PHYSICOCHEMICAL AND BACTERIOLOGICAL POLLUTION STUDY OF A HOSPITAL EFFLUENT WITH THE AIM OF THE IMPLEMENTATION OF AN ADEQUATE TREATMENT: CASE OF AR-RAZI HOSPITAL, MARRAKECH (MOROCCO).

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ABSTRACT

The goal of our study is to characterize the rough effluent of the Mother-Child Hospital connected with the Center University Mohammed VI in Marrakech and to recommend a suitable treatment for this effluent. The physico-chemical and bacteriological analysis of the total rejected effluent before evacuation by the various services, of the Mother Child Hospital, revealed that this liquid rejection is very charged by organic matter in terms COD (1931.66 mg/l ±1712, 81) in BOD₅ (1071.74 mg/l ±1141, 71), in TSS (847.28 mg/l ±295, 6), VM (55.69% ±19, 65), DM (1.77 g/kg ±0, 96), Conductivity (1954 μs/cm ±539) with a pH of 6.8 (±1, 57). The average contents: nitrates, nitrites, ammonical nitrogen and Kjeldhal nitrogen are in order about 3.23 mg/l (±4, 91), 8.9 mg/l (±0, 1), 59,3mg/L (±43, 54) and 117.67 L (±41, 21). The bacteriological analyses showed a concentration raised in faecal coliform (CF average: 5.8 × 10⁶ UFC ml-1 ± 10%) and in faecal streptococci (average SF: 4.6 × 10⁵ UFC ml-1 ± 10%). Although the hospital wastewater presented a high organic load and a satisfactory biodegradability (reports BOD₅/COD = 1.5 and TSM/BOD₅ = 1.5), there was, however, detection of a high average contents chromium plates, some (0.604 mg/L), mercury (1,986mg/L) and silver with (0.388 mg/L) underlines well the industrial character of waste waters or effluent of the hospital) Ar-Razi. Based on these findings of the Hospital Effluent, we are proposing a need for a plan for proper treatment, before evacuation.
into the communal network. This Proposal is based upon the physiochemical concentrations of these metals and pathogens within the effluent. However, it is necessary to take into account the volume of domestic wastewaters that are mixed with the effluents from the hospital of caring for their patients.

**KEYWORDS:** Hospital effluent, Physical-chemical, biological, characterization, Morocco.

**INTRODUCTION**

Due to their daily activities the establishments of care of such entities like hospital laboratories, medical and pharmaceutical research institutes, they will generate large volumes of effluent which results in a variety of by-products like antibiotics, heavy metals, radioelements, active and pharmaceutical products human waste and biohazardous material. These biohazardous materials, once disposed of from their individual sectors are not separated for waste disposal except for radionuclides elements who must generally be isolated from other waste material.[1,2]

In an establishment where care is given, like the Mother child Hospital, effluent or biohazardous material from the hospital. Contains a variety of substances and chemicals from the hospital network of communal waste disposing areas without prior treatment of that biohazardous waste.[3] Moreover, the network of waste management and the designated (and separate) waste processing areas are not equipped with the proper education, materials or procedures for treating this effluent or biohazardous waste.[4, 5, 6]

Even more concerning is that the effluent coming from hospitals is 150 times more concentrated with micropollutants, chemicals and potentially harmful toxins than the comparative domestic effluent.[7] It explains not only the presence of these dangerous micrometric substances of order in the stations of purification[8, 9], but also in the different compartments of environment (water of surface, underground water, fauna, flora, sediments).[10,11] So on quantitative plan, an establishment of 1000 Beds would be polluting to the same degree as the city of 10 000 inhabitants.[12]

Following the example of the developing countries, the problems of the hospital and pharmaceutical effluents in Morocco are still away lacking in the protective strategies for this waste disposal. This oversite of protective strategies may be linked, on one hand, to institutional, financial and technical pressures of the political region, and on the other hand,
confronted with the complexity of the composition of effluent from these types of institutions.

By its geographical situation, the University hospital Mohammed VI (CHUM VI) of the city of Marrakech serves all regions of Marrakech Tensift Al-Haouz (figure 1). This service area stretches over a 32 114 km area \(^2\), which is 4.5 % national territories, with a population of 3.5 million more than the TEACHING HOSPITAL is responsible for taking care of.

