VETIVER SYSTEM USED IN WASTEWATER TREATMENT

Abstract: The concern for environmental health is a topic of discussion and a global alert that is reflected in many movements of awareness. In changing laws of many countries, the creation of international conventions and protocols and the constant search for new industrial technologies that are environmentally friendly.

Empresas Polar, firm leader in the manufacture of food and beverages in Venezuela has been no exception to the concern over environmental health, which is why research has developed systems for water treatment and soil using Vetiver agent decontaminator.

In Cerveceria Polar C.A. - East Plant located in Barcelona, Venezuela was made a test pilot with the main objective of evaluating the efficiency of the method for treating wastewater using Vetiver as agent decontaminator.

Based on the properties that own this plant for the removal of organic contaminants, elimination of suspended solids and reducing levels of COD in the effluent brewer.

Cerveceria Polar C.A. has recently installed a test system for treating wastewater using Vetiver grass to decontaminate the effluent brewer.

Figure 1. Vetiver System in Cerveceria Polar C.A East Plant

The development and use of Vetiver System is a worldwide movement with more momentum every day because of the effectiveness in removing pollutants and agrochemicals, by having a low-cost/high-profit, and not to generate environmental impacts and contribute to the sustainable use of soil and water. They are known uses of this system in Australia, Venezuela, China and India.

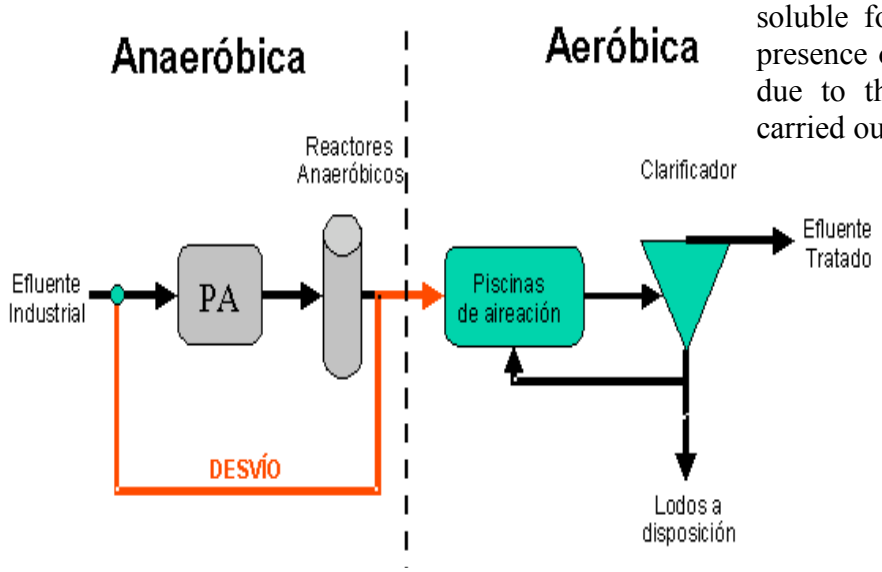
WASTEWATER TREATMENT USED IN CERVECERIA POLAR C.A – EAST PLANT

To treat effluents there are several processes, the specific use of one or a combination of these, will depend on the characteristics of the effluents and the cost, the availability of space, and the quality of water they want to learn about and the requirements in the standards of the water quality.

The aim of these treatments is to implement and achieve the parameters set out in environmental legislation to be unloaded in natural bodies of water can be reused or in internal processes such as irrigation, cleaning, cooling mechanisms, among others.

In the specific case of Cerveceria Polar C.A – East Plant, the wastewater treatment process consists in two stages, the first is the anaerobic treatment and the second is the aerobic treatment.

Figure 2. Waste Water Treatment Plant Diagram



The water resulting from the effluent treatment is not reused. It must comply with the parameters set out in Decree 883 (Standards for the classification and quality control of the water or liquid effluent discharges) to be able to be downloaded in the Neverí River.

