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Potential of Particle Size Mix Ratios of Plantain Ogoni Red with Clay Soil: The Integrity of Adsorbent Performance in AGO Treatment in Fresh Water Environment

Nnadi V.G.[1], Ukpaka C.P.[2,*], Akpa J.G.[3], Dagde K.K.[4]

Abstract

The research is focus on monitoring the performance of various formulated adsorbent mix ratio of clay soil with some agro-based materials in treatment of contaminated water environment. The agro-based material used was Plantain Ogoni Red (POR) and fresh water environment was used for this research. The agro-based material was processed into different particle sizes of 150 µm, 300 µm, 600 µm and 1.18 mm and the clay soil into fine particle as well as the mix ratios of R1:9, R2:8, R3:7, R4:6 and R5:5 formulated as adsorbents. The grain volume bulk density, porosity, ash content and iodine number of each sample was determined including physicochemical properties of clay soil and all the adsorbent. The research was carried out to examine the suitability of the various formulated adsorbent mixing ratios that will be high in potential in terms of optimum percentage removal of AGO in fresh water contaminated environment. The performance of the formulated adsorbent was monitored by considering the following parameters adsorbed by the adsorbent, ammonia, nitrogen, chlorine, iron, phosphorus, potassium, sulphur, silicon, silicon and total petroleum hydrocarbon. The maximum percentage removal of parameters from the contaminated fresh water environment was 95% of C4-Fe-AGO-4:6-150µm > 35% of C4-N-AGO-4:6-1,18 mm > 33% of C4-S-AGO-4:6-1.18 mm > 3.3% of C4-NH_3-AGO-4:6-150 µm of Plantain Ogoni Red – POR mix ratio achieved. Finally, the research has showcased the potential of the various adsorbents formulated and the possible element and compound it can be adsorbed with respect to the particle size as well as the mix ratios.

Key words: Potential, particle, plantain, Ogoni, soil, integrity, adsorbent.

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INTRODUCTION

Researchers have been conducted on formulation of different adsorbents for treatment of pollutants in different environment [1–2]. The rate of adsorption has been attributed to the bulk density, porosity and particle size characteristics [3–5]. Different materials have been projected and tested to ascertain their potential in treatment of contaminated water and swamp environment for both stagnant water and flowing water systems. Most of the treatment are carried out in surface area and the already diffused contaminants are left untreated in most cases. However, some of treatment mechanism involve the application of stirring the system to allow through mixing as well as the mechanism allows the already

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diffused contaminates t to have contact with the adsorbent for the purpose of initialing adsorption of those contaminants [6–8].

The application of only clay soil in treating contaminated water medium have been conducted in water medium polluted with crude oil [9]. The result contained showed that clay soil possesses the characteristics of adsorbing crude oil without any addition characteristics [10]. Some of the researchers have introduced the application of formulated bio adsorbents for treatment of polluted water medium and some of the pollutants are petroleum hydrocarbon (crude oil) and its products [11–12]. Observation from their research have demonstrated the significantly the application of application of bio adsorbent as a good adsorbent for treatment of contaminated water medium.

This research is to address the significance of particle size in some selected element and compound mitigation by the application of formulated clay soil with plantain Ogoni red (POR). Stem. The elements and compound considered are Sulphur (S), iron (Fe) Manganese (Mn) ammonia (NH_3), copper (cu) and nitrogen.

MATERIAL AND METHODS

Materials: the following materials was used for the research to be achieved, which include plantain Ogoni red stem, AGO, clay soil, furnace, measuring cylinder, beaker, plastic container, siever, grinding machine, mould etc.

Sample Collection

The samples used in conducting this research were obtain with Rivers State of Nigeria and all the based materials such as plantain Ogoni red, was collected form Borri town in Khana Local government area of Rivers State, clay soil obtained from Ogbuboru Town in Ogba/Egbema/Ndoni Local Government area of Rivers State and AGO obtained from filling station located in Port Harcourt Local Government area of Rivers. All materials were transported to the department of chemical/petrochemical laboratory for analysis.

Preparation Sample

The clay soil sample obtained from Ogbuboru community was dried initially on sun for the purpose of moisture reduction and all impurities removed. The clay soil was further subjected into over dried at temperature of 400°C for a period of 30 minutes and the clay soil was subjected into a grinding machine to obtained fine particle size. The plantain Ogoni red (POR) stem obtained from the plantation from Borri town was cut into smaller sizes and then sun dried before subjecting it into grinding machine to obtained another particle size of different sizes. The different particle sizes obtained were 150 μm, 300 μm, 600 μm, and 1.18 mm.

Experimental Procedures

The clay soil and plantain Ogoni red (POR) of different particle sizes were mixed with the clay soil in different proportionality of mix ratio R5:5 which is 50% of clay soil to 50% of plantain Ogoni red (POR) of different particle of 150 μm, R4: 6 which is 40% of clay soil and 80% of POR of particle size of 300 μm, R1:9 which is 10% clay soil and 90% of POR of particle size of 150 μm were prepared and immersed into each contaminated fresh water of 3 liters with contaminants volume of 200 mL of AGO in each container set up. Each of the formulated adsorbent was immersed into the system and the adsorption process monitored for 1 hour to 5 hours. Samples were collected at each 1 hour covered and analysis conducted to determine the concentration of Sulphur, ammonia, iron, manganese, copper and nitrogen. The process was repeated for four times and the obtained result recorded. The formulated adsorbent was mounded in spherical shape and caclin in an oven at temperature of 500 ℃ to 600 ℃ for the period of 5 hours and no ash content stage was obtained, rather the bonding strength of the adsorbent increased. This process enhanced the kinetic value of the adsorbent as well as its strength to withstand the fresh water environment contaminated with AGO without dissolving, but rather mitigate parameters adsorbent by the adsorbent.

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RESULTS AND DISCUSSION

Result of Variation of Concentration of Parameters on Effect of Adsorbent

The concentration of some parameters was monitored upon the effect of the adsorbents immersed in both salt and fresh media as well as the variation on concentration within the period of five interaction. The obtained data from the investigation were demonstrated in Figures 1 to 15 and the trend in terms of its characteristics well documented on the performance of each adsorbent immersed in the plastic container.

