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**Title of study: “Efficiency of filter with post-treatment of effluent stabilization’s lagoon, by one experimentation’s unit in San Marcos, Carazo; using red rock volcanic how medium filter in April to September 2008”**

## **ABSTRACT**

The purpose of this study was to determine the effectiveness of a rock filter unit in the post-treatment of the effluent in stabilization ponds, using red concrete as a filtering medium. The study consisted of the laboratory testing of effluent water samples. Red rock would be used as the filtering medium in order to determine the effectiveness of this medium in removing organic matter. Three different hydraulic retention times were used: 19 hours, 15 hours, and 12 hours.

Firstly was built experimental unit which was located near the treatment plant for domestic wastewater in the municipality of San Marcos in the department of Carazo. This unit was constructed so as to allow a vertical flow which combines an upstream and a downstream, resulting in a greater length of seepage through the supporting medium composed of rocks in the internal space the filter.

The variables physicists can mention: Temperature, Total Solids, Total Dissolved Solids, Total Solids suspense. Among the biochemical parameters are Biochemical Oxygen Demand, Chemical Oxygen Demand; and microbiological find thermotolerant coliforms. The result, to determine the efficiency of the filter is analyzed the same parameters used in the characterization of the effluent from the lagoon, resulting in removal efficiencies up to 55.53% in organic matter removal, and 64.60% for suspended solids retention time Water for 19 hours, the same way we analyzed the efficiency of filter retention times of 15 hours and 12 hours in what they found removal of organic matter 67.84% and 56.59% and 82.77% and 77.51% for total suspended solids respectively.

## CONTAIN

### Sewage.

There are several definitions of waste water, according to Eduardo Ortega Korea. (1953)<sup>1</sup>

“is known residuary water, to all water produced by urban life and are made from the excrement of the human body, feces and urine produced by the domestic, washing, cooking, etc.; those produced by industries and the water flow to sewage infiltration”.

Rolim, Mendonça, S. (2000)<sup>2</sup> said "The Wastewater can be defined as the water from the water supply system of a population, having been amended by various applications in domestic, industrial and community, being collected by the sewerage system that lead to a proper destination. "

From the above we can see that the authors agree that sewage is water from human activities, generated from different sources with different uses and characteristics. The composition of waste water depends on their origin and treatment before discharge to receiving bodies, since even in their natural state waters contain components of active and inactive substances such as gases, microorganisms, metals, acids, etc. Table 1.

**Table 1: Summary of uses and the type of property of each constituent used to estimate the quality of wastewater.**

Taste	Characteristic	Use or significance of result
Totals Solids	Physical	Determine the process more efficient for its treatment.
Total Dissolved Solids	Physical	Determine this sediment solids between at time
Chemical Oxygen Demand	Chemical	Used how substitute of COD's test
Biochemical Oxygen Demand	Chemical	Quantity's measure of oxygen for stabilize biological a residue
Thermotolerant coliforms	Biochemical	Quantity the bacteria's pathogen
Temperature	Physical	Design and operation of installation
pH	Chemical	Measure of acid of solution watery

Source: Wastewater Treatment in Small Towns. ENACAL. pp. 22.

<sup>1</sup> Ortega Corea, E. (1953). *Proyecto de Planta de Tratamiento de Aguas Negras para una Población de 10000 habitantes*. D.F.: México. pp.14

<sup>2</sup> Rolim Mendonça, S. (2000). *Sistema de Lagunas de Estabilización*. Brasil. pp.1

### **Sand Filter.**

Sand filtration technology is a wastewater treatment oldest known. Sand filters are beds or beds of granular material, or sand and drained or drained to below pre sewage - treated can be treated, collected and distributed by the land application system.

These are generally used to polish the effluent from septic tanks or other treatment processes before distributing it on the floor. The typical sand filter is an airtight box lined, usually concrete or plastic and filled with a sandy material.

### **Rock Filters.**

They consist of beds of submerged rocks in which they remove suspended solids (algae) by sedimentation as water flows through the bed. The algae accumulated in the filter are degraded biologically releasing nutrients that are used by bacteria that grow on the surface of the filter.

The performance of these filters depends on the load of application are in an order of  $1 \text{ m}^3$  of effluent filter for  $1 \text{ m}^3$  of stone every day. The stones have dimensions between 50 mm and 200 mm (values greater exposure reduced surface area, lower can lead to stagnation and shorts). The bed height should be 1.5 m to 2 m. In this type of filter the water can flow horizontally or vertically, the vertical type may be further upward or downward flow. Most recommended are those upstream, since being introduced below the surface layer can be avoided odors.

