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Characterization of the SEHOUE – MASSI clay used for chemical purification: case of GBAGO ponds (Porto-Novo. Republic of Benin)

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Abstract

The principal objective of this research is to develop the local fisheries with the aim of increasing the productivity of local halieutics resources. The depollution of the studied ponds was made with the clay of SEHOUE-MASSI which is a locality located at 98 km of the town of Cotonou. The site of SEHOUE-MASSI is located between 213'E and 216'E then between 657' and 659'N in LAMA depression with generally flat relief. Ten wells with the mesh of 100m and maximum depth 5m for the majority and sometimes 7m were explored. The clays obtained are plastic, of bank gray color in general. The samples are taken according to the colors observed according to depths and are put in sachets from 5 to 10kg. The clay reserve on the site of SEHOUE-MASSI is estimated at 15,30,000 tonnes according to work's of the Beninese Office of Geological and Mining Research (BOGMR). The purpose of the depollution of the studied ponds is to increase the productivity on a scale of the local fisheries by treating the ponds with lower cost than to booster local consumption and the marketing of the halieutics products in order to reduce the importation of the imported frozen products. The results obtained showed that clays used can cleanse the water samples of GBAGO ponds.

Keywords: Depollution, species halieutics, decontamination, ponds, clay.

Introduction

Clays are rocks of geological origin. The phenomenon of erosion accentuated by chemical reactions entrains the degradation of the rocks[1]. The study area is within the Pan-African range zone of Dahomeyids[2]. The rocks are metamorphic and magmatic. The climatic conditions having caused their formation and the nature of the bed rock determine the nature of formed clay. The plasticity and adsorption of the clays are the properties due to the presence of the fine particles of size lower than 2µm were noted during levitating of the components of clays according to their sizes.

SEHOUE - MASSI clay was used as adsorbents for chemical purification of the water samples pollutants of GBAGO ponds.

The mineralogical characterization of the crystallized substances was made by Diffraction with x-rays technique. It arises from work of Wiewiora[3], Brewster[4] and Robert[5], that the reticular plans of more or less crystallized minerals are obtained by diffraction of incident rays.

The diffraction of x-rays remains the first method for the mineralogical characterization of argillaceous minerals. It is often used identify the type of clays and for their semi quantitative evaluation[5]

Material and methods

Material: The diffraction of X-rays on powder was carried for mineralogical study of the total or raw rock, finely crushed. A diffractometric study was also made on the fine fraction (< 2µm) purified or normal. The normal fraction obtained was used to prepare directed pastes to undergo the specific treatments.

A Philips brand diffractometer provided with a generator PW 1800 and graphite monochromator was used for recording the diffractograms. The machine used the cobalt radiation and functioning under 40Kv, 40my. X' PERT High Score and the software X' PERT& IDENTIFY were used for treating the spectra.

Material of the test of cytotoxicity of the water samples of the ponds: We bought the Onions at kpétoukpinmèdé market in Porto-Novo and dried with the laboratory and some samples of water of the studied sites[6]

Clays of SEHOUE-MASSI were used to treat the water samples of the three sites.

The water samples are those of three ponds of the locality of GBAGO

Method: Method of treatment of clays: The samples of clay were crushed in an agate mortar and sometimes filtered with 2 mm before the preliminary analyses. These are brute clays. The diffraction of X-rays on powder of the finely crushed raw rock and on the fine fraction (< 2µm) purified or normal was used for the mineralogical study.

The analyzed sample must be rich in argillaceous minerals. The sample subjected to the beams of x-rays must present the greatest possible number of plans of maximum atomic density from where orientation of the preparations according to a direction parallel with that of the leafs; these are directed preparations. The sample must be subjected if one needs it for treatments specific to highlight the variability of the interfoliaceous equidistant to knowing: saturation by a polyalcohol, saturation by hydrazine, the heating with 490°C during 4H)[7]. In this case the angular sector ranging between 3 and 35 Å is completely satisfactory.

Method of cytotoxicity test of water: Various concentrations: 0%, 25%, 50%, 75% and 100% were used for the cytotoxicity test.

We placed onions in the darkness and we changed their culture medium every 24 hours.