Figure 1 shows the variation of Potassium (K), Ammonia (NH_3), Sulphur (S), Nitrogen (N), Copper (Cu) and Manganese (Mn) characteristics in container 1 containing plantain Ogoni red with fresh water medium contaminated with AGO with increase in adsorption time period using adsorbent mixture of R1:9 is 10% to 90% ratio of plantain Ogoni red (POR) to clay soil sample of both with particle size of 150 μm. The degree of the parameters shown in Figure 1 revealed decrease in Potassium (K), Ammonia (NH_3), Sulphur (S) and Copper (Cu) from zero hour to 3 hours samples before a sudden increase in the same parameters. This revealed that after 3 hours the adsorbent has attained supper saturated point, hereby reversable process was experienced in which the adsorbed parameters are leached back to the system. For the case of Manganese (Mn), continues decrease in concentration was experienced with increase in time. This revealed that saturation and supper saturation point has been achieved. In the case of Nitrogen (N), an increase was experienced from above zero hour to 2 hours before sudden decrease was experienced and constant values achieved showing saturation points or supper saturated. The Figure 4.1a further demonstrates the magnitude of parameters in container 1 pollution level with AGO as K > NH_3 > S > Cu > N > Mn. The increase in Nitrogen can be attributed to initial leaching of nitrogen present in the formulated adsorbent of R1:9 ratio of POR to clay soil sample. The formulated adsorbent was carbonized at the temperature of 500℃ to 600℃ for 5 hours in the heating oven and no ash content stage was obtained.

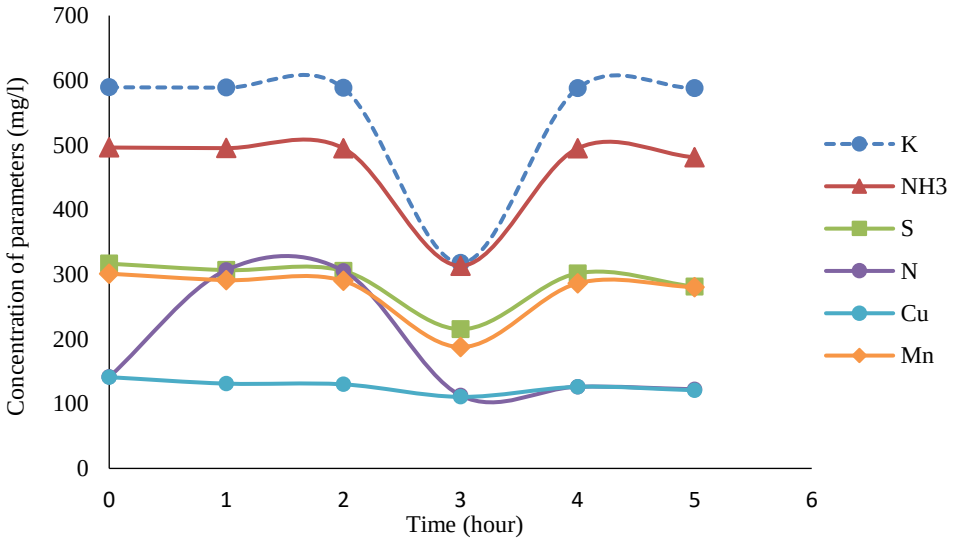

Figure 1. Variation of concentration of parameter versus time in Container 1 of Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R1:9, 150 um).

Figure 2 shows decrease in Silicon (Si) and Phosphorus (P) concentration with increase in contact time for mixture of formulated adsorbent ratio of R1:9 of Plantain Ogoni red (POR) of 10% to clay soil of 90% of particle size of 150 μm. The reduction of the concentration of Silicon (Si) and Phosphorus in container 1 revealed that the adsorbent is effective as well as enhancing mitigation of these parameters monitored. The container was contaminated with AGO and the integration of adsorbent into medium enhance decrease in Silicon (Si) and Phosphorus (P) reduction in process. The result further demonstrates that saturated point was not yet achieved because no reversable condition was observed

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as shown in some parameters in Figure 2. In comparison of the concentration of Silicon (Si) and Phosphorus revealed Silicon (Si) > Phosphorus (P).

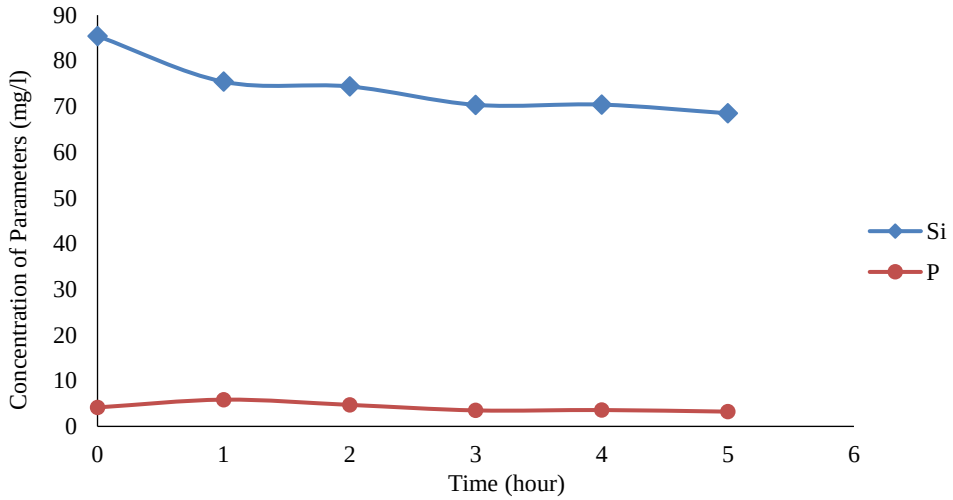

Figure 2. Variation of concentration of Silicon and Phosphorous versus time in Container 1 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R1:9, 150 um).

