MICROBIOLOGICAL ADJUSTMENT OF A WASTEWATER TREATMENT POND SYSTEM FROM A CASSAVA STARCH INDUSTRY

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The processing for extraction of the cassava starch generates a great amount of residues, liquid and solid. The wastewater treatment technology more used in many Brazilian cassava starch industries is the system of stabilization ponds. However, some plants have deficiencies that result in the awkward odor release and low organic load removal. Correcting these deficiencies, the Mokiti Okada Foundation has carried through microbiological adjustment works in different pond systems.

In this paper, the case study refers to an industry that processes about 400 tons of cassava per day, generating a daily average of 2,100 m^3 of wastewater. The treatment plant consists of sieves to retain cassava peel, decantation tanks and a system of stabilization ponds (01anaerobic, 02 facultative and 01 of burnishing) placed in series. The aim of this work is the microbiological adjustment of the wastewater treatment ponds.

In the beginning of the work, it had problems of preferential hydraulic flow in the ponds and there was a great solid presence in some areas, resulting in a reduction of the hydraulic retention time, decreasing the treatment efficiency and releasing odors.

Once readjusted the hydraulic flow, improving the effluent distribution in the ponds, Mokiti Okada Foundation carried through works of microbiological adjustment of the effluent. This adjustment was made from species selection, using *Effective Microorganisms (EM)* and through analytical monitoring (microbiological and physical-chemical analysis). Results have shown increase in the overall treatment efficiency and minimization of the odor release. The BOD_5 removal was over 80%, arriving 99%, with values lower than 40 mg/L in the final effluent, demonstrating that Mokiti Okada Foundation technology is efficient and feasible.

Key words: Wastewater Treatment, Cassava Starch, Effective Microorganisms, Efficiency, Odor.

Introduction

Cassava starch processing is an important activity in Brazil and it is in constant growth, employing many people. According to ABAM (Cassava Starch Producer Brazilian Association) an average of 428,051 tons of cassava starch were produced in Brazil in 2003, emphasizing that Paraná State produced 64.7% of this amount [1]. The cassava starch industry mentioned as a case study here is placed at this State and it processes about 400 tons of cassava per day, generating a daily average of 2,100 m^3 of wastewater.

Wastewater from cassava starch industry usually is a result of the cassava root washing and the starch extraction activities [2]. The last one is technically called *manipueira*.

The washing wastewater has a great amount of solids (soil and peels), but when it is partially removed by a decanter or a sieve, the effluent contains low organic loading rates. However, *manipueira* contains minerals (nitrogen, carbon, phosphorus, potassium, calcium, magnesium, sulfur, zinc, manganese, copper, iron and sodium [3] and a higher organic load. This effluent can become a by-product, with economic value.

Some researchers have already mentioned in their paper a list of works developed to aggregate economic value to the *manipueira* by considering its utilization as a fertilizer, herbicide, insecticide, nematicide, biosurfactant or substrate for microorganism growth, among other uses [4].

It is necessary to find low cost solutions to treat cassava wastewater tailored to the social and economic level of the industries to avoid dumping into rivers or on the soil, causing serious environmental impact. In this context, anaerobic and facultative ponds have been used as a low cost alternative to treat the cassava starch wastewater in many Brazilian regions. Anaerobic process possesses several advantages over an aerobic process, such as lower energy requirement, possibility of recovery of methane as energy source and lower sludge production, thus low nutrient requirements. The process can operate at low hydraulic retention time, high COD loads, wide fluctuation in influent feed characteristics, without the requirement of mixing [5]. This author mentioned the disadvantage of odor release of sulfide generated from the pond system, but nowadays there are solutions for solving these problems. Mokiti Okada Foundation developed a technology for treating wastewaters and minimizing the odor release (mainly from sulfur compounds), through applied microbiological techniques using Effective Microorganisms.

Effective Microorganisms are a result of a mixed culture of beneficial microorganisms, resulting from selection and cultivation of different species found in natural environment (soils, rivers, lakes), consisting of fungi, yeast, bacteria and actinomycetes [6]. Nowadays, there are different places where this technology is developed and one of these is the Research Center of Mokiti Okada Foundation, placed in Ipeúna, SP, Brazil.