Volcanic rock filters have advantages in terms of their low costs of construction and operation. As for its disadvantages can be mentioned in particular odors when raw sewage have significant concentrations of sulfate (more than  $50 \text{ mg l}^{-1}$ ). Moreover the period of design and cleaning procedures for these filters has not been established yet.

### **Red as a filter medium Concrete.**

Red Concrete is a stone of volcanic origin composed of porous particles and interconnected. Geologically are pyroclastic reddish, massive in structure, although there seems to be very rude lamination defined by the larger grains do not show any hardening, due to its stability.

In Nicaragua they are found in abundance in the west of Managua, one of these sites is located near the south road on the track sub urban, others are in the neighborhood Batahola in Jiloa and pebbles. Also find them on the edge of the highway to Masaya, near the volcano where are cinder cones and Nandaimé municipality, department of Granada.

Some mechanical properties<sup>3</sup> of this material are its dimensional weight ranging between 1200 and 1800 kgm<sup>-3</sup>, average of 2.65 specific gravity, high porosity with an average absorption rate of 2.48% and a compressive strength between  $3.5E^{+06}$  Pa - $4.0E^{+07}$  Pa.

### **Type of study**

The study is located in the category of experimental research prospective cross-sectional<sup>4</sup> and that determined how well they rock filters of vertical flow and post-treatment of wastewater stabilization ponds based on the reason that these waters flow into a inadequate quality, and while the study takes place in a period of time.

Moreover, the study is multidisciplinary with a quantitative approach because it encompasses various scientific areas such as chemistry, biology, microbiology, civil engineering, environmental health and, in addition to data collected and analyzed.

**Runtime:** The investigation was carried out over a period of thirteen months. Which two weeks were used to characterize the effluent from the stabilization pond, sixteen weeks for laboratory sampling and analysis to determine the efficiency of the filter, which began its operation on 2 June this year and the rest of the time for theoretical data collection, fund raising and reporting?

**Universe:** The universe for the study covered the domestic waste water treated in stabilization ponds plant San Marcos, Carazo.

**Sample:** The sample to determine the efficiency of the filter, consisted of a certain amount of domestic wastewater collected from the effluent treatment system.

**Sampling:** Sampling of waste water and receiving streams, is one of the most fundamental aspects in any program that aims to reduce the degree of pollution in natural resources. As

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<sup>3</sup> Jerez Fernández, J. (1991). *Uso de la escoria volcánica como agregado grueso para concreto*. Managua, Nicaragua: Monografía.

<sup>4</sup> Piura, López, J. (1995). *Introducción a la Metodología de la Investigación Científica*. Tercera edición. pp. 92.

for performance evaluation of this system was previously necessary to raise a careful sampling program considering the following aspects:

Sample volume: taking into account the possibility of repeated analysis with dubious results, the total volume was 12 liters.

For the composite sample was necessary to consider the average flow, the flow times, the sampling time and the total sample to determine the sample volume to be collected per hour

using the following expression. 
$$V_{mh} = \frac{Q_H \times V_{muestra}}{Q_{prom} \times T_m} \quad (1)$$

Where:  $V_{MH}$  = Volume of sample Time

$Q_H$  = Flow time

$Q_{prom}$  = average flow

$V_{muestra}$  = Sample Volume

$T_m$  = Sampling time

**Sample Type:** The type of sample was composed and performed the flow proportional to the characterization of wastewater from the current system. To determine the efficiency single samples were taken.

**Sampling frequency:** To characterize the wastewater effluent from the existing treatment system were carried out four rounds of sampling for two weeks, of which two rounds were 12 hours and 2 of 24 hours.

For the analysis of efficiency, single samples were taken for 18 weeks, carried out as shown in Table 3 sampling frequency. Table 2.

**Table 2: Sampling.**

For determinate the efficiency of filter			For characterize lagoon's effluent		
Parameter	Frequency of show	Totals of show in four month	Frequency of show	Totals of show	Totals of analysis
Biochemical Oxygen Demand	A time on week	14	Four time on week	4	32
Chemical Oxygen Demand	Two time on week	25		4	54
Totals Solids	A time on week	15		4	34
Totals suspend solids	A time on week	15		4	34
Total Dissolved Solids	A time on week	15		4	34
Thermotolerant coliforms	A time on week	11		4	26
ph	A time on week	15		4	34

\* This value must be multiplied by two to find the overall analysis, since sampling only represents a tributary of the filter and does not include sampling for the effluent from the filter.