Figure 3 shows the trend of characteristics of Iron (Fe) and Chlorine (Cl) concentration in container 1 with increase in contact time. The result revealed decrease in concentration of Iron (Fe) and Chlorine (Cl) in Container 1 with increase in period of monitoring. However, the variation in each parameter concentration of Iron (Fe) and Chlorine in container 1 can be attributed to variation in contact time as well as the effectiveness of the formulated adsorbent immersed in the container 1 which is made up of Plantain Ogoni Red (POR), Fresh water and AGO. The ratio of the formulated adsorbent is 1:9 (10%: 90%) of plantain Ogoni red (POR) to clay soil and the particle size is 150μm was used in this case. Figure 4.1c demonstrates initial decrease from above zero hour to 3 hours, before sudden increase was experienced after saturated point has been achieved, this phenomenon was the same for Iron (Fe) and Chlorine (Cl) concentration. The decrease in Iron (Fe) and Chlorine (Cl) in container 1 shows how effective the adsorbent is in the treatment of contaminated fresh water using plantain Ogoni red (POR) of 10 percent to 90 percent of clay soil. The comparison of the magnitude of Iron (Fe) and Chlorine (Cl) shows Iron (Fe) > Chlorine (Cl). The formulated adsorbent was Calculated at temperature of 500 ℃ to 600 ℃ for 5 hours in the oven and no ash content stage was achieved.

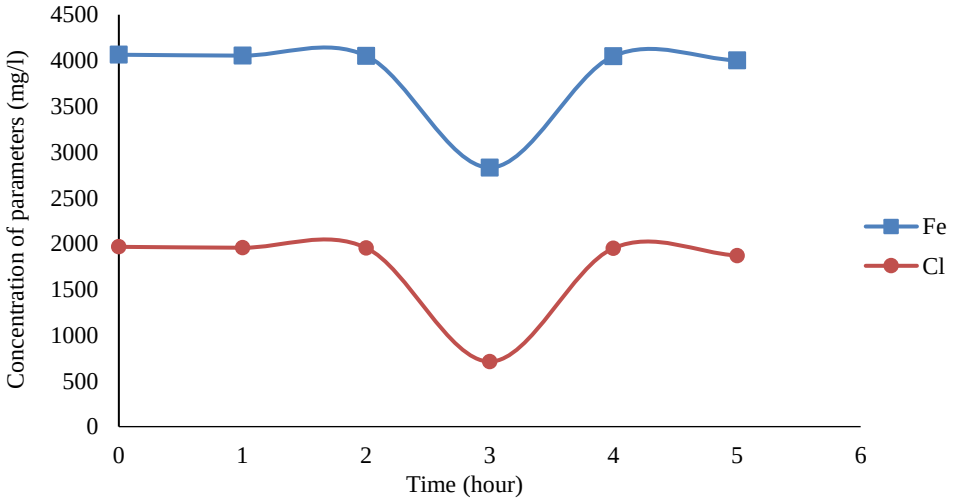

Figure 3. Variation of concentration of Iron and Chlorine versus time in Container 1 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R1:9, 150 µm).

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Figure 4 shows the effectiveness of the adsorbent mixture of 2:8 ratio of particle size 300μm in the adsorption of Potassium (K), Ammonia (NH_3) and Iron (Fe) in fresh water medium contaminated with AGO. The adsorbent consists of 20% of plantain Ogoni red (POR) sample and 80% of clay soil sample. The formulated adsorbent was mounded in spherical shape and caclin in an oven at temperature of 500℃ to 600℃ for the period of 5 hours and no ash content stage was obtained, rather the bonding strength of the adsorbent increased. This process enhanced the kinetic value of the adsorbent as well as its strength to withstand the fresh water environment contaminated with AGO without dissolving, but rather mitigate parameters adsorbent by the adsorbent. Decrease in ammonia (NH_3) and Iron (Fe) was observed from above zero hour to 3 hour before sudden increase was experienced. This shows that the adsorbent has attain the saturated point of ammonia (NH_3) and Iron (Fe) in take by the adsorbent rather leaching of the initial adsorbed parameters back to the contaminated fresh water medium was observed. For the case of Potassium (K) continuous adsorption of the component was experienced from above zero hour to 5 hours and no leaching was observed as demonstrated in experimental set-up of container 2.

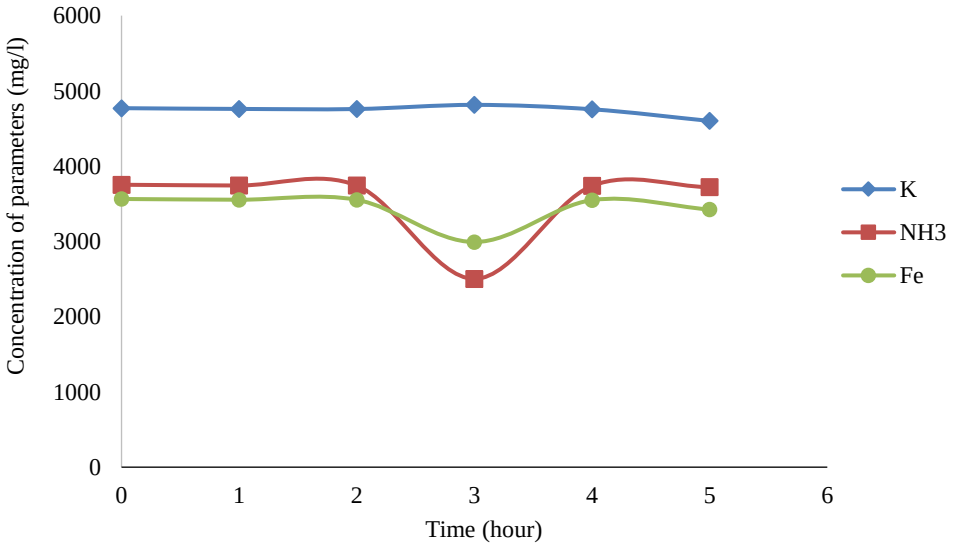

Figure 4. Variation of concentration of parameters versus time in Container 2 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R2:8, 300 µm)