The objective of this study is the evaluation of the degree of pollution of the hospital effluent of the Ar-Razi hospital (Mother Child HME), the Hospital of Mohammed VI de Marrakech by a physicochemical and bacteriological characterization of this effluent.

2. MATERIALS AND METHODS

2.1 Site of study

The Mother - child (HME) hospital opened its doors in 2008, it spreads out on a 5000 m\(^2\) area with a complete capacity of 247 beds and a medium occupancy rate of 89 %.

![Figure 1: Geographical situation of Ar Razi Hospital](attachment:image.png)

It contains 8 specialties: Genetics, Pediatric Orthopedic Trauma, General Pediatrics, Pediatric Hematology-Oncology, Gynecology, Resuscitation, Neonatology and Pediatric Surgery. It is situated in the city of Marrakesh (figure 1). It average consumption in water is 253,175 L/j. This consumption does not concern that the hospitalized people because it also covers the housing of the staff.
There three branches and subsequent buildings included within hospital campus. Its functional capacity for care includes 876 functional beds distributed between three branches of this large hospital (figure 2).

![Hospital bed capacity of the University Hospital Mohammed VI of Marrakesh](image)

**Figure 2:** Hospital bed capacity of the University hospital Mohammed VI, Marrakesh

### 2.2 Sampling

Meetings for cooperation with the representatives for the HME-TEACHING HOSPITAL Mohammed VI allowed to define the optimum conditions of holding of the inquiry and the continuity of sampling of the effluent (determination of length and period of operation, identification to the personnel, permission of access, distribution of material, location of the points of the sampling, equipment used and human means displayed during the characterization).

One took a sample from the main branch of the hospital allocated for the internal processing and handling of the effluent within the network of communal sewer of the analyzed samples of wastewater, receiving practically ¾ liquid hospital biohazard material coming from services named previously.

Sequential measuring and samples were taken on the dates as follows: 1/13/2014, 2/24/2014, 9/10/2014, and on 11/25/2014 at the rate of analysis every 10 days. These samples were put in sterile bottles of 500 mL glass containers for the microbiological analyses and in polyethylene for the physicochemical analyses. Kept in 4°C in a cold box, they are transported to the laboratory according to the norm of conservation and manipulation of samples NF IN ISO 5667-3.
2.3 Parameters and analytical methods

2.3.1 Physicochemical analysis

Except for the pH and the temperature, which were measured on the ground, all the analyses (picture n°2) carried the main parameters likely to characterize these liquid wastes. Heavy metals were dosed by spectrometry of atomic adsorption in programs of flame (Classify AA SPECTROMETER GF 95 GRAPHIT FURNACE). A multi analyzer (WTW pH 3210 WELLHEIM) and conductivity measured the pH and the temperature by a conductivimetre of type HACH SENSIONS.

2.3.2 Bacteriological analysis

The Bacteriological parameters for quantification of the parameters of faecal origin: Faecal Coliform (CF) and Faecal Streptococci (SF). The count of CF and SF was performed by the use of a series of 5 tubes, according to the method of most probable number\cite{13} and by identification of specific circles of insulation according to the norms described in the table n°1.

Table 1: Parameters of the physico chemical and bacteriological analyses realized for the characterization of the effluent of Ar Razi Hospital