In the beginning of this work, the wastewater treatment plant of the cassava starch industry evaluated had problems of preferential hydraulic flow in the ponds and there was a great solid presence in some areas, resulting in a reduction of the hydraulic retention time, decreasing the treatment efficiency and releasing odors. The aim of this work was to adjust this plant, promoting stabilization of the biochemical processes in the ponds, improving the efficiency treatment and minimizing the odor release.

Materials and Methods

The evaluated wastewater treatment plant is placed at the industry *Amidos Yamakawa* (Amaporã, Paraná State - Brazil) and is composed of sieves to retain cassava peel, decantation tanks and a system of stabilization ponds (01 anaerobic, 02 facultative and 01 of maturation) placed in series. This industry processes 400 tons of cassava per day, generating 2,100m^3 of wastewater /day (about 100 m^3/h), working 21 hours/day, from Monday to Saturday.

It was developed analytical and “in loco” monitoring, on monthly basis, through visits of technical support and samples collection for microbiological and physical-chemical analyses. The analyses were made by Mokiti Okada Foundation, using the Standard

Methods procedures [7], in samples collected in the following points: Pond 01 Inlet (influent) and Pond 04 Exit (effluent). The physical-chemical parameters analyzed were: BOD_5, COD, N, P, Cl, Solids, pH and Temperature. The monitoring was made from January 2002 to December 2004.

One decision made in order to get stabilization of the microbiological processes in the pond, improving the treatment efficiency, was the *EM* inoculations besides of the hydraulic flow adjustment. This adjustment was made by inserting new points for effluent distribution on the stabilization ponds (inlet and exit) to use all available area and to assure a “right direction” of the flow, improving the hydraulic retention time.

Effective Microorganisms (EM)

EM is cultivated in a molasses medium (liquid medium), supplied in a concentrate form. It was necessary to make its activation before use, by gradual water changing (adding molasses), to avoid large changes in the osmotic pressure in the cell wall of the microorganisms. The rates used were: 85% of water, 10% of EM and 5% of molasses. After homogenization, a fermentation period of 3 to 5 days is used, where the gases formation (mainly CO_2) was monitored every day, through the pressure relief in the container cover, during the EM activation process.

The activated EM proportion used in the wastewater plant was 1:52500 (40 L/d), added daily. EM was gradually added on daily bais (through dripping system on Pond 01) and, sometimes, through shock doses – “punctual doses” of the total volume, spread on the first half of the superficial area of the pond. These shock doses were applied in the beginning of the works, in three followed days in a proportion of 1:10500 (200 L/d), to assure a bigger population of microorganisms, increasing the microbiological activity in the environment and the treatment efficiency. These doses were always repeated when bigger organic loads were noticed in the inlet stream, through physical-chemical analyses, and when it was noticed some release of odors, especially from sulfur compounds.

Treatment Efficiency

The treatment efficiency was calculated comparing the analytical results obtained at

Pond 01 – Inlet and Pond 04 – Exit, in terms of BOD_5 and COD analyses, as expressed Eq.(1):

$$E_x (\%) = [(X - X_0)/X_0] \times 100 \quad \ldots (1)$$

Where:

E = treatment efficiency [%]

X = Analyzed Parameter – output value (effluent) [mg/L]

X_0 = Analyzed Parameter – output value (influent) [mg/L]

Results and Discussion

Results of the treatment efficiency are shown in Figure 1 and 2, in which is noticed that the BOD_5 and COD removal was upper 95% in most of the monitoring period. Lower efficiencies for BOD_5 removal were observed in months of January 2003 and January 2004, among others, and it is explained because in these months the influent organic loading rate was lower, once the cassava processing activity decreased. However, the treatment efficiency for both BOD and COD removal was upper 85%, an excellent result for this wastewater treatment plant. Figure 3 shows analytical results obtained to the effluent during the monitoring period (Pond 04 Exit).

There was a significant minimization of odor release, mainly from sulfur compounds, through the use of the Effective Microorganisms, besides of the improvement of the biodegradation processes ocurring in the ponds.