Table 1. Parameters implement in Decree 883 (Standards for classification and quality control of the water or liquid effluent discharges)

Parameters implemented in Decree 883 (Standard for classification and quality control of water or liquid effluent discharges	
pH	6 - 9
COD	350 mg/l
BOD	60 mg/l
SST	80 mg/l
N	10 mg/l
P	10 mg/l

There is great variability in the characteristics of these effluents, but in most cases they are handled in common denominator in terms of high-volume, high COD and BOD, high biodegradability, the organic matter is in soluble form within the wastewater, the presence of suspended solids and pH end due to the various clean-up operations carried out in each area.

PROJECT VETIVER

There are 12 types of species Vetiver distributed in the tropics of Asia and the Americas. Only 3 of these 12 species are used in Systems Vetiver (SV) which are: Vetiveria Zizanioides, Vetiveria Nigritana, Vetiveria Nemoralis.

The use of Vetiver System considerably improves water quality by the ability of Vetiver grass to tolerate extreme conditions and the ability to absorb pollutants and solids. For these characteristics, in addition to its excellent cost-benefit, have turned to this method in the art of root filtration more effective to recover wastewater.

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For each liter of beer produced it consumes 6 liters of water, which translates to 9000 m3 a day of effluent going directly to the Waste Water Treatment Plant of Cerveceria Polar C.A along with the waste generated during the process of processing and packaging.

The effluent brewer is characterized by high levels of organic matter (N and P) as well as the presence of SST, and significant amounts of COD, maintaining a ratio of 0.6 to the BOD, and is characterized as an organic effluent readily biodegradable. These elements are absorbed by the root Vetiver by absorption, which contributes to the growth of the same.

Pollutans generates by liter of produced beer	Quantity
N	0,12 grs.
P	0,5 grs.
COD	10,5 grs.
SST	2,2 grs.

Table 2. Pollutants generates by Liter of produced beer.

Hart (2003) showed that under hydroponics conditions Vetiver grass is more effective in terms of removal of pollutants, which is why this method was chosen for the development and evaluation of this system.

The Vetiver System development in Cerveceria Polar C.A – East Plant consists of a set of 200-liter drums combined with each other, directing the flow of wastewater from the bottom of the container to the surface while passing through the roots of Vetiver. Each drum contains a unit of Vetiver (Vetiveria Zizanioides) planted in hydroponics on floating platforms. The incoming sewage system is supplied by a set of 1500-liter tanks. Each tank is filled with water from the anaerobic reactor. The purpose of these tanks is to separate solids from the anaerobic treatment to avoid obstructing the pipeline system.

Vetiver System was installed at the exit of the reactors of anaerobic treatment, in order to compare the effectiveness of Vetiver System with conventional aerobic treatment.

Figure 3. Vetiver System developed in Cerveceria Polar C.A. – East Plant.

