Comparative Study of use of Commercial and Microwave Activated Carbon for Waste Water Treatment

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Abstract
Around 98% of earth is covered with water, only very little amount is available for domestic as well commercial use. Heavy industrialization is need of the day but it is also leading to various pollutions. Industrialization leads to large amount of discharge of polluted water and waste water. There are various methods for treatment of water. This paper deals with use of two different types of activated carbon for treatment of water **(**Mall, et al.;1996) (Rahman, et al.; 2005)**(**Rodman and Shunney ,1971). Paper results show that microwave activated carbon more efficiently treats water as compared to commercial activated carbon. The process gives almost 80%treatment of wastewater. Also the microwave process used for manufacturing is environment friendly (Emmanuel, et al.; 2008).

Keywords: Waste Water, Commercial Activated Carbon, Microwave.

Introduction:

Based on a comprehensive field study, it was observed that the wastewater characteristics of the influent, specifically COD being received at the CETP far exceeded than the permissible COD. Though the incoming wastewater deposition to the plant was very less but still, the plant could not take any additional hydraulic load due to more organic loading, particularly with regard to COD(Galambos, et al.;2004) (Hector, et al.; 2007). Efforts therefore have been made either to control the wastewater quality at the CETP inlet or to provide some specific treatment employing advanced treatment methods/ processes to improve the quality of treated wastewater **(**Mahesh, 1989). There are many ongoing processes for treatment such as sedimentation, coagulation, filtration chlorination etc. (Bansode, et al.;2004) (Goel P.K., (2003) this paper discusses about the use of conventional and microwave activated carbon for treatment of wastewater(Gitchel, et al.;1974) (Sun et al.,2008).

Material and Method:

i) Synthesis of Microwave Activated Carbon:

Conventional and microwave technique were used for the synthesis of activated carbon from biologically waste material (Healy, et al.;2007). The raw material was first dried and then subjected to activation (Menendez, et al.;1999). This activated carbon was stored in dried condition. The activated carbon compound was kept in oven for one hour and then kept in desiccators to remove moisture. Microwave activated carbon is giving acceptable yield with high Iodine number (Jankowska et al.;1991)(Nassar,1995)(Peres, et al.; 2004).

ii) Study of initial parameters of waste water:

Physico-chemical analysis of wastewater samples was carried out for the parameters under five categories namely (1) physical parameters, (2) inorganic parameters, (3) organic parameters, (4) nutrient parameters and (5) heavy metals.

In this study we have discussed about organic parameter, their significance and methods of analysis:

Organic Parameters

- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)

Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) by definition is the quantity of oxygen utilized by a mixed population of microorganisms to destabilize the organic matter under aerobic condition (of the organic matter in a sample of wastewater). The test is carried out for 5 days at 20°C as 70-80% of the organic waste is oxidized during this period. In this method, measured amount of wastewater, diluted with prepared water, were placed in 300 ml BOD bottles. The dilution water, containing phosphate buffer (pH 7.2), magnesium sulphate, calcium chloride, ferric chloride was saturated with dissolved oxygen. Acclimatized seed organisms were added to oxidize the waste organics if sufficient microorganisms were not already present in the wastewater samples **(**Devi and Dahiya, 2008) (deWalle and Chian, 1977).

The BOD test is widely used to determine:

- Pollution load of wastewater

- Degree of pollution in lakes and streams at any time and their self- purification capacity, and
- Efficiency of wastewater treatment systems

Chemical Oxygen Demand

Chemical oxygen demand test determine the oxygen equivalent of organic matter that is susceptible to oxidation with the help of a strong chemical oxidant. The test can be related empirically to BOD, organic carbon or organic matter for samples from a specific source taking into account its limitation. The test is useful in studying performance evaluation of wastewater treatment plants and monitoring of relatively polluted water bodies (Kong and Cha,1996).