Figure 5 shows the variation of some selected parameters of Copper, Manganese, Silicon, Chlorine, Nitrogen and Sulphur in fresh water medium polluted with AGO of the same concentration as in other containers and the effect of particle size of 300μm of mixture ratio of R2:8 was monitored with increase in contact time. The result demonstrates decrease in concentration of manganese (Mn) and Silicon (Si) for period of above zero hour to 2 hours before sudden increase and decrease in Copper (Cu) concentration with increase in time. Indeed, the characteristics of the nitrogen (N), chlorine (Cl) and Sulphur (S) showcases decrease in the parameters concentration in the container 2 containing AGO as pollutant. The decrease in the concentration of these parameters revealed that the formulated adsorbent mixture possesses the property of adsorption characteristics. The adsorbent was caclin at temperature range of 500 ℃ to 600 ℃ in the oven for period of 5 hours and no ash content was observed. The formulated adsorbent was able to withstand the effect of the medium without dissolving rather performed the function of adsorbing the parameters of interest as presented in Figure 5. The variation in the concentration of the parameters monitored could be related to the effectiveness in performance of the formulated ratio of the adsorbent.

Figure 6 shows the variation in concentration of phosphorus upon the effect of contact time using formulated adsorbent mixture ratio R2:8 of plantain Ogoni red (POR) to clay soil sample of particle size 300 μm. The result obtained illustrate initial increase in concentration of phosphorus from above

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zero hour to 1 hour before sudden decrease in concentration of the phosphorus in the container 2 containing contaminants of AGO in fresh water medium. The increase in phosphorus concentration in container 2 shows that the adsorbent formulation in terms of available phosphorous present in it, however, induce the contaminated container 2 for a period of 1 hour, before the process reverse was observed. Indeed, after 1 hour the adsorbent possess the characteristics of adsorbing the phosphorous in container 2 and decrease in phosphorous concentration was experienced with increase in contact time. The adsorbent maintains its bonding strength without dissolving in the fresh water medium and this can be related to the caclin process carried at temperature of 500 ℃ to 600 ℃ at 5 hours without formation of ash content. In this case, the trend of phosphorous adsorbed by the adsorbent is unique in the sense that the initial stage involves the discharge of phosphorous present in the formulated adsorbent to be leached into the fresh water medium before in return the adsorbent performed its duty without attaining saturated point for the period of investigation.

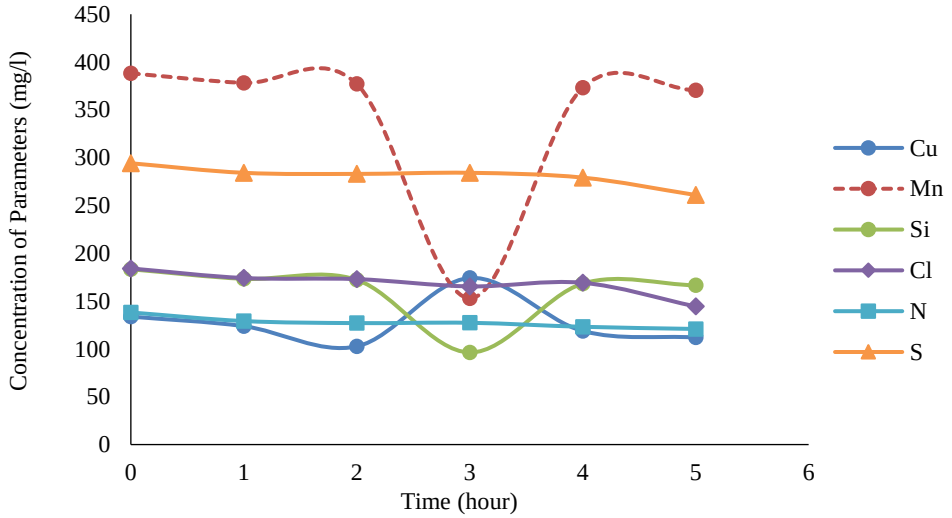

Figure 5. Variation of concentration (mg/l) with time (hours) in Container 2 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R2:8, 300 µm).

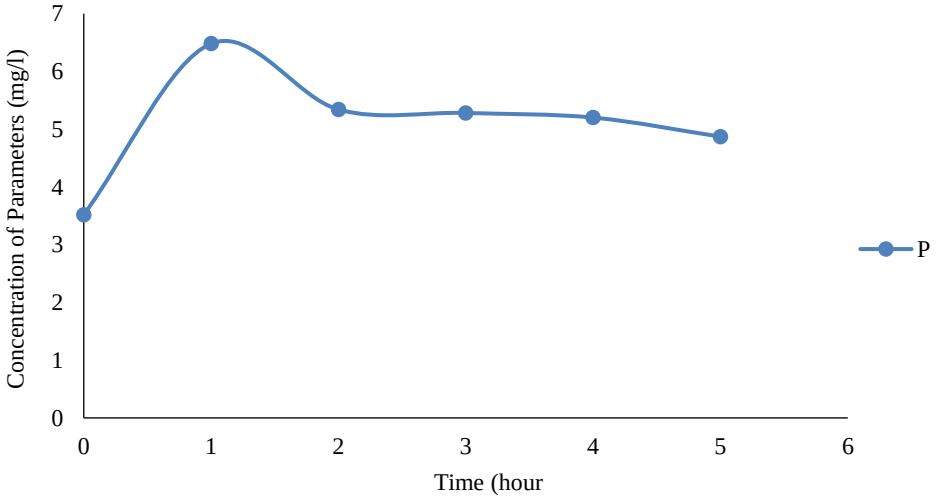

Figure 6. Variation of concentration of Phosphorus versus time in Container 2 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R2:8, 300 µm).

Figure 7 shows that effect of adsorbent mixed in the ratio of 3:7 of plantain Ogoni red (POR) clay soil sample of 600 μm of particle size with contact time. Decrease in concentration of the following parameters like Potassium (K), Ammonia (NH_3) and Iron (Fe) was experienced with increase in contact

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time for a period of above zero hour to 3 hours and sudden increase in the concentration of parameters investigated was seen, revealing the effect of leachate of the adsorbent to the fresh water container 3. The result further showcases that concentration of potassium (K) > concentration of Iron (Fe) > concentration of Ammonia (NH_3), both in the adsorption process of forward and backward. The research further revealed that the formulated adsorbent mixture possesses the characteristics of adsorbing potassium (K), ammonia (NH_3), and Iron (Fe) for the period of 3 hour effectively without reversable process taking place in the medium. The same process of caclin was carried out during the preparation of the adsorbent.