<table>
<thead>
<tr>
<th>Physico-chemical analyses</th>
<th>Norms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Matters (TSM)</td>
<td>NM ISO 9963-1/2001</td>
</tr>
<tr>
<td>pH</td>
<td>NF T90-008</td>
</tr>
<tr>
<td>Conductivity</td>
<td>NM ISO 7888/2001</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NF EN ISO 7027</td>
</tr>
<tr>
<td>COD</td>
<td>NF T 90-101</td>
</tr>
<tr>
<td>BOD</td>
<td>NF EN 1899-1/1998</td>
</tr>
<tr>
<td>Chlorides</td>
<td>ISO 10 304</td>
</tr>
<tr>
<td>Sulphates</td>
<td>ISO 10 304</td>
</tr>
<tr>
<td>Sulphides</td>
<td>Potentiometri</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>EN 1189</td>
</tr>
<tr>
<td>Orthophosphates</td>
<td>NF EN ISO 15681-2</td>
</tr>
<tr>
<td>Kjedahl nitrogen</td>
<td>ISO 25 663</td>
</tr>
<tr>
<td>Ammoniacal nitrogen</td>
<td>NF T90-015</td>
</tr>
<tr>
<td>Nitrites</td>
<td>NF T 90-013</td>
</tr>
<tr>
<td>Nitrates</td>
<td>ISO 10 304</td>
</tr>
<tr>
<td>Heavy Metals : Cd, As, Pb, Cu, Ni, Zn, Cr, Ag</td>
<td>ISO 11 885</td>
</tr>
<tr>
<td>Hg</td>
<td>NF T 90 –113</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bacteriological analyses</th>
<th>Norms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faecal coliform (E. coli)</td>
<td>NF T 90-433</td>
</tr>
<tr>
<td>Faecal streptococci (Enteroviruses)</td>
<td>NF T 90-432</td>
</tr>
</tbody>
</table>
3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Results of physicochemical characterization

All results are regrouped in the table n°4.

Table 2: Results of the physico-chemical analyses of the effluent of Ar-Razi Hospital

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Minimal value</th>
<th>Maximal value</th>
<th>Medium Value</th>
<th>Standard deviation</th>
<th>Etendu E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity</td>
<td>µs/cm</td>
<td>1641</td>
<td>2180</td>
<td>1954</td>
<td>266.36</td>
<td>539</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>11</td>
<td>14.45</td>
<td>13.2</td>
<td>0.95</td>
<td>3.45</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>684.4</td>
<td>980</td>
<td>847.28</td>
<td>152.65</td>
<td>295.6</td>
</tr>
<tr>
<td>VM</td>
<td>%</td>
<td>42.61</td>
<td>62.26</td>
<td>55.69</td>
<td>6.57</td>
<td>19.65</td>
</tr>
<tr>
<td>DM</td>
<td>g/kg</td>
<td>1.02</td>
<td>1.98</td>
<td>1.77</td>
<td>6.57</td>
<td>0.96</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>743</td>
<td>2455.81</td>
<td>1931.66</td>
<td>789.83</td>
<td>1712.81</td>
</tr>
<tr>
<td>BOD5</td>
<td>mg/L</td>
<td>432.8</td>
<td>1580.51</td>
<td>1071.74</td>
<td>474.38</td>
<td>1147.71</td>
</tr>
<tr>
<td>COD/BOD5</td>
<td>-</td>
<td>1.3</td>
<td>1.7</td>
<td>1.58</td>
<td>0.13</td>
<td>0.4</td>
</tr>
<tr>
<td>TSS/BOD5</td>
<td>-</td>
<td>1.1</td>
<td>1.7</td>
<td>1.5</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>BOD5/COD</td>
<td>-</td>
<td>0.5</td>
<td>2.3</td>
<td>1.5</td>
<td>0.5</td>
<td>1.8</td>
</tr>
<tr>
<td>PO4+</td>
<td>mg/L</td>
<td>0.52</td>
<td>7.92</td>
<td>2.17</td>
<td>3.2</td>
<td>7.4</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>mg/L</td>
<td>2.12</td>
<td>13.61</td>
<td>7.43</td>
<td>5.11</td>
<td>11.49</td>
</tr>
<tr>
<td>S²⁻</td>
<td>mg/L</td>
<td>&lt;0.1</td>
<td>2.2</td>
<td>1.9</td>
<td>0.37</td>
<td>2.1</td>
</tr>
<tr>
<td>NH4+</td>
<td>mg/L</td>
<td>22.09</td>
<td>91.63</td>
<td>59.3</td>
<td>27.27</td>
<td>69.54</td>
</tr>
<tr>
<td>NO3⁻</td>
<td>mg/L</td>
<td>1.26</td>
<td>6.17</td>
<td>3.23</td>
<td>2.12</td>
<td>4.91</td>
</tr>
<tr>
<td>NO2⁻</td>
<td>mg/L</td>
<td>0.08</td>
<td>26.96</td>
<td>8.9</td>
<td>10.13</td>
<td>26.88</td>
</tr>
<tr>
<td>NTK</td>
<td>mg/L</td>
<td>45.95</td>
<td>166,. 6</td>
<td>117.67</td>
<td>38.71</td>
<td>120.21</td>
</tr>
</tbody>
</table>

**pH, conductivity**

The pH of samples studied in the course of the countryside or general populous analysis vacillates between 6.1 and 7.67 with a lower variation in the 1st unit of pH is noted in the measures of samples.

