Nitrate Removal From Groundwater Using Activated Carbon Technique Prepared From Rice Husk

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Abstract- *Presence of nitrate in the groundwater for the past decades has arisen some serious problems to the associated regions. Different methods are used for removal of nitrate. One of the methods used is adsorption technique which is highly efficient and economic. In this study, activated carbon method is used for adsorption. The Activated carbon is prepared from rice husk. The groundwater samples were taken from two different regions, agricultural and industrial. Taking temperature as a leading factor, activated carbon was prepared from rice husk as Carbonized (CR) and Activated Carbonized (ACR) for 500°C and 600°C. Phosphoric acid (H3PO4) was used for preparation of Activated carbonized (ACR) rice husk. Taking ACR600 as a prominent result, graph was plotted accordingly.*

Keywords- adsorption, efficient, economic, activated carbon, phosphoric acid.

I. INTRODUCTION

Occurrence of nitrate and nitrate contamination in groundwater as well as facade water has left to drinking and practice anxiety of water. The amplified use of fertilizers in farming sector has lied to contamination of groundwater. Also, indecent disposal of waste water from industries has led to the contamination of groundwater in their in close proximity region. Other factors such as sewage, air pollution which contains nitrogen compounds and improper waste removal are also accountable for the rise of pollutants in water. Due to elevated solubility of nitrates in water, they are most probable to cause water contamination.

Presence of Nitrates beyond its allowable limits may have adverse consequences on human health. Methamoglobinemia also recognized as blue baby syndrome, is a situation urbanized when the level of Nitrates is 10mg/l or higher (Sudipta Chatterjee *et al.* 2011). High nitrate content may also lead to stomach and gastrointestinal cancer in the long time. Also, modern studies show a risk of varieties of cancer to the humans. This led to declaration from the environmental protection agency (US EPA) that the highest nitrate content to be limited to 10 mg/lit in water (Amit Bhatnagar *et al.* 2010). As a result of its high solubility and sustainability, elimination of nitrate from drinking water has bowed into a exigent responsibility to researchers. There are physical, chemical, and biological methods accustomed to remove nitrate from drinking water, to be exact chemical denitrification method by zero capacity iron, zero capacity magnesium, ion exchange, reverse osmosis, electro dialysis, and biologic denitrification (Jae-Hee Ahn et al. 2008). On the other hand the existing technology useful to remove nitrate comprise shortcomings and restrictions, expensiveness, low-impact, and side products can be regarded as its other deficiencies. Therefore, the way of research has gone into the expansion of successful and low-cost technologies (Yunfei Xi et al. 2010). Amid other technologies used for water treatment, the adsorption process is in general economical, plainly designed, as it is known as an easy related technique (Sachin N. Milmile et al. 2011). Activated carbon has been practiced to remove various pollutants from aqueous solutions. At the current moment, research has developed to amend carbon level in order to amplify the potentiality for its adsorption (Abbas Afkhami et al.2007). Variation on carbon level may be a path to new applications of activated carbon in turn to remove definite pollutants.

II. MATERIAL AND METHOD

a) Water sample

For the above study, water samples were taken in two different formats, i.e Agricultural and Industrial. The agricultural sample was taken as a composite sample from Shivapur region, pune within 5-8km range.

Properties of the unknown water samples:

Description	Agricultural sample	Industrial sample
pH value	7.13	7.25
Alkalinity	248 mg/lit	208 mg/lit
Hardness	148 mg/lit	100 mg/lit
Nitrate content	23 mg/lit	22 mg/lit

b) Preparation of Adsorbents :

In this paper, adsorbent was prepared from Rice husk by activation carbon technique for nitrate removal. To prepare

absorbent, rice husk was taken from Chintamani Rice Mill Bhugaon, Pune. Four types of adsorbents were prepared called as CRH500, CRH600, ACRH500, and ACRH600. 500, 600 represent the representated temperatures at which they were carbonized, and CRH and ACRH represents carbonized rice husk and activated carbonized rice husk respectively.

(1) Carbonization of Rice Husk (CR) :

To begin with, rice husk were washed to remove filth. Two 20gm of rice husk samples were carbonized at 500°C and 600 °C in a muffle furnace respectively one at a time to produce charcoal. The sample was crushed with blender and sieved to a size smaller than 850 µm to get hold of the charcoal of rice husk (CR).