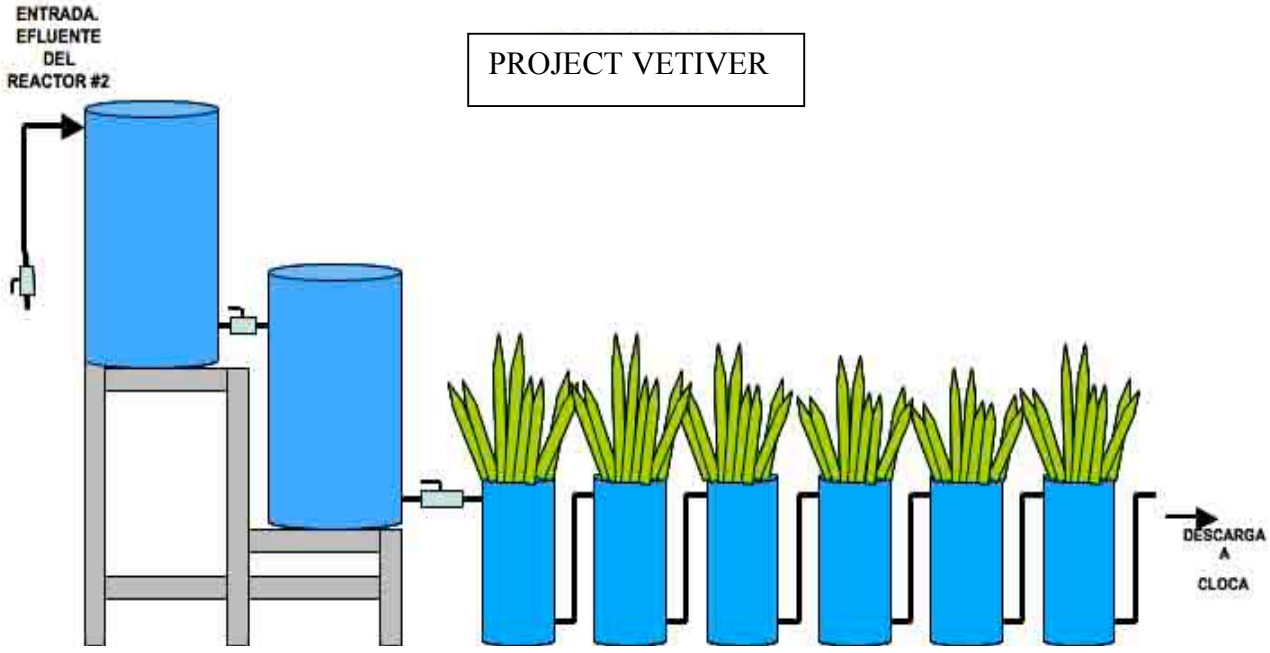
To assemble the Vetiver System, drums and installation valves, piping and adapters are necessary. The next step was to locate them and to connect them with the two tanks supplying the effluent from the anaerobic treatment.

Two tanks were used for the purpose of separating solids in the first tank (located at 1.50 m higher than the second tank) making the effluent of the second tank circle with a lesser amount of solids and between the system of drums by gravity (this tank to 1.50 m high soil), which is why, these tanks were placed in a two step metal platform system.

One of the major factors responsible in the outcome of Vetiver System is the time of residence to set out the effluent with Vetiver grass, the more time of residence the more effective in the removal of pollutants. In this case, we calculate an optimum flow rate of 27 Liters / Hours, taking into account the number of drums, the volume of water to be treated and the length of residence desired.

The key to the efficiency of Vetiver System is the ability to have this fast grass to absorb organic compounds and agrochemicals, retain sediment and withstand extreme weather conditions.

Figure 4. Vetiver System Diagram developed in Cerveceria Polar C.A. – East Plant.



