Feasibility Study of Cow Dung Ash as a Disinfectant in Water

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Abstract

In case of emergency water which is not purified our filtered may be used but water without the process of disinfection cannot be taken in use for drinking purpose. Disinfection process of water is very important in order to avoid the health related problem. This study addresses the issue of disinfection of water. The main objective of this study is to provide an economical and ecofriendly alternative to existing disinfectant. The cow dung ash has a property of disinfecting the water. Some researchers have proved that cow dung ash not only disinfectant the water but also improves its mineral content and DO. When water is treated with chlorine, if the excessive amount of chlorine is added in water it may form some disinfection by products called trialo-methane (THMs).This by-product form when chlorine reacts with organic matter like leaves etc. In the less knowledge area of disinfection it may affect hazardously as it causes cancer.

Keywords- Cow Dung Ash, Disinfection, Dissolved Oxygen, Most Probable Number, Contact Time

I. INTRODUCTION

Water constitutes one of the important physical environments of man & has direct effect on itself. There is no gain saying that contamination of water leads to health hazards. Safe & adequate drinking water should be provided to the consumer. Water supplied should be aesthetically clean & biologically safe. Coagulation, flocculation and filtration remove bacteria up to 99% but 1% of bacteria entering water may be pathogen and may cause some disease. So, disinfection of water is necessary before supply of water for drinking purpose. Chlorine, which is applied to water at various points in a water treatment plant for various, proposes including the main purpose of disinfection, combines with naturally occurring organic matter present in trace amounts in raw water to generate certain unwanted chemicals known as Disinfection By Products (DBPs) in general and halogenated DBPs in particular. Amongst the halogenated DBPs Trihalomethanes (THMs) represent the largest fraction are toxic. So, there is need to discover alternative methods of disinfection.

Fig. 1: Case study site (Govardhan Anusandhan Kendra) ,Dehugoan (self)

So it is essential to provide a alternative method of disinfection. We used cow dung ash as a disinfectant alternative to chlorine. Cow dung ash has been used as a pesticide since ages, but its disinfecting property still remains undiscovered. Some researchers have proved that cow dung ash not only purifies water but also improves its mineral content. Moreover, it is economical and eco-friendly.

Fig. 2: Aerobic cow dung ash [i]

A. Objectives of the Study

1) To check the feasibility of cow dung ash as a disinfectant.
2) To find the quantity of dosage for cow dung ash as a disinfectant.
3) To check the improvement in the quality of water by adding cow dung ash for the standard parameters (pH, MPN, DO)

II. EXPERIMENTAL INVESTIGATION

A. Performing pH, MPN Index Test & DO

What is pH?

pH=log{1/H^+}.The pH of water for waste water is measure of its free acidity or alkanity.

The pH scale extends from 0 to14.At pH 7,equal concentration of H^+ and OH^- ions are present in pure water at 25^oC.This is the pH for neutrality. Acidity increases as pH drop from 7 to 0 and alkalinity increases as pH rises from 7 to 14.

1) Procedure of Pen Probe Type pH Meter

1) We have taken the calibrated digital pH meter for pH testing.
2) To avoid fluctuation in pH first of all clean it with distilled water.
3) Then pH meter dipped into water and get pH on the screen of pH meter.

Fig. 3: pH measurement by using Pen probe type pH meter

B. What is MPN?

It is a Most Probable Number of coliform. The most probable number of coliform organisms in a water sample is a statical estimate of the density of bacteria most likely to produce a particular result of some significance, associated with the bacterial quality of water.

1) Procedure of MPN Index Test

1) Preparation of the Medium

Prepare medium (either mac conkey broth or Lactose broth)in single and double strength concentration.

a) For untreated or polluted water

Dispense the double strength medium in 10 tubes (10ml in each tube) and single strength medium in 5 tubes (10 ml in each tube) and add a durham tube in inverted position.

b) For Treated Water

Dispense the double strength medium in 5 tubes (10ml in each tube) and 50 ml single strength medium in 1 bottle and add an durham tube in inverted position.

Examine the tubes to make sure that the inner vial is full of liquid with no air bubbles.

