Surface Modification of Activated Carbon and its study for water born diseases

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Abstract-

Water is major component on the earth. Without water, no life can survive. Water is important for industrial as well as domestic purposes .Commonly all over the world, most of the death occurs due to waterborne diseases such as diarrhoea, typhoid, etc. Major outbreak of these occurred all over the world so it is really necessary to treat the water for the reduction of such pathogenic microorganisms such as ***Salmonella Shigella***, ***Ecoli***. In this Paper activated carbon synthesized from biological waste material is used for the study of microorganisms present in the water .The surface of activated carbon is modified with modifying agent which result in restricting the further growth of the bacteria.

Keywords – Waterborne disease, MW-ACF, MFT, Activating agent.

Introduction:

The rapid development of industrialization and population growth and the long term projection of water scarcity have produced an increasing demand for clean water sources. To address this problem, various useful strategies and solutions have been adopted, including new forms of water treatment, recovery and reuse. The availability of clean water can increased by introducing low cost and highly efficient water treatment technologies and many efforts have been recently carried out in this field.

The pathogen load to the water body from different contamination sources varies strongly with time, often due to the prevalence of the disease in the population. Under epidemic conditions pathogens are excreted from many more human or animal host then endemic conditions .The estimation of pathogen load to the water body can be performed using traditional faecal indicators such as ***Escherichia coli*** or indicators that are applied in microbial source tracking to determine the origin of faecal contamination

Material And Method:

Sample Collection:

Samples were collected from various representative location of Nagpur region. 125ml sampling bottles with 0.025N Sodium thiosulphate were properly autoclaved at 121°C temperature and 15lbs Pressure. Samples were immediately preserved in ice box

The details are as given below:

Sample No.	Sample Type	Sampling Location
1	Surface Water	Ambazari Lake
2	Surface Water	Futala Lake
3	Surface Water	Naagnala
4	Ground Water	Dugwell
5	Ground Water	Tubewell
6	Ground Water	Tap water

Sample Preparation:

i) ASTM standard activated carbon was purchased from local market of Nagpur from Merck Suppliers and its iodine number was determined.

ii) Preparation of Microwave Activated Carbon for microbial treatment:

Activated carbon was prepared from biological waste material by muffle furnace and modern microwave technique The raw material was processed before activation for moisture removal.

iii) Surface modification of Activated Carbon for Microbial Treatment:

The raw material was impregnated with activating agent. Further this treated raw material was subjected to activation to obtain activated carbon with modified surface

The surface modified activated carbon gave higher iodine number which indicates high adsorptive capacity.

Sample Study:

i)Study of microbes in water sample at initial stage:

Microbial analysis of water samples were carried out. In this study we have discussed about Total coliform, Fecal coliform, ***Salmonella*** and ***Shigella***, their significance and methods of analysis

Media used:

- M-Endo agar LES
- M-FC agar base
- Salmonella and Shigella agar
- Slanetz and Bartley agar

Samples were proceeding by commonly used Membrane Filtration Technique (7). The Membrane Filter (MF)

Technique was introduced in the late 1950s as an alternative to the Most Probable Number (MPN) procedure for microbiological analysis of water samples. The MF Technique offers the advantage of isolating discrete colonies of bacteria, whereas the MPN procedure only indicates the presence or absence of an approximate number or organisms (indicated by turbidity in test tubes)

ii) Analysis of water and its Lab-Scale treatment at initial stage

The water samples were analyzed for microbial study of the water at primary stage. The treatment sequence was followed as described below:

Step I : Collection of water samples

Step II : Sterilization of all required materials by autoclaving

Step III : Preparation of selective and differential media plates

Step IV : Microbial analysis of water sample by MFT

Step V : Incubation at 37^0C and 44^0C as per the respective media

Step VI : Counting of colonies after 24hrs of incubation

iii) Analysis of water and its Lab-Scale treatment with ASTM standard activated carbon

Microbial study of the water samples was done after the treatment with standard activated carbon. The treatment sequence was followed as described below:

