Use of Life Cycle Assessment in the technology development for obtaining a biosorbent.

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Abstract.

The present paper deals with the application of Life Cycle Analysis (LCA) in the development of a technology in order to use a biosorbent, from bagasse of sugar cane chemically modificated, in order to remove heavy metals contained in wastewater spilled by galvanic process.
The LCA was applied to evaluate the environmental impact of the process before to scale up the technology developed. The Sima Pro v 6.0 software has been used to obtain the results. The energy consumption is the principal effect over ecosystems and human health damages.
It was possible to modify the original technology taking into account the results of the LCA study.

Keywords

LCA, eco indicators, biosorbent, heavy metals.

Introduction

In the last decades the concern has grown for the degradation from the environment to world level, its consequences can determine disastrous results in the humanity's well-being and in the economic development of the nations.
At the present time, due to the development of the science and the technique, the waste waters has been increasing their volume and composition, if the same ones are poured in an indiscriminate way on the means, one runs the risk of surpassing the itself purge capacity of the nature and with it the balance man-nature [1].
In the search of technological solutions that propitiate the sanitation of this wastewaters, the biosorption has been specially considered to be a road ecologically and economically sustainable. At world level they are carried out studies of the behavior of different biosorbents in the treatment of this wastes, among them we have; coconut shell, shell and pulp of vegetables, crops residuals., stubble of corn, hemp, leaves of pine barks, shell of rice, grasses like the medic, and cane trash [2,3,4,5]. These materials are characterized to be cheap, they constitute waste of the agricultural production and they are formed by lignocelulosics material. [6].

One of the ways in order to reduce the biosorbents absortion capacity it's the use of activation by chemical proccess.
Searching groups think about a technology to obtain chemically modified baggasse [7] using like heavy metals biosorbent, the same one has as inconvenience the emission of waste acids over the water body, causing the negative impact to the means, the high consumption of water and energy. This intends to evaluate the environmental impact caused by technology using Ecoindicators 99 and the Sima Pro 6.0. Software

Materials and methods

For the obtaining of Chemically Modified Bagasse to employ to remove heavy metals contents in waste water of galvanic process, the technology of the figure 1 are used.

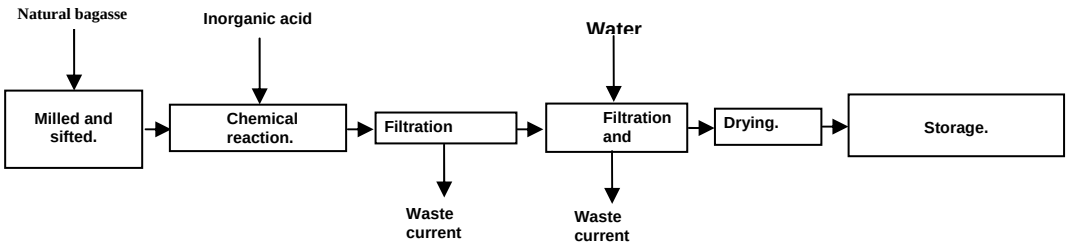

Figure 1. Original chemically modified Bagasse Technology

Stage 1: Milled and Sifted.
The trash decreased using a mill with the purpose of obtaining a material sufficiently fine thing. During the operation three fractions are obtained, which are: Dust (2%), Trash to chemical treatment (46%) and Trash to recirculation (52%)
Stage 2: Chemical modification.
The bagasse underwent a chemical treatment with Sulfuric Acid 0,5 M in a discontinuous reactor with the purpose of to modify it and to improve the absorption capacity
Stage 3: Filtration and laundry.
The solid filtrate was subjected to 4 laundries and filtrations, using water hang-over, in order to increasse the pH since the neuter value. It becomes agitated during 40 minutes and later is separate for filtration the solid and the liquid.
Stage 4: Drying.
The bagasse extended on a stainless steel tray so that it embraced the whole surface and it allowed this way a quicker drying. The tray was placed in a stove, during one hour.
It was carried out the characterization of the liquid currents generated in the process applying the established analytic techniques [8].
In order to analyze the impact chemically modified Bagass Technology, it was use a Cycle of Life Assessment (LCA), keeping in mind the following conditions:
"Functional unit": Production of 1 kg of modified Bagasse to laboratory scale.
"Objectives and Reach of the study": One kept in mind the entrance flows and exit of materials and energy of the obtaining process from the absorbent to laboratory scale, considering the natural Bagasse.
"There were used the Eco indicators 99 and the Sima Pro 6.0 Software educational version".

To the purpose of the environmental impact generated for waste currents, diminishing intend two alternatives (it Figures 2) permit the minimization of the waste water spilled over the water body near the factory as well as the reduction of the costs for energy concept.

