Elimination of Organic Matter Effluents from Chemical Laboratory of Anatomy, Pathology of a Hospital

W. Bjjou, O. Asali, E. EL Azzouzi, A. Elyahyaoui, M. Fekhaoui

Background: Laboratories use a wide range of products with one or more chemical or biological hazard properties. These waste generated that retain a chemical or biological hazard property must be removed by specific sectors to ensure the safety of people, property and the environment. Most chemical waste is liquid, pasty or solid exceed the threshold and therefore require disposal. This step must be respectful of safety and environmental protection throughout its evacuation route. The present study aims to investigate the recovery and treatment of chemical releases laboratories of anatomy pathology hospitals Ibn Sina Hospital Center with the main study sites Rabat Specialties Hospital by drug use available and inexpensive as clays, products and by-products agricultural, forestry and food, hence the use of the bark of eucalyptus in this study for the treatment and distillation for the recovery of liquid waste.

INTRODUCTION

The industrial liquid wastes convey an important organic and inorganic pollution toxic. It is about various wastes coming from the various socio-economic activities (food industry, tanning, textile, paper, chemical industry, petrochemical industry, Public discharges, ...). This type of pollution has adverse and toxic effects on living organisms, the power of self-purification of water and leads to the accumulation of certain harmful strong elements in the food chain (heavy metals, radioactivity…).[5,13]

It should be announced on this subject that the liquid effluents resulting from the medical institutions, the private clinics, laboratories of analyses or research are part of the liquid industrial waste which represents a potential danger for the environment and health. [3] However, the evolution of the regulation [1] forces from now on the health care institutions to register quality, the security and environmental protection like priority challenges in their functioning. That supposes the installation of approaches aiming at the risk prevention and control of health security (security of the care, the people and wastes…).[4]

MATERIALS AND METHODS

This part contains the experimental techniques used. Specifically, protocols and conditions of substrate preparation from the bark of Eucalyptus 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.

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.

Keywords: Chemical releases, processing treatment, biochemistry laboratory, eucalyptus bark
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. [12]

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. [14]

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.

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 (photo 1, Fig 1).

Photo 1: Montage utilisé au laboratoire Fig 1: Schematic of the column used bark pour le traitement des rejets for the treatment of discharges

1.3 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:

\[
R = \frac{\text{COD}_i - \text{COD}_f}{\text{COD}_i} \times 100
\]

COD : Value of the chemical demand for oxygen before the treatment by substrate (mg O2 / l); CODf : 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):

\[
Q_f = \frac{\text{COD}_i - \text{COD}_f}{m} \times v
\]

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) m: mass of substrate (g) v: volume elapsed (l)
1.5 Presentation 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>
<thead>
<tr>
<th>Physicochemical parameters studied</th>
<th>Methods and Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>PH meter, conductivity meter and thermometer Type 2 ORION</td>
</tr>
<tr>
<td>conductivity</td>
<td>STAR.</td>
</tr>
<tr>
<td>Temperature</td>
<td>Acidic, K2Cr2O7 + DComètre 6 Velp brand positions (PNM) *</td>
</tr>
<tr>
<td>Chemical Demand Oxygen: COD</td>
<td>Winkler method</td>
</tr>
<tr>
<td>Organic demand Oxygen during 5 days: BOD5</td>
<td></td>
</tr>
<tr>
<td>Heavy metals (copper, zinc, chromium)</td>
<td>atomic absorption spectrometry</td>
</tr>
<tr>
<td>Verification of the purity of regenerated products</td>
<td>Infra Red Spectroscopy Gas chromatography(3)</td>
</tr>
</tbody>
</table>

* PNM: Standard Moroccan Project
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It is necessary to specify that the rejections of anatomy-pathology present a layer of fat which may clog the active sites of adsorbent surface. So it was decided proceed with the decantation[4] of the rejection considered RAP followed by a natural flotation[5] to eliminate these greases which go back easily to the surface of the rejection, and then proceed to treatment with eucalyptus bark.

Characterization of physicochemical parameters of the sample studied:

2.1 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 specially 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[6]. 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 waste water. 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 COD are: Sulfuric acid (H2SO4), silver sulfate (Ag2SO4), Mohr's salts (iron solution and ammonium (NH4)2Fe (SO4)26H2O), bichromate of potassium (K2Cr2O7) and ferroin (FeSO4, 7H2O) as an indicator dye.