**Variables:** To characterize the effluent from the stabilization pond and determine the efficiency of the filter is taken into account the following variables and sub variables: Flow, Hydraulic Retention Time, and Volumetric Organic Loading

Water Quality Biochemistry: pH, Biochemical Oxygen Demand (BOD) and chemical oxygen demand (COD).

Physical Quality of water: Total Solids, Total Dissolved Solids and Total Solids moment pause.

Bacteriological Quality of Water: Thermotolerant coliforms.

**Description of unit testing to pilot scale:** Overall, the upflow rock filter consists of three functional areas: Entrance area, which allows a uniform distribution of the residue on the filter media; packed zone, which senses the environment and presents the main bacterial growth; and Zone output.

**Entrance area:** It was composed of a collection unit, a driving unit, a flow control unit, and two units of distribution. The collection unit consisted of a container of approximately 12 cm in diameter and 25 cm high connected to pipelines. The driving unit was a ½-inch PVC pipe diameter with a length of 18.70 m. The flow control unit was carried out with a pass valve ½ "which will regulate the flow for a given hydraulic retention time. And the distribution unit was composed of a perforated hose which allows a distribution to a perforated sheet also allows the percolation of water into the filter medium.

**Area packaged:** packed area is known as that part of the filter which is the filter medium. In practice, the axis of the system, as this is where we present the cell growth of microorganisms and the consequent removal of organic pollutants.

This part consisted of two parts, one which models a downstream filter media which are rocks from 2.5 cm to 10 cm and distributed in a circular ring in the filter in three layers of rocks, and an area where an upward flow is modeled rocks consisting of 1 cm to 3 cm in diameter, equally distributed in three layers into a cylinder in the center of the circular ring. On the other hand, these areas were separated by a false bottom unit located at the bottom of the filter which consists of a metal grid designed exclusively to hold the rock material.

**Output Area:** Similar to the entrance area, exit area should ensure a homogeneous and uniform distribution of residual water, thus avoiding the formation of dead zones and short circuiting. It consists of a ½ inch pipe diameter, it was connected to the inner cylinder

where the material is finer, and the upward flow occurs, the pipe was placed at a height of 1.40 m.

## CONCLUSIONS

The results obtained in the characterization stage effluent water stabilization pond system in San Marcos, Carazo, show that water pouring this system is not very suitable to be discharged to a receiving environment or for reuse through irrigation, since the results presented values above those required by Nicaraguan standards, this plant discharged an average flow of  $4.7 \text{ ls}^{-1}$ , the water has an average total solids content of  $589.75 \text{ mg l}^{-1}$ , divided into Total Dissolved Solids  $466.50 \text{ mg l}^{-1}$  and suspended from  $123.25 \text{ Total solids mg l}^{-1}$ .

As for the parameters that determine the degree of contamination Biochemistry, the waters have a chemical oxygen demand of  $253.95 \text{ mg l}^{-1}$  and Biochemical Oxygen Demand of  $160.12 \text{ mg l}^{-1}$ , so this water needs to a post - treatment which reduces their pollution levels.

It is therefore considered that the filter would rock a viable option for this post - treat as is evidenced by the experiment that this method has very good results from removal of organic matter, although she had been inoculizado prior to its operation.

The efficiency of the filters in load removal is associated with biological activity strongly related to temperature and mainly by the variable time

Hydraulic retention time in respect of the environment in which a liquid remains inside the filter.

To analyze the removal efficiency of this filter is used the retention times of 19 hours, 15 hours and 12 hours. Of which performed better when using the HRT of 15 hours, since in this period, showed the highest loads and effluent values remained below the maximum required in the Ordinance 33-95 to be poured and used in irrigation.

For the HRT of 19 hours, the average volumetric loading the filter was operated  $\text{grDQOm}^3\text{día}$   $438.01^{-1}$  and a flow rate of  $0.0042 \text{ ls}^{-1}$ , yielding averages of 55.53% in removal of Chemical Oxygen Demand, 58.93% for Biochemistry Demand Oxygen and 64.60% for total solids withdrawn.

Then, using the HRT of 15 hours, the average volumetric loading the filter was operated  $\text{grDQOm}^3\text{día}$   $760.29^{-1}$  and a flow rate of  $0.0054 \text{ ls}^{-1}$ , yielding averages of 67.84% in

removal of Chemical Oxygen Demand, 48.14% for Biochemical Oxygen Demand and 82.77% for total solids withdrawn.

