

use of coffee grind with cocoa shell as the basis for a filter to reduce lead from contaminated water from a river, Peru

Valeria Joselin Morales Diaz^a, Jorge. Leonardo Jave Nakayo^{a, b, *}, Elmer Benites Alfaro^a

^aUniversidad Cesar Vallejo, Peru.

^bUniversidad Nacional Mayor de San Marcos, Peru
Jorge.jave@unmsm.edu.pe

Resumen

La presente investigación tuvo la finalidad de evaluar la eficiencia de los residuos de café (borra) con cáscara de cacao como base de un filtro para reducir plomo del agua contaminada del río Chirino, San Ignacio – Cajamarca, 2018. Brindando un método de bajo costo y sin empleo de tecnologías de gran escala, por medio de aprovechamiento de los residuos orgánicos mencionados propios del lugar logrando mejorar su disposición final. La experimentación se realizó en un sistema de diseño convencional, donde el filtro colocado presentó una estructura esponjosa conteniendo 60 % de borra de café con cáscara de cacao aplicado en tres dosis distintas (15g borra de café con 15 g cáscara de cacao, 10g borra de café con 20g cáscara de cacao y 20 g borra de café con 10 g cáscara de cacao) y 40 % de azúcar en solución de elastómero de silicona; teniendo propiedades bioadsorbentes para reducir metales. El punto de muestreo y la cantidad de muestra en litros fue por conveniencia, evaluando la concentración de Plomo presente en el agua del río Chirinos en las etapas de pre tratamiento y post tratamiento. Los resultados obtenidos con respecto a la eficiencia para reducir Plomo de las tres dosis aplicadas codificadas con T-1, T-2 y T-3 fueron de 77.1%, 98.53% y 87.36% respectivamente; siendo la más eficiente T-2 conteniendo la dosis de 10g borra de café con 20g cáscara de cacao, sin la necesidad de añadir un activador químico, haciendo que la aplicación sea amigable con el medio ambiente

Palabras clave: Borra de café, cáscara de cacao, eficiencia, reducción, bioadsorbente

Abstract

The purpose of this research was to evaluate the efficiency of coffee grind residues with cocoa shell as the basis for a filter to reduce lead from the contaminated water of the Chirino River, San Ignacio - Cajamarca, 2018. Providing a method of low cost and without the use of large-scale technologies, by taking advantage of the organic waste mentioned above, thus improving its final disposal. The experimentation was carried out in a conventional design system, where the placed filter presented a spongy structure containing 60% of coffee borage with cocoa shell applied in three different doses (15g coffee grind with 15 g cocoa shell, 10g coffee grind with 20g cocoa shell and 20g coffee grind with 10 g cocoa shell) and 40% of sugar in silicone elastomer solution; having bioadsorbent properties to reduce metals. The sampling point and the amount of sample in liters was for convenience, evaluating the concentration of Lead present in the water of the river Chirinos in the stages of pre-treatment and post treatment. The results obtained with respect to the efficiency to reduce Lead of the three doses applied coded with T-1, T-2 and T-3 were 77.1%, 98.53% and 87.36% respectively; being the most efficient T-2 conteniendo the dose of 10g coffee grind with 20g cocoa shell, without the need to add a chemical activator, making the application friendly with the environment.

Keywords: Coffee grind residues, cocoa husk, efficiency, reduction, bioadsorbent

1. Introduction

The agricultural and agro-industrial activity of coffee and cocoa constitutes the main alternative of socioeconomic development in the places of the jungle of Peru, as long as the balance of each stage of the process is maintained between the development of productive activity and the care of the environment. As part of the process in the manipulation of the raw material until its final disposition and the consumption of these products, whose demand comes generating great volumes of solid organic residues, according to Bazarte and Sangranis (2008) manifests that it generates a great quantity of residues, if it is considered that only 10% of the weight of the fresh cocoa bean and 20% of the coffee is economically taken advantage of, constituting the remaining 90 and 80% respectively in organic residues of farm and processing industries.

It should be added that, in Peru the contamination of water resources is occurring increasingly by different economic activities, as is the case of "mining explorations" being an activity that has been addressing socio-environmental conflicts in relation to water resource that is derived to human consumption, fishing, agriculture, livestock, among others. This situation has intensified due to the weakness of our highest authorities with an environmental management sectorized by a legislation driven by foreign investment.

