. In this way 60 composite grey water samples were collected and analyzed over a period of 2 years.

III. GREY WATER TREATMENT SYSTEMS

A grey water treatment system consists of different treatment steps that might be considered, depending on the required quality of the effluent. Several treatment technologies can be used in each step. Technologies examined for treating grey water are classified based on the treatment principle: physical, biological, chemical or a combination of these. Furthermore, the technologies are reviewed in terms of performance, operation, and the encountered problems.

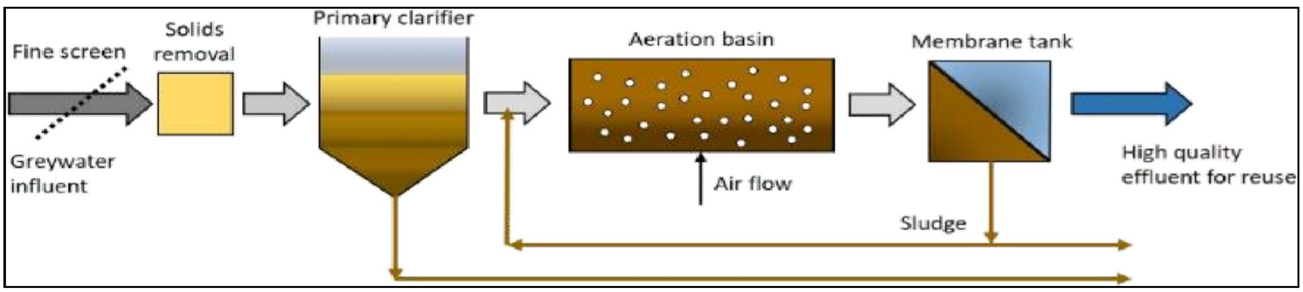


Figure 1 Grey water treatment with membrane bioreactor technology

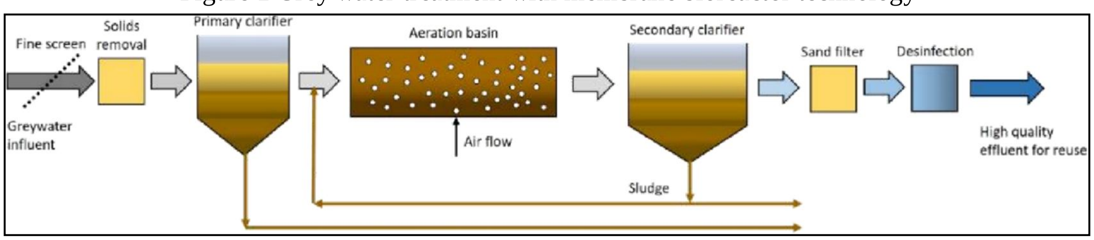


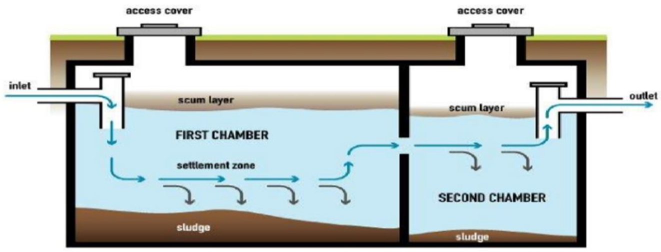
Figure 2 Grey water treatment with conventional technologies

A. Primary Treatment

1) Grease Trap

A grease trap (also known as grease interceptor, grease recovery device, grease capsule and grease converter) is a plumbing device (a type of trap) designed to intercept most greases and solids before they enter a wastewater disposal system. Common wastewater contains small amounts of oils which enter into septic tanks and treatment facilities to form a floating scum layer. This scum layer is very slowly digested and broken down by microorganisms in the anaerobic digestion process.

2) Septic Tank



B. Working

Most septic tanks have two chambers. The first chamber receives all the household sewage from toilets, showers, sinks, dishwasher, etc. The solids (sludge) sink to the bottom of the tank, and fats, oils and grease (scum) float. The remaining water (known as effluent) then passes into the second chamber. From the second chamber in the septic tank the effluent is either sent to a septic field, or a wastewater lagoon or lift station.

IV. CONCLUSION

An anaerobic treatment unit operated in up-flow mode, at a feeding pattern following the dormitory grey water discharge pattern and at a continuous constant discharge pattern with a varying liquid reactor volume, in a 1 day operational cycle, can combine storage and treatment grey water, while accommodating the variation in flow pattern.

The COD removal from anaerobic treatment of grey water, combining storage and treatment, reaches up to 42 and 89%, for respectively the otal and suspended COD fractions.

