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Treatment of chemical releases from a hospital biochemistry laboratory with eucalyptus bark

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ABSTRACT

The present study aims to investigate the treatment of chemical releases of laboratories Biochemistry of the hospitals in the hospital center IbnSina with the main study sites: Specialties Hospital and IbnSina Hospital. Generally, the waste can be treated with thermal, chemical, biological, and physical processes, but these methods are expensive and sometimes can't be supported by the small industry sector thereby prohibits the use of these techniques and consequently leads the non-treatment of liquid waste from this sector. Thereby to reduce the cost of treatment of industrial effluents, more research is oriented towards the use of available and inexpensive products such as clays, products and agricultural by-products, forestry or food, hence the use of the bark of eucalyptus in this study.

Keywords: Chemical releases, processing treatment, biochemistry laboratory, eucalyptus bark.

INTRODUCTION

It considers industrial water all effluent that can't be discharged to the sewer because of its characteristics or its volume. This type of pollution is very variable composition depending on the production activity generating wastewater. Liquid chemical wastes generated by laboratories are part of the pollution of industrial waters.

There is no official definition of laboratory waste, They are considered part of DTQD (Toxic Waste Quantities in Dispersed) [1]. Usually when we talk about chemical laboratory waste (excluding radioactive waste), we consider two categories of waste:

- Laboratory Chemicals: all of reagent bottles used in connection with the activity of a laboratory. They may be of very different natures. Generally concentrated products, they require special precautions for sorting and processing. In the profession of waste management laboratory, the term PCL (Chemical products of Laboratory) often refers to all the chemical waste bottles in less than 5 liters.
- Effluent laboratory: it is liquid waste from controllers (liquid chromatography ...) or manipulations performed in the laboratory. These can include acids, bases, solvents, dyes, toxic products; solutions containing heavy metals ... These laboratory wastes must be collected in special containers awaiting treatment before discharge.

EXPERIMENTAL SECTION

This part contains the experimental techniques used. Specifically, protocols and conditions of substrate preparation from the bark of Eucalyptus (2) and analysis methods that have allowed the characterization of the biochemistry laboratory discharges.

The chemicals used in this study are analytical in nature and have not undergone any previous treatment.

1.Experimental protocol and pre bark
1.1 Physical Preparation

The bark used is that of boxwood which is a short clear fibrous bark gray finely reticulated or obliquely furrowed surface.

The bark is washed with tap water to remove dust and remove suspended solids. Then it is dried in the open air, crushed and sieved.

The preparation is carried out at the Laboratory of Radiochemistry of the Faculty of Sciences Rabat.

1.2 Chemical Treatment
The untreated barks strongly color the solutions because of the solubilization of organic substances as tannins which are toxic compounds, which presents a major drawback for their employment without preliminary chemical treatment.

To remedy this problem, the bark is used after washing with different acids. We can cite for example hydrochloric acid that is both effective, available and affordable to implement the treatment.

Other acids such as sulfuric acid, nitric acid, phosphoric acid may also be employed in this case acid. Among the bases used in this context soda.

In the present work the bark is heat treated initially with sodium hydroxide (2M) and a second time with phosphoric acid (1,4M). This process continues until the washings become colorless.

Photo1- crushed Eucalyptus bark before Chemical-treatment

Photo2- crushed Eucalyptus bark after Chemical-treatment

1.3 Preparation of the adsorption column
Effluent treatment by the bark is performed in units of 8 mm in diameter. The full height of the column depends on the mass of fastener material.(Fig1)

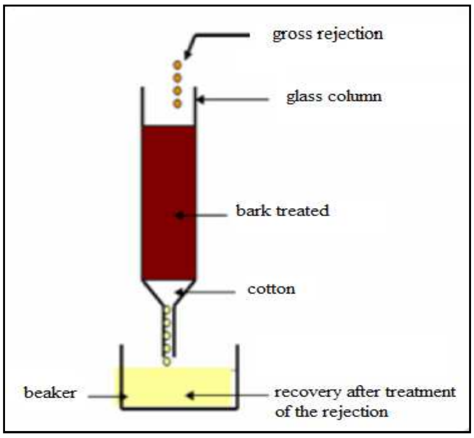

Fig 1: Schematic of the column used bark for the treatment of discharges

1.4 Selecting the amount of applied substrate
Effluent treatment is performed by substrate masses (Eucalyptus bark) that vary in area 3 -10g. The treatments are carried out on an aliquot of 100ml rejection. The flow rate is about 5 ml / min. The treated samples are kept at room temperature.