COD determination has an advantage over BOD determination. COD results can be obtained in 3-4 hrs as compared to 3-5 days required for BOD test. Further, the test is relatively easy, precise, and is unaffected by interferences as in the BOD test. The estimation was carried out by taking the sample in COD flask with the addition of potassium dichromate (0.25 N), sulphuric acid (conc.), mercuric sulphate and silver sulphate refluxing it for 2 hrs and titrated with ferrous ammonium sulphate (0.1 N) using ferron indicator.

iii) Analysis of wastewater and its Lab-Scale treatment with commercial activated carbon

The wastewater samples were analyzed for different physico-chemical characteristics and nature of the wastewater having high organic load were studied. The treatment sequence was followed as detailed below:Phase I : Collection of waste water samples

Phase II: Initial analysis of waste waterPhase III : Sample treatment with Commercial activated carbon by jar tester method

Phase IV: Final analysis of waste water after treatment

iv) Analysis of wastewater and its Lab-Scale treatment with Microwave activated carbon: The treatment sequence was followed as detailed below:

Phase I: Collection of waste water samples

Phase II: Initial analysis of waste water

Phase III : Sample treatment with microwave activated carbon by jar tester method

Phase IV: Final analysis of waste water after treatment

v) Comparison of commercial and microwave activated carbon: It is observed that activated carbon is efficiently reduces various parameters specifically COD. It is observed that Microwave technique also successfully reduces COD of wastewater and further it greener technology (Ford and Pei 1967) (Hutton and Robertaccio,1975,1978).

Result and Discussion:

The percent COD reduction per unit weight of activated carbon was found to increase with increase in the initial COD concentration (Bansode et al.; 2004) (Kurt et al.; 2007). The adsorbent dose was varied to evaluate the maximum possible contribution of the adsorbent dose to the COD reduction (Cheremishinoff and Moressi, 1978), (Haghseresht and Lu, 1998). The adsorption studies conducted at 6 pH and at initial COD concentration. The result obtained shows that the mixing time had greater impact on COD removal **(**Devi, et al.; 2002) (Gupta, et al., 2006) (Gitchel, et al.; 1974).These experiments were conducted at constant initial COD concentration of 1216 mg/l and the pH was varied by adding alkali or acid (Devi et al., 2007) the results indicated that the COD reduction is 80 %. at pH 6 by using commercial activated carbon. While the reduction of COD by using microwave activated carbon is quite less than the commercial but it is economical as compared to commercial (Devi and Dahiya 2007,2006). It is concluded that activated carbon efficiently reduces various parameters specifically COD. It is observed that Microwave technique also successfully reduces COD of wastewater and further it greener technology (Copson, 1995). This would be beneficial not only to the manufacturing industry in terms of minimising cost of COD treatment, but also to minimise the impact on the environment. If the study is carried out at large scale then it will require only one time investment and it is more economical (Hegazy, et al.; 2007) (Tchobanoglous,et al.;2003). Further this technology is greener technology and do not lead to environment pollution.

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Sr.No.	Parameters	Physico- Chemical Characteristics
1	pH	8.3
2	Alkalinity (mg/L)	518
3	T.S.S (mg/L)	337
4	TDS (mg/L)	8460
5	TVS(mg/L)	2043
6	BOD(mg/L)	500
7	COD(mg/L)	1216
8	TOC(mg/L)	274
9	Phosphate(mg/L)	742
10	Sulphate(mg/L)	1958
11	Ammonical nitrogen(mg/L)	180
12	Nitrate(mg/L)	2.57
13	Total nitrogen(mg/L)	294
14	Phenol(mg/L)	1.89
15	Sodium(mg/L)	1478
16	Total Hardness(mg/L)	908
17	Calcium Hardness(mg/L)	768
18	Chloride(mg/L)	2329

Table 1.1Initial analysis of wastewater

Sr. No.	Parameter	Initial Value of waste water	After treatment of waste water by commercial activated carbon
1	Temperature (^{0}C)	30	29
2	pH	8.3	7.8
3	COD (mg/l)	1216	240
4	BOD (mg/l)	500	143

Table 1.2 Lab-Scale treatment of waste water with commercial activated carbon

Sr. No.	Parameter	Initial Value of waste water	After treatment of waste water by microwave activated carbon
1	Temperature (^{0}C)	30	28
2	pH	8.3	7.8
3	COD (mg/l)	1216	800
4	BOD (mg/l)	500	300

Table 1.3 Lab-Scale treatment of waste water with Microwave activated carbon

Sr. No.	Parameter	Initial Value of waste water	After treatment of waste water by commercial activated carbon	After treatment of waste water by microwave activated carbon
1	Temperature (^{0}C)	30	29	28
2	pH	8.3	7.8	7.8
3	COD (mg/l)	1216	240	800
4	BOD (mg/l)	500	143	300

Table 1.4 Comparative study of waste water treatment by commercial and microwave Technique

Figures 1.1 Lab scale synthesised Activated Carbon

Fig 1.2 Waste Water Before and After Treatment