MUNICIPAL WASTEWATER TREATMENT USING RICE HUSK AND KIKAR CHARCOAL AS ACTIVATED CARBON

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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 in Quetta city particularly Habib Nala region. 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. Rice is one of the major crops produced in Pakistan that plays an important role in the rational economy as it is the 11th largest crop production in the country. Kikar trees on the other hand are also abundant in Sindh Pakistan. In this study, Adsorbent used was produced from rice husk and kikar 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 chemical oxygen demand (COD), total dissolved solid (TDS), total suspended solid (TSS), color, turbidity from municipal wastewater. Wastewater samples were collected from drainage systems near Shehbaz town (Quetta, Pakistan), where main sewage lines of Quetta are combined. The wastewater was treated using two different particle size (180 and 300 µm) and three different concentrations (35, 40 & 50 gram/500 ml) to check the effect of Particle size and concentration on the reduction of impurities present. Analysis showed that the activated carbons used were significantly different in their efficacy for municipal wastewater treatment. It was observed that by increasing the concentration of activated adsorbent, the removal efficiency of both activated adsorbents increased except turbidity that was decreased by increasing the concentration. The maximum percentage removal of COD, TSS, TDS, turbidity, color with rice husk are up to 90%, 80%, 70%, 99.4%, 98% and 67% respectively. While using kikar charcoal reduced the impurities i.e COD 88%,TSS 80%,TDS 65%, Turbidity 98.2%,Color 95% respectively. The rice husk based activated carbon was found more efficient than kikar charcoal based activated carbon for the removal of COD, TDS, turbidity and color while the TDS removal efficiency for both adsorbents was same. 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.

***Key words*:** Rice husk, Kikar charcoal, Adsorption, Activated carbon, Municipal wastewater

1. INTRODUCTION

Rice is one of the major crops produced in Pakistan that plays an important role in the rational economy as it is the 11th largest crop production in the country. Kikar trees are also abundant in Sindh Pakistan. [1] A large amount of rice husk is wasted in terms of the byproduct as it is used for burning processes, and to feed domestic animals. Agriculture waste such as coconut shell [2], oil palm shell [3], peanut shell [4], rice straw [5], sugarcane bagasse [6], pecan shell [7] and corn cob [8] have been used for decades as adsorbent to treat water. Municipal wastewater discharges openly that polluted the surface water. Municipal waste includes industrial wastewater, domestic, infiltration and stormwater. It should be pretreated before it is drained to surface water. Contaminants such as COD, TSS, TDS, turbidity, heavy metals, odor and taste causing compounds are removed by treatment with activated carbon. [9] EPA names the activated carbon as the best available technology that has the ability to remove unwanted compounds for water purveyors needing to meet federal regulations. Due to the large surface and amphoteric surface, activated carbon is known as an excellent adsorbent.

Various researchers widely used the adsorption process for removing heavy metals such as zinc, lead, arsenic, chromium etc. from wastewater. Adsorption process offers some flexibility in operation, design, and in some cases, it can produce high quality treated effluent. Regeneration of adsorbents is done by desorption process. [10] Activated carbon is expensive for a large amount of wastewater hence, it is necessary to produce low-cost activated adsorbents. Rice husk and kikar charcoal are economical and from environment point of view, it offers significant advantages such as availability, ease of operation, efficient. Rice husk comprises of lignin, cellulose, hemicelluloses and minerals with 21.44%, 32.24%, 21.34% and 15.05% respectively. The kikar consists of carbon, hydrogen and oxygen with 45.89%, 6.08% and 47.43% by weight respectively. [11] Rice husk has a granular structure, good chemical stability, high mechanical strength, unique chemical composition and low cost. These properties make the rice husk a good adsorbent for the treatment of wastewater. [12] In this study, rice husk and kikar charcoal have been utilized, to prepare activated adsorbent, to treat municipal wastewater.

2. METHODOLOGY

Activate carbon produced from Rice husk and kikar charcoal were used as adsorbent in this study.

