International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 06 | June - 2021 ISSN: 2582-3930

REMOVAL OF CHROMIUM FROM ADSORBENT MADE BY USING VETIVER GRASS

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Abstract:-Water quality, nowadays, has become a burning issue, as best quality water is needed for daily lives. Numbers of techniques were developed to overcome the environmental issue and currently we didn't have adopted any wastewater treatment to overcome the issue. Variety of cost effective techniques may be used to treat this water and further may be utilized in agriculture crops, one of them is adsorption. In this study, Adsorbent used was produced from vetiver grass charcoal using H_2SO_4 as activating agents.

The purpose of this study was to identify the effectiveness of activated carbon for the reduction of pollutants from municipal wastewater. Wastewater samples were collected from drainage systems. Analysis showed that the activated carbons used were significantly different in their efficacy for wastewater treatment. It was observed that by increasing the concentration of activated adsorbent, the removal efficiency of both activated adsorbents increased The vetiver grass based activated carbon was found more efficient After the treatment of municipal wastewater, its quality was found to be appropriate for direct discharge into streams, lakes, rivers. The water could be used for irrigation purpose.

Keyword:-Biochar, Adsorbent, Wastewater, Heavy metals, Water treatment,

1. INTRODUCTION

Water is an essential resource from the nature and is quite important for supporting the life of all living things. According to reports, about 2.4 billion population across the world is not able to get clean drinking water and this is also known as a fundamental right for the human beings. Besides, over 946 million of the population across the world is bound to drink impure water while having insecure sanitary practices as well, according to WHO in 2015. Lots of human activities such as industrial development, mining and discharge of sewage from urban centres force contaminated water into natural systems of water and they also contain heavy metals. Moncur et al (in 2005) brought a report about mining of metals which is an important cause leading to discharge of heavy metals in the natural water.

The metals may be adsorbed on the surface of the ground, pollute the rivers and lakes by activities such as runoffs or leaching to reach the underground water (by Mulligun et Al in 2001). Mining activities and wastes from ores produce drainage of acid mines by reduction and oxidation process, and this leads to leaching of huge amount heavy metals discharged in earth. This brings down the surface water quality as well as the ground water quality (Concas et Al in 2006). The last decades have seen a huge increase in produce and use of metals according to Mulligan in 2001. One of the most important and used metals is Chromium and is employed in several commercial processes such as glass manufacture, chemicals, tannery industry, dyes, electroplating, paints and steel alloys etc (by Mishra and Das in 2010). While the demand for Chromium was so intense, its production has seen a huge upsurge in the past few years and as per reports, it went up from about 2.83 million tons (in 2013) to about 2.85 million tons as of 2014 (as per IBM in 2015). Chromium exists in a couple of oxidation states in nature and these are Cr3 and Cr6. Between these, Cr3 is not readily solvable in any aqueous solution and cannot enter any living cells. Against this, Cr6 is among the highly reactive elements that can dissolve in aqueous solution and can even enter the alive cells (by Rai et Al. in 1987, Alloway in 2010, Ensley in 2001, Naz et Al in 2016 and Stasicka and Kotas in 2000). Generally, chromium is released by chromite ores as Cr3 in groundwater and surface water but it has a distinct natural settings such as highly alkaline nature (pH less than 7) and great electrical conduction as well with existence of MnO2, causing Cr3 to convert to Cr6 (by Rai and Eary in 1989 and GAMA in 2014).

According to USEPA in 1998, Cr6 is most likely a hazard when exposed to the living beings dermally and orally. It can be stated that Cr6 enhanced the progress of poisonous nature and there were reports of toxicity in the reproductive parts of a man and a woman (DART IC in 2008, Marouani in 2015 and Tiwari et Al in 2012). IARC or international Agency for Research on cancer has divided Cr6 in 2 groups which are Group 1 (humanoid hazard) and Cr3 as Group 3 (cannot be considered carcinogenic to the humans) (according to IARC in 2015). The Max allowable intensity of chromium or TCr in consumable water should not be more than 0.05 mg/L (about 50 µg/L) (According to IS: 10500 in 2012 and WHO in 2012). Hazards of health led by a hazardous material are according to their quantity in the level of risk and are normally denoted as cancerous or non-cancerous for the health. Risk of cancer is an increasing chance and will depend on an individual to develop this disease in their life course due to exposure of chemicals and other septic conditions (As per Obiri et Al in 2006 and Chen and Liao in 2006).

2. MATERIALS & METHODS

Material: -

The prime material required for the present research work is Roots of Vetiver Grass. This grass is highly carbonaceous which is good for making biochar.

