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Valorization of powder of neem hulls like bioadsorbant for the detoxification of the hospital effluents: Case of CNHU-HKM

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Abstract

The chemical subtances used in hospitals for various treatments are often found in hospital liquid effluents. This discharge of these liquid effluents into the natural environment is an enormous risk for human health. It can cause a real problem in our environment with harmful and sometimes irreversible consequences on the aquatic ecosystem. The objective of this Master's thesis is to evaluate the chemical pollution of liquid effluents from the National Hospital and University Center Hubert KOUTOUKOU MAGA (CNHU-HKM) of Cotonou by the cytotoxicity test based on the inhibition of the growth of the roots of onions cultivated. These effluents were subject to decontamination with neem husk powder and its activated carbon. The cytotoxicity test carried out on samples of untreated CNHU-HKM Hospital effluent shows that the Effective Concentration for which chemical effects are observed for 50% of the effluents tested (EC50) is 22%. Depollution whith hull powder of neem (BA) gave 27% and that obtained with is Activated Carbon (AC) gave 37%. The results obtained reveal that the effluents from the CNHU-HKM are chemically polluted, that is to say, do not comply with the standards in force in Benin. These clearly show that it is important to carry out regular monitoring and evaluation of our hospital effluents before their discharge into urban sanitation networks.

Keywords: Hospital liquid effluents, pollution, purification, neem hull powder, cytoxicity, activated carbon.

Introduction

Worn water resulting from industries or domestic generally contains organic compounds and/or inorganic in strong concentrations which can be toxic. They contain in some of the cases of the pathogenic micro-organisms. In the same way, this water must be treated by suitable techniques before their rejection[1]. The methods which in general are used for the water treatment worn can imply physical processes, biological or physico-chemical/chemical. The choice of the treatment is carried out according to the nature of the pollutants to eliminate as well as theirs concentration. Adsorption on activated carbon (AC) is used little for the purification of the worn water polycontaminées in principal épuratoire treatment, whereas its capacity of adsorption for the chemical compounds is high, and that it constitutes a process of choice for the water treatment container of weak concentrations of pollutants. The capacity of an Activated carbon to adsorb the pollutants depends on the distribution of the size of its pores, the size of the molecules to be treated, their concentration and other parameters such as the temperature, the nature of solvent (here, water or the effluent) as well as the force ionic[2]. We will give processes useful and appropriate to the preparation of ACs like their physico-chemical properties and the advantages which are related to their use in the water treatment worn.

Contrary to hospital solid waste which is generally collected by specialized structures and is destroyed by systems of incineration, hospital liquid waste is very complex and they require really a more particular management before their rejection in nature because specific substances representing of the infectious risks and/or poisons are diluted there[3].

The Hospital National Center and University Hubert KOUTOUKOU MAGA (CNHU-HKM) of Cotonou obtained a system which allows a durable management of its worn water. Indeed a system was put on the site to treat hospital worn water of CNHU-HKM before their rejection in the environment. The effectiveness of this equipment could contribute to the improvement of agriculture in urban environment.

But a thing is to have the infrastructures and of the adequate equipment of collection and water treatment worn but another is to make sure that this equipment functions normally and answers the discounted objectives effectively but the hospital rejections liquidate threaten the environment much more than the urban effluents[4].

A regular follow-up of the installations and a control deepen hospital effluents are thus necessary in order to evaluate the performance of the systems set up to this effect. This research

will make it possible to evaluate the toxicity of the hospital effluents of CNHU-HKM and to detoxicate them using bioadsorbant natural and of the activated carbon of hulls of neem.

Materials and Methods

Material: We need the material which follows: powder of hull of neem; activated carbon of hull of neem; gloves; glasses; muffler; Bottles; columns; cooler; béchers; Erlenmeyer bottles; test-tube graduated; balance laboratory; porcelain crucibles; magnetic stirrer; centrifugal machine; drying oven; muffle furnace; desiccator; mortar; the pH meter and Phosphoric acid, distilled water, acid hydrochloric, hospital effluents.

Preparation and characterization of the adsorbents: The activated carbon was prepared from bioadsorbant natural by chemical activation by using the phosphoric acid.

Figure-1: Seeds of dried neem.