Step I : Collection of water samples

Step II : Sterilization of all required materials by autoclaving

Step III : Preparation of selective and differential media plates

Step IV : Treatment of water samples with ASTM standard carbon

Step V : Microbial analysis of water sample by MFT

Step VI : Incubation at 37^0C and 44^0C as per the respective media

Step VII : Counting of colonies after 24hrs of incubation

iv) Analysis of water and its Lab-Scale treatment with Surface Modified activated carbon

The water samples were carried out with surface modified microwave activated carbon in aseptic condition and analyzed for microbial study. The treatment sequence was followed as mentioned below:

Step I : Collection of water samples

Step II : Sterilization of all required materials by autoclaving

Step III : Preparation of selective and differential media plates

Step IV : Preparation of surface modified ACF

Step V : Treatment of water samples with surface modified ACF

Step VI : Microbial analysis of water sample by MFT

Step VII : Incubation at 37^0C and 44^0C as per the respective media

Step VIII : Counting of colonies after 24hrs of incubation

Result And Discussion:

i) Microbial analysis of water at initial stage (before treatment) -

Water samples were analyzed in differential and selective media for initial stage identification of microbial colonies and result in terms of CFU/100ml and CFU/1ml are as follows:

Sample No.	Total coliform	Faecal coliform	Bacterial Genus		
			Salmonella	*Shigella*	*Enterococci*
	CFU/100ml		CFU/ml		
1	4190	TNTC	65	32	18
2	TNTC	TNTC	28	15	19
3	6500	TNTC	90	43	100
4	TNTC	1058	1	ND	3
5	2040	TNTC	43	22	10
6	1120	TNTC	2	ND	ND

Table 1- CFU obtained after 24hrs of incubation on different media before treatment

ND- Not detected.

TNTC- Too numerous to count

ii) Analysis of water and its Lab-Scale treatment with Standard activated carbon

Water samples were first treated with Standard activated carbon and result in terms of CFU/100ml and CFU/1ml is as follows:-

Sample No.	Total coliform	Faecal coliform	Bacterial Genus		
			Salmonella	*Shigella*	*Enterococci*
	CFU/100ml		CFU/ml		
1	3100	TNTC	14	9	11
2	1870	TNTC	7	2	4
3	TNTC	TNTC	22	13	TNTC
4	310	1000	8	6	13
5	510	760	80	24	ND
6	895	157	15	ND	ND

Table 2- CFU obtained after 24hrs of incubation on different media after treatment with standard activated carbon

iii) Analysis of water and its Lab-Scale treatment with surface modified Microwave activated carbon

Water samples after processing with surface modified MW-ACF gives following results-

Sample No.	Total coliform	Faecal coliform	Bacterial Genus		
			Salmonella	*Shigella*	*Enterococci*
	CFU/100ml		CFU/ml		
1	85	ND	ND	ND	3

2	56	ND	ND	ND	5
3	20	ND	ND	ND	2
4	ND	8	ND	ND	ND
5	280	305	8	ND	1
6	ND	ND	ND	ND	ND

Table 3- CFU obtained after 24hrs of incubation on different media after treatment with surface modified ACF

Comparison among the Different types of treatment

i) Comparison of commercial and Surface modified activated carbon

Sample No.	Initial	Treatment with standard	Treatment with surface modified MW-ACF
1	4190	3100	85
2	TNTC	1870	56
3	6500	TNTC	20
4	TNTC	310	ND
5	2040	510	280
6	1120	895	ND

Table 4- comparison of Standard and surface modified MW-ACF colonies obtained on M-Endo Agar