The raw conductivity of the effluent varies between 1641µs / cm and 2180µs / cm with an average of 1954 µs / cm.

The temperature, and major factor of the increase of the kinetics of deterioration of organic biodegradable matter, varies between 11°C and 15 °C. This remains always lower in 30°C, in accordance with the norms of direct and indirect rejection, which are respectively 30°C and 35°C.
Figure 3: Variation of the pH, the conductivity and the temperature in the effluent of the Ar-Razi Hospital (ARH)

**Total suspended matters, volatile matters and Dry matters**

Samples in suspension which represent the totality of good samples and those samples that did not contain organic or mineral have a medium value of 862.18 mg / L, with a maximum value recorded by 980 mg / L and a minimal concentration of 684.4 mg / L.

Figure 4 : Variation of total suspended matters (TSS), dry matters (DM), volatile matter (VM) in the effluent of the Ar-Razi Hospital (ARH)

The medium concentration in dry material is in the order of 1.77 g / kg. Dry material includes at the same time the TSS and the salts dissolved after drying of the sample in 105°C during 24 h. The medium percentage in volatile material is 55.69% with a maximum and minimal content successively 62.26% and 42.61%. The volatile samples got after calcination in 550°C by reducing the mineral samples.
Organic matter: BOD5, COD, BOD / COD: The main parameters of quality were habitually studied to assess second-hand, the total organic load contained in a wastewater are the biochemical request (BOD₅) representing the quantity of organic matter biodegradable and the chemical request in O₂ (COD) which represents the quantity of necessary oxygen to oxidize all organic matter contained in the effluent. So for the waste of the Mother - child Hospital and during the period of study stocks of BOD₅ recorded are included between 432.8 and 1580.51 mg / L with a medium value of 1071.74 mg / L. 

As for COD, recorded maximum and minimal concentration is respectively 2455.81 mg of O₂ / L and 743 mg of O₂ / L. Raised medium value is 1931.66 mg of O₂ / L.

Figure 5: Variation of the report COD / DBO5, SM / BOD, and BOD /COD in the effluent of the Hospital Ar-Razi

The effluent introduces for all the performed samples, a lower report COD / BOD in 2. Having a medium value of 1.58, a maximum of 1.7 and a minimal of 1.1. The medium report BOD₅/ COD of recorded concentration is 0.7, with a minimal of 0.6 and a maximum of 0.9. The medium value of fraction SM /BOD₅ is 0.9 with one minimal and maximum recorded respectively 0.5 and 2.3.

Nutriments

a/ Nitrate NO₃-, Ammoniated Nitrite NO₂-Azote NH₄ + and Kjeldhal Nitrogen NTK

Nitrogenous nitrates as other forms evolve very fast in the natural environment according to the cycle of nitrogen. Contents of NO₃-introduce considerable variations and wobble of 1.26 mg / L in 6.17 mg / L with a medium content of 3.23 mg/. Also for nitrites, concentration introduces considerable fluctuations with an average of 8.9 mg / L, maximum one recording of 26.96 mg / L and a minimal of 0.08 mg / L.
Figure 6: Variation of the kjeldhal nitrogen, Nitrites, nitrates and Ions of ammonium in the effluent of the ARH

The concentration of the ammoniated nitrogen introduces in the effluent of the Mother-child Hospital, were classified as the least unstable during the period of analysis. Stocks of the samples varied between 22.09 mg / L and 91mg / L with a medium concentration of 59.3 mg / L.

b/ Total phosphorus, Orthophosphate and Sulphides $S^2$-
Stocks of phosphorus-complete remained unstable in time and vary 13.61 between 2.12 mg / L and mg / L with a percentage of 70 % of concentration recorded in PT which exceeded the direct and indirect norms of waste when fixed to 10 mg / L.