Figure-2: Hulls of seed of neem

Part of bioadsorbant (BA) was transformed into activated carbon (AC) according to the experimental protocol optimized[5].The chemical activation of the biomass by H_3PO_4 is made in two stages an impregnation followed by a pyrolysis like continuation: i. A mass of the BA powder weighed was impregnated with a solution of H_3PO_4 to 40% with a mass report/ratio of 1:2; ii. the mixture obtained is put out of drying oven (Memmert model) during 6 to 8 hours at 110 C; iii. the product obtained was put in crucibles out of porcelain with lids then placed in a furnace at pulley block (Nabertherm model) whose temperature of the furnace evolves/moves in an increasing way with heating rates of 10C/min, then a stage of isotherm of 120 min at 450C. iv. at the end of pyrolysis, the crucibles were left the furnace to be deposited in a desiccator during 30 min for cooling; v. hydrochloric acid solution to 0,1.n[6], vi. the hydrochloric acid was eliminated by washing with distilled water several times until obtaining from constant pH; vii. after rinsing, washed coal was dried in a drying oven at 120 C throughout one 24 H then filtered to 0,8 mm; the activated carbon obtained is preserved in hermetic bottles for the studies later, the product is noted AC.

Determination of Mass efficiency of the activated carbon: The output is a significant quantitative characteristic for the activated carbon. It translates the loss of mass of the biomass during its pyrolysis[7,8]. It is a significant measurement of the feasibility of making of activated carbon starting from a precursor given and under given conditions and an indicator of the performance of a method of preparation of this material especially on an industrial scale[9].

The expression of the mass output is given by the following formula:

Output (%) = (mass final / mass initial) x 100

Test of toxicity of the effluents: The test rests on the inhibition of the growth lengths of the roots of onions cultivated in the various concentrations of hospital effluents. The onions are laid out in transparent disposable glasses of 160 ml containing the various concentrations of the taken samples**.**The concentrations carried out for this study are:0%;25%;50% and 100%.They are obtained by diluting the effluents with distilled water.Each concentration is repeated three times;one thus has twelve (12) culture media for the activated carbon (AC) and 12 culture media for bioadsorbant gross.

The onions are cultivated during three (3) days in the darkness to prevent the roots from collecting the light. The culture media to various concentrations are changed every 24 hours.After the third day of culture, each root is cut and measured by a rule.

Experimental protocol of depollution of the effluents with the powder of hull of neem : i. To weigh 10g cleansing (gross bioadsorbant) and to mix it with a solution of 1000 ml of the pollutant (samples of hospital effluents), ii. To constantly agitate the mixture during 2 hours using a magnetic stirrer at ambient temperature. iii. To separate the solid phase from the liquid phase by centrifugation using a centrifugal machine during 15 mn at a speed of 4000 turns/mn. iv. To recover the liquid phase and to use it for the test of cytotoxicity.

Results and Discussion

Parameters based over the length of the onions roots put in culture in the hospital effluents: The test of cytotoxicity carried out on the onions roots showed that there exists on the level effluents of CNHU-HKM an inhibition of the growth of the roots. This inhibition appears by the fact that the roots of

onions put in culture did not push well compared to onions put in culture at 0%.One thus carried out the processing liquid waste of CNHU-HKM by of Bioadsorbant (BA) and the Activated Carbon (AC) obtained starting from the hulls of neem. A comparative study of the growth of the roots of onions put in culture in the samples of the hospital liquid effluents of CNHU-HKM and those treated by both cleansing BA and AC showed the effectiveness of cleansing used.

This result confirms the physico-chemical and bacteriological analyses carried out on the effluents of CNHU-HKM[10].

After the 72h we recovered onions, then cut the roots and to measure using a scale in cm for each concentration of dilution carried out.

According to the results obtained, the roots of onions pushed more when the samples of the effluents of CNHU-HKM were cleansed by bioadsorbant gross concentrated to 100%. On the other hand when the effluents are concentrated to 25%, they are the roots of onions cultivated in the effluents cleansed by the activated carbon which push more than those of onions put in culture in the effluents cleansed by bioadsorbant gross.