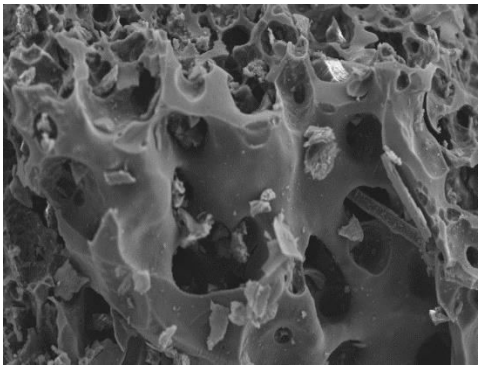
Methodology:-

Methodology that was used in this paper for conducting present research work is enlisted below

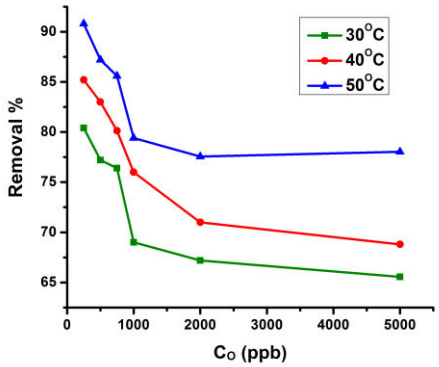
- **Pyrolysis of vetiver grass:** Pyrolysis is the thermo-chemical decomposition of organic material in the absence of oxygen at high temperature. Vetiver grass was collected from the farmyard and thoroughly washed with distilled water to remove the dirt and unwanted materials.
- **Estimation of volatile organic carbon:** Volatile organic compound are emitted into the atmosphere from anthropogenic and biogenic source and also found in situ in the atmosphere as product of the atmospheric transformations of other VOC_S. Vetiver grass was burnt at 520^0C for 2 hours in muffle furnace.
- **Estimation of Ash content:** The residue after completely burnt vetiver grass and the ash remain during combustion which consists metal oxides. Ash is one of the components in the proximate analysis of biological materials consisting mainly of salty inorganic constituents. It includes metal salt which are important for processes requiring ions such as Na (sodium), K (potassium) and Ca (calcium). The pre-weighted amount of dried vetiver grass was pyrolysed at 800^0C for 2 hours in a porce line boat kept in tube furnace.
- **Surface modification of biochar (charcoal) by acid treatment:** The accurately weighed (2 gm) prepared biochar was mixed with 100 ml of molar of H_2SO_4 solution and stirred in an orbital shaker for 5 hrs and the mixture was placed in a stainless steel Teflon autoclave vessel and kept in a hot air oven for 2 hrs at 140^0C. After cooling of the solution, it was washed until neutral pH was obtained then the modified biochar was dried in a hot air oven at 140^0C.
- **Estimation of acidic group present on the biochar:** The prepared biochar and as acid treated biochar was added individually NaOH solution $NaHCO_3$ solution. The solution were made by dissolving required amount of NaOH and $NaHCO_3$ distill water. Boiling was done to eliminate the CO_2 present in the water which could interfere in the overall results.
- **Loading of MnO_2 crystal on acid treated biochar:** biochar was added with HNO_3 and $KMNO_4$ solution. The mixture was stirred vigorously and then kept in a stainless Teflon liner and placed in a hot air oven at 140°C. After cooling, the mixture was washed with distill water and pH of the solution was made neutral. After that the modified biochar was dried in a furnace.