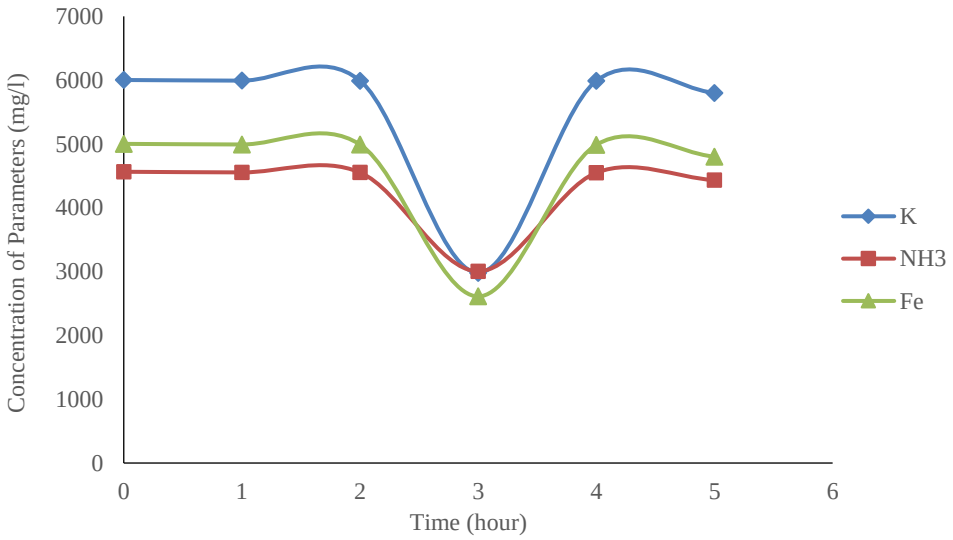

Figure 7. Variation of concentration of parameters versus time in Container 3 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R3:7, 600 µm).

Figure 8 shows the variation of some selected parameters upon the effect of contact time in treatment of contaminated container 3 with AGO as well as application of the adsorbent mixed ratio R3:7 of plantain Ogoni red (POR) with clay soil sample of both with particle size of 600 μm. The following concentration of parameters were monitored such as nitrogen (N), sulphur (S), copper (Cu), manganese (Mn), Silicon (Si) and Chlorine (Cl) with respect to adsorbent performance as well as exposure with increase in contact time. The result shows decrease in concentration of parameters of manganese (Mn), Sulphur (S), and Chlorine (Cl) within the period of above zero hour to 3 hours before sudden increase with increase in contact time. The components of Silicon (Si) and nitrogen (N) demonstrated continuous decrease in concentration on the contaminated present in container 3 whereas the concentration of copper decreased slightly from above zero hour to 2 hours before sudden increase in copper. Concentration was observed in the container 3 for the period of above 2 hours to 3 hours before sudden decrease in copper concentration from above hour 3 to hour 5 as shown in Figure 8.

Figure 9 shows increase in concentration of phosphorous from above zero hour to 1 hour before sudden decrease from 1 hour to 5 hours with increase in contact time for adsorbed mixed ratio of R3:7 of plantain Ogoni red (POR) with clay soil samples of particle size of 600 μm in container 3 contaminated with AGO in fresh water medium. The increase and decrease could be related to the leaching of parameters of phosphorous from the adsorbent to contaminated medium (fresh water) with the period of 1 hour before adsorption process of the adsorbent started adsorbing the phosphorous in the medium. However, the obtained result illustrates the significance of the formulated adsorbent in carrying out treatment of polluted fresh water with AGO with adsorbent and the adsorbent was prepared using the process of caclin temperature was within the range of 500 ℃ to 600 ℃ and the bond strength of the adsorbent was able to withstand for period of more than 5 hours.

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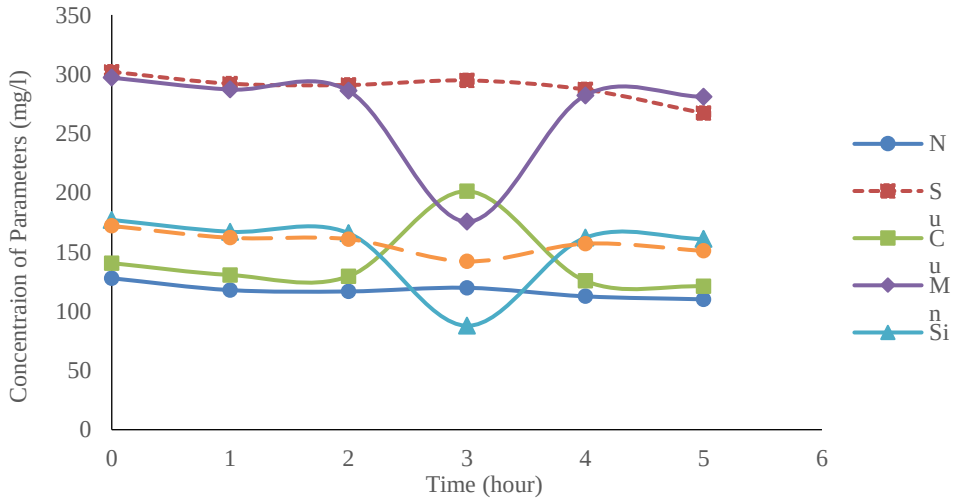

Figure 8. Variation of concentration of parameter versus time in Container 3 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R3:7, 600 µm).