2.1 Activation of Rice Husk and Kikar Charcoal

First, the rice husk was kept in a pressure cooker. The vent tube was removed from the pressure cooker to make an opening for the smoke during the burning of the rice husk. The pressure cooker was placed on a stove to burn the rice husk. The color of smoke was initially black. The pressure cooker remained on the stove until the color of the smoke changed from black to white. After the smoke color changed to white, the cover of the pressure cooler was removed. Also, the pressure cooker was left uncovered overnight. After that, the rice husk and kikar charcoal were grinded and sieved in order to obtain particles size up to 180 and 300 µm. Then these raw materials were washed with distilled water. To activate them chemically a solution of sulfuric acid was prepared. The raw materials were soaked for 16 to 18 hours in the solution. The activated carbons were washed again with distilled water, to remove the free acid, and then dried on a hot plate.

2.2 Experiment Procedure

Samples of municipal wastewater were collected from the point where the main sewage lines of Quetta combine. Different samples of 500ml wastewater were collected. Each sample of the wastewater was put into the agitator column and different dose of adsorbents was mixed using agitator with 300-350 rpm speed for 1 hour. After agitation, each sample was kept for sedimentation for about 40 minutes to settle down the particles. After the sedimentation, each sample was filtered through multi-media bed filter. The multi-media bed filter was made from gravel, sand and nylon cloth. After filtration of two samples, backwashing of the filter was done each time. Each sample filtrated was analyzed for different results.

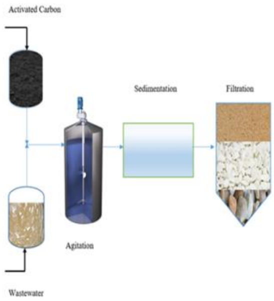

Figure 1 Schematic diagram of physical treatment

3. RESULTS

Effect of the activated adsorbent while changing the dose was studied using a particle size of 180 µm. Experimental results obtained from rice husk are shown in Figure 2. The COD, TSS, TDS and color percentage removal increases as the dose of adsorbent increases. The turbidity removal decreased as the dose of adsorbent increases. The maximum reduction of COD, TSS, TDS, turbidity, color are up to 84%, 80%, 69%, 97%, 95% and 67% respectively.

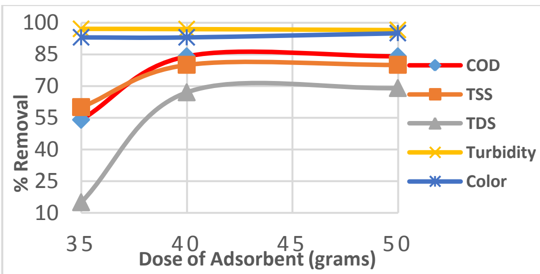

Figure 2. Removal of COD, TSS, TDS, Turbidity, Color with rice husk using 180 µm

To investigate the effect of particle size the same amount of adsorbent is used as in the above experiments. Figure 3 shows that using 300 µm particle size the percentage reduction increases as compared to 180 µm. It is also observed that an increase in the dose of adsorbent increases the percentage reduction of COD, TSS, TDS and color except turbidity.

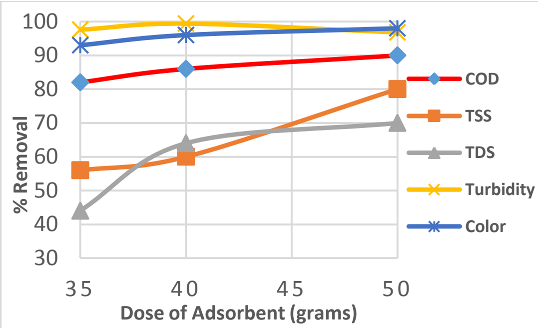

Figure 3: Removal of COD, TSS, TDS, turbidity, and color with rice husk using 300 µm

Activated adsorbent kikar charcoal with a dose of 35, 40 and 50g and using a particle size of 180 µm are studied in these experiments. Experimental results are shown in Figure 4. It is observed that percentage reduction of COD, TSS, TDS, and color increases when the dose of adsorbent increases. The Maximum removal for COD, TSS, TDS, turbidity and color are up to 82%, 80%, 60%, 98.2% and 93% respectively.

