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Study On The Application Of Cob Or Corncob For The Reduction Of Color In Wastewater From The Spinning Mills, Guano Canton

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ABSTRACT

This research work was conducted with the waste water from the spinning mills, Canton Guano, in order to provide a solution to the problem of pollution that origínate from these waters because they are not properly treated before being discharged into the riverbeds.

Different methods, procedures and analysis was used in the laboratory for the collection and identification of physico-chemical wastewater characterization parameters and filter material (corn cob or gopher). After that the design and construction of the filter (prototype) was performed for different practices in the laboratory, with the following specifications, a tank inlet and outlet (0.30m x 0.15m) filtration zone (0.80m x 0.60m) with different compartments or chambers (0.30m x 0.15m), and plates or separation baffles equally spaced holes.

In the characterization process corncob of different particle sizes were used in the filters (prototypes) made of plastic containers for treatability tests in which were observed a satisfactory result in reducing colors in wastewater was obtained using sample 2 of cob or corncob with 4,5mm in size and sample 3 with 2.36mm in size.

As a result of the investigation it was determined that the best application of cob or corncob as bed filter to reduce the color of wastewater, thus through various tests it was determined that the cob filter or corncob was 2.3 TP (Sample 2 sizes of corncob or cob 4.5 mm, sample 3 size: 2.36 mm and gravel) being the most optimal, leading to reduced light colors 55, 52%, dark colors 67.65%. Also obtained was activated carbón from the cob or corncob which was 50.72% efficient in a color reduction in wastewater, obtaining the optimum filter bed as the final results in the prototype was 2.3 TP and CAT (cob sizes or corncob 2 shows the number of size 4.5 mm, sample number 3 of size 2.36 mm, gravel and activated carbón from cob or corncobs) decreasing by 78.63%, for which the best applicability of the cob or corn cob as filter bed should be as an individual process for each color, which is to eliminate the visual impact that is generated when discharging the effluent to the river bed Guano.

Keywords: Cob or corncob, Spinning mills, pollution, riverbeds.

Introduction

Globally, large amounts of wastewater contaminated with color that is mainly produced by industrial processes are generated. The amount of water used in textile processing, varies considerably depending on the specific process and equipment used by the plant. Textile dyes are highly persistent in the environment, and classic removal methods are not useful because oxidations or reductions may generate highly partial toxic byproducts. Often the effects are observed in the long term, and in most cases are difficult and expensive to treat. (Collaguazo, 2013).

The spinning mills, for their wool washing processes and dyed thread uses a lot of water and variety of dyes; processes also are handled batchwise, so that the concentrations of the residual materials vary significantly, for this reason we have been interested in finding or creating new ecological alternative through the use of a waste product and easily accessible.

The characterization of wastewater from the spinning mills was performed and characterization of cob or corncob necessary for testing the hypothesis which states that it can reduce or not 50% of color in the wastewater with the application of cob or corncob.

The research was conducted through the application of methods and laboratory practices, which was done through different procedures for each of the required parameters used in the color reduction of wastewater through the cob or corncob, in order to obtain favorable results.

Using filters through plastic packaging test was performed with different filter beds, changing the particle size of the cob or corncob, gravel and also compared with activated carbon, vegetable activated carbon and activated carbon cob or husk corn, to observe efficiency of the corncobs as filter material.

With the results obtained it was observed that dark colors is easily reduced, whereas in light colors its reduction is more complicated, despite this reduced color was achieved and also saturating the filter bed in short time compared with dark colors.

Through various laboratory tests it was determined that the filter 2.3 TP (cob sizes or corncob with with sample number 2 size 4.5 mm sample number 3 size 2.36 mm and gravel), is the most efficient color reduction for both light colors with 55.52%, dark color 67.65%, CAT (activated carbon from cob or corncob) a 50.72% and overall color (mix of all colors) optimal filter was 2.3 TP and CAT (corncob or cob with sample number 2 size 4.5 mm sample number 3 size 2.36 mm, gravel and activated carbon from cob or corncob), thus reducing 78.63% of the sample.

