BIOFILTRATION FOR TREATMENT SEWAGE WATER OF MEXICAN SOUTHEAST COMMUNITIES

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Abstract

Mexico Southeast is located south of Neovolcanic axis. In this area there are tropical forests with a great diversity of wood species, that are manufactured in sawmills where are produced several tones of wood wastes. On the other hand, in the Mexico Southeast there are not enough sewage water plants. One of the purposes of The Mexican Institute of Water Technology is develop and implement treatment technology, economic and easy to operate. The trickling biofilter is a technology that helps to reduce Chemical Oxygen Demand, Oil and Grease, Total nitrogen, Total phosphorus and Fecal Coliforms. For the Mexico Southeast this technology is an available option, because there are sawmill and wood manufacturing companies that generate wastes that aren't totally used and represent a good source of organic matter. The objective of this study was evaluate the remove efficiency of two trickling biofilter packed with tropical wood chips from sawmills with two kind of effluent (slaughterhouse sewage water and municipal sewage water). It was possible obtain high percentages of removal of organic matter, nutrients and microbiological indicators.

Keywords: Trickling filter, Woodchips, Mexican southeast and slaughterhouse.

Introduction

Mexican Southeast is located south of Neovolcanic axis, to 20°, include the following Mexican states: Guerrero, Oaxaca, Puebla, Chiapas, Veracruz, Tabasco, Campeche, Yucatan and Quintana Roo, (Plan (Puebla-Panamá, 2001). The covered area is 54,568 km^2 about 27.5% of Mexican territory, with a 28.6 millions inhabitants (INEGI, 2005). Around 8 million people from this area live in small towns with marginal conditions (CONAPO, 2005). Water availability in this area is 13,290m^3/inhabitant/year. On the other hand, in this area there are not enough sewage water plants. The sewage treatment facilities in this region are 400, (CNA, 2008). One of the purposes of the Mexican Institute of Water Technology is develop and implement treatment technology, economic and easy to operate. According with Rzedowski (2006), the principal vegetation communities present on Mexican Southeast are: Pine-Oak forest, (mainly Quercus); mesophile mountain forest; evergreen tropical forest; tropical subcaducifolium forest and tropical caducifolium forest. Many of these trees are used with different purpose. The trees are processing in sawmills where are produced several tones of wood wastes, that can be grinded to produce wood chips, photos 1 to 2. Trickling filter packed with organic materials

removes suspended solids (TSS), chemical oxygen demand (COD), total nitrogen (TKN), total phosphorus (PO4-3), oil and grease (O&G) and fecal Coliforms (FC), (Garzon, et al. 2007). This technology is a feasibility option because there are a lot of wood wastes from sawmill that can be used as available source of filter media (FM). The purpose of this study was to assess the efficiency of two trickling filter packed with tropical wood chips in the treatment of two kind of sewage water: slaughterhouse waste water (SHSW) and municipal sewage water (MSW).

Photos 1 to 3.-Wood wastes in sawmills and regional wood processing companies

Methods

Analytical methods used in this study are mentioned in table 2.

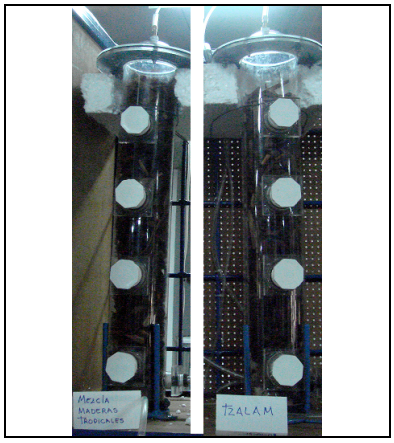
Table 2.-Analytical methods

Parameter	Method
COD mg/L	Method 5220-C. "Chemical Oxygen Demand" "Closed Reflux, Colorimetric Method", American Public Health Association, "Standard Methods for The Examination of Water and Wastewater", American Public Health Association, United States of America, Washington, DC 20005, 19th Edition 1995, pp. 5-12,5-16.
Oil and Grease mg/L	Method 5520 E "Soxhlet Extraction Method". Standard Methods for the Examination of Water and Wastewater, USA, American Public Health Association (APHA), Washington, DC 20005, 19th Edition 1995, pp 5-34.
Total Kjeldahl Nitrogen mg/L	4500-Norg B "Macro-Kjeldahl Method", American Public Health Association, "Standard Methods for The Examination of Water and Wastewater", USA, APHA, Washington, DC 20005, 19th Edition 1995, pp 4-92 4-93.
Total phosphorus mg/L	Method 4500-P D, "Stannous Chloride Method", American Public Health Association, "Standard Methods for The Examination of Water and Wastewater", American Public Health Association, United States of America, Washington, DC 20005, 19th Edition 1995, pp. 4-106 – 4-112.
Fecal Coliforms	Standard Methods for the Examination of Water and Wastewater. 15th edition. 794-805 pp. 1980.