Performance calculation (R%)
The removal efficiency of organic materials R (%) is given by the following relationship:

$$R = \frac{CODi - CODf}{CODi} \times 100$$

COD_i:Value of the chemical demand for oxygen before the treatment by substrate(mg O2 / l);
COD_f: Value of the chemical demand for oxygen after the treatment by substrate (mg O2 / l).

Calculating the amount of binding of the organic material (Qf):

$$Qf = \frac{CODi - CODf}{m} \times v$$

Qf : quantity of fixing the organic matter (g COD / g)
CODi: value of the DCO before treatment by substrate (g / l)
CODf: COD value after substrate treatment (g / l)
v: volume elapsed (l)
m: mass of substrate (g)

1.5Presentation of gross releases and analytical methods
The rejections of laboratory of the medical institutions of the Hospital center Ibn Sina chosen for this study is: The rejection of the Biochemistry Laboratory at the Ibn Sina Hospital, designated by R1.The different physicochemical techniques used in the processing of R1 releases (rejection Biochemistry Laboratory) considered are summarized in Table 1.

Table 1:Analytical methods used for sample analysis.*PNM:Standard Moroccan Project

Physicochemical parameters studied	Methods and Materials
pH	PH meter, conductivity meter and thermometer Type 2 ORION STAR.
conductivity	
Temperature	
Chemical Demand Oxygen: COD	Acidic, K2Cr2O7 + DCOmétre 6 Velp brand positions (PNM) *
Organic demand Oxygen during 5 days: BOD5	Winkler method
Heavy metals (copper, zinc, chromium)	atomic absorption spectrometry
Verification of the purity of regenerated products	Infra Red Spectroscopy Gas chromatography(3)

2.Characterization of physicochemical parameters of the sample studied
2.1 Temperature Measurement
Microbial activity strongly depends on the medium temperature; therefore the measurement of this parameter proves of great need. In addition, the oxygen content of the environments studied depends on this factor.Thus for example the rate of saturation of oxygen in water is of 14,6à 0°C and 8.4mg/l at 25 ° C.

It should also be noted that the temperature is a measure of the homogeneity of some releases such cases wastewater [4].

This is why we proceeded to the measure of the temperature of discharges studied before and after treatment.

2.2 pH measurement
Moreover the importance of the physic-chemical reactions is sometimes related to the acidity of the aqueous media, the pH alters the growth and reproduction of microorganisms existing in given water. Thus, most of the bacteria can grow in aquatic environments, in a pH range between 5 and 9, but the optimum conditions corresponding to a pH acidity of between 6.5 and 8.5. According to the World Health Organization (WHO), the growth and survival of aquatic organisms can be affected when the pH is outside of this area acidity.

The pH measurement of samples is performed before and after treatment using a pH meter type 2 ORION STAR.

2.3 Conductivity measurement
Conductivity, also referred to the total dissolved solids (TDS = Total Dissolved Solids), is defined as the amount of dissolved solids in water. It depends essentially on the solubility of the sediments which are in contact with water. Conductivity is a measure of the ability of the water to conduct an electric current. The value of this parameter which is the inverse of the resistivity depends on the dissolved solids and thereby the conductivity increases with the value of TDS.

2.4 Analysis of copper, zinc and chromium
Heavy metals are micro in nature cause nuisance even when they are released in very small quantities (toxicity develops through bioaccumulation).This is why our interest has focused on the analysis of some elements of this family, generally very used as reagents such as Cu, Zn and Cr (VI). This analysis is made by atomic absorption spectrometry technique.

2.5 Analysis of the COD and BOD5
The organic matters (OM) are oxidizable materials which require for their decomposition a certain amount of oxygen. This decomposition process then leads to oxygen depletion of the natural environment receiving these materials. Therefore these organic materials are considered undesirable pollutants especially in water currents as they exceed a threshold defined by the standards. The organic content is evaluated by two parameters, namely the chemical oxygen demand (COD) and biological oxygen demand (BOD).

BOD5 is the quantity of oxygen necessary for the degradation of the biodegradable organic material to water by the development of microorganisms for 5 days at 20 ° C. Analyzed by the Winkler method, it is expressed in mg /l [5]. COD is the amount of oxygen required to oxidize the organic material (biodegradable or not) of water using an oxidant, the bichromate of potassium. This parameter offers a more or less complete representation of oxidizable materials present in the sample. It is expressed in mg / l. COD is generally 1.5 to 2 times BOD5 in urban waste water and 1 to 10 for all the whole industrial wastewater. The empirical relationship of the organic matter (OM) according to the COD and BOD5 is given by the following equation:

$$OM = \frac{2BOD_5 + COD}{3}$$

Note that the ratio of BOD5 / COD allows us to assess the biodegradability of the effluent.