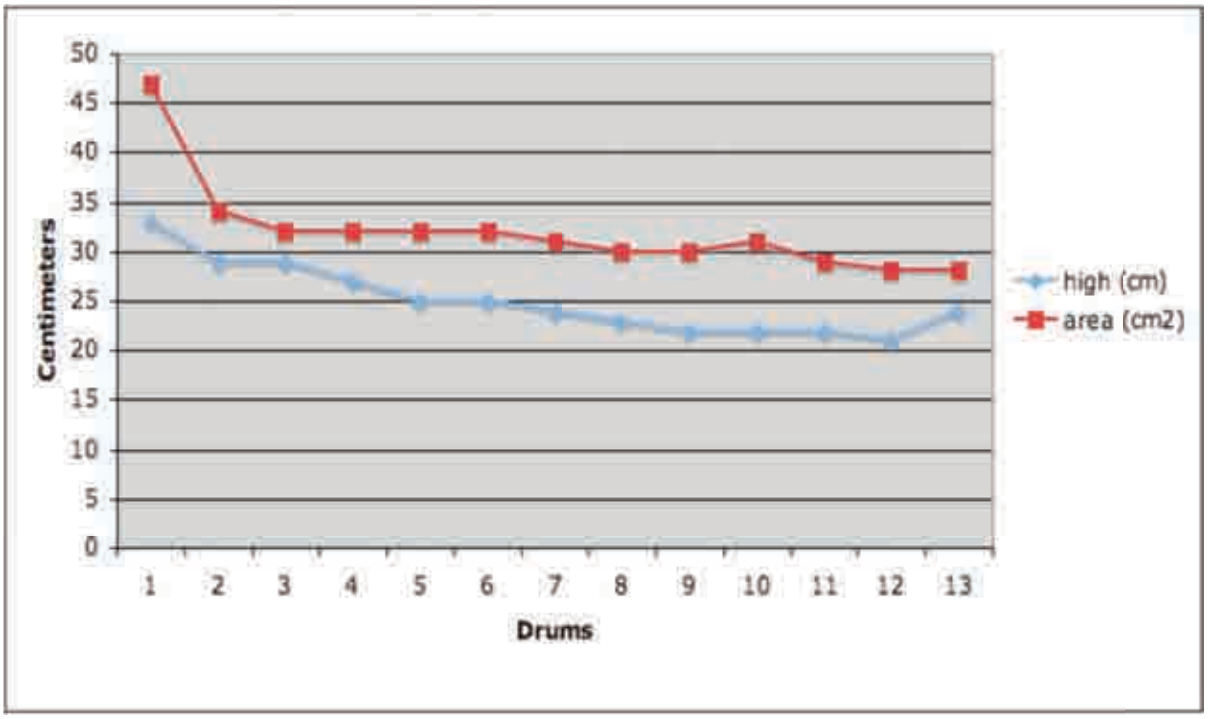
RESULTS OBTAINED

Biomass Monitor

The rate of growth of the stem of Vetiver grass is 2 centimeters per day. To monitor effectively the growth of the stem was measured up to this once a week as well as the area occupied by the unit inside the drum.

According to the results the plants had a higher rate of growth at the first reel, who were exposed to higher organic loads, while the end of the system had slower growth; this confirms the theory that the greater the concentration of organic matter the greater the development of biomass.

Figure 5. Biomass Growth Rate of the Vetiver System in Cerveceria Polar C.A. – East Plant.

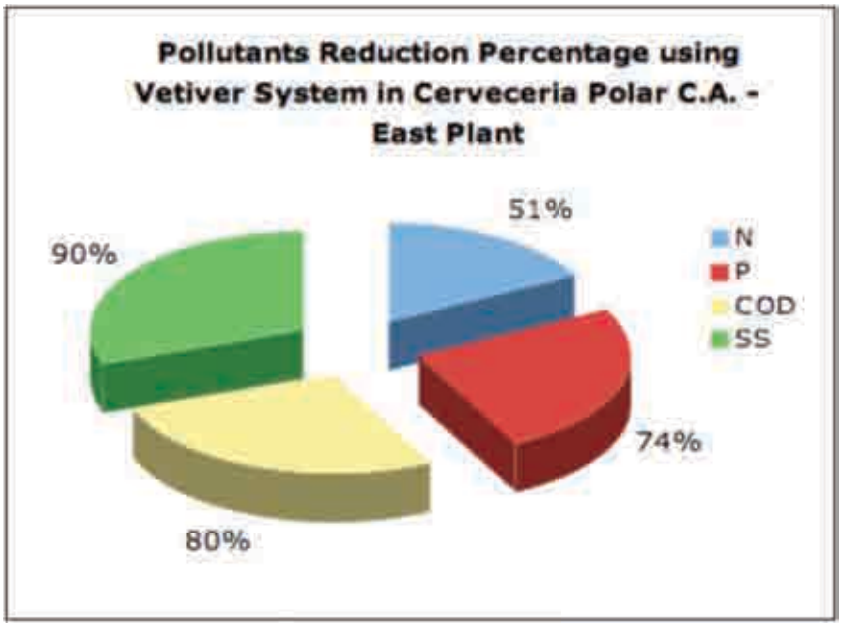


Because the pollution loads of effluent from Cerveceria Polar C.A. – East Plant is mostly made up of organic waste Vetiver absorbed these pollutants turning them into nutrients. Their growth was based on the fixation of nutrients like nitrogen and phosphorus. This leads us to conclude that a greater concentration of organic compounds, the greater the growth of biomass.