Methodology

It consists of a set of methodical and technical activities that are performed to obtain the necessary information and data on the subject to investigate and solve the problem. In experimental research the researcher manipulates one or

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more study variables to control the increase or decrease of these variables and their effect on the observed behaviors. Put another way, an experiment is to make a change in the value of a variable (independent variable) and observe its effect on another variable (dependent variable). This is carried out under controlled conditions in order to describe how or why a particular situation or event occurs. Experimental methods are appropriate to test hypotheses of causal relationships. (Murillo, 2002)

The experimental study was based on the application of cob or corncob (independent variable), in order to observe that situation occurs or color reduction of wastewater (dependent variable) is presented; a number of process parameters and finding methods to identify or characterize the cob or corn cobs, obtaining important data on the properties of corncob was used. Similarly, various was conducted with different filters through laboratory analysis to determine the efficiency of each one in regard to the reduction of color in waste water was determine with comparison done before filtration and after this, and determining what percentage of decrease color was achieved through the use of corncobs as a filter medium. (Murillo, 2002)

Results and Discussion

The following results were obtained, they were based on the chronological order taking into account the specific objectives.

1. With regard to the collection and identification of the physical-chemical wastewater from spinning parameters, which was performed the following:

For characterization, analysis of wastewater from the spinning mills, parameters was performed such as: pH, temperature, conductivity, turbidity, total solids, suspended solids, color, BOD_5, COD.

2. With respect to the characterization of filter material (cob or corncob), it proceeds to perform the following procedures, as can be seen below:

- **Process for crushing and sieving the cob or corncob**

A sample of 100% cob or corncob was crushed and sieved through different screens, different particle sizes was obtained.

Table 1: Crushing and sieving of the cob or corncob

Samples	Number Sieve	Particle size (mm)	100% Sample
1	3/2	9.5	8.919
2	4	4.5	41.619
3	8	2.36	33.088
4	10	2	3.421
5	16	1.18	6.262
6	40	0.425	3.836
7	60	0.25	0.439
8	Residual from corncob		0.04
		Total	100%

Source: Nicole Torres and Karla Gaibor

- **Process for determination of the structure, shape and porosity of the cob or corncob**

Its structure, shape and porosity was determined through the images obtained by SEM (Scanning Electron Microscope):

Table 2: Analysis of the cob or corncob

Samples	Number Sieve	Particle size (mm)	100% Sample
Sample 1 (Diameter:9,5mm)	3/2	9.5	8.919
Sample 2 (Diameter:4,5mm)	4	4.5	41.619
Sample 3 (Diameter:2,36mm)	8	2.36	33.088
Sample 4 (Diameter:2,00mm)	10	2	3.421
Sample 5 (Diameter:1,18mm)	16	1.18	6.262
Sample 6 (Diameter:0,425mm)	40	0.425	3.836
Sample 7 (Diameter:0,25mm)	60	0.25	0.439
Activated Carbon from corncob (CAT)	Residual from corncob		0.04

Source: Nicole Torres and Karla Gaibor

- **Procedure for determining the density and percentage of absorption of the cob or corncob.**

The procedure was perform following the Ecuadorian Technical Standard NTE INEN 156, a total of 10 trials to get the following results, obtaining a density of 0.761 Kg / m^3.

3. For the design and construction of the filter (prototype), the experimental part was done, performing different treatability tests, using plastic containers proceeding to place the filter beds with different particle sizes, before proceeding with the actual prototype.

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- Different prototypes based on the corncob or cob was conducted. They are: T2, TP2, T3, TP3, TT, TTP, TP2CV, T2CV, TP3CV, T3CV, TTCV, TTPCV, CV, CA. Performing analysis of water at the beginning and end of the sample.

Obtaining optimal results with the filter 2.3 TP (cob sizes or corncob with with sample number 2 size 4.5 mm sample number 3 size 2.36 mm and gravel), proceeded to perform the calculation of prototype to use.

Filters made of plastic bottles due to their easy handling were performed, the filters had a total bed height 0.25 m, each filter bed had a height of 0.83m with the diameter of bottle 0.12 m which was composed of three filter beds in descending gravel or cob with a size of 4.5 mm (T2), or corncob with a size of 2.36 mm (T3). The residual water from the Hilandería Guijarro, was placed from top to bottom in descending order and there was a retention time of 24 hours, the bottle was placed in an inverted manner for easy handling, past the specified time the bottles was carefully opened and the waste water is placed in beakers for further analysis. This residual water was subjected to initial and final analyzes obtaining parameters as temperature, pH, conductivity, turbidity, color and dissolved oxygen, each of the colors tinturan in the company and the overall color waste water mixed) comprising all colors together).