There is on Figure-3 the histogram of the average lengths of the roots of onions put in culture in the samples of taken hospital effluents. On the whole, twelve (12) onions are put in culture. The smallest length of the measured roots is 0,2cm and largest east 3,4cm. The figure obtained shows that the roots of onions did not push same manner. Only 17 roots pushed for 12 onions put in culture. The averages lengths of the roots are respectively 98,51% and 35,06% for onions put in culture in the concentrations 0% and 10%. In the culture medium concentrated at 50% of hospital effluents, the average lengths of the roots are 11,79%. For 100% of effluents of CNHU-HKM, the average lengths of the roots of onions put in culture decreases up to 4,44%. One notes that the average lengths of the roots decreased as the concentration in effluent increases in the culture medium. What shows that the roots were prevented from pushing.

Parameters based over the length of the onions roots put in culture in the effluents of CNHU-HKM cleansed by Bioadsorbant and the activated carbon at base of the hulls of neem.

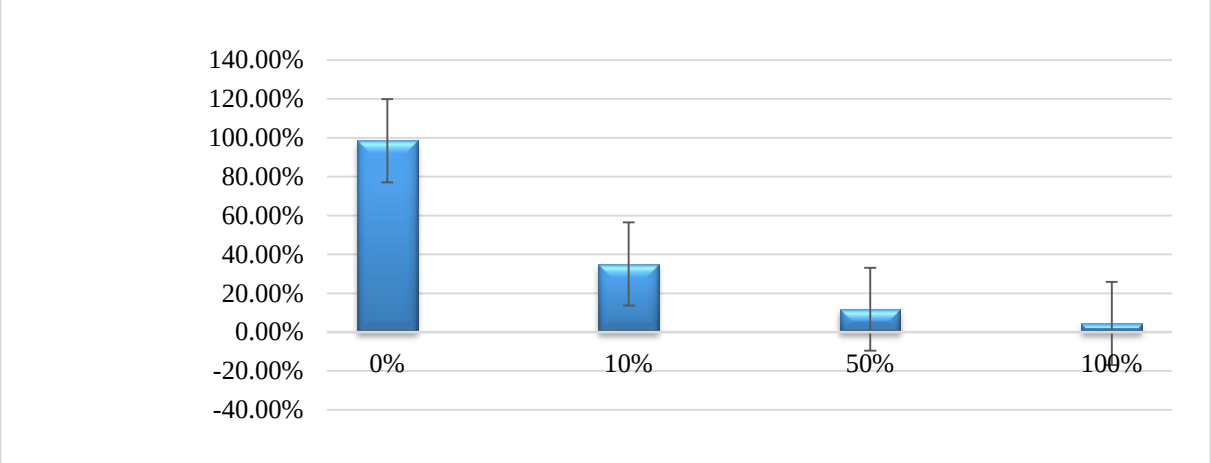

Figure-3: Average lengths of the onions roots put in culture in the effluents of CNHU-HKM.

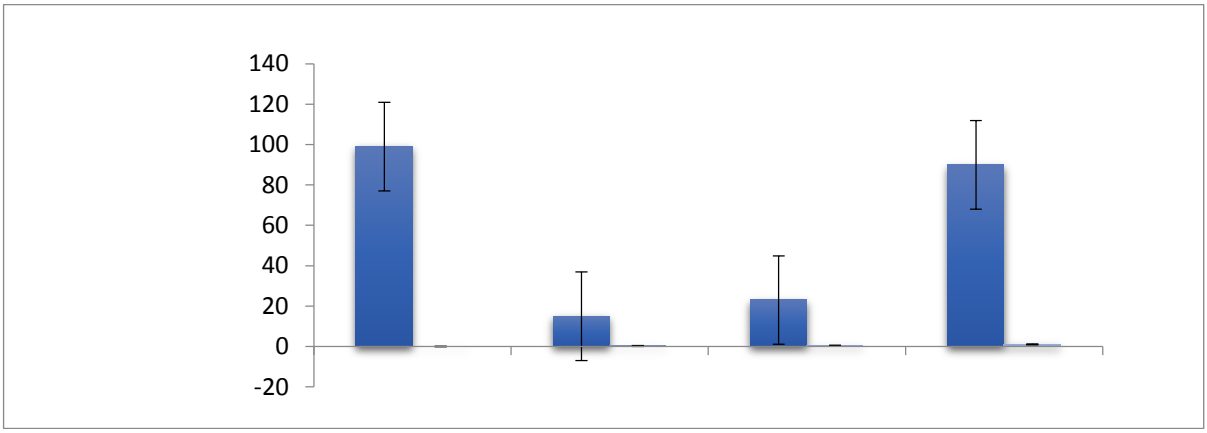

Figure-4: Average lengths of the onions roots put in culture in the effluents of CNHU-HKM treated by BA.