2) Procedure of Presumptive Test

1) 50 ml tubes forming set-A
2) 25 ml tubes forming set-B
3) 10 ml tubes forming set-C

a) Pour 25 ml.Double strength MacConkey broth into each 50 ml tube in set-A.
Pour 12 ml.Single strength MacConkey broth into each 25 ml tube in set-B.
Pour 5 ml Single strength MacConkey broth into each 10 ml tube in set-C.

b) Shake the sample bottle to distribute the microorganisms (if any), most evenly. Extract 100ml of the sample into a sterile graduated jar.

c) Using 10ml pipette, inoculate 10 ml of the sample into each of the tubes in set-A. Using 5ml pipette. Inoculate 1ml of the sample into each of the tubes in set-B. Using 1ml pipette, inoculate 0.1ml of the sample into each of the tubes in set-C.

d) Insert a sterile Durham tube, upside down into each fermentation tube. Firmly stopper each fermentation tube. Turn the tube upside down shake and hold it till the durham tube is completely filled with the broth with no air bubble trapped inside. The entire work of inoculation should be done under sterilize condition.

Table 1: MPN Reference Table

Number of tubes Giving positive result out of			MPN index per 100ml	Number of tubes Giving positive result out of			MPN index per 100ml
5 of 10 ml each	5 of 1ml each	5 of 0.1 ml each		5 of 10ml each	5 of 1 ml each	5 of 0.1ml each	
0	0	0	< 2	2	0	0	5
0	0	1	2	2	0	1	7
0	1	0	2	2	1	0	7
0	2	0	4	2	1	1	9
1	0	0	2	2	2	0	9
1	0	1	4	2	3	0	12
1	1	0	4	3	0	0	8
1	1	1	6	3	0	1	11
1	2	0	6	3	1	0	11
3	1	1	14	5	1	2	63
3	2	0	14	5	2	0	49
3	2	1	17	5	2	1	70
3	3	0	17	5	2	2	94
4	0	0	13	5	3	0	79
4	0	1	17	5	3	1	110
4	1	0	17	5	3	2	140
4	1	1	21	5	3	3	180
4	1	2	26	5	4	0	130
4	2	0	22	5	4	1	170
4	2	1	26	5	4	2	220
4	3	0	27	5	4	3	280
4	3	1	33	5	4	4	350
4	4	0	34	5	5	0	240
5	0	0	23	5	5	1	350
5	0	1	31	5	5	2	540
5	0	2	43	5	5	3	920
5	1	0	33	5	5	4	1066
5	1	1	46	5	5	5	> 2400

Fig. 4: C- ϕ Soil Murrum

C. What is DO?

It is a content of dissolved oxygen in water. DO saturation mainly depends on the following properties and DO saturation decreases with them, they are as following:

1) Rise in temperature
2) Rise in salt concentration
3) Rise in altitude and
4) Rise in organic concentration

1) Procedure of DO Test

- Take a 250 ml reagent bottle (or 300 ml BOD bottle) and fill it up completely with the sample. Tap the bottle all round to release entrapped air bubbles. Record the temperature. Stopper the bottle.
- Remove the stopper and add 2 ml of MnSO4 using a pipette, dipping the open end of pipette below the liquid surface.
- Add 2 ml of alkali iodide azide using a pipette, dipping the end of pipette below the liquid surface.

a) If DO is absent a stable white ppt. of magnous hydroxide is formed. The experiment may stopped at this stage.
b) If DO is present, mangnous ions are oxidized to manganic ions and a brown ppt. Of mangenic basic oxide is formed. Stopper the bottle and mix by inverting the bottle several times.

- Remove the stopper and add 2 ml of conc. H2SO4 (36N). Stopper the bottle and mix the contents by inverting the bottle several times until the brown ppt. get completely dissolves to yield a uniformly yellow coloured free iodine solution. Under acidic conditions manganic basic oxide oxidizes iodine to free iodine.
- Take 230 ml of iodine solution in a conical flask. Titrate against standardized sodium thiosulphate (Na2S2O3) of 0.025N using 1 to 2 ml of starch as an indicator. This is an Oxidation-Reduction reaction. Free iodine, an oxidizing agent, is reduced to iodine and sodium thiosulphate, a reducing agent, is oxidized to sodium tetra thionate.
- Stop the titration at the end point, when the solution in the flask blue to colourless. Record the amount of titration used (X ml) up to the first disappearance of blue colour.