After 96 hours of culture (4 days) we measured the lengths of the onions roots for the cytotoxicity test[8]

Results and Discussion

Toxicity of ponds water: Parameters based on the length of the roots of onions: According to the parameters based on the lengths of the onions roots[9] , the roots are growing more on the level of the water samples[10] of the three sites treated by clay B of SEHOUE-MASSI (Figure-1) that when they are not treated (Figure-2). On Figures-3, 4 and 5; we noted on each studied site that the roots have grown more quickly on the site treated by clay B than on the untreated sites. We therefore deduce that the clay used makes it possible to reduce the toxicity of the studied sites.

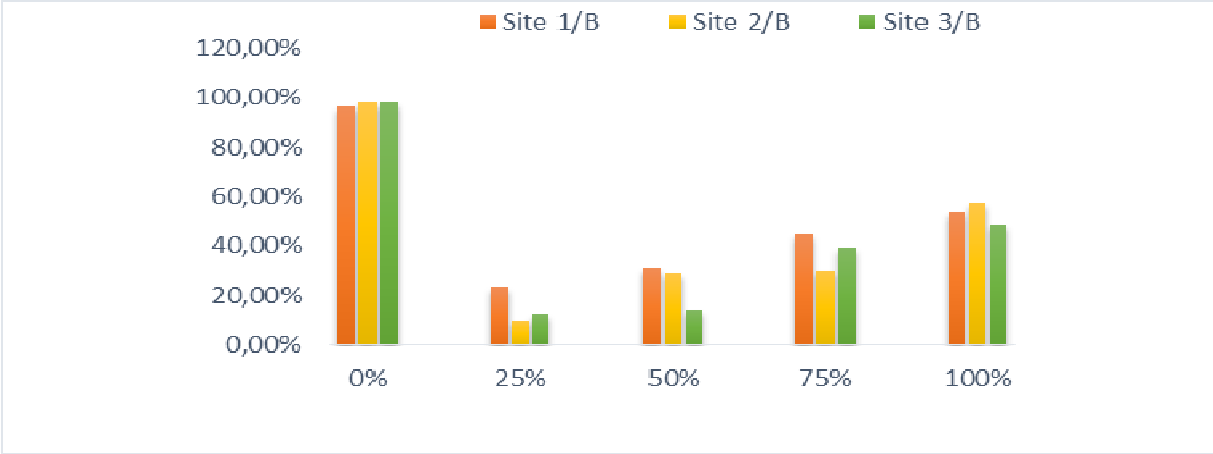

Figure-1: Average lengths of the onions roots of the three sites treated by clay B (Clay of SEHOUE-MASSI).

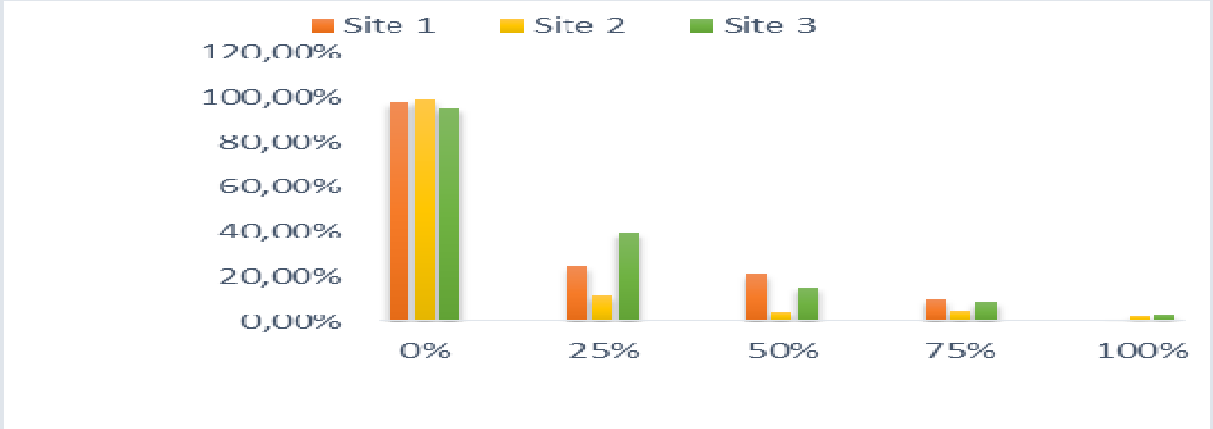

Figure-2: Average lengths of the onions roots of the three sites untreated by clays**.**