Also, for the HRT of 12 hours, the average volumetric loading the filter was operated  $\text{grDQOm}^3\text{día } 362.14^{-1}$  and a flow rate of  $0.0066 \text{ ls}^{-1}$ , obtaining clearance averages 56.59% for Chemical Oxygen Demand, 58,47% for Biochemical Oxygen Demand and 77.51% for total solids withdrawn.

On the contrary, regarding the removal of total dissolved solids and thermotolerant coliforms this type of treatment was not well suited for load holding time employed, as levels were very high in the effluent of them.

As the filter medium, we affirm that the concrete red may be a filler material to be used in the filter rock, because it has good features to retain and remove the organic matter present in the household-type waste water treated in lagoons stabilization.

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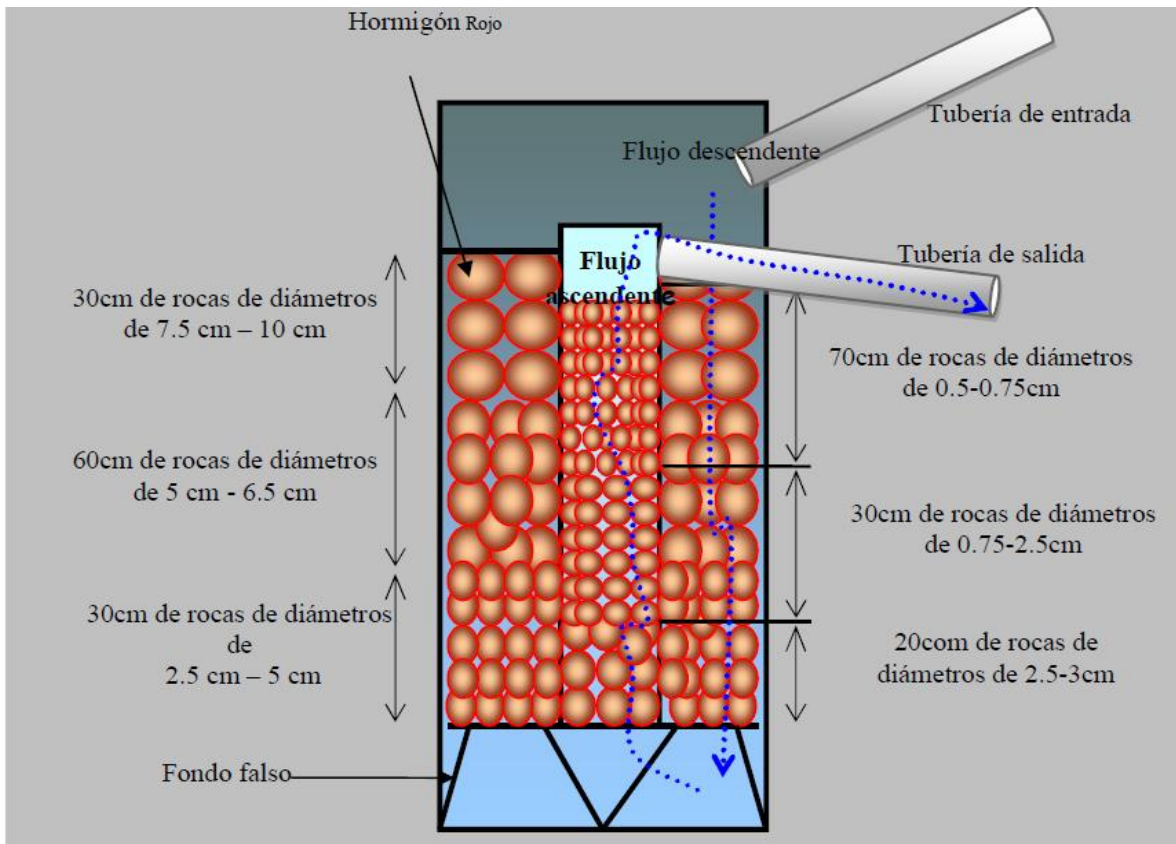


Figure 1: Schematic of the filter material rocky red concrete.  
 Source: Authors. (2008). Filter Scheme rocky red concrete material.



Figure 2: Unit testing at pilot scale, located on the grounds adjacent to the concrete-lined canal and along the stream to which discharge their effluent.  
 Source: Authors. (2008). Taken by the author.



Figure 3: Sample collected in the influent and effluent of the filter rock. You can see the difference in color, green in the influent and effluent clearer.  
Source: Authors. (2008). Taken by the author.