The Figure-4 respectively shows averages equal to 15% and 23% for the concentrations 25% and 50%. This average pass to 90% for a concentration of 100%. One notes that the roots of onions put in culture in the samples of effluents treated by Bioadsorbant BA pushed than the onions which were put in culture in the untreated hospital effluents. These results make it possible to deduce that Bioadsorbant used made it possible to reduce the toxicity of the hospital effluents tested.

The results obtained on Figure-5 showed a growth of the average of the roots of onions of 25% to 100%. For a concentration of 25%, the average lengths of the roots is 40%. It passes à.70% when the concentration is 50% and becomes 98% for a concentration in effluents treated by the Activated carbon (AC) of 100%. These results show that the Activated carbon more effectively decreases the toxicity of the treated hospital effluents.

Table-1: Averages lengths of the onions roots put in culture in various concentrations (%).

Concentrations of the samples of treated effluents	Averages lengths of the onions roots (%)		
	Untreated hospital effluents	Hospital effluents treated by BA	Hospital effluents treated by AC
0 %	98,51	99	99
10 %	35,06	-	-
25 %	-	15	40
50 %	11,79	23	70
100 %	4,44	90	98

The weak averages obtained for the concentrations varying from 10% to 100% (Table-1) show that the hospital liquid effluents untreated of CNHU-HKM prevent the roots of onions from growing. What indicates that these studied liquid effluents are toxic. When the concentration increases by 25% to 100%, it is noted that the averages lengths of the roots of onions obtained after the hospital liquid liquid waste processing by the Activated Carbon (AC) are greater than those obtained after having treated them by Bioadsorbant (BA). The same remark is made when one compares the averages obtained after the hospital liquid waste processing by the untreated Bioadsorbant (BA) and samples. One thus deduces from it that the Activated carbon (AC) cleanses the hospital liquid effluents more effectively than Bioadsorbant (BA) used.

Parameters based on inhibitions of the growth of the onions roots: These parameters are based on the effective concentration. Effective concentration EC50 is the concentration for which the chemical effects are observed for 50% of the individuals tested[11].

Effective concentrations EC50 obtained starting from the analysis of the toxicity based on the inhibition of the growth of the roots of onions made it possible to evaluate the toxicity of the effluents tested. Effective concentration EC50 of the effluents of CNHU-HKM untreated is 22%. Two cleansing containing hulls of neem were used for the detoxication of the hospital effluents of CNHU-HKM.

Effective concentration EC50 obtained when one treated the hospital liquid effluents by Bioadsorbant is equal to 27%. The strongest EC50 which is 37%, was obtained when these effluents were treated by the Activated carbon obtained containing hulls of neem.