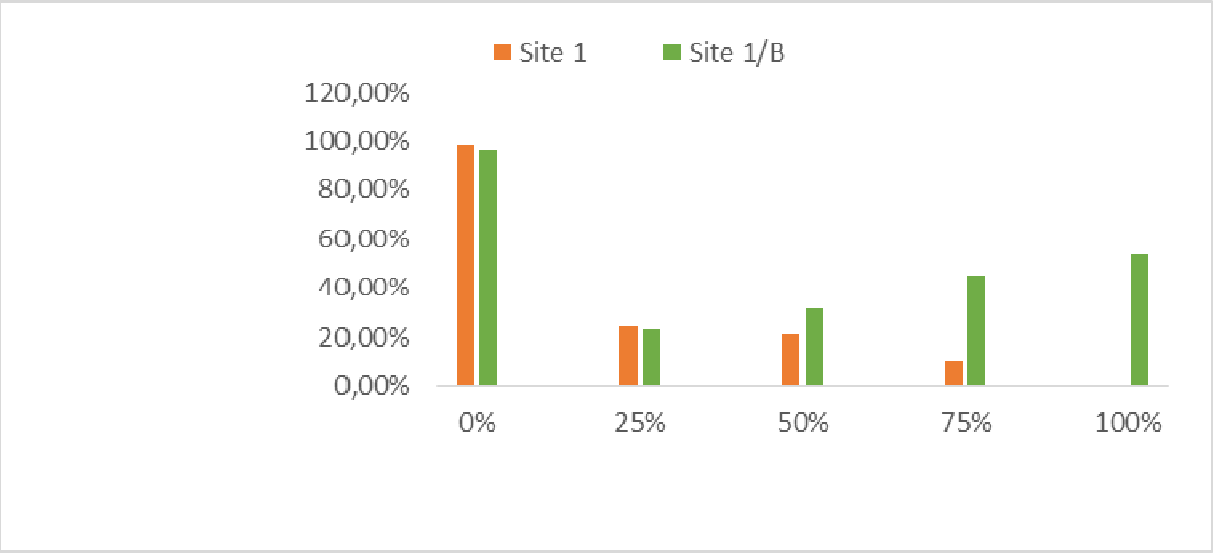

Figure-3: Average lengths of the onions roots of site 1 untreated and treated by clay B.

Figure-4: Average lengths of the onions roots of site 2 untreated and treated by clay B.

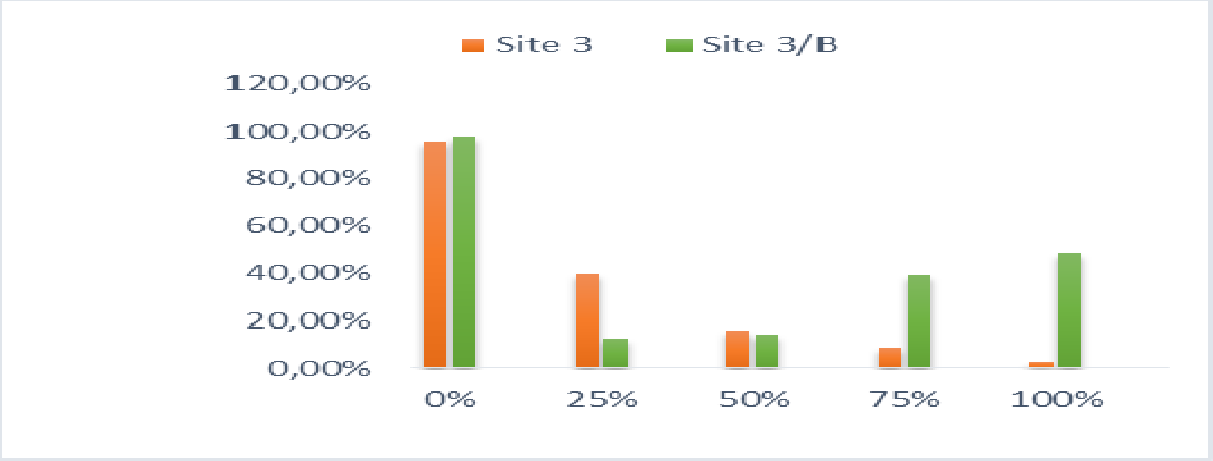

Figure-5: Average lengths of the onions roots of site 3 untreated and treated by clay B.