Stock samples raised in phosphorus complete, remained unstable in time and varied between 13.61 to 2.12 mg/L and mg / L with a percentage of 70 % of concentration recorded in PT which exceeds the direct and indirect norms of waste who are fixed to 10 mg / L.
**Heavy metals:** The table n°3 regroups the results of the analysis of the present heavy metals in raw wastewaters of the Mother – child Hospital VI of Marrakech.

**Table 3 : Results of heavy metals analyses in effluent of ARH**

<table>
<thead>
<tr>
<th>Element</th>
<th>Code</th>
<th>Unit</th>
<th>Average concentration</th>
<th>Min-Max</th>
<th>Direct Standard$^{[1]}$</th>
<th>Indirect Standard$^{[1]}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium</td>
<td>Br</td>
<td>mg/L</td>
<td>0,071</td>
<td>0,0448-0,0967</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nickel</td>
<td>Ni</td>
<td>mg/L</td>
<td>0,188</td>
<td>0,195-0,18</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Selenium</td>
<td>Se</td>
<td>mg/L</td>
<td>&lt;0,0009305</td>
<td>&lt;0,00035-&lt;0,001</td>
<td>0,1</td>
<td>1</td>
</tr>
<tr>
<td>Money(Silver)</td>
<td>Ag</td>
<td>mg/L</td>
<td>0,388</td>
<td>0,375-0,4</td>
<td>0,1</td>
<td>0,1</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>mg/L</td>
<td>0,132</td>
<td>0,074-0,19</td>
<td>0,5</td>
<td>1</td>
</tr>
<tr>
<td>Zinc</td>
<td>Zn</td>
<td>mg/L</td>
<td>0,120</td>
<td>0,09-0,15</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td>mg/L</td>
<td>0,044</td>
<td>0,079-0,0089</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Mercury</td>
<td>Hg</td>
<td>mg/L</td>
<td>1,986</td>
<td>0,0723-3,9</td>
<td>0,05</td>
<td>0,05</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Cd</td>
<td>mg/L</td>
<td>&lt;0,1</td>
<td>&lt;0,006-&lt;0,1</td>
<td>0,2</td>
<td>0,2</td>
</tr>
<tr>
<td>Chromium</td>
<td>Cr</td>
<td>mg/L</td>
<td>0,604</td>
<td>&lt;0,012-1,195</td>
<td>0,2</td>
<td>0,2</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Ar</td>
<td>mg/L</td>
<td>0,032</td>
<td>0,0021-0,061</td>
<td>0,1</td>
<td>0,1</td>
</tr>
<tr>
<td>Cyanide</td>
<td>Cn</td>
<td>mg/L</td>
<td>&lt;0,04</td>
<td>&lt;0,0019-&lt;0,04</td>
<td>0,1</td>
<td>1</td>
</tr>
</tbody>
</table>

3.1.2 Results of the bacteriological characterization

The results of the microbiological analysis concerning the presence of the faecal coliforms and faecal streptococci in the effluent of the Ar-Razi hospital are summed up in the table n°4.

**Table 4 : Result of bacteriological analyses in the effluent of ARH**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CF (UFC/100mL)</td>
<td>1.7104</td>
<td>2.2108</td>
<td>3.5107</td>
<td>1.7107</td>
<td>2.6107</td>
<td>1.7108</td>
<td>1.5105</td>
<td>1.2104</td>
<td>2.1104</td>
<td>2.5103</td>
<td>5.8106</td>
</tr>
<tr>
<td>SF (n/100mL)</td>
<td>6.103</td>
<td>9.106</td>
<td>2.6105</td>
<td>3.5107</td>
<td>2.2104</td>
<td>2.2106</td>
<td>3.6103</td>
<td>1.6102</td>
<td>2.8105</td>
<td>1.7105</td>
<td>4.6105</td>
</tr>
</tbody>
</table>
Figure 8: Comparative graph of the concentrations of heavy metals in the effluent of the ARH and the standards of direct and indirect rejections.