According to the news alert Observatory of Mining Consultation in 2013, the Office of Indigenous Affairs of the Provincial Ecological Municipality of San Ignacio and the Awajún Border Organization of Cajamarca (ORFAC), requested the authorities of the province of San Ignacio and the Prosecutor of Crime Prevention, to carry out a study of water and analysis of the fish that is the main source of food for the population, which would contain high concentrations of heavy metals.

According to Gufrides (2015), the study of toxic substances with high levels of heavy metals such as mercury, lead, arsenic, ammoniacal nitrogen has been confirmed after the alarm of different media and denouncements by the population, bringing with it the death of fish and diseases. At present, the process of the lawsuit for protection continues because its right of prior consultation against the MEM has been affected with respect to the mining project Yagku Entsa, of Águila Dorada S.A.C., since it has endangered the habitat where 1500 people that integrate 16 Awajún communities live in both margins of the Chirinos River.

There are techniques (Iakovleva, 2018; Ayucitra, 2017; Namane et al, 2005) to reduce heavy metals (Paredes, 2014) such as chromium (Angarita, 2015; Guerrero, 2014), lead, mercury (Pastrana et al, 2017) among others.

The main objective of this research is to determine the efficiency of cocoa-shelled coffee ground residues as a filter base to reduce lead from the polluted water of the Chirinos River, San Ignacio-Cajamarca.

2. Materials and Methods

This research has an experimental design, where the cocoa shell with coffee grounds as a filter base is subject to the experiences of the researcher, which will allow to know the appropriate concentrations showing the efficiency to reduce lead.

First stage, the water sample was collected from the Chirinos River, which includes the districts of Chirinos, San José de Lourdes and Huarango, province of San Ignacio, region of Cajamarca; coffee and cocoa wastes were collected from the inhabitants who live near the Chirino River, who

generate these wastes by instant consumption of ground coffee and the activities of the process to obtain cocoa.

Second stage, the collected water sample was determined the parameters of conductivity (Us/cm), temperature (°C), pH and turbidity in the field, later 0.5 L is taken for the evaluation of lead concentration (Pb) as an initial sample.

Third stage, the pre-treatment of the coffee borer and cocoa shell, was washed with distilled water to eliminate some foreign compounds involved in the retention of the contaminant, dried in the open air, then passed by ignition at 105 ° C for 24 hours to extract the odor, flavor or other component, for the case of the cocoa shell went to the process of pulverized by a mill, managing to reduce its size to obtain a homogeneous particulate compound. For the elaboration of the filter with spongy structure, three proportions were taken into account: 15 g cocoa shell with 15 g coffee grounds, 20 g cocoa shell with 10 g coffee grounds and 10 g cocoa shell with 20 g coffee grounds. Having a total of 30 grams for each filter making up 60% of the composition of the filter and 40% being represented by silicone elastomer with sugar, each proportion suitable for convenience for the effectiveness of the product and proceeded to weigh each. The coffee grounds were mixed with the ground cocoa shell and the proportion of sugar in a solution of silicone elastomer in the same circular mold with a diameter of 10 cm, leaving to dry and polymerize during one night; through the technique of sugar leaching, the material was immersed in warm water to dissolve the crystals of the sugar thus obtaining porosity.



Figure 1. Treatment of Water Contaminated with Lead

Fourth stage, the execution was proceeded, pouring a 1 L of contaminated water for its first repetition (A) in the T-1, T-2 and T-3 each one, measuring before its physicochemical parameters (pH, T°, conductivity) by means of the multiparameter; Once contained the water the keys were opened. It was expected to collect ½ L of treated water as post treatment, measuring again the physicochemical parameters, in the case of turbidity it was taken to the laboratory. Afterwards, INASSA was sent to evaluate the lead concentration. In the same way it was for the second (B) and third (C) repetition.

3. Results

Analysis of dosage results to reduce lead concentrations in water - before undergoing the treatment plan (pre-test) and after undergoing the treatment plan (post test).