Results of mineralogical analyses: The chemical analyses showed magnesium and calcium abundance in clays of SEHOUE-MASSI compared to those of the other sectors whereas the contents of iron and titanium appear less low[11]. The samples of clay contain quantitatively SiO_2 (45.4-63.8%) and Al_2O_3 (13.9-23.1%) as mains oxides. Follow-up of Fe_2O_3 or and FeO (6-11%), and of TiO_2 (0.9-1.5%) and according to each site we have K_2O, MgO, P_2O_5, CaO and Na_2O in variable quantity. Barium, lead, zinc, copper and nickel are the other components which also appear with the state of traces. The results of the analysis by diffraction of the X-ray are conforming with chemical analyses. Indeed, the samples of clay contain (SiO_2 + Al_2O_3) between 67 and 81%. Thus silico-aluminous minerals with dominance of $SiO_2$are the mains components.

The diffractograms of x-rays obtained on the total rocks are presented on figure 7. The major crystalline phases contained in all the clay samples minerals such as: Kaolinite (K): $Al_2Si_2O_5(OH)_4$ (7.14Å;3.56Å). Quartz (Q): SiO_2 (3.33Å;1.81Å;4.26Å)[12]. Smectite (S): $(Ca,Mg)(Al,Fe)_2(Si,Al)O_{10}(OH)_2$ (14-15Å)[7] and like trace phase the Anatase (A): TiO_2 (3.52Å;1.89Å).

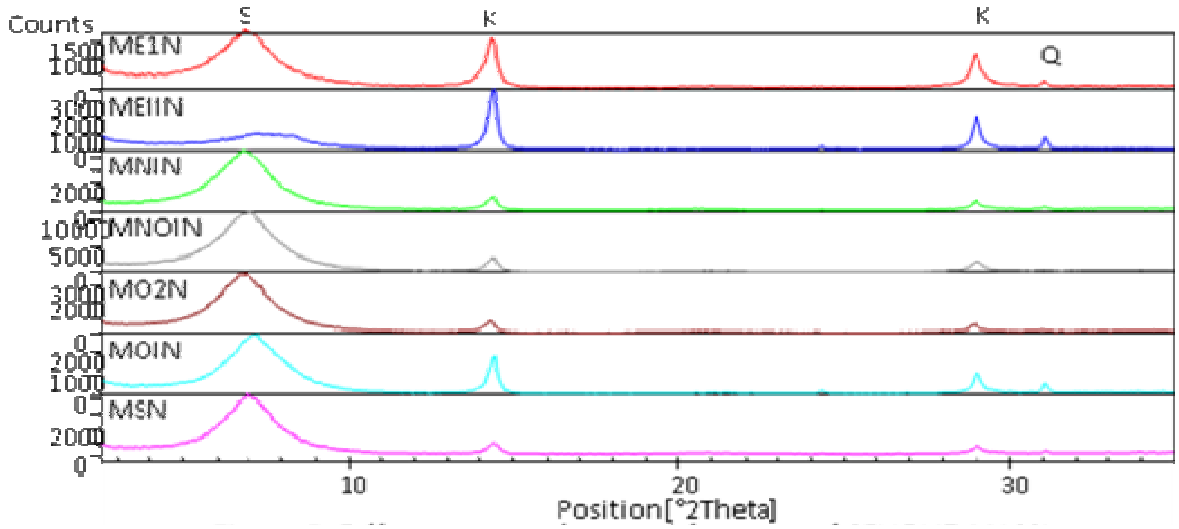

Figure-6: Diffractograms of normal fractions of SEHOUE-MASSI.