Alternative A: Applied the sulfuric acid and the water of the fourth laundries recirculation, and used the stove in order to apply bagasse modified drying.

You come from an experimental way to measure the pH of the water of each one of the laundries of the first cycle; being obtained that in the fourth laundry the pH is neuter. When making the recirculation of the laundry water there are not affectations of the pH in the Bagasse Modified, being achieved this way to diminish the consumption of water and their spilled to the means.

Alternative B: To recycle the out sulfuric acid and the water of the fourth laundry and using sun drying stove drying

In this alternative the original technology was analyzed with the following measures of minimization: to recycle the out sulfuric acid and the water of the fourth laundry, also the drying of the trash in exposed trays in the sun, for what doesn't waste away electric power. The consumption of water hang-over as well as the emissions of acid waste waters to the ecosystem decrease in 69, 9% with regard to the original technology, and avoiding emissions out of acid to the receiving body. The cost of production of 1 kg of Bagasse according to the original technology corresponds at 35,849 $/ kg while for the alternative B this is diminished at 8, 86$/kg, corresponding to a gain of 24, 71%.

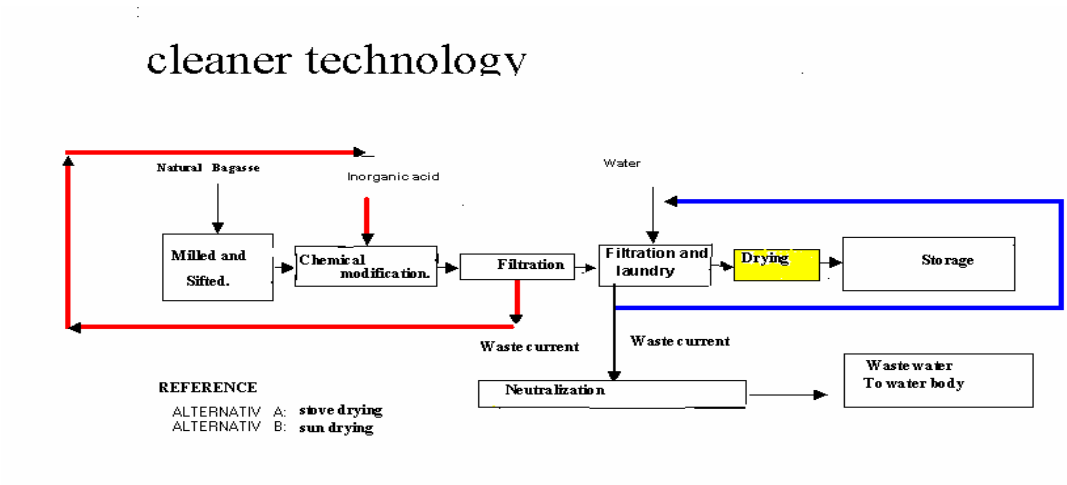

Figure 2 Alternatives of minimization of wastes in the technology of obtaining a biosorbent starting from sugar cane bagasse.

Results.

It was carried out an analysis of life cycle the original technology and two alternatives proposals to evaluate the environmental impact that each one of them causes on the means. It has been used eco indicators 99 and Sima Pro v 6.0. Software. The results allowed making design decisions before climbing the technological process.
The figure 3 shows the incidence technology of interest on the damages categories in those that one observes that the most affected one is the human health, later the quality of the ecosystems and lastly the resources. The biggest incidence here appears given by the electricity use starting from fossil materials and of sulfuric acid, as main aspects.

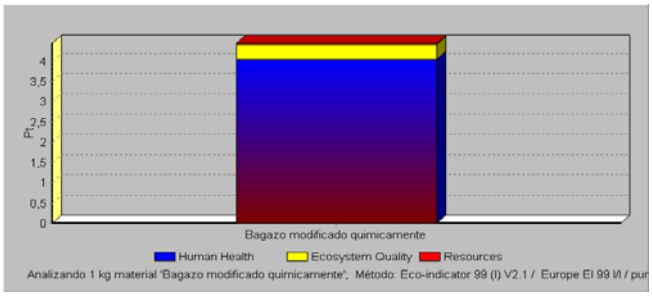

Figure 3.Incidence of the technology over damages categories.

In the figure 4 it can be observed this behavior, but analyzed by impact categories. It is by showing the main impacts of the studied technology over the breathing of compound, takes place appear organic and inorganic, the carcinogens, the climatic changes, layer of ozone affectation, acidification and eutrophication, use of the land, etc.

The most affected item is the breathing compound inorganic. It continues in order of importance the one related to the eutrophication and acidification that it can take place on the ecosystems, motivated by the waste waters spilled coming from laundry processes.