2) Action of Starch as an Indicator

Starch is an absorption type of indicator. During titration of iodine with sodium thiosulphate, addition of starch results in the formation of a weak blue complex due to absorption of iodine on colloidal starch particles, as iodine is extracted and reduced, and the intensity of blue colour gradually decreases. When all the free iodine is reduced to iodide, the blue colour totally disappears. This indicates the end point of titration.

III. ANALYSIS OF DATA AND VALIDATION

A. pH Test Result

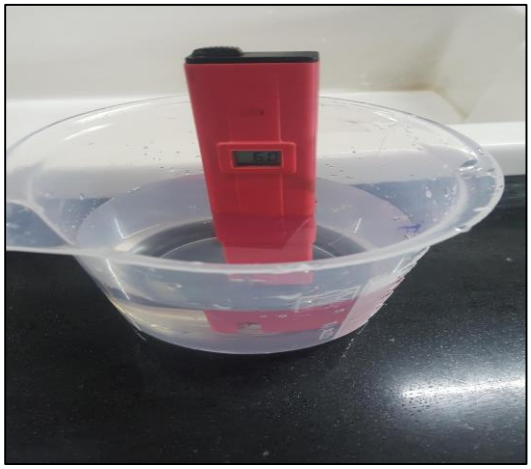

Fig. 5.1: Tap water (self)

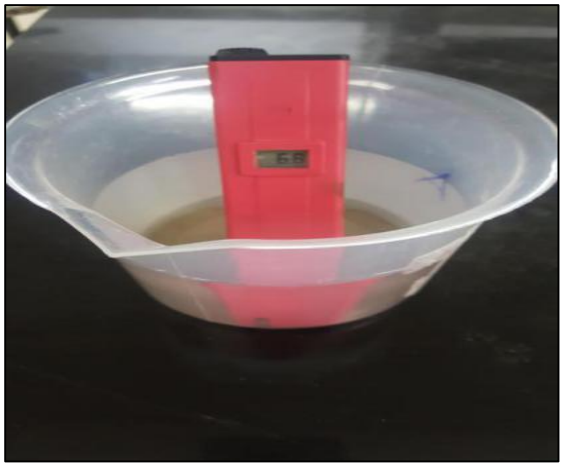

Fig 5.2: Tap water with 0.2g/l cow dung ash (self)

Table 2: pH Result

Sample	*pH*
Tap water without using cow dung ash	*6*
Tap water with cow dung ash	*6.8*

B. MPN Index Test Result

Fig. 5.3: Tap water sample at 0 hrs (self)

Fig. 5.4: Tap water sample at 48 hrs (self)

Fig. 5.5 Tap water+1 g/l cow dung ash sample (self)

Fig. 5.6: Tap water+1 g/l cow dung ash sample (self)

Table 3: MPN Index Table

Sample No.	*Description of sample*	*No of tubes giving positive results out of*			*MPN Index No*
		5 of 10ml each	*5 of 1ml each*	*5 of 0.1ml each*	
1.	*Tap water sample*	*4*	*4*	*1*	*34*
2.	*Tap water + 1 g/l cow dung ash*	*5*	*0*	*1*	*31*

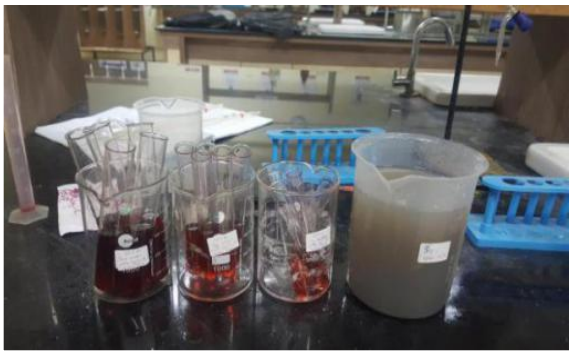

Fig. 5.7: Tap water +3 g/l cow dung ash sample at 0 hrs (self)

Fig. 5.9: Tap water+3 g/l cow dung ash sample at 48 hrs (self)