(2) Chemical Activation of Rice Husk (ACR) :

Similarly, rice husk were washed to remove filth. 100 g of rice husk was subjected impregnation in 1 dm3 of 3 molar Phosphoric acid (H3PO4) at 80 °C for 3 hr each. Following that, they were cleaned with De-ionized water until its pH value was 7. The sample was dried at 100 °C for 24 hr. The dried samples were carbonized at 500°C and 600 °C in a muffle furnace to obtain charcoal. The charcoal was crushed and sieved to a size smaller than 850 µm to get hold of the activated carbon of rice husk (ACR).

c) Testing Method :

Spectrophotometer 106 and spectroscopic method were used to read nitrate concentration in the solution. For the spectrophotometric method to find out nitrate content, Calibration curve method was used.

d) Calibration curve method :

5 known samples were prepared using Potassium Nitrate (KNO3). The five samples were prepared for nitrate content of 30mg/lit, 15mg/lit, 7.5mg/lit, 3.75mg/lit, 1.875mg/lit respectively. Calculating the Absorbance rate from spectrophotometer, a graph of absorbance vs. nitrate content was plotted for CR500, CR600, ACR500 and ACR600. The curve was said to be Standard curve.

III. OBSERVATIONS

Using spectrophotometer for calculating the absorbance rate, here are the observations,

1.) ACTIVATED CARBON FROM RICE HUSK :

	AGRICULTURAL SAMPLE	INDUSTRIAL SAMPLE
Unknown sample	**1.013**	**1.003**
After 24 hours		
CR500	1.005	0.998
CR600	1.003	0.996
ACR500	0.920	0.905
ACR600	**0.890**	**0.884**
After 48 hours		
CR500	0.996	0.992
CR600	0.993	0.989
ACR500	0.789	0.780
ACR600	**0.783**	**0.772**
After 72 hours		
CR500	0.981	0.976
CR600	0.974	0.968
ACR500	0.630	0.618
ACR600	**0.602**	**0.594**

IV. RESULTS AND DISCUSSIONS

After studying the observations, ACR600 was found out to be the most effective out of all. Accordingly, ACR600 was taken into consideration for plotting graph of absorbance rate vs. nitrate content.

a.) Graph 1 :

With the reference of Standard curve, points of unknown agricultural sample and agricultural sample for 24 hrs, 48 hrs, 72 hrs were plotted on the graph for ACR600 for Agricultural sample using rice husk as Activated carbon. Interpolating the points, nitrate content values were calculated accordingly.

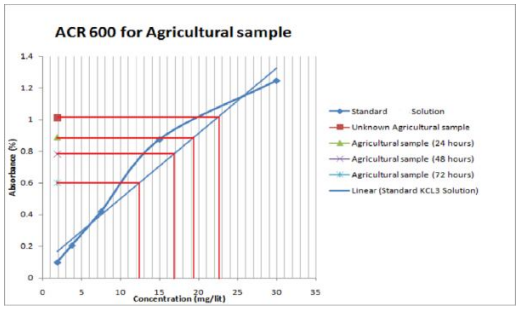

Figure 1

In figure 1, Nitrate content was reduced approximately from 23 mg/lit to 12 mg/lit using ACR600 made from rice husk.

b.) Graph 2 :

With the reference of Standard curve, points of unknown agricultural sample and agricultural sample for 24 hrs, 48 hrs, and 72 hrs were plotted on the graph for Industrial sample using Rice husk as Activated carbon. Interpolating the points, nitrate content values were calculated accordingly.

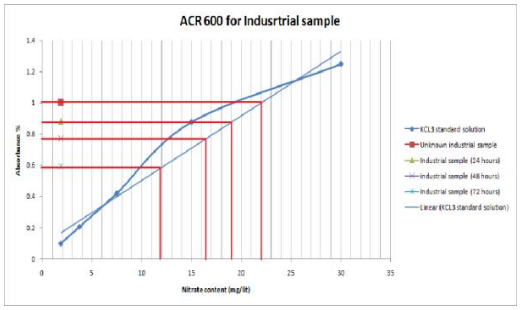

Figure 2

In figure 2, Nitrate content was reduced approximately from 22 mg/lit to 11 mg/lit using ACR600 made from rice husk.

V. CONCLUSION

The results of the study demonstrated that, the adsorption process for the activated carbon prepared from rice husk is effective..

There was a limited positive effect using CR500, CR600 when compared to the ACR's for nitrate removal procedure. Also, ACR600 was the most effective adsorbent in this study. Therefore we can predict that, with increasing temperature for activated carbon for preparation, gives more success. The use of H3PO4 as a reagent for activation process of adsorbent has a positive effect on nitrate removal.

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