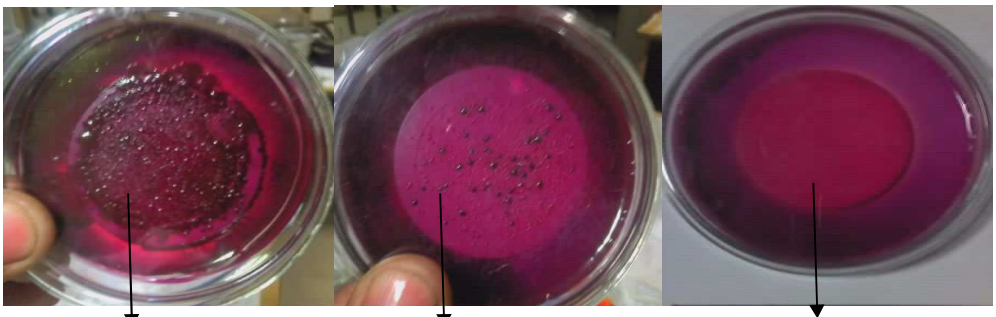


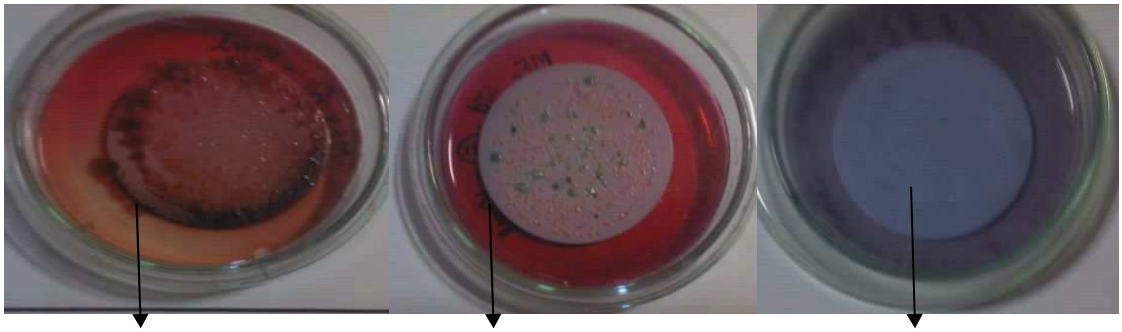
Figure1- comparison of Standard and surface modified MW-ACF colonies obtained on M-Endo Agar

Above figure shows CFU /100 ml in surface modified treatment was less as compared to treatment with standard.

Sample No.	Initial	Treatment with standard	Treatment with surface modified MW-ACF
1	TNTC	TNTC	ND

2	TNTC	TNTC	ND
3	TNTC	TNTC	ND
4	1058	1000	8
5	TNTC	760	3O5
6	TNTC	157	ND

Table 5 - comparison of Standard and surface modified MW-ACF colonies obtained on M-Fc Agar



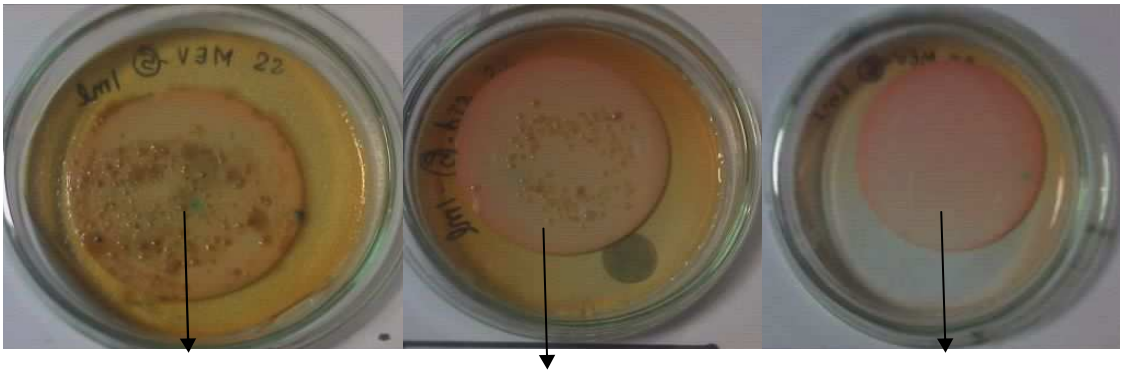
INITIAL **STANDARD** **SURFACE MD MW-ACF**

Figure2- comparison of Standard and surface modified MW-ACF colonies obtained on M-Fc Agar

Above figure show, surface modified treatment was more effective than standard and show reduced no. of colonies than both Initial and Standard.