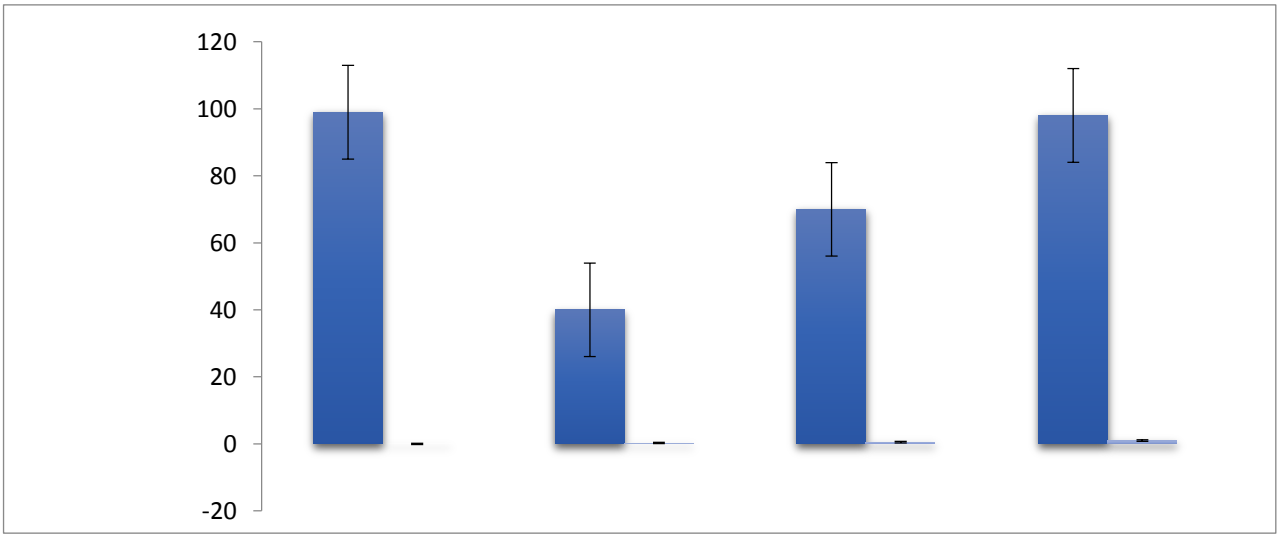

Figure-5: Average lengths of the onions roots put in culture in the effluents of CNHU-HKM treated by AC.

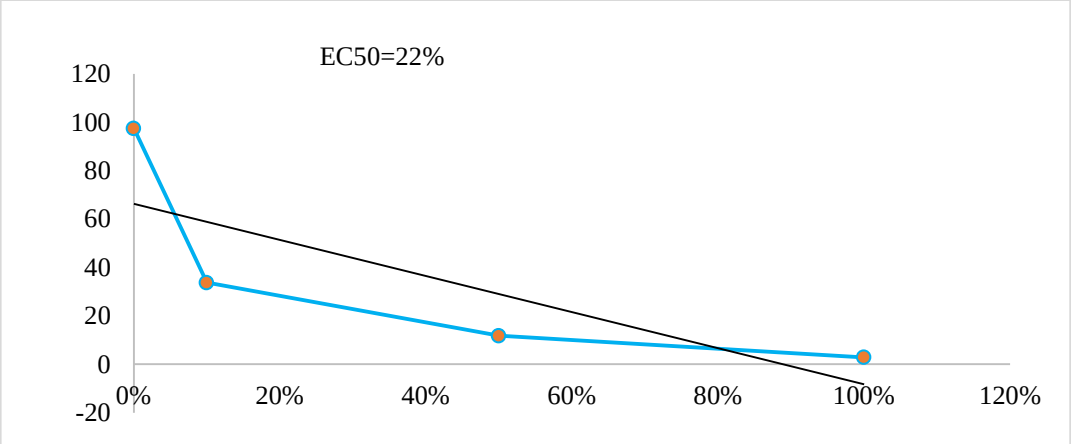

Figure-6: EC50 of the CNHU-HKM Hospital effluents untreated.

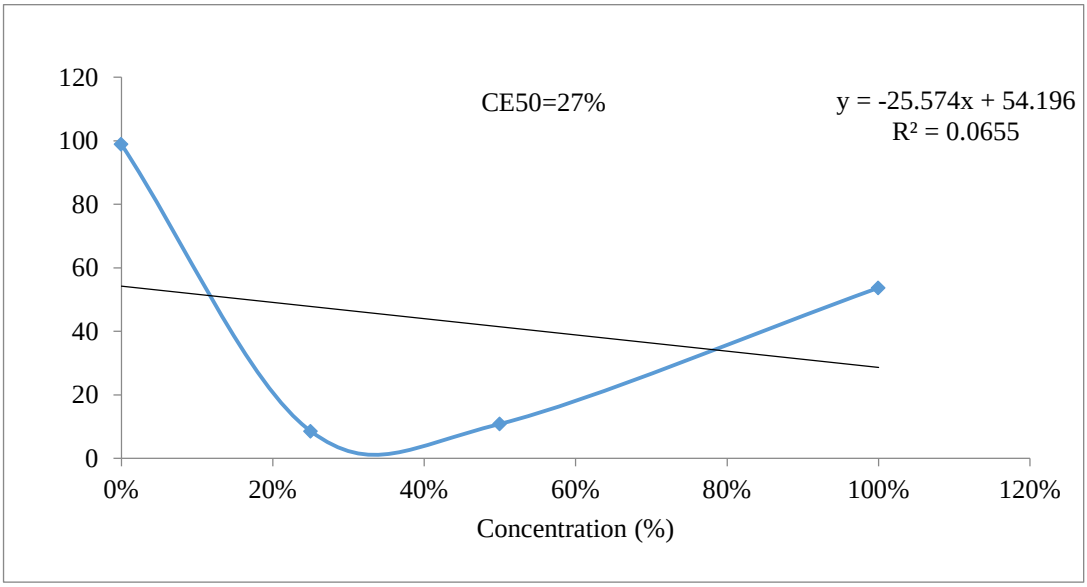

Figure-7: EC50 of the CNHU-HKM effluents treated by Bioadsorbant (BA).