3.2 DISCUSSION

Studied waste highlights an alkaline median. Medium concentrations comply with norms according to the World Health Organization (WHO) which states that a pH <5 or a pH < 8 affects the balance of the aquatic growth of microorganisms and belongs at the interval of compliance [6.5-8.5] fixed by direct and indirect Moroccan norms. It is a parameter that has need for the re-evaluation of corrosion within internal and external pipes of the hospital.[15]

Stocks of conductivity recorded for all the samples remain lower in allowed norm (2700µs / cm) but remain relatively high and can be exceeded in the dry period. This saltiness is principally linked to the wastewaters of disinfection and of washing. This translates the degree of total mineralization and gives information to us about the rate of saltiness. A high saltiness can cause problems corrosion of the pipes. Beyond 3000 µs / cm, conditions are disadvantageous for a normal ecological balance.[16]

For the temperature, major factor of the increase of the kinetics of deterioration of organic matters biodegradable, the temperature remains always lower than 30°C, in accordance with the norms of direct and indirect waste, which are respectively 30°C and 35°C. Results are in accordance with those.[15]
Stocks of samples in TSS widely exceed the limit of stocks of direct waste (50mg / L) and in the limit value of indirect rejection (600mg / L). Samples in suspension represent all the mineral and organic particles contained in wastewaters. Their effects on physicochemical characteristics are very harmful (modification of the turbidity of waters, reduction of the penetration of the light jeopardizing photosynthesis).[17]

Dry material includes at the same time the TSSM and the salts dissolved after drying of the sample in 105°C during 24 h. Composed of minerals (MM) and organic matters called dry volatile subjects after calcination in 550°C by reducing the mineral staying subjects. These parameters allowed following of the stability of the present mud in wastewaters. So for a medium concentration in MS of 1.77 g / kg and MV of 55.6 %.

$\text{BOD}_5$ is an expression to point out the quantity of oxygen, which is used for the destruction of decomposable organic matters by biochemical processes.[13] Stocks of $\text{BOD}_5$ recorded are included between 432.8 and 1580.51 mg / L with a medium value of 1071.74 mg / L. For all got results, stocks are superior in 100mg / L considered limit value of direct rejection and in 500 mg / L considered limit value of indirect rejection.

Chemical request oxygenates (COD) there allows us to appreciate the concentration in organic and mineral matters, dissolved or in a suspension in the water, through the quantity of oxygen necessary for their chemical oxidation completeness.[13] Recorded concentrations are far superior to the parameters allowed by direct (500 mg of $\text{O}_2$ / L) and indirect Moroccan norms (1000mg of $\text{O}_2$ / L). The evolution of the COD and the $\text{BOD}_5$ is in parallel to the concentrations of fecal coliforms and fecal streptococcus. This significant variation explains the higher proliferation of the organic pollution of the analysis.

For a better evaluation of the origin of wastewaters, the calculation of reports COD / $\text{BOD}_5$, $\text{BOD} / \text{COD}$, TSS / $\text{BOD}_5$ introduces a very important point. That the use of these parameters of characterization constitutes a measurable picture of the degree of pollution of raw effluents of the Mother – child Hospital and will help to optimize the physicochemical parameters of these wastewaters and offer a mode of analysis for proper treatment.

The COD / $\text{DBO}_5$ report allows the deduction of wastewaters directly into the middle campus waste receptacle, which have characteristics of domestic wastewaters.[18,13] Indeed, a weak value of the report by the COD/BOD$_5$ implicates that the presence of a large proportion of the
biodegradable waste allows for planning of a proper biological treatment area. Conversely, an important value of this report points out that a lot of the organic matter is not biodegradable and, in that case it is preferable to plan for a physicochemical treatment area as well.\cite{19} The effluent for all the performed samples and a lower report COD / BOD$_5$ in 2. Having a medium value of 1.58, a maximum of 1.7 and a minimal of 1.1. Therefore, it is possible to conclude that even if wastewaters of the effluent of the Mother - child Hospital introduce a high organic load, they are easily biodegradable. The examination of this report underlines very well the characteristics of the biodegradable waste of the Hospital within the blended wastewaters from the population for which a biological treatment center seems not only necessary but a proper thing to do for the general health and well-being of all exposed to it.

Moreover, the report COD / BOD$_5$ is weak, what allows us to deduce that organic matters in wastewaters of this type are easily biodegradable.\cite{20} This conclusive result is confirmed by the estimate of oxidizable material by the medium report of TSS / BOD$_5$ of 0.90.