Sample No.	Initial	Treatment with standard	Treatment with surface modified MW-ACF
1	32	14	ND
2	15	7	ND
3	43	22	ND
4	ND	8	ND
5	22	18	8
6	ND	15	ND

Table 6- comparison of Standard and surface modified MW-ACF colonies obtained on SS Agar



INITIAL **STANDARD** **SURFACE MD MW-ACF**

Figure3- comparison of Standard and surface modified MW-ACF colonies obtained on SS Agar

From above figure it was observed that,Surface modified MW-ACF treatment was more effective as colonie constantly reduced from Initial to Surface MD MW-ACF.

Sample No.	Initial	Treatment with standard	Treatment with surface modified MW-ACF
1	18	11	3
2	19	4	5
3	TNTC	TNTC	2
4	3	13	ND
5	10	ND	1
6	ND	ND	ND

Table 7- comparison of Standard and surface modified MW-ACF colonies obtained on SNB Agar

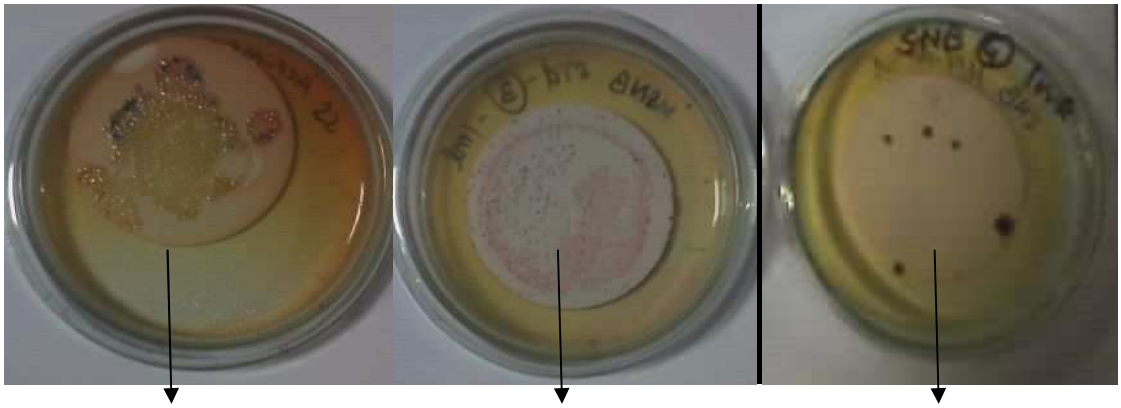


Figure4- comparison of Standard and surface modified MW-ACF colonies obtained on SNB Agar

Above figure shows CFU/ml was very less in Surface MD MW-ACF than standard and initial.

Conclusion:

It is observed that surface of activated carbon modified by activating agent more efficiently reduces various microbial contaminants such as **total colifrom, faecal coliform, *Salmonella spp.*** and ***Shigella spp.*** of waterborne diseases causing microorganisms than these reduced from treatment with modified Standard Agent **.** It is further observed that severe disease causing organism of water from surface as well as ground like shigella and salmonella can more effectively removed by surface activated carbon modified by activating agent.

- If the study is carried out at large scale then it will require only one time investment
- It is more economical. this technology is cheaper
- Greener technology and do not lead to environmental pollution

Recommendation:

§ Further treatment and modification of Surface Modified ACF-MW can help to consider much more parameter affecting water quality including biologically, chemically and giving similar effective results.

§ It is cost effective and Eco-friendly.

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Web Resources-

http://www.epa.gov/microbes/ (EPA methods on pathogens, parasites and indicator organisms)

http://www.cdc.gov/ (Center for disease control and prevention)