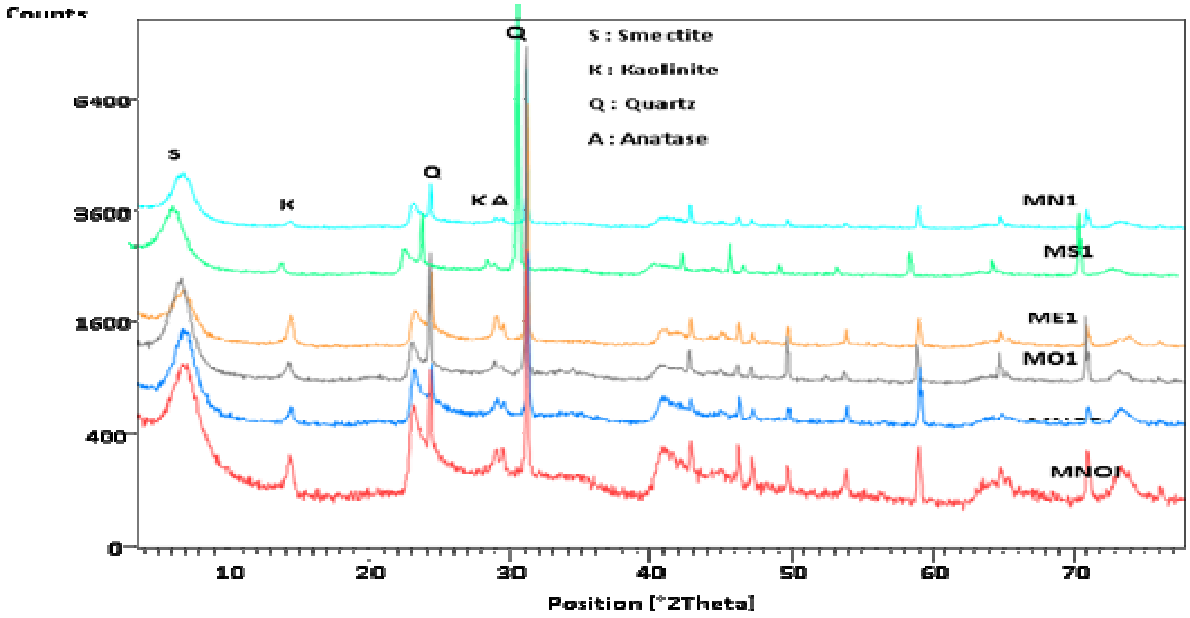

Figure-7: Diffractograms of the total rock samples of SEHOUE-MASSI.

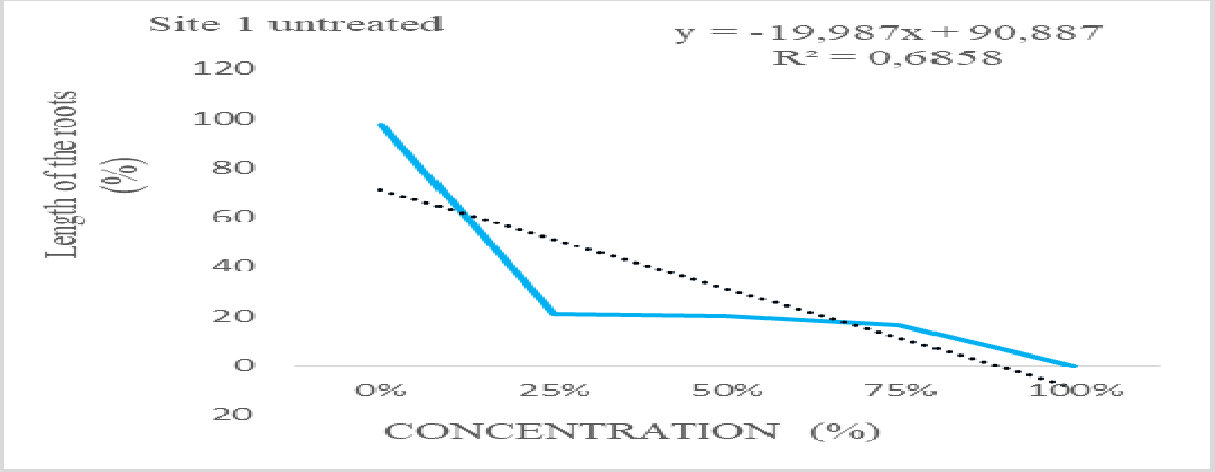

Figure-8: EC50 of site 1 untreated.