The principle is to measure the excess K2Cr2O7 by iron sulfate and ammonium in the presence of ferroin. COD is expressed by the amount of oxygen from K2Cr2O7, consumed during the mineralization of organic matter (mg / l), the dilution factor is 100.

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RESULTS AND DISCUSSIONS

Analysis of the COD and the BOD₅ of the discharges of the laboratory of anatomy-pathology (RAP):

The results of the analysis of the samples before and after treatment are reported in Table 2. Rb indicates the RAP gross untreated, and Rt indicates the RAP after treatment.

Table 2: Values of COD and BOD₅ Rb and Rt and removal efficiency of OM.

<table>
<thead>
<tr>
<th>Rejet</th>
<th>COD (mg/l)</th>
<th>BOD₅ (mg/l)</th>
<th>removal efficiency COD (R) en %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rb</td>
<td>190680</td>
<td>109310</td>
<td></td>
</tr>
<tr>
<td></td>
<td>93 120</td>
<td>52 400</td>
<td>51,2</td>
</tr>
<tr>
<td></td>
<td>40 860</td>
<td>20 300</td>
<td>78,7</td>
</tr>
<tr>
<td></td>
<td>19 280</td>
<td>11 550</td>
<td>89,9</td>
</tr>
</tbody>
</table>

The obtained results show that these rejections are very loaded in organic matter. Indeed, the values of the COD and the BOD exceed widely the limiting values prescribed by the standards[7].

Although the elimination rate of this charge in COD is close to 90%, the organic matter content remains high for a substrate mass of 10 g. To reduce the load rate of this material, we proceeded to a treatment by cycle taking advantage of three columns containing each one 30 g of substratum. The treated volume is 100 ml with a flow rate of 5 ml / min (Fig. 2).

Table 3 shows the results for the three stages of treatment.

Table 3: Values of COD and BOD₅ of RAP before and after treatment (m = 30g).

<table>
<thead>
<tr>
<th>Rejet</th>
<th>COD (mg/l)</th>
<th>BOD₅ (mg/l)</th>
<th>1st traitement</th>
<th>2nd traitement</th>
<th>3rd traitement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rb</td>
<td>190680</td>
<td>109310</td>
<td>32 450</td>
<td>5010</td>
<td>710</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15 700</td>
<td>2232</td>
<td>287</td>
</tr>
</tbody>
</table>

Fig. 2: Schéma du traitement en cycle de RAP (m=30 g).

Fig. 3: Elimination rate of the organic load in the RAP expressed by COD and BOD₅.
Table 4: Summarizes elimination rates of the organic load in RAP expressed as COD and BOD5.

<table>
<thead>
<tr>
<th></th>
<th>Rt (traitement1, m=30g)</th>
<th>Rt (traitement2, m=30g)</th>
<th>Rt (traitement3, m=30g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>removal efficiency COD (%)</td>
<td>82.98</td>
<td>97.37</td>
<td>99.62</td>
</tr>
<tr>
<td>removal efficiency BOD5 (%)</td>
<td>85.63</td>
<td>97.95</td>
<td>99.73</td>
</tr>
</tbody>
</table>

The use of bark as an adsorbent for the treatment of RAP releases allowed the elimination of organic matter and reducing its content to values in accordance with the standards. [17]

Table 4: elimination of the organic load efficiency expressed as COD and BOD5 RAP processed by a cascade of 3 columns with a diameter of 8 mm and substrate 30g.

Fig. 2: Taux d’élimination de la matière organique du rejet RAP.

These results reveal that the efficiency increases from one cycle to another to reach about 100% at the last phase of the treatment cycle.

The use of the bark of eucalyptus as an adsorbent in the treatment of the liquid chemical rejections of the studied laboratories, made it possible to eliminate the organic matter present and to bring back its content to the standards with rates of performance reaching 99%.

Conclusion:

Toxic potential of the hospital effluents revealed by this pleasing work to formulate proposals in order to decrease the danger related to the studied scenario: the management of pollution at source and improving the sanitation system.

Indeed, the management of the pollutants to the source appears being a solution relatively easy to set up and which forms part perfectly of the concept of sustainable development searched today.

This study's main objective is the proposal of liquid waste treatment methods of hospital laboratories using natural substrates not expensive, practical, and can not be after use harmful waste for the environment.

After treatment by this process, these rejections can be evacuated towards the urban network since the polluting load of the studied rejections expressed in DCO and DBO5 was brought back to the standard authorized by the regulations (project of the Moroccan standards of 2006).

RÉFÉRENCES

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