Table 1 shows the values corresponding to the concentration of Lead before and after the treatments submitted, differentiated by the different quantities-proportions of residues (coffee borer and cocoa shell) used for the elaboration of filters present in the water treatment system contaminated with Pb.

Table 1. Lead concentration results.

Parameter	Treatment	Before treatment	After treatment	average	Reduction Amount	efficiency
Lead (mg/L)	T-1	0.125	0.0282	0.0287	0.0968	77.01%
		0.125	0.0293		0.0957	
		0.125	0.0287		0.0963	
	T-2	0.125	0.0017	0.0018	0.1233	98.53%
		0.125	0.0020		0.1230	
		0.125	0.0018		0.1232	
	T-3	0.125	0.0163	0.0158	0.1087	87.36%
		0.125	0.0157		0.1093	
		0.125	0.0154		0.1096	

In Figure 2, it is evidenced the comparison of Lead concentration of the initial result and after the treatment with respect to the RCT of the water for category 1 and category 4, where the concentrations of lead are located within the allowed and being the most adequate treatment (T-2).

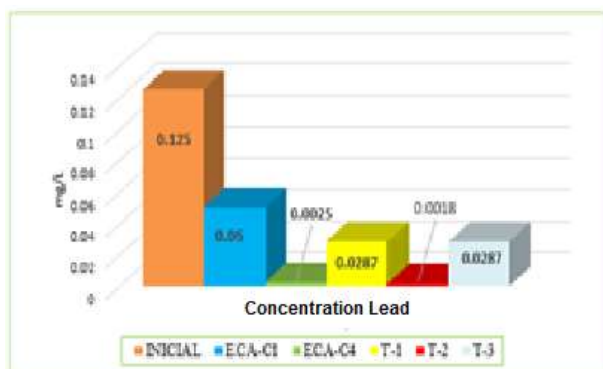


Figure 2. Lead Concentration Comparison

In Figure 3, it is identified that the T-2 is more efficient compared to the others

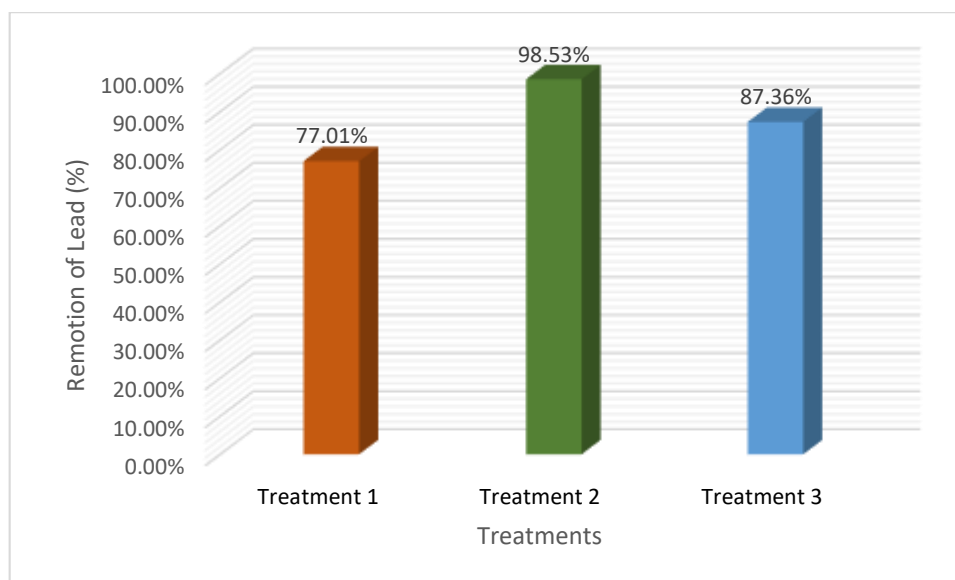


Figure 3. Removal Efficiency Pb per Treatment

4. Conclusions

The efficiency of coffee grind residues with cocoa shell as a base for a filter to reduce lead was 98.53% with a dose of 10g coffee grind with 20g cocoa shell having a total of 30 grams that makes up 60% of the composition of the filter and 40% being represented by silicone elastomer with sugar. Demonstrating the obtaining of a greater percentage of efficiency for reduction of lead and not being necessary the application of a chemical activator, in comparison to other investigations.

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