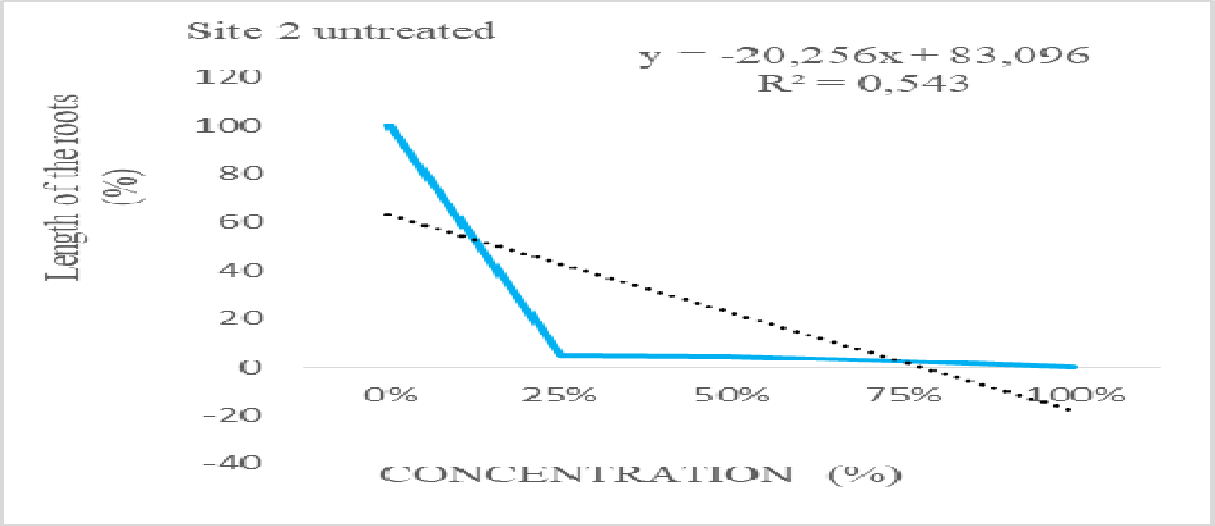

Figure-9: EC50 of site 2 untreated.

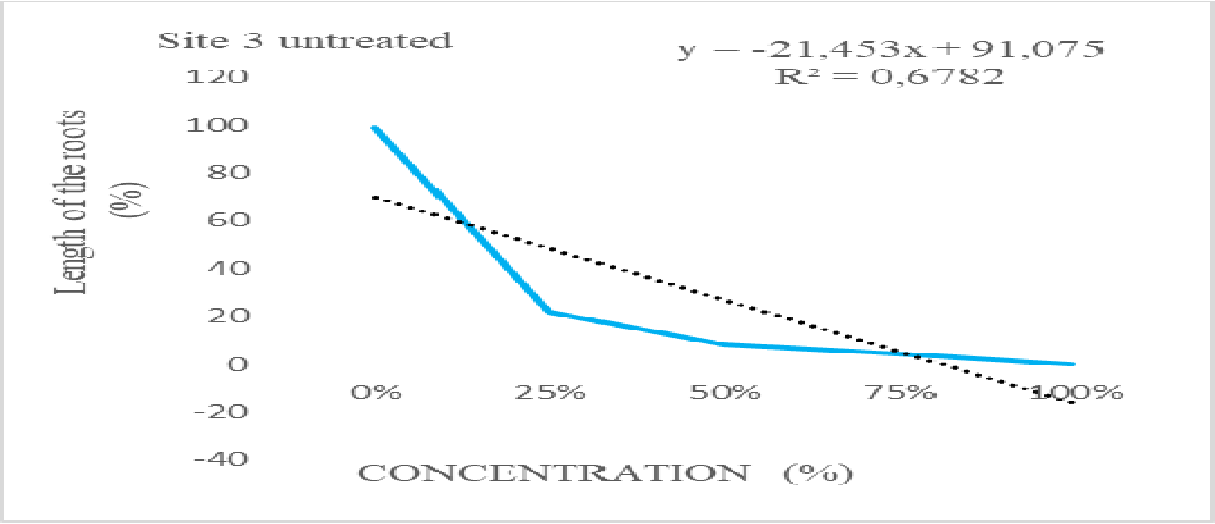

Figure-10: EC50 of site 3 untreated.