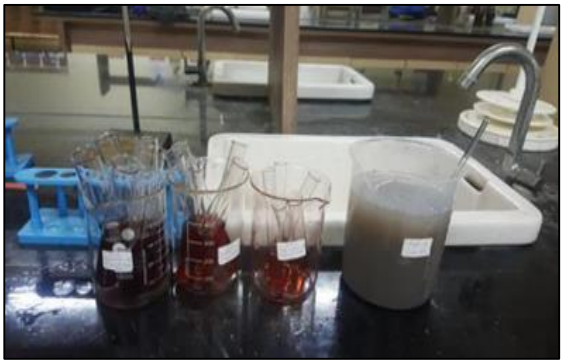

Fig. 5.10: Tap water+6 g/l cow dung ash sample at 0 hrs (self)

Fig. 5.11: Tap water+ 6 g/l cow dung ash sample at 48 hrs (self)

Table 4: MPN Index Test Result

Sample No.	*Description of sample*	*No of tubes giving positive results out of*			*MPN Index No*
		5 of 10ml each	*5 of 1ml each*	*5 of 0.1ml each*	
1.	*Tap water + 3 g/l cow dung ash*	*4*	*3*	*0*	*27*
2.	*Tap water + 6 g/l cow dung ash*	*3*	*1*	*1*	*14*

C. Check for Quality Parameter and Modification if Needed

We were checking the quality parameters on the basis of experimentation. This quality parameters are pH, MPN Index, DO etc. On the basis of experimentation we got good results in pH test and MPN Index test but not satisfactory.

Main modification needed was contact time. On the basis of work done earlier, we have to provide contact time of 6 to 8 hrs. Between cow dung ash and water sample. As cow dung ash is an adsorbent, so it needs to provide contact time.

Even we may try this for sewage treated disinfection in which more pathogens are there, and reduce in percentage of pathogens may be more.

On the basis of this tap water testing we got an idea, that it can be more preferable for waste water. So we carried out testing on waste water with 3Hrs, 6 Hrs and 9 Hrs of contact time with Cow dung ash.

The results were provided as follows:

1) MPN Index Test Results after Adding Sewage to Tap Water

Fig. 5.12: Tap water + 0.5 ml sewage

Fig. 5.13: Tap water + 0.5 ml sewage + 3 g/l cow dung ash

Table 5: MPN Index Test Result

Sample No.	*Description of sample*	*No of tubes giving positive results out of*			*MPN Index No*
	After proving contact time of 3 hrs	*5 of 10ml each*	*5 of 1ml each*	*5 of 0.1ml each*	
1.	*Tap water + 0.5 ml sewage*	*5*	*5*	*2*	*540*
2.	*Tap water + 0.5 ml sewage + 3 g/l cow dung ash*	*5*	*4*	*2*	*220*

Fig. 5.14: Tap water + 0.5 ml sewage + 3 g/l cow dung ash (6 hrs contact time)

Table 6: MPN Index Test Result

Sample No.	*Description of sample*	*No of tubes giving positive results out of*			*MPN Index No*
	After proving contact time of 6 hrs	*5 of 10ml each*	*5 of 1ml each*	*5 of 0.1ml each*	
1.	*Tap water + 0.5 ml sewage*	*5*	*5*	*4*	*920*
2.	*Tap water + 0.5 ml sewage + 3 g/l cow dung ash*	*5*	*3*	*2*	*94*

Fig. 5.15: Tap water + 0.5 ml sewage + 3 g/l cow dung ash

Table 7: MPN Index Test Result

Sample No.	*Description of sample*	*No of tubes giving positive results out of*			*MPN Index No*
	After providing contact time of 9 hrs	*5 of 10ml each*	*5 of 1ml each*	*5 of 0.1ml each*	
1.	*Tap water + 0.5 ml sewage*	*5*	*5*	*5*	*1066*
2.	*Tap water + 0.5 ml sewage + 3 g/l cow dung ash*	*3*	*0*	*0*	*8*

Fig. 5.16: Titration of sample (self)

Fig. 5.17: Sample titration (self)