The solutions used for the determination of CODare:
Sulfuric acid (H_2SO_4), silver sulfate (Ag_2SO_4), Mohr's salts (iron solution and ammonium $(NH_4)_2Fe(SO_4)_2 6H_2O$), bichromate of potassium ($K_2Cr_2O_7$) and ferroin ($FeSO_4, 7H_2O$) as an indicator dye.

The principle is to measure the excess $K_2Cr_2O_7$ by iron sulfate and ammonium in the presence of ferroin. COD is expressed by the amount of oxygen from $K_2Cr_2O_7$, consumed during the mineralization of organic matter (mg / l), the dilution factor is 100.

RESULTS AND DISCUSSION

It must be remembered that the treatments are performed by bark masses equal to 3g, 6g and 10g. The columns are of diameter 8mm.

1 **Measurement of the physic-chemical parameters**
We proceeded in this part of the study to measure the temperature, pH, conductivity, COD and BOD5 biochemical laboratory waste before and after treatment.

1.1 Measuring the temperature of samples
The collected results are summarized in Table 2:

Table 2: Temperature measurement of discharges studied before and after treatment

Type of Release	Initial temperature(° C)	After treatmenttemperature(° C)
biochemistry laboratory releases	22	22

We note comparable temperature before and after treatment, the temperature would not be a factor explaining the performance of the applied substrate. These values correspond to those allowed by national standards (PNM) [6]. Appendix 3 shows the grid limits of direct and indirect emissions.

1.2 pH measurement
pH measurement is performed several times for the same sample .The Table 3 shows the average results. We indicate respectively by pHav and pHap pH before and after treatment.

Table3: pH measurement before and after treatment of the studied discharges

	R1
pH_{av}	**11,2**
pHap	**7**

It is clear from these results that the rejection of the biochemistry laboratory is alkaline and does not correspond to national and international standards (6.5 <pH <8.5). After treatment, the pH of the discharge becomes neutral.

1.3 Conductivity measurement
Table 4 shows the results of measuring the conductivity of the biochemistry laboratory discharges studied.

Table 4: Measuring the conductivity of discharges studied before and after treatment

Type of Rejection / conductivity(microseconds / cm)	biochemistry laboratory releases
before treatment	12800
After treatment with3gbark	5674
After treatment with6 gof bark	2000

We notice that the conductivity of the rejections (discharges) of the laboratory of biochemistry before treatment far exceeds the authorized standard which is 2700 µs / cm. The application in these liquid discharges of the technique of adsorption on substratum with bark of eucalyptus allowed an important reduction of the conductivity bringing to the standards authorized by the PNM. The reduction is of the order of 84,4 % for the sample treaties with a mass of the substratum of 6g.

1.4 Heavy Metals Analysis
Analysis of Copper, Zinc and Chrome are made by atomic absorption spectrometry (7). The results are summarized in Table 5 below.

Table5: Measurement of heavy metal pretreatment levels of discards.<LD *: below the detectable limit

Métal**(µg/l)** / Type de rejet	**copper**	**Zinc**	***Chrome***
R1	0,12	51	*< LD**

The values obtained are low and consistent with standards and are safe for the environment (Appendix3).

1.5 Analysis of the COD and BOD5
The results of measurements of COD and BOD5 are shown in Table 6. R1b is designated by the gross rejection before treatment and after treatment R1T rejection.

Table 6: Values of COD and BOD5 R1b and R1tet removal efficiency of MO expressed as COD.

Rejection	R1b	R1t		
		3g	6g	10g
COD (mg /l)	6140	**2500**	**1000**	**350**
BOD_5(mg /l)	3540	**1000**	**600**	**200**
Overall removal efficiency **R (%)**		**59,28**	**83,71**	**94,29**

Figure 2 shows the variation of the removal efficiency of the organic matter as a function of the mass of the bark.