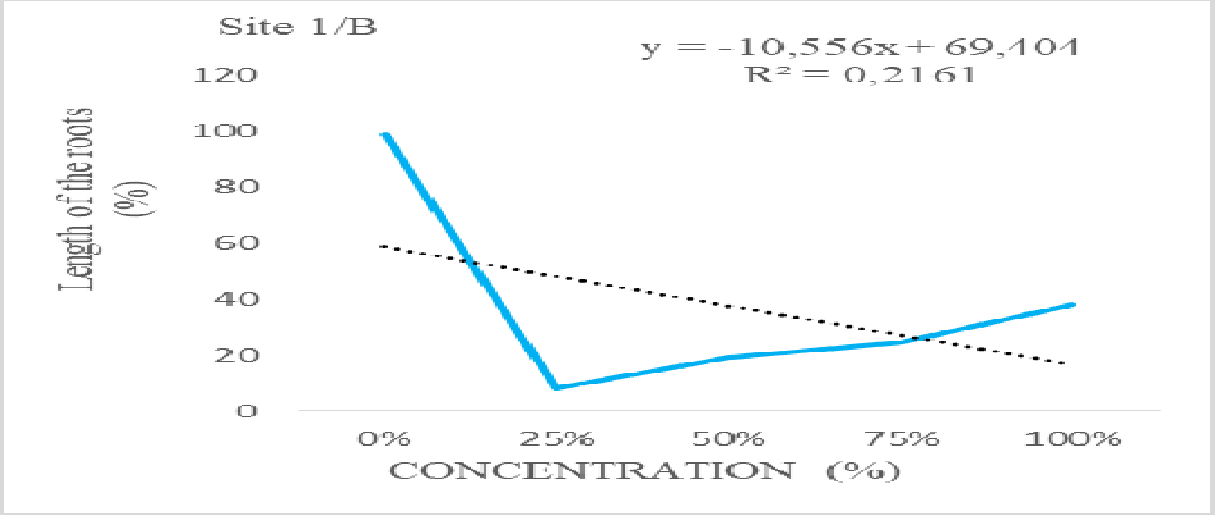

Figure-11: EC50 of site 1 treated by clay B.

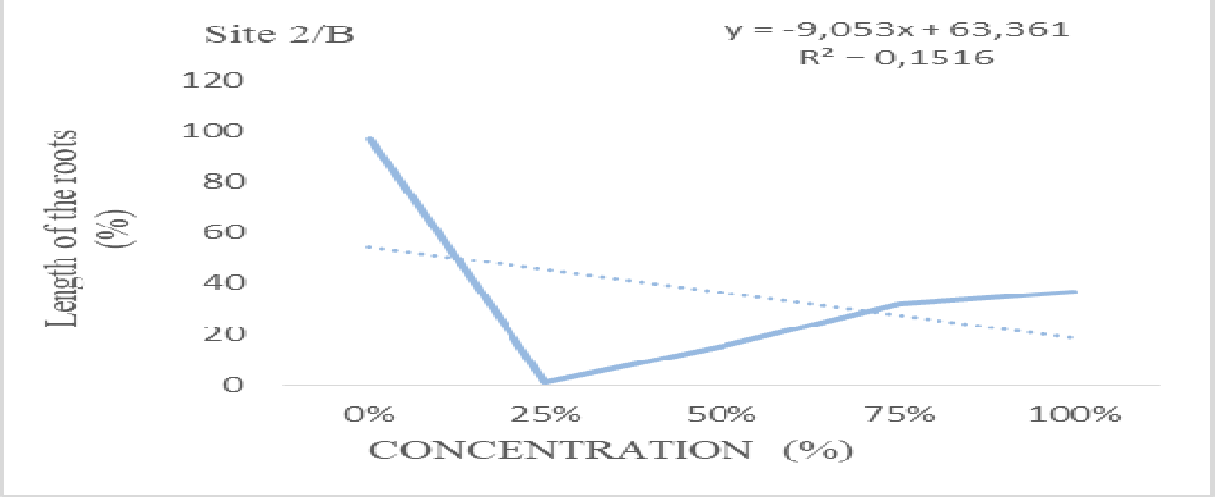

Figure-12: EC50 of site 2 treated by clay B.