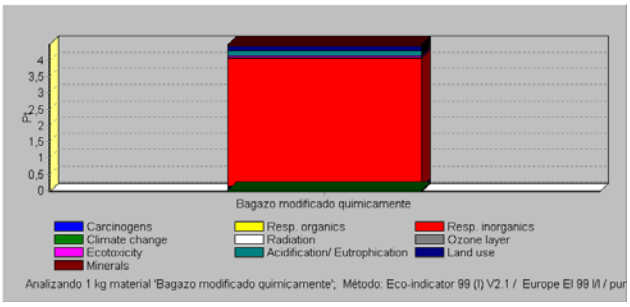

Figure 4. Incidence of the technology over impact category

The figure 5 shows that the human health is mostly affected with the use of the technology proposed initially and the alternative A (recirculation of the currents and drying of the trash modified in stove), while with the application of the alternative B (recirculation of the currents and drying of the trash in trays in the sun there is not a significant affectation.
The implementation of the alternative B doesn't affect the quality of the ecosystems comparing it with the remaining alternatives that has incidence on this indicator.

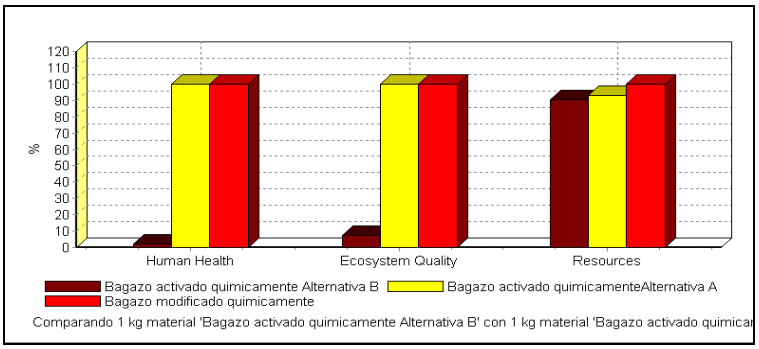

Figure 5: Incidence of the technology to produce Baggase Modified on the impact categories.

The figure 6 corroborate that the alternative B is the most feasible because it doesn't affect the quality of the ecosystem.

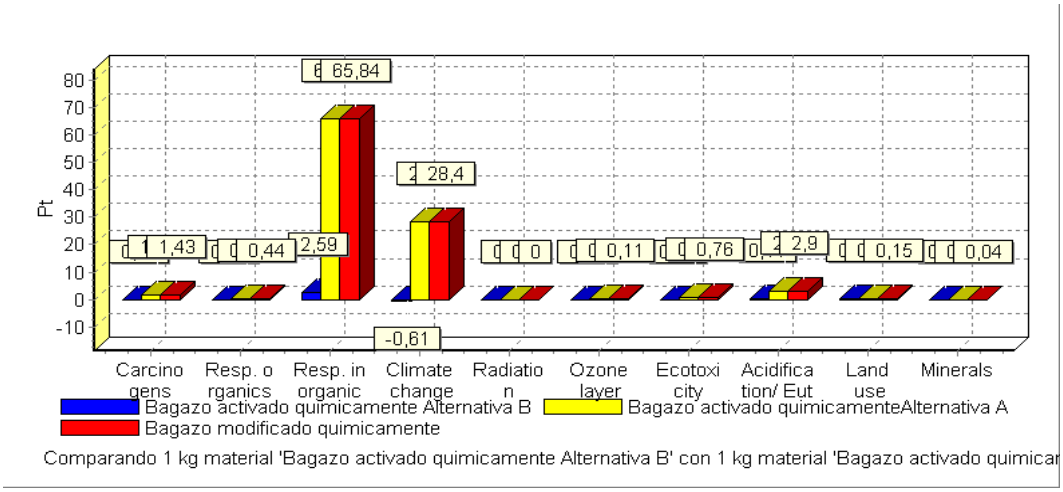

Figure 6: Incidence of the technology to produce Bagasse Modified on the categories of damages

Conclusions

1. The identification, characterization and evaluation of the residuals that generates the obtaining technology and use of chemically modified trash hurtled that although not high, the impact of the same ones affects the environment and requires taking solution measures.
2. The evaluation of the environmental impact of the technology of the process of Bagasse Modified obtaining and the life cycle assessment (LCA) using the software Sima Pro 6.0, giving as results that the biggest impacts produce the pour of acid waters and the energy consumption.
3. The proposed measures of minimization are: recirculation of the out sulfuric acid, the recycle of waters of the fourth laundry and drying of the bagasse modified and tray in the sun.
4. From the point of view of the environmental impact the evaluated alternatives were less chocking to the means than the original one, being the alternative B (recirculation of the out sulfuric acid and the water of the fourth laundry with drying in trays in the sun) the best in them; given fundamentally by the decrease of the energy consumption starting from fossil, evaluated fuels, using the LCA.

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