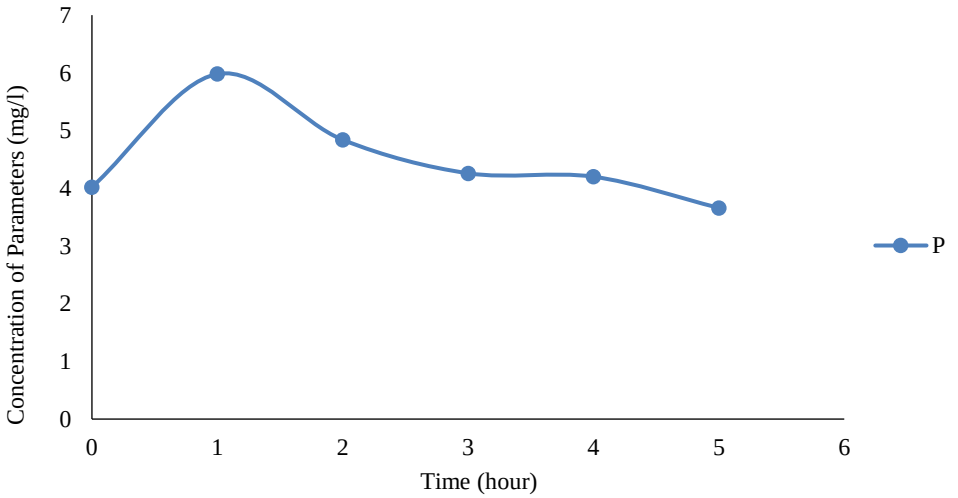

Figure 9. Variation of concentration of Phosphorous versus time in Container 3 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R3:7, 600 µm).

Figure 10 shows how the characteristics of potassium (K), ammonia (NH3), and iron (Fe) vary in container 4 containing plantain Ogoni red with fresh water medium contaminated with AGO as the adsorption time period increases using an adsorbent mixture of R4:6 10% to 90% ratio of plantain Ogoni red (POR) to clay soil sample of both with particle size of 600 μm. Potassium (K), ammonia (NH_3), and Iron (Fe) levels decreased from zero hour to hour 2 samples, according to the parameters indicated in Figure 10, before abruptly increasing after hour 3. This showed that the adsorbent had reached a very saturated point after two hours, and that a reversible process had taken place in which the adsorbed parameters were leached back into the system. The magnitude of the parameters in container 4 as per the pollution level is further illustrated in Figure 10, where K > NH3 > Fe for the AGO. In the heating oven, the prepared adsorbent was carbonized for five hours at a temperature between 500 °C and 600 °C without reaching the ash content stage.

Figure 11 illustrates the variation of a few chosen parameters under the influence of contact time during the treatment of polluted container 4 with AGO and the application of an adsorbent mixed ratio of R4:6 of plantain Ogoni red (POR) with clay soil sample of both with a particle size of 600 μm. With regard to adsorbent performance and exposure with increasing in contact time, the concentrations of the following parameters, including nitrogen (N), sulphur (S), copper (Cu), manganese (Mn), silicon (Si),

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and chlorine (Cl), were monitored. The outcome reveals a drop in the parameters of manganese (Mn), sulphur (S), and chlorine (Cl) content within the range of above zero hours to three hours before a dramatic increase with increased contact time. On the polluted present in the container, the components silicon (Si) and nitrogen (N) showed a constant reduction in concentration. Silicon (Si), on the other hand, showed a very noticeable increase at hour 3, followed by a decrease then an increase at the end of the hour. Concentration was seen in container 4 for around two to three hours before other parameters, with the exception of silicon (Si), suddenly decreased at hour three and then abruptly returned to line at the end hours.

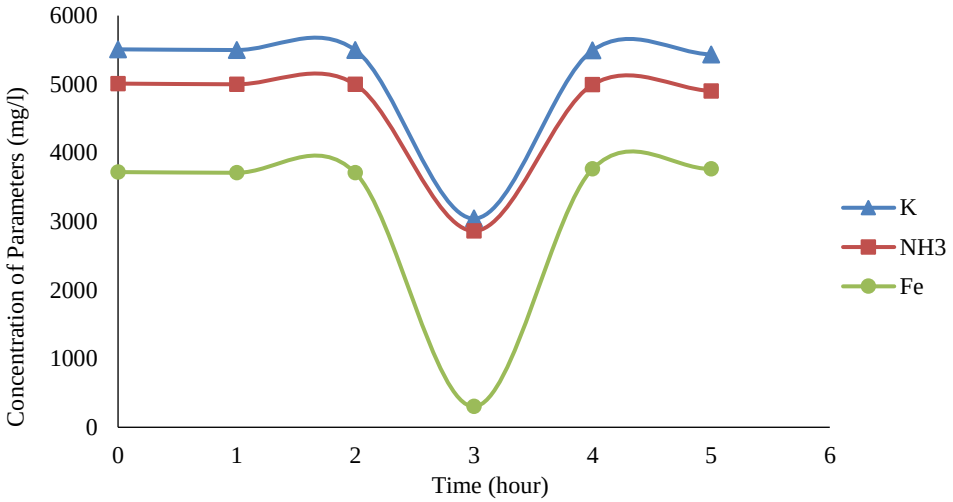

Figure 10. Variation of concentration of parameter versus time in Container 4 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R4:6, 600 µm).

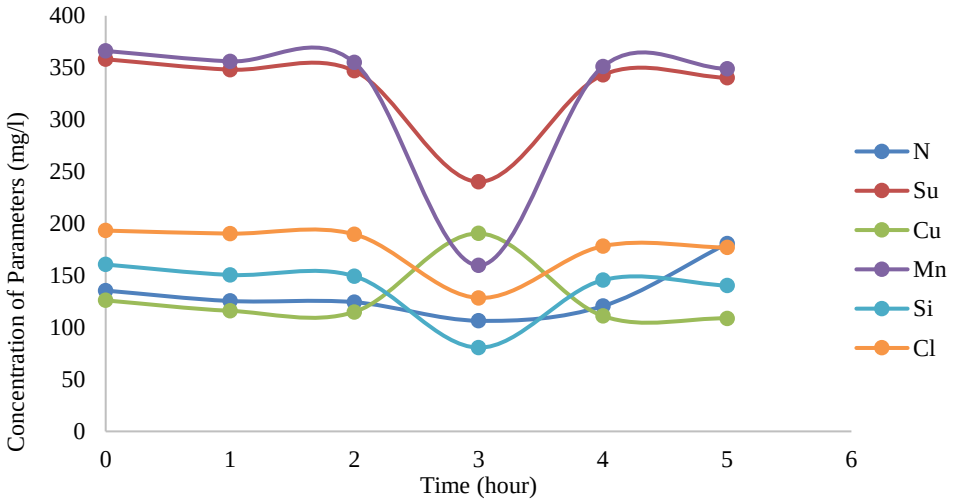

Figure 11. Variation of concentration of parameter versus time in Container 4 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R4:6, 600 µm).