In considering the BOD$_5$ / COD report, which gives notable indications on the origin of pollutions of waste waters and the possibilities of treatment. For our study, this report is relatively high in the order of 0.7. The organic load of returns of these rather unstable wastewaters quickly evolve towards forms "digested", which are generally not able to be detected by us through the smell. Indeed, wastewaters of this particular Hospital have an organic dominant feature.

The presence of nitrogen in the wastewater can have an organic or mineral character. The organic nitrogen is mainly a constituent of proteins, polypeptides, amino acids and of urea. The mineral nitrogen which includes the ammonium (NH$_4^+$), Nitrates (NO$_3^-$), and Nitrites (NO$_2^-$) constitutes the better part of the complete nitrogen. Contents of NO$_3^-$ remain on the lower end of concentration within the waste. Concentration of nitrites has considerable fluctuations with an average of 8.9mg/ L. Stocks of samples of ammoniated nitrogen NH$_4^+$ vary between 22.09 mg/L and 91mg/L in concentration. Thus, beyond 2 mg/L the treatment of Chlorine becomes very expensive, for the effluent with high concentration of ammoniated nitrogen. Ammonium Ions come from the deterioration of the animal proteins (due to the Nitrogen Cycle), domestic effluents (urea) and urban streaming.\cite{21,22} However, for the milligrams of nitrogen of ammoniated origin, 10 mg of chlorine are what is needed to oxidize chloramines in gaseous nitrogen.\cite{13}
For the nitrites (NO$_2^-$) constitute an important stage in the metabolization of the nitrogenous waste, they are inserted into the cycle of nitrogen, between ammonium and nitrates. Nitrites come generally either from an incomplete degradation of Ammonia or of a reduction of nitrates, they represent only a stage of intermediary and are able to easily oxidized their nitrates via chemical pathway or by bacteria. Stock samples vary between 0.08 mg/L and 26.96 mg/L with a medium concentration of 8.9 mg/L. Weak concentration in nitrites met at the level of wastewaters of the studied effluent, could be explained due to the fact that ion Nitrite (NO$_2^-$) is a composite intermediary, unstable in the presence of the oxygen, whose concentration is generally much less than that of both of the other forms, which are linked to it for example ions nitrates and ammonium.[23]

Phosphorus compounds exist in natural waters and wastewaters under different forms; to know the soluble orthophosphates, hydrosoluble phosphates and organophosphorus derivatives.[13] The complete phosphorus is, at its origin, in the presence of the active additives, added to detergents as well as of the decomposition of the organic matter.[23]

Concentration observed for the effluent of the Mother-Child Hospital exceeds the direct and indirect norms of rejection which are fixed to 10 mg/L. The big part of the organic phosphorus concentration also comes from the metabolism of proteins, and of its elimination in form of phosphates contained within human urine.[24]

Orthophosphates (PO$_4^{3-}$) with a medium concentration of 2.17 mg/L, a maximum of 7.92 mg/L and a minimal of 0.25mg / L, is an allowable limit value of a direct rejection in receiving middle.[14]

The bacteriological analysis accomplished on the effluent of the Mother - child Hospital is concerning due to the classical bacteriological samples of faecal pollution. The medium concentration raised at the level of this rejection in CF is 5.8.10$^6$ UFC / 100mL (UFC: units forming colony) and in SF is in the order of 4.6.105 (UFC / 100mL). These samples are very high and exceed the direct and indirect norms.[14] These results go in accordance with jobs[25], which are recorded in the hospital Mohammed V de Meknes in concentration in CF =7.44.10$^6$ UFC / 100 mL and SF: 2.28.10$^6$ UFC / 100mL and those other contribution jobs of[26], which recorded a concentration of the complete flora in the order of 10$^6$ UFC / ML. Moreover, these results are far superior to those found in a similarly sized hospital in France 2.10$^3$ and 2.10$^6$ coliform faecal by 100 mL.[27, 28]
The concentration in faecal coliforms was used\textsuperscript{[27,3]} as an indicator for the degree of pollution, water with characteristically faecal germs and the like, are considered to be an indirect indicator of the massive presence of antibiotics and/or of antiseptics. In addition, with the use augmented at the level of HME, are the products of disinfection and of maintenance, of which the highest contributor is the wastewater containing bleach and other toxic products such as the antiseptic products; these antiseptic maintenance products raise the activity of care. Also, with high concentration in discerned CF who exceeds 5.8.106 UFC / 100mL, the effluent of the hospital Mother Child of the CHUM VI is very loaded in chlorinated antibiotics and substances\textsuperscript{[27]} and can be an indication of the presence of enteropathic microorganisms\textsuperscript{[29]}

And regarding the elemental matters contained within this, the metallic traces, the analysis of raw wastewaters of the Mother-child Hospital revealed a presence of weakly concentrated measurements of elements in the direct and indirect norms of the waste water (figure n°8) of following heavy metals were traceable: Br, Cn, Ar, Pb, and Cd.