With these values obtained proceeded to perform the actual prototype design:

The prototype is equipped with a reservoir tank with a capacity of 80 liters supplied to all the prototype, the residual water passes through a hose, entering the storage tank then goes to the first chamber of the prototype by which wastewater passes overflow to different filter chambers separated by baffles or sheets with holes or openings following each other. Thus the water continues its journey through the first filter chamber which contains a filter bed of gravel, then the residual water flows into the second filter chamber, this is cob or corncob with a size of 4.5 mm (T2), then the residual water flows into the third chamber filtering it with corncob or cob with a size of 2.36 mm (T3), continues its journey to the last chamber consisting of gravel and activated carbon cob or corncob (in the latter filter chamber is optional depending on type of crushing of the waste water, i.e if they are light and dark colors will remain with gravel instead if the color is overall color (all colors merged) activated carbón cob or corncob were used, and finally the wastewater after passing through all the filter chambers is stopped by a sheet or baffle which has a stopcock ½ after 24 hours it is open and allows water to pass to the next chamber which is a reservoir tank and overflow surpassing the final storage tank, in said tank you can see the final product which is the waste water from the spinning mills treated by filtration , Figure 1 and 2.

4. Then proceeding to analyze the results and the application of corncob or cob for the removal of color and evaluate their efficiency.

Optimum results are obtained in terms of color removal filter bed using the cob or corncob, light colors 55.52%, 67.65% dark colors, mix of all colors 30.77%, activated carbón cob or corncob 50.72% with residual water from the mixture of all the colors or full color, 10% charcoal, activated charcoal 36.23%, 80% activated carbon and with the design of real prototype 2.3TP and CAT (cob sizes or corncob with sample number 2 size 4.5 mm sample number 3 size 2.36 mm and gravel) 78.63% removal was achieved, leaving a 21.37% of color not retained.

After the experimental part proceeded to establish a procedure for the preparation of activated carbon from the use of cob or corn cobs as feedstock.

Process for making activated carbon cob or corncob

- Proceed to grind and sift the cob or corncob.
- 3.1ml solution with H_3PO_4 is prepared and beach on a ballon of 100ml.
- Weigh the pots and place the cob or crushed corn cobs.
- Place the distilled water soaking the corncob up before pouring into pot and add 5 ml of phosphoric acid solution.
- Turn the muffle to 180°C and get the pots on it and leave for an hour.
- Then turn the muffle off in an hour after attaining 480°C.
- Allow to cool for 24 hours at room temperature.
- Finally washed thoroughly with distilled water to obtain a pH of 7.

Conclusions

Prototype based cylindrical containers

- 14 prototypes was conducted: T2, TP2, T3, TP3, TT, TTP, TP2CV, T2CV, TP3CV, T3CV, TTCV, TTPCV, CV, CA, the most optimal are for light colors T3, TP3, TP2 and for the most optimal dark colors were T2, TP2, TP3, 2,3TP, TTP and TT. When making prototypes of the filter bed with cob or corncob was observed that using wastewater in light colors such as blue, green lettuce, lilac, came was minimal and rapid saturation reduction, but when TP3 was used (cob or corncob particle size 2.36 mm and gravel) and TTP (all particle sizes cob or corncob and gravel) were compared to be of satisfactory results tan other filters, but continued rapidly saturating.
- It was noted that at the time of the prototypes of the filter bed with cob or corncob TP2 (cob or corncob particle size 4.5 mm and gravel) and T2 (cob or corncob particle size 2.36 mm), residual water was used with dark colors like military green, black, coffee, fell more than 50% to reach 76.47%, however when TP3 was used (Cob or corncob particle size 2.36 mm and gravel), the color is reduced to 60.59%, obtaining very good results as regards the amount of color retained by the filter bed, also observed that it is not saturated very fast compared to light colors. When T3 (Cob or corncob particle size 2.36 mm) was used, it reduced to 60.88% but saturated very fast compared to other filters mentioned TP2, T2, TP3.
- Also by using activated carbon, a reduction of more than 80% color was obtained and with charcoal, we got good results, it increases the color of the original sample by more than 100%.
- When the prototype TP2 (Cob or corncob particle size 4.5 mm and gravel), TTP (all sizes of the cobo r corncob and gravel particles) and TT (all sizes of the particles of the cob or corn cob), these were the most optimal but when we use the residual water from the overall color (CT) good results were not obtained, because it saturated very fast in comparison when carried out separately or by colors.
- Two different filtration processes with residual total color wáter was performed, the first was place in CAV (Sulfonated coal), and then the residual wáter from the first filter was placed on the second filtration process, good result was observed in the prototype 2.3T (Sample 2 cob or corncob with particle size 4.5mm and simple 3 with size 2.36 mm), reducing to 32.25% and TTP (all sizes of the particles of the cob or corncob and gravel), reducing to 20% and in addition results were not very satisfactory in the prototype 2.3TP (Cob or corncob simple number 2

size 4.5 mm, sample number 3 size 2.36 mm and gravel), reducing to 11.54% and TT (all sizes of the particles of the cob or corn cob) , reducing to a 18.75% and saturating is very fast in comparison to the other filters. Through the treatability testing it was noted that it was necessary to have two processes of filtration in the wastewater total color sample, because making a single filtration process color reduction is minimal or negligible, and in some cases exceeding 100% of the initial sample.