For adsorbed mixed ratio of R4:6 of plantain Ogoni red (POR) with clay soil samples of particle size of 600 µm in container 4 contaminated with AGO in fresh water medium, Figure 12 depicts an increase in phosphorous concentration from zero hour to one hour before a sudden decrease from one hour to two hours with a slight increase in contact time from 2 to hour 3, before a decrease took effect from after hour 3 to hour 5. Before the adsorption process of the adsorbent began adsorbing the phosphorus in the medium for the period of one hour, the increase and reduction may have been caused by the leaching of phosphorous parameters from the adsorbent to polluted medium (fresh water). The

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adsorbent was prepared using the process of caclin temperature within the range of 500 °C to 600 °C and the bond strength of the adsorbent was able to withstand for a period of more than 5 hours. However, the obtained result illustrates the significance of the formulated adsorbent in carrying out treatment of polluted fresh water with AGO with adsorbent.

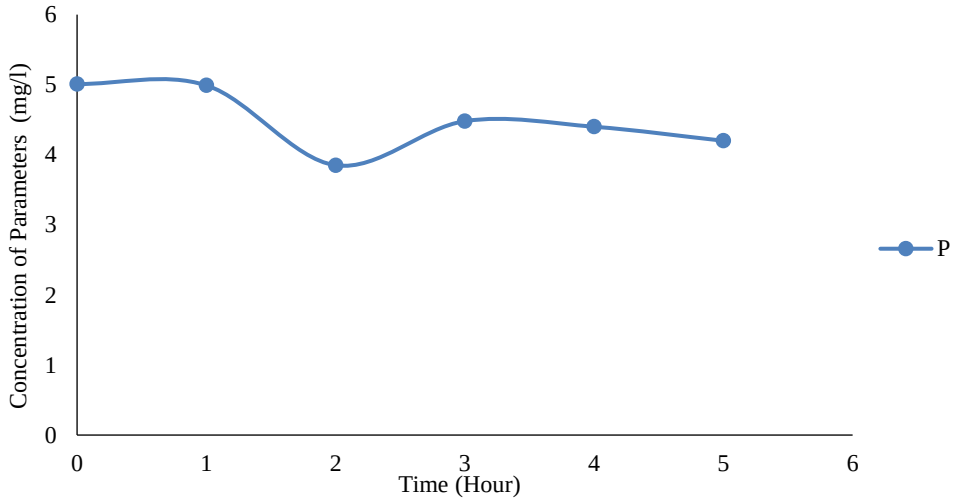

Figure 12. Variation of concentration of Phosphorous versus time in Container 4 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R4:6, 600 µm).

Figure 13 shows the variance characteristics of potassium (K), ammonia (NH3), Iron (Fe) and Manganese (Mn) in container 5 containing plantain Ogoni red with fresh water medium contaminated with AGO as the adsorption time period increases using an adsorbent mixture of 5:5 10% to 90% ratio of plantain Ogoni red (POR) to clay soil sample of both with particle size of 600 μm. Potassium (K), Iron (Fe) and Manganese shows almost a similar trend of movement from hour 0 to hour 5, except for the fact that the concentration of Potassium (K) in container 5 was above 10000 mg/L where Iron (Fe) and manganese were both below 2000 mg/L. Whereas Ammonia shows the concentration of 7000 ml at hour 0 and increased to concentration of over 8000 mg/l from hour 1 to hour 3, before a decease took place in hour 4 and then a slight increase in hour 5 as seen in Figure 13. The magnitude of the parameters in container 5 as per the pollution level is further illustrated in Figure 4, where K > NH3 > Fe > Mn for the AGO. In the heating oven, the prepared adsorbent was carbonized for five hours at a temperature between 500 and 600 °C without reaching the ash content stage.

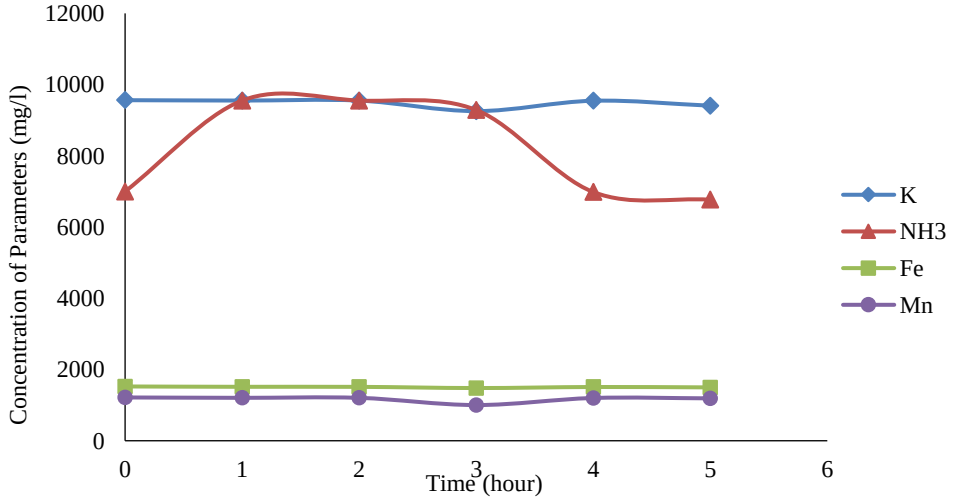

Figure 13. Variation of concentration of parameter versus time in Container 5 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R5:5, 600 µm).