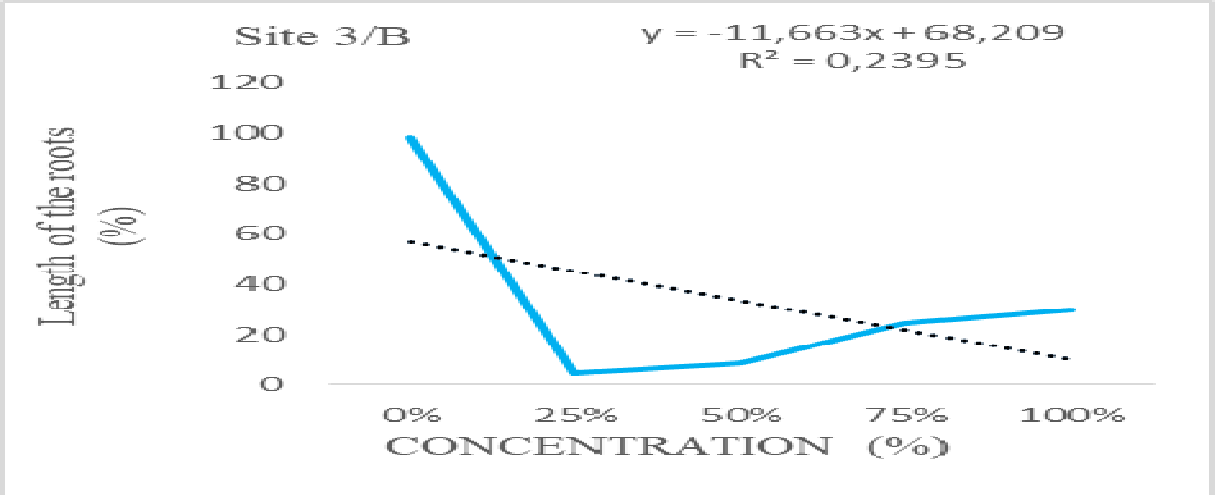

Figure-13: EC50 of site 3 treated by clay B.

The diffractograms of the normal fractions are represented on Figure-6. They highlight the argillaceous phases contained in the total samples of the sites according to various proportions at knowing: Smectite detected by the line d(001) which is presented between 14Å and 15Å, Kaolinite which is presented at 7.2Å and 3.56Å. The width of the peak of the Smectite could easily include a line towards 10Å which would be due to the illite. The quartz is almost eliminated by sedimentation. All this confirms the homogeneity of the sites.

Parameters based on growth inhibitions of onions roots: According to the parameters based on growth inhibition of onion roots, the effective concentrations (EC_{50}) varied from 20 % to 28 % (Figures-8, 9, 10, 11, 12, 13). The values obtained in Table-1 show that the EC_{50} (the effective concentration of the chemical producing 50% of the total effect) of the three untreated sites are lower than those of the sites treated by clay B. We therefore deduce that the clay used made it possible to decontaminate the three sites studied. These results of the cytotoxic study[13] confirm those of toxicity obtained previously.

Table-1: Concentrations EC_{50} of three sites.

Site	EC_{50} (Site untreated)	EC_{50} (Site treated by clay B)
Site 1	25%	28%
Site 2	20%	24%
Site 3	22%	26%

Conclusion

The physicochemical parameters varied slightly according to the three sites. Total toxicity on the three (3) sites varies according to parameters' based over the length of the roots of onions[14]. Acute toxicity (*EC_{50}: Effective Concentration 50*) on the three (3) sites varies according to parameters based on inhibition of onion root growth.

According to results obtained, site 2 is the most polluted of the three sites followed more by site 3. The acute toxicities (*EC_{50}*) obtained on the three sites make it possible to note that clays of *SEHOUE- MASSI* decontaminate the water samples of the treated ponds

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