3. RESULTS

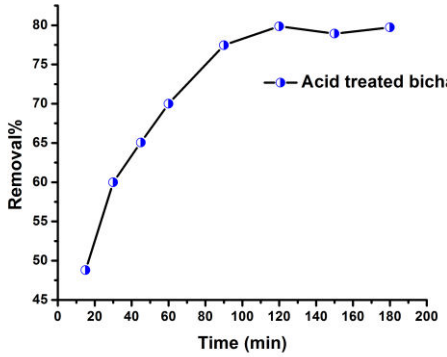
Results for FESEM



Results for Equilibrium dose of Adsorbent

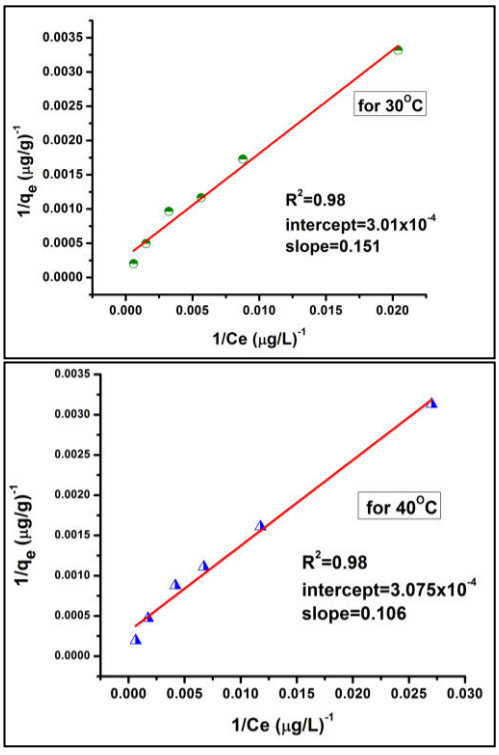


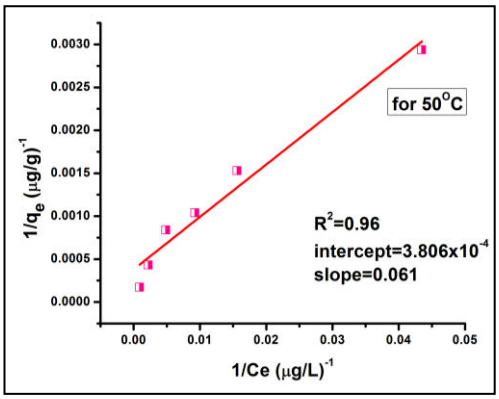
Equilibrium Contact Time



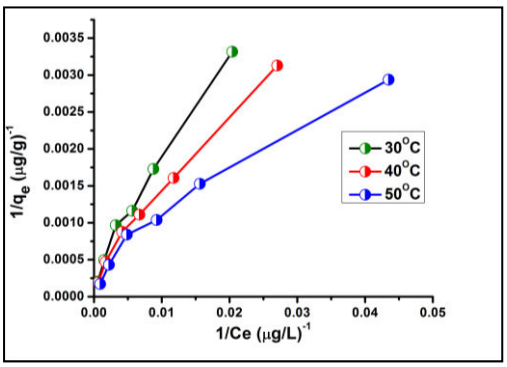
Result of Isothermal studies at different temperature

Langmuir Isotherm at 30^0, 40^0 and 50^0 C

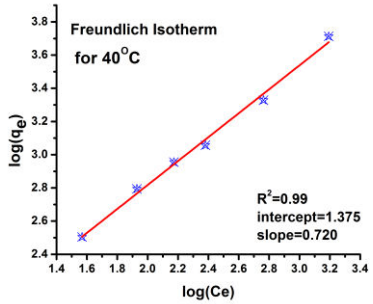


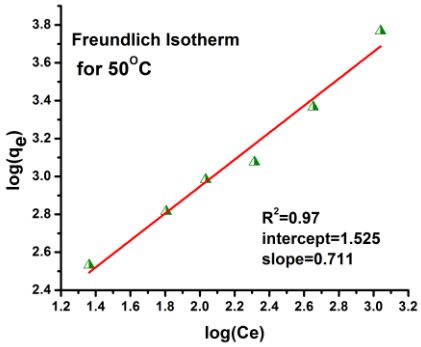


Langmuir Isotherm (different temp.)

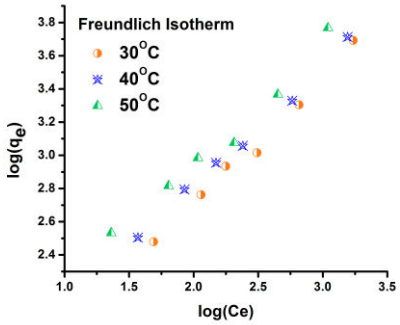


Freundlich Isotherm at 40^0C and 50^0 C





Freundlich Isotherm(different temp.)



4. CONCLUSIONS

Biochar made from vetiver grass is an environmental friendly adsorbent. Modification of biochar by acid introduces many (10^{21} sites/g) active sites on the surface of biochar and makes it active for adsorbent. Adsorption of Arsenic on the adsorbent were studied with different parameters. Adsorption was found suitable at higher temp. Indicating its endothermic nature. The isotherm states indicate that both the Langmuir and the Frundlich isotherm describe the adsorption process in both the cases. The max adsorption capacity (q_m) was found to be 3.32 mg/g, 3.25 mg/g, 2.26 mg/g at 30°C, 40°C and 50°C respectively for acid treated biochar. The values of R_L is both the cases for both the adsorbents tell the feasibility of adsorption. Analysis the Frundlich Isotherm it also indicate the feasibility of adsorption. The presence of $FeSO_4$ has been found to have played a detrimental role in removal of Arsenic for the adsorbents. Whereas, the presence of bicarbonate plays a detrimental role in the removal percentage for acid treated biochar.

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