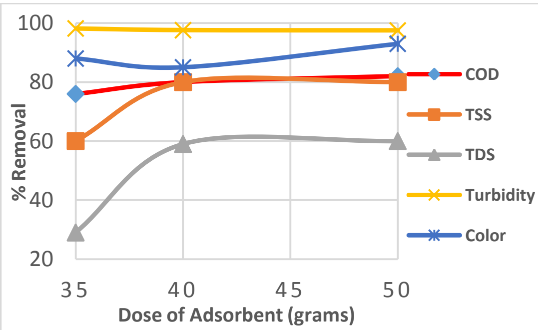

Figure 4: Removal of COD, TSS, TDS, turbidity and color with kikar charcoal using 180 µm

Further investigation of the same amount of kikar charcoal using 300 µm particle size is observed in Figure 5. Like rice husk based activated carbon the percentage reduction also increases with increase in particle size. It is also observed that by increasing the dosage of activated adsorbent the COD, TDS, Color percentage reduction also increases except turbidity while the TSS removal remains the same.

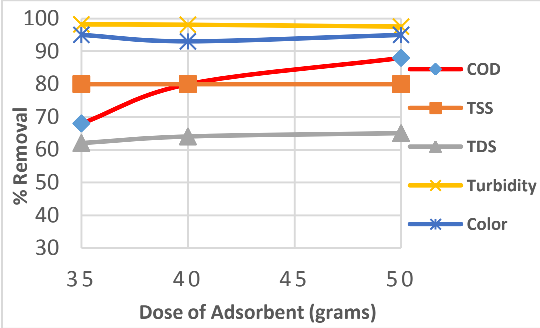

Figure 5: Removal of COD, TSS, TDS, turbidity, and color with kikar charcoal using 300 µm

Comparison of both activated adsorbents rice husk and kikar charcoal are investigated in Figure 6. Overall, the rice husk based activated carbon has a better reduction efficiency than kikar charcoal based activated carbon. The reduction of TSS is same for both activated carbons. With kikar charcoal the maximum reduction of COD, TSS, TDS, turbidity and color are up to 88%, 80%, 65%, 98.2%, 95% and 60% while with rice husk based activated carbon are up to 90%, 80%, 70%, 99.4% and 98% respectively.

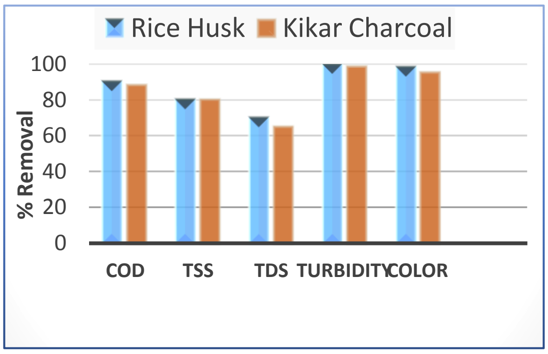

Figure 6: Comparison of Rice Husk and Kikar Charcoal based activated carbon against % removal of COD, TSS, TDS, turbidity and color

4. CONCLUSION

These are natural activated carbons, which do not have harmful effects on human beings. These adsorbents have the potential to become a source of the environment-friendly and for the treatment of municipal wastewater. The selected low cost activated carbon rice husk and kikar charcoal are promising starting materials for the preparation of activated adsorbents by using sulfuric acid (H_2SO_4) as chemical activated agents. It is observed that rice husk based activated carbons removed the COD, TSS, TDS, turbidity and color from wastewater up to 90%, 80%, 70%, 99.4%, 98% and 67% while with kikar based activated carbon are up to 88%, 80%, 65%, 98.2, 95% and 60% respectively. Moreover, the rice husk based activated carbon has a better removal efficiency than kikar charcoal based activated carbon. The adsorbents produced from rice husk and kikar charcoal can be, effectively, used to treat municipal wastewater for the reduction of COD, TSS, TDS, turbidity and color. The municipal wastewater treatment with rice husk and kikar charcoal based activated carbons can be discharged into stream, lakes, rivers, and can be used for irrigation purpose. The treated water is harmless for aquatic life.

5. REFERENCES

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