The COD removal from aerobic post-treatment of anaerobically treated grey water at an HRT of 1 day amounts to 54, 53 and 59%, for respectively the total, colloidal and dissolved COD fractions.

A. Recommendations

To improve the biodegradability of grey water pollutants, i.e. to promote that materials that end up in the grey water are better degradable, such as biodegradable detergents. To develop reliable multi-category standards for grey water reuse, combined with guidelines for safe practice.

B. Future Research

Investigating the physical properties of grey water pollutants, such as the particles’ size distribution and surface charges, in order to improve the performance of both biological and physico-chemical processes needed for the cost-effective treatment of grey water. Studying the potential of integrating grey and black waters recycling processes, in Jordan as well as the proper management of it.

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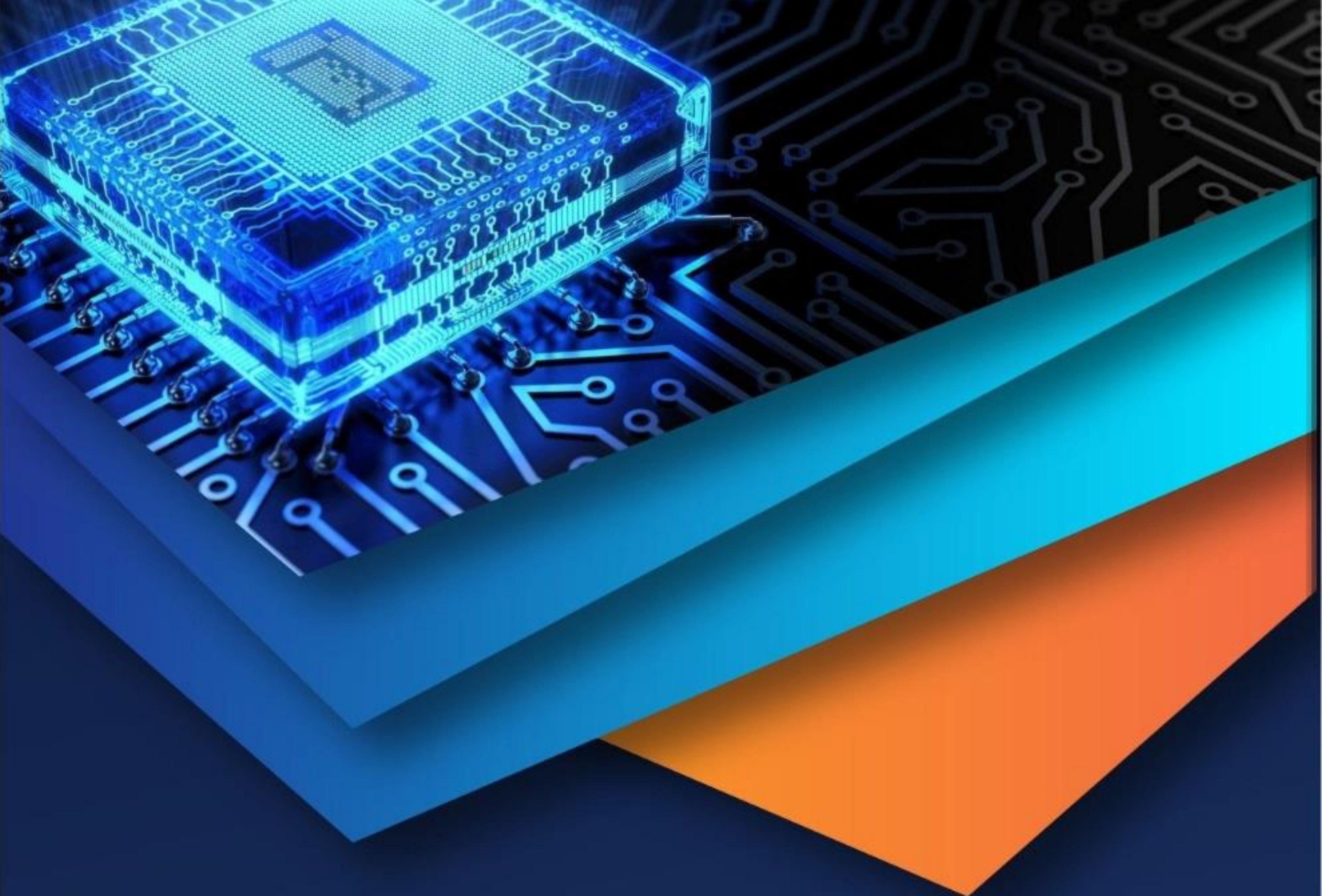

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