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Figure 14 demonstrates the variation of concentration of parameters such as Nitrogen (N), Sulphur (Su), Copper (Cu), Chlorine (Cl) and Silicon (Si), versus Time (hour), in container 5 containing plantain Ogoni red with fresh water medium contaminated with AGO as the adsorption time period increases using an adsorbent mixture of R5:5 10% to 90% ratio of plantain Ogoni red (POR) to clay soil sample of both with particle size of 600μm. All the varied parameters demonstrated a systematic decrease from zero hour to hour 5 with a concentration value under 150 mg/l, except for Sulphur (Su) having a concentration value over 450 mg/L as shown in Figure 14. In the heating oven, the prepared adsorbent was carbonized for five hours at a temperature between 500 and 600 °C without reaching the ash content stage.

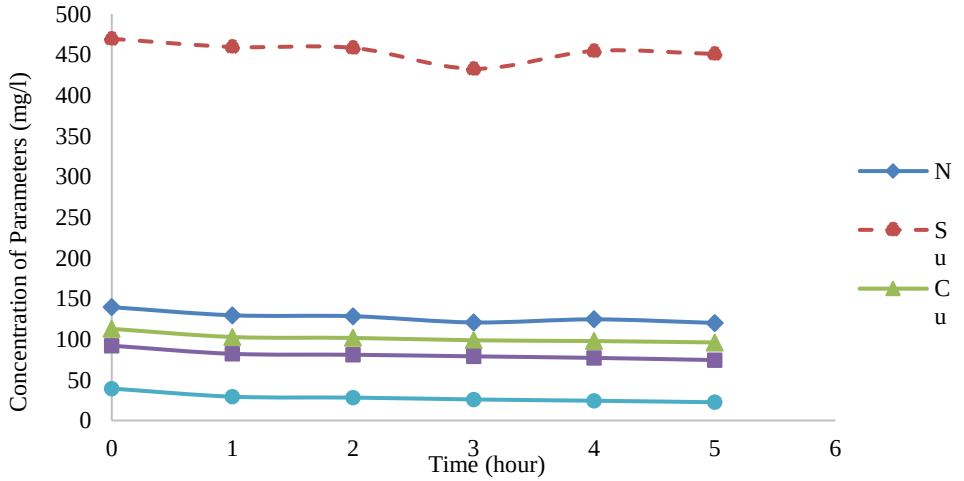

Figure 14. Variation of concentration of parameter versus time in Container 5 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R5:5, 600µm).

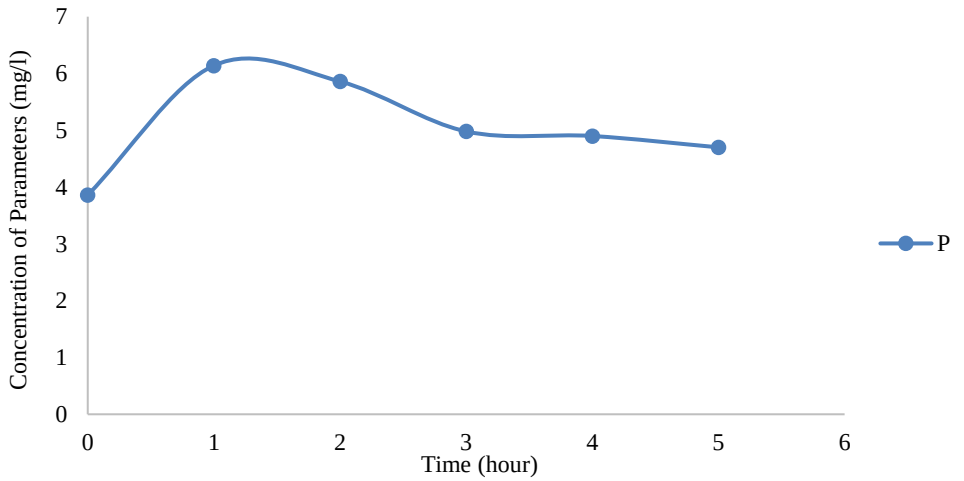

Figure 15. Variation of concentration of Phosphorous versus time in Container 5 containing Plantain Ogoni Red in Fresh Water & AGO and clay adsorbent (R5:5, 600 µm).

Figure 15 shows increase in concentration of phosphorous from above zero hour to 1 hour before sudden decrease from 1 hour to 5 hours with increase in contact time for adsorbed mixed ratio of R5:5 of plantain Ogoni red (POR) with clay soil samples of particle size of 600 μm in container 3 contaminated with AGO in fresh water medium. The increase and decrease could be related to the leaching of parameters of phosphorous from the adsorbent to contaminated medium (fresh water) with the period of 1 hour before adsorption process of the adsorbent started adsorbing the phosphorous in the medium. However, the obtained result illustrates the significance of the formulated adsorbent in carrying out treatment of polluted fresh water with AGO with adsorbent and the adsorbent was prepared

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using the process of caclin temperature was within the range of 500 ℃ to 600 ℃ and the bond strength of the adsorbent was able to withstand for period of more than 5 hours.

CONCLUSION

The research was able to address the significance of the formulated absorbents of different mix ratio using clay soil and plantain Ogoni Red (POR) as follows:

i. The mix ratio of C_4–N–AGO – R4:6–1.18 mm was able to remove 35% of nitrogen with particle size of 1.18 mm and clay soil to POR mix ratio of 40% to 60%.
ii. Also, the same formulation of C4–S–AGO–R4:6-1.18 mm was able to remove 33% of Sulphur and 95% of iron for mix ratio of C4–Fe–AGO–R4:6–1.18 mm.
iii. The research further revealed that the process was more of adsorption rather than bioremediation and this was attributed to the time contact.
iv. This research has proof that the different mixed ratio possesses the potential of being used as adsorbent in treatment of contaminated fresh water for removal of element and compound or recovering of this substance from contaminated fresh water with AGO.
v. The research has shown that the clay soil formulation with plantain Ogoni red (POR) obtained adsorbent with particle size mixed ratio R4:6 of 1.18 mm possesses maximum potential in iron (Fe) removal up to 95% followed by of nitrogen (N) of 35% as well as 33% of Sulphur (s) and 3.3% of ammonia (NH_3) with particle size of 150 μm and mix ratio of R5:5.

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