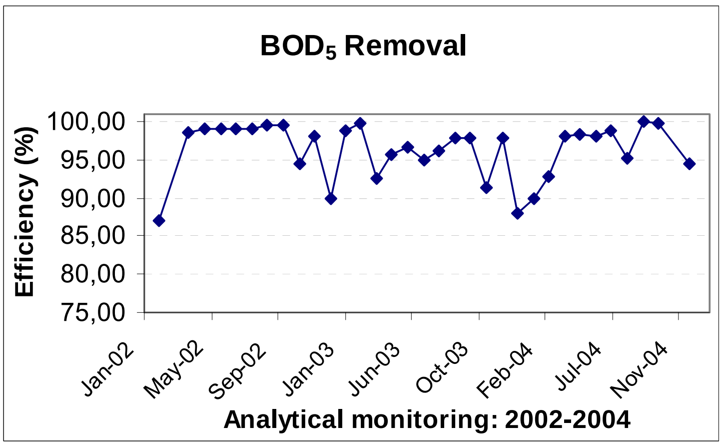

Figure 1. Treatment efficiency based on BOD_5 removal.

Good results for BOD_5 and COD in the effluent of this cassava starch industry were obtained due to the adjustment of the hydraulic flow and the adjustment of the biochemical processes made in the ponds.

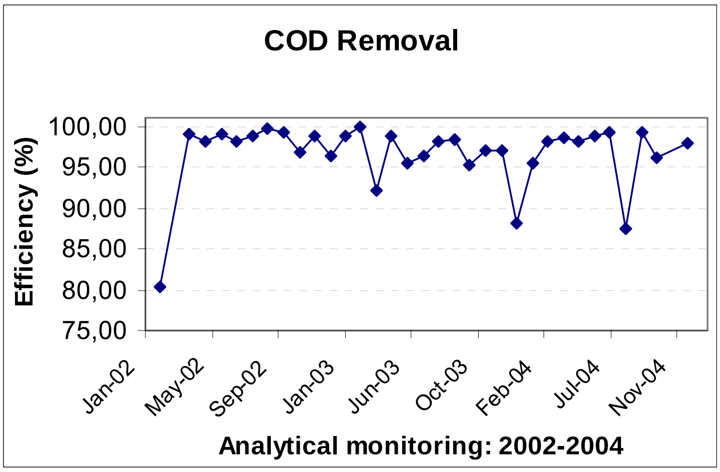

Figure 2. Treatment efficiency based on COD removal.

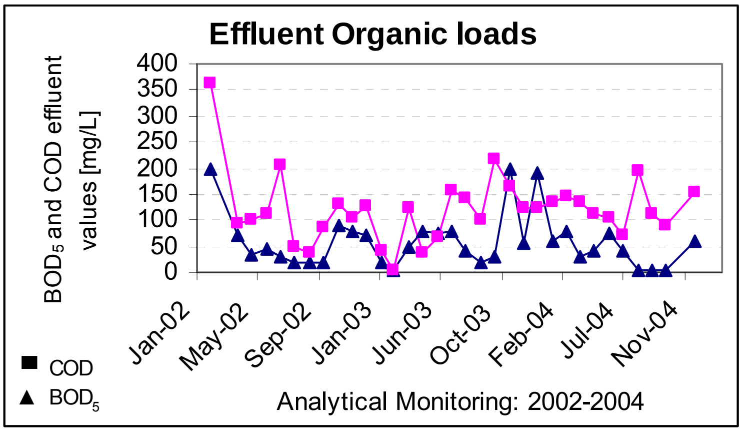

Fig.3. BOD_5 and COD results of the effluent.

Conclusions

Results have shown increase in the overall treatment efficiency and minimization of the odor release. The BOD_5 removal was over 80%, arriving 99%, with values lower than 40 mg/L in the final effluent, demonstrating that Mokiti Okada Foundation technology is efficient and feasible.

Acknowledgments

We would like to thank the cassava starch industry *Amidos Yamakawa* by the cooperation on the work development and *Mokiti Okada Foundation* by the support offered.

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