For copper and nickel, they are present at considered in the medium stocks in the order of Norm (0.188 mg / L) and Cu (0.132 mg / L) remain lower in the direct and indirect norms of rejection (Face 8). On the contrary, it’s disclosed presence in contents raised the chromium, the mercury and the money with medium concentration, respectively 0.604 mg / L, 1.986 mg / L and 0.328 mg. / L which exceeds limit direct and indirect stocks of rejections.

Medium contents raised of mercury were also discerned in many research works. That of\textsuperscript{[15]} is worth 0.75 mg / l, and a concentration of 29 mg / l silver was measured in the punctual sample of technical services.\textsuperscript{[26]}

The study accomplished in 2013, on the impact of the chromium VI on the treatment of wastewaters in the station of purification of Marrakech, disclosed high concentration in chromium VI which varies between 0.06 and 0.34 mg / L at the entrance of the station of purification of wastewaters of the city of Marrakech. These high rates have an impact on the technique of treatment by muds speeded up.\textsuperscript{[30]} Except with a medium content in the order of 0.604mg / L in chromium recorded for the effluent of HME, it can be said that the hospital has its part of contribution of the metallic pollution met at the level of communal STEP.

Considered to be a marker that can potentially identify an effluent of establishment of care, the money can attain punctually maximum one of 29 µg / L.\textsuperscript{[1, 31]} Results obtained confirm
that the hospital effluents has presence of the mercury and the money.\cite{27} The presence of such concentration in heavy metals requires a physicochemical processing.

**CONCLUSION**

Due to the knowledge of the established activity of the Mother-Child Hospital, bibliographic data and results of the physicochemical and bacteriological characterization of its waste waters. Raw wastewaters of HME introduce major physicochemical and biological parameters of pollution, which exceed general limit stocks of direct and indirect rejections what represents a risk of environmental pollution where from the necessity of a treatment of these raw wastewaters.

At the end of the valuation of degree of organic pollution, it is possible to note that all the studied parameters (especially with BOD\textsubscript{5}, COD and TSS) local wastewaters analyzed with high concentration parameter values.\cite{32} Besides the organic matter, they contain adequate quantities of organic nitrogen for necessitating the need for microorganism purifiers of their general waste systems. The examination of the report COD / BOD\textsubscript{5} underlines definitively the character of the biodegradable wastewaters or effluent. It is possible to conclude these wastewaters are easily biodegradable even if the reports of BOD\textsubscript{5} / COD and TSS/ BOD\textsubscript{5} is high. However, high concentration of mercury, chromium and money can introduce a problem for the biological treatment.\cite{33}

The treatment of these wastewaters is necessary to produce an effluent, which respects the norms of direct and indirect rejections.\cite{14} The current biological treatment is not adequate, in as much as the rejected effluents are not characteristic of the counterpart domestic rejections and waste but rather to a great extent more comparable to the industrial. Therefore, supplementary methods must be set up, such as physicochemical and electrochemical treatment plans. On the other hand, it is necessary to take into account physicochemical and microbiological characteristics of domestic wastewaters with the liquid waste and rejections coming from the activity of care of the patients to minimize the treated volume and the spread of the microbial load into the general population.

Our study allows us to conclude that the studied waters are of poor quality. We furthermore conclude that the treatment of these wastewaters before their disposal into the network of waste management of the city of Marrakesh and its inhabitants. These observations would
benefit from further investigations, which must be confirmed by multiplying the number of samples and so as to accomplish other toxicological analyses.

According to the raised official reports, we hope to have provoked a true realization of the stakeholders on the necessity to develop, in every establishment of care, and hope to generate further interest into treatment of these wastewaters.

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