- It can be said that when two filtration processes was carried out with full color wastewater it was identified that there is a slight percentage reduction in color due to it passing through a single filter cob or corncob as 2.3TP (cob or corn cobs sample number 2 and sample size 4.5 mm, sample number 3 with simple size 2.36 mm and gravel), 2.3T (Cob or corncob sample number 2 size 4 5 mm and sample No. 3 size 2.36 mm), TT (all sizes of the particle of the cob or corncob), TTP (all sizes cob or corncob particles and gravel), the color reduction values are unfavorable and in turn there is an increase of color compared to the initial sample.
- Also proceeded to make another option to transforming the cob or corncob in CAT (Activated charcoal cob or corncobs), which was obtained very good results by reducing up to 50.72%.

Actual Prototype

A decrease or color retention in a 78.63% and 21.37% of color is not retained with the optimal filter beds which were 2.3 TP and CAT (Cob or corncob sample No. 2 size 4.5 mm size, sample No. 3 size 2.36 mm and gravel), with these values we can say that the filter bed is effective since it managed to reduce a significant amount, however the other parameters also reflects a reduction as suspended solids in comparison to the initial sample by 79.89% reduction, turbidity was reduced by 80.55% compared to the initial sample, the chemical demand of oxygen cod reduced by 57.44% and biochemical demand of oxygen BOD_5 55.13% in comparison to the initial sample. Instead the pH values and dissolved oxygen decrease slightly was observed compared to the initial sample and finally the parameters experiences a slight increase in total dissolved solids (TDS) which was observed an increase of 2.96% due to decomposition of the material and with respect to the conductivity was an increase of 3.44%, this parameter is rationed with total dissolved solids (TDS) since there was a light increase of decomposition of the matter this is breakdown in ions charged positively and negatively.

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Annexes

Annex 1.

General laboratory results

Settings	Method / Procedure	Units	Initial	Filtered Sample	Permissible limits for discharges into water bodies
Ph	PE-LSA-01	[H+]	7.83	7.2	5-9
Dissolved oxygen	STANDARD METHODS4500-O-G mod	Ppm	1.45	1.39	Not less than 5mg/l
Conductivity	PE-LSA-02	ms/cm	1394	1442	1500
Turbidity	FTU - NTU	STANDARD METHODS 2130 B	229	44.55	10
Total solids	mg/l	PE-LSA-04	79.4699	79.0447	100
Suspended solids	mg/l	STANDARD METHODS 2540 - D	368	74	500
Total Dissolved Solids	mg/l		981	1010	1600
Color	unit ptCo	STANDARD METHODS 2120 C (Upt-co)	3275 (1/25) 100% color	700 (1/25) 79% retained Color 21% Color unretained	* Priceless dilution: 1/20
DOD_5			1248		100
COD	mg/l	STANDARD METHODS 5220 - D mod	1670	960	250

Source: Nicole Torres and Karla Gaibor

Annex 2

Illustration of acronyms

T = COB or corn cob.
P = Gravel
CV = Charcoal
TT = Tusa Total (all particle sizes).
CAT= Activated Carbon from corncob
2 = shows particle size 4.5 mm
3 = shows particle size 2.36 mm.

Overall results

Different treatability tests	
	% Color retained
T2	50
TP2	76.47
T3	60.88
TTP	36.23
CV	10
CVA	36.23
CA	80

Source: Nicole Torres and Karla Gaibor

Total color by two filtering processes.	
	% Color retained
CV - 2,3 T	32.25
CV - 2,3 TP	11.54
CV - TT	18.75
CV - TTP	20

Source: Nicole Torres and Karla Gaibor

	% Color unretained	**% Color retained**
Light colors	44.48	55.52
Dark colors	32.35	67.65
Color Total	69.23	30.77
CAT	49.28	50.72

Source: Nicole Torres and Karla Gaibor

General information

This study was conducted to give greater importance to the cob or corncob being easily accessible and economical that can be used for color reduction of water coming from the spinning mills, these waters are disposed of without any control to the natural effluents, producing a great environmental pollution. Be part of this protected nature, let's make awareness so we do not harm our rivers.

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