Two laboratory scale biofilters (BFs) were installed and fed with two different effluents. The biofilters used were PVC columns of 0.7 m high and 0.13 m inner diameter and 3.5 L volume. Both biofilter were operated and fed similarly during 180 days. Operational conditions: Filtration velocity ≤ 0.5 $m^3/m^2.d$; aeration rate 15 m^3 air/ $m^2.d$. Each column was packed, from the bottom to top with: 1) 0.05 m of gravel and 2) 0.63 m wood chips. **BF-1** was packed with mix woodchips. The different wood species were: Lysiloma lasiliquum, Lochoncarpus Castillo, Cedrela odorata, Swetenia microphylla, Bucida buceras, Acosmium panamense, Manikara zapota, Tectona grandis and Burcera simaruba and was fed with slaughterhouse sewage water (SHSW) and **BF-2** was packed only with wood chips from Lysiloma lasiliquum, more available wood in the area and was fed with municipal sewage water (MSW), (photos 4 and 5).

Results

BF-1 fed with SHSW removed: 99% of COD; 96% of BOD_5; 90% of NTK; 46% of PO_4^{-3}; 90% of O&G; and removed FC from 1.5E+06 to 75.0 NMP/100 ml. **BF-2** fed with MSW removed: 83% of COD; 96% of BOD_5; 90% of NTK; 38% of PO_4^{-3}; 91% of O&G; and removed FC from 1.6E+06 to 69.0 NMP/100 ml, (Table 3).



Photos 4 and 5.-Experimental units Biofilter BF-1 and BF-2

Table 3. Biofilter removal parameters

Parameter	BF-1 (SHSW)		BF-2 (MSW)	
	Influent	Removal	Influent	Removal
	mg/L	%	mg/L	%
COD	2364	99	971.27	83
BOD_5	1820	96	255	96
TKN	566.26	90	44.13	90

Total phosphorus (PO_4^{-3})	125.46	46	30.59	38
O&G	83.3	90	78.45	91
FC NMP/100 ml	1.5E+06	75	1.6E+07	69

Conclusions

It was possible to remove, with high percentage, from both sewage water (SHSW and MSW) the organic mater, nutrients and microbiological indicator using trickling filter packed with tropical woods chips from sawmill. Better results were obtained using mix woods.

References

CNA. Inventario nacional de plantas municipales de potabilización y de tratamiento de aguas residuales en operación. Edición 2008. Subdirección General de Agua Potable, Drenaje y Saneamiento. ISBN 978-968-817-889-8. Edit: SEMANAT. México. 259 pp.

CONAPO. Indice de marginación a nivel de localidad. 2005. Disponible en: http://www.conapo.gob.mx/index.php?option=com_content&view=article&id=46&Itemid=194.

INEGI. Conteo de Población y Vivienda 2005. Instituto Nacional de Estadística y Geografía. Disponible en: http://www.inegi.org.mx/lib/Olap/consulta/general_ver4/MDXQueryDatos.asp?proy=cpv05_pt.

Garzón-Zúñiga, M.A., Lessard, P., Aubry, G., et Buelna, G. 2007. Aeration effect on the efficiency of swine manure treatment in a trickling filter packed with organic materials. Water Science and Technology, 55(10) : 135–143.

Plan Puebla-Panamá. Documento base del Plan Puebla-Panamá. Capítulo México. Marzo 2001. Coordinación del Plan Puebla-Panamá; Presidencia de la República Mexicana. Disponible en: http://64.202.170.137/index.php?option=com_docman&task=cat_view&gid=18&Itemid=4.

Rzedowski, J. 2006. Vegetación de México. 1ª. Edición digital, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México. 504 pp. Disponible en: http://www.conabio.gob.mx/institucion/centrodoc/doctos/vegetacion_de_mexico.html..