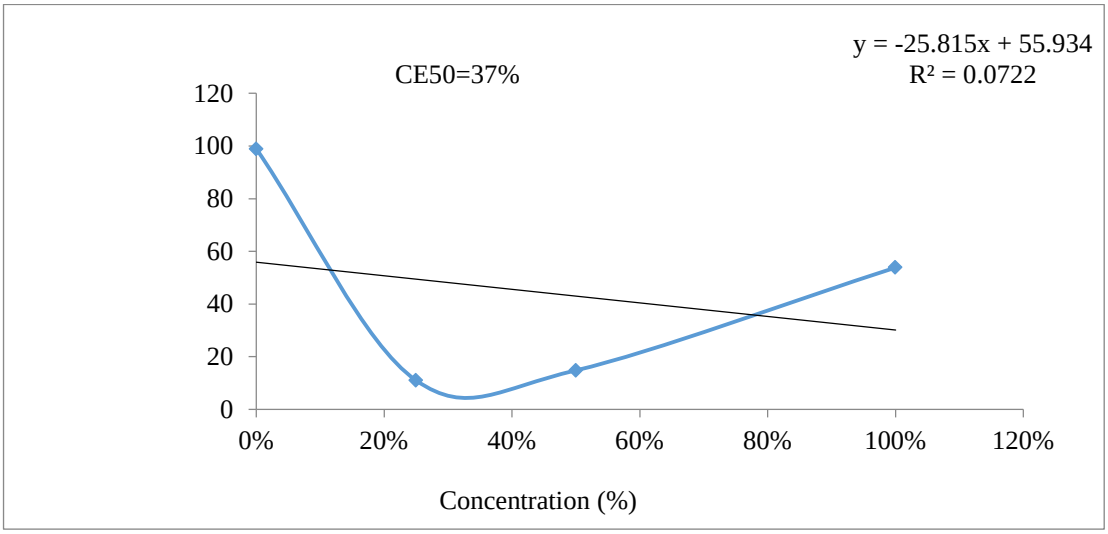

Figure-8: EC50 of the CNHU-HKM effluents treated by Activated Carbon (AC).

Table-2: EC50 of the hospital liquid effluents.

	Hospital Untreated effluents	Hospital effluents treated by BA	Hospital effluents treated by AC
EC50	22 %	27 %	37 %

When we consider all the effective concentrations obtained, we note that the effective concentration highest is equal to 37%. One deduces from it that the Activated Carbon (AC) prepared starting from the hulls of neem detoxicates the hospital liquid effluents more effectively than Bioadsorbant (BA). We note that the EC50 of cleansing BA and AC have values higher than that of the untreated hospital effluents. That is explained by the fact why both cleansing used underwent treatments which increased their specific surfaces what makes it possible to increase their capacity of adsorption.

Expression of the Output: Bioadsorbant Output BA (%) = (70 /100) x 100=70%.
Activated Carbon (AC), Output (%) = (41.9625/100) x 100 =41.9625%.

Conclusion

The research tasks within the framework of the report of Master led us to study the cytotoxicity of the effluents of CNHU-HKMtaken downstream from the station of purification. The evaluation of the toxicity of these effluents by using the test of cytotoxicity based on the inhibition of the growth of the onions roots reveals that the effluents tested prevented onions the roots from pushing. This inhibition was completely observed in the concentration 100% and the roots of onions practically did not push in the effluents tested. It comes out from this work that the liquid effluents of CNHU-HKM are polluted and are not likely to support a good development of the species in the mediums where they are poured. The results obtained after the study of total toxicity confirmed that the hospital effluents are toxic. On the other hand these effluents can be treated with powder of hulls of neem and the activated carbon of the powder of hulls of neem.

The results obtained show that the Station of Purification (SE) of CNHU-HKM does not manage to eliminate all the chemical pollutants which are found in its liquid effluents. It is thus concluded that this station does not function correctly any more.

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