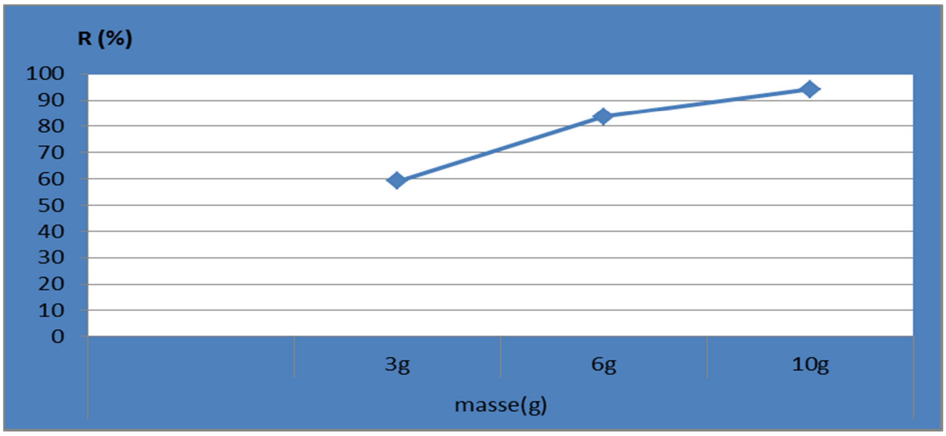

Fig 2: Removal of organic matter expressed as rates (COD) discharges by biochemistry laboratory according to the mass of the substrate

These results show that the rejection is considered loaded in oxidizable organic materials with a COD of 6140mg / l and with a biodegradable BOD5 of 3540 mg / l, since the standards permitted by the PNM for direct discharge of COD and BOD5 are respectively 500 mg / l and 100 mg / l. We note that the best treatment is obtained when the mass of the substrate is 10g reaching 94.29% removal efficiency.

2.Study of the substrate binding capacity depending on the volume of the discharge

To determine the maximum binding capacity of the organic matter in the substrate considered, we examined the evolution of performance for removing a mass of 10g. To this effect, the discharges of Biochemistry laboratory are processed by a fixation on a column of diameter equal to 10 mm. The COD analysis is performed in three steps after flowing 40ml of rejection with a 5ml / min flow rate for a total volume of 120 ml.
Table 7 shows the results obtained after flow of 120ml, the initial value of the COD is 6140mg/ l.

Table 7: Change in COD removal rate and quantity of fixing the organic load depending on the volume sold reject (R1) (m = 10g).

	Rejection of the biochemistry laboratory **R1 (m=10g)**		
Volume elapsed (ml)	40	80	120
COD (mg/l)	300	350	380
Elimination rate % (R)	95	94,29	93,81
Qf en (mg COD /mg of substrat)	23,36	46,32	69,12

It is found that at each stage, the removal of the organic material is approximately 94%. The maximum COD value determined by mg of the substrate is about 69.

Figure 14 below shows the variation in the removal rate of organic matter expressed in (%) based on the flow volume of rejection.

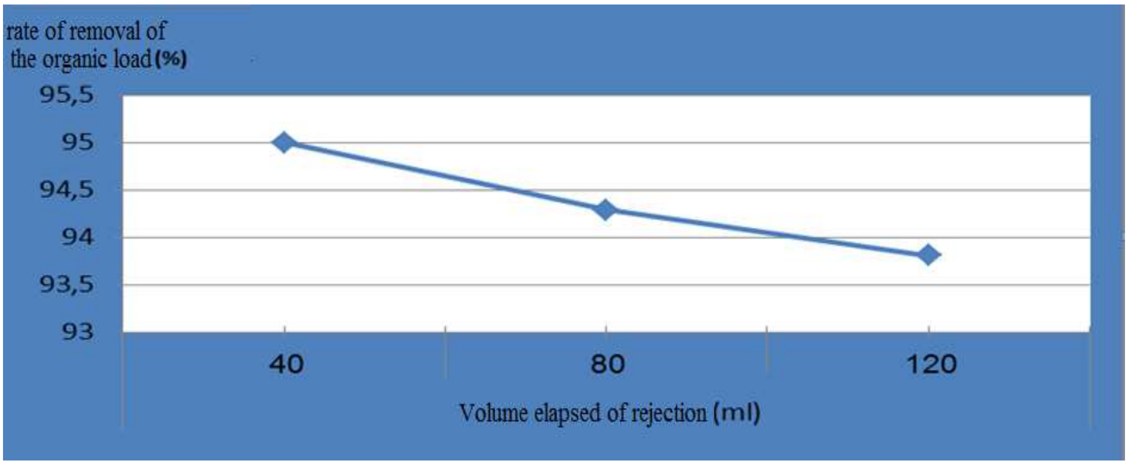

Fig 3: Elimination rate of the organic load in the volume of up to R1 m = 10 g

Values removal performance remain high V = 120ml about 94%, this result can be explained by the non-saturation of the adsorbent surface used three successive times for treatment.