Physiochemical Lab Results

The Vetiver System is highly effective in the removal of solid particles suspended, introducing a percentage of clearing SST 90% since their roots act as a means to filter effluent flowing through them. As for the removal of N and P, there is a percentage of removing 51% and 74% respectively on the COD show a rate reduction of 80%

Figure 6. Pollutants Reduction Percentage using Vetiver System in Cerveceria Polar C.A – East Plant.



Comparing the results obtained in the conventional wastewater treatments (anaerobic and aerobic) with the Vetiver System results it is evident the efficiency of Vetiver System. Even though the Aerobic Treatment has a bigger removal capacity of contaminants particles, the Vetiver System fulfills the requirements established in the Venezuelan environmental legislation.

Table 3. Results Comparison between Conventional Wastewater Treatment and Vetiver System

Physiochemical Parameters	Anaerobic Treatment	Aerobic Treatment	Vetiver System
N	30 mg/l	10 mg/l	12 mg/l
P	27 mg/l	7 mg/l	7 mg/ l
COD	364 mg/l	59 mg/l	280 mg/l
pH	***	7_8	7_8
SS	175 m/l	19 mg/l	30 mg/l

A brewery handles massive flux quantities reason why it is considered necessary a fast way to treat the effluents. Vetiver System is very successful but requires long residence time to accomplish a maximum level of pollutants reduction. It is possible that the most recommended use for this treatment system is for low flux industry.

Similarly comparing the values of wastewater treated with the Vetiver System with those established in the Venezuelan environmental legislation, this indicates that the Vetiver System is highly efficient and meets the established Decree 883 for effluent on natural water channels.

Table 4. Results Comparison between Vetiver System and Parameters established in Decree 883.

Physiochemical Parameters	Vetiver System	Decree 883
N	12 mg/l	10 mg/l
P	7 mg/ l	10 mg/l
COD	280 mg/l	350 mg/l
pH	7_8	6_9
SS	30 mg/l	80 mg/l

CONCLUSIONS & RECOMMENDATIONS

The results of the evaluation of Vetiver System developed Cerveceria Polar C.A – East Plant, confirm the belief that Vetiver is an essential tool in effluents decontamination; this converts this method in an element that might contribute in alleviating the water crisis faced globally.

1. In Cerveceria Polar CA East-Plant, the use of Vetiver System was successful, the research proved the Vetiver efficiency to remove organic contaminants in wastewater. These results give a green and economical alternative to treat effluents, contributing with the sustainable development and to improve the environmental planning and the natural resources management.

3. The volume of wastewater treated daily by the Waste Water Treatment Plant of Cerveceria Polar C.A – East Plant is 9,000 cubic meters. This is why the implementation of the Vetiver System is not a tangible possibility for the treatment of these effluents. The implementation of Vetiver System as an alternative for the disposal of septic recommend applying the MEDLI model by creating wetlands channels through which circulate sewage, and pass through the Vetiver planted in the ground.

4. The Vetiver System is efficient when the wastewater treatment with high organic matter content, and low flux. This is due to the large residence time required to obtain efficient results for the treatment of effluents.

5. Industrially it is not recommended to use this system, due to high volumes of flow and the need for rapid treatment. It is important to take into account the characteristics of the effluent to deal with Vetiver and the origin of the same power to decide considerations to be taken into account.

6. It was noted that a more effective removal of contaminants in the results of physicochemical analysis during power to Vetiver System by potholes when compared with continuous flow of food, this is due to more precise control of the flow and concentration of solids in the tank.

In short, the Vetiver System could be an option for enabling rural and/or urban areas with limited economic resources, which is intended to treat sewage and avoid the use of septic tanks (polluting major aquifers).

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