Table 8: Dissolved Oxygen Test Results

Sr No	*Description of sample (After providing 3 hrs of contact time)*	*Temperature of sample (^0C)*	*DO (mg/l)*	*Remark*
1	*Tap Water*	*27.8*	*2.96*	*Can't disposed into natural stream*
2	*Tap Water + 0.5 ml of sewage*	*27.8*	*1.31*	*Can't disposed into natural stream*
3	*Tap Water+ 0.5 ml of sewage + 3 g/l of cow dung ash*	*27.8*	*4.376*	*Can be disposed into natural stream*

Table 9: Dissolved Oxygen Test Results

Sr No	*Description of sample (After providing 6 hrs of contact time)*	*Temperature of sample (^0C)*	*DO (mg/l)*	*Remark*
1	*Tap Water*	*27.8*	*2.94*	*Can't disposed into natural stream*
2	*Tap Water + 0.5 ml of sewage*	*27.8*	*1.29*	*Can't disposed into natural stream*
3	*Tap Water+ 0.5 ml of sewage + 6 g/l of cow dung ash*	*27.8*	*4.976*	*Can be disposed into natural stream*

Fig. 5.18: Amount of titrant (self)

Table 10: Dissolved Oxygen Test Results

Sr No	*Description of sample (After providing 9 hrs of contact time)*	*Temperature of sample (^0C)*	*DO (mg/l)*	*Remark*
1	*Tap Water*	*27.8*	*2.9*	*Can't disposed into natural stream*
2	*Tap Water + 0.5 ml of sewage*	*27.8*	*1.224*	*Can't disposed into natural stream*
3	*Tap Water+ 0.5 ml of sewage + 6 g/l of cow dung ash*	*27.8*	*5.916*	*Can be disposed into natural stream*

IV. RESULTS AND DISCUSSION

1) After adding 0.2g/l of cow dung ash in water sample change in the pH is observed to be from 6 to 6.8.
2) The decrements in the MPN index number after adding 1g/l of cow dung ash in water sample is from 34 to 31.
3) 3g/l of cow dung ash in water sample improves its disinfection rate and decrements in the MPN Index Number from 34 to 27.
4) 6g/l of cow dung ash in water sample giving MPN index number 14.
5) Percentage decrease in pathogens by adding 1g/l of cow dung ash is 8.82%.
6) Percentage decrease in pathogens by adding 3g/l and 6g/l of cow dung ash is 20.58% and 58.82% respectively.

- After providing contact times of 3hrs, 6 hrs and 9 hrs between 3 g/l cow dung ash and sewage water, the change in the MPN index No and DO is as following;

7) For providing 3hrs, 6hrs and 9hrs of contact time MPN Index Number changes from 540 to 260, 920 to 94 and 1066 to 8 respectively.
8) Percentage decreases in bacteria for contact times of 3hrs, 6hrs and 9hrs are 51.85%, 89.78% and 99.24% respectively.
9) By adding 3g/l of cow dung ash with contact times of 3hrs, 6hrs and 9hrs increase in the dissolved oxygen of sewage water from 1.31 to 4.376, 1.29 to 4.976 and 1.224 to 5.916 respectively.

V. CONCLUSION

After doing a rigorous study on water by addition of cow dung ash for improving quality of water, we found that

1) Improvement in the quality parameters of water such as pH, MPN index number etc.
2) Need to provide contact time between water sample and cow dung ash.
   [Cow Dung Ash is a bio-organic waste and adsorbent. So adsorbent need time to react with provided sample to get better and required results.]
3) Cow dung ash is an eco-friendly and low cost adsorbent for disinfection purpose.
4) After providing contact time of 3hrs, 6 hrs and 9hrs we conclude that 9hrs of contact should be feasible and giving good results for parameter such as MPN Index No and DO.
5) The cow dung ash is more feasible for disposal of sewage as compare to disinfecting water for drinking purpose.
6) According to BIS (Bureau of Indian Standard) the DO should be equal to or greater than 3 mg/l for disposal. So we can dispose the sewage water into natural stream on the basis of DO parameter, as our DO found to be 5.916 mg/l.
7) On the basis of MPN for contact time of 9hrs we can dispose sewage into natural stream.
   "Thus we found that cow dung ash is feasible to use in Sewage Treatment Plant (STP) on the basis of Dissolved Oxygen (DO) and MPN index No (Most Probable Number)"

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