Figure 4 shows the variation of the amount of organic material attached (Qf) per gram of bark in the volume of discharge treated (V).

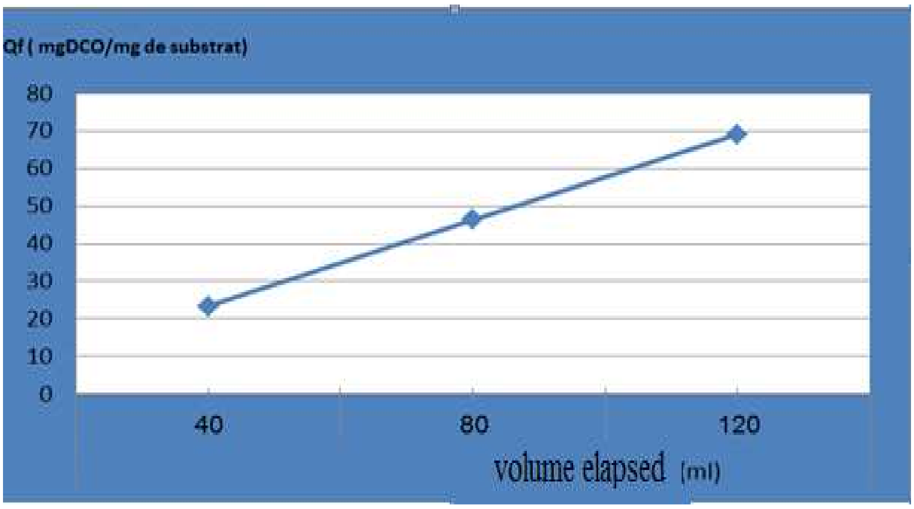

Fig.4: Change in the amount of organic matter Qf fixing according to volume sold (rejection of the biochemistry laboratory = R1, substrate weight = 10g)

This figure shows that the amount of fixation of organic matter (measured as COD) per gram of substrate increases linearly with the volume of the treated waste.

Improved sanitation

Improved sanitation can be considered by the development of a treatment plant for which a model is presented below.

Indeed, it is proposed to settle effluents and manage flows. The establishment of a buffer tank effluent would begin received settling and flow regulation and thus limit significantly the pollution caused by the effluent because the solid waste will settle to the bottom of the basin by simple force of gravity . This will be followed by decanting the waste treatment using adsorption on eucalyptus bark in the case of Biochemistry effluents.

After treatment by this method, these releases can be evacuated to the urban network. Indeed, the pollution load of discharges studied expressed in COD and BOD5 was reduced to the standard permitted by regulations (draft Moroccan standards of 2006).

CONCLUSION

This study reveals the following conclusions:

• All metal analyzes conducted revealed in a comprehensive manner, the presence of a non-metallic contamination.

• The physicochemical analysis shows that these discharges are characterized by high pollution load that could be purified with the application of the substrate eucalyptus bark at significant rates, which reach 99%.

• The temperature of releases is always less than the permitted standard of 30 ° C and the risk of thermal pollution can be avoided.

• In addition to a conductivity of 3000 S / cm, unfavorable conditions for normal ecological balance. The values recorded for conductivity exceeds the allowable standard 2700 S / cm. Any time the application of the technique of adsorption on eucalyptus substrate such discharge, a significant reduction of the conductivity of up 2000µS / cm.

As perspective, we plan to do the same study knew discharges of bacteriology laboratory and hematology and discharges of anatomy pathology. This study's main objective is the proposal of liquid waste treatment methods of hospital laboratories using natural substrates not expensive, practical, and can't be after use harmful waste for the environment.

This work has also examined the possibility of regeneration solvent by the use of simple means such as distillation.

REFERENCES

[1] The Joint Order No. 1607-1606 of 25 July **2006** laying down specific limit values for domestic release; Official Bulletin No. 5448 of Thursday, August 17, **2006**

[2] METRO.AThe ecology of Eucalyptus: Application to Morocco: Company Brief the natural sciences of Morocco, P109, 194

[3]Arpino P., Prevot A., Serpinet J., Tranchant J., Vergnol A., Wittier P. Manual gas chromatography practice-Ed phase Masson, Paris, **1995**.

[4] French Environmental Code (OJ of 21 September **2000**).

[5] Study of the quality of wastewater effluent at the wastewater treatment plant in Ben Slimane.

[6] Water, industry, nuisance - Journal n° 334.

[7] Avram,M. et G.H.D. Mateescu.**1970**. Infrared spectroscopy.Dunod Editions. Paris. 642 pp.