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*Full Length Research Paper*

# Using of iron sulfide and hydrogen peroxide to treat the eutrophication

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**Iron Sulfide and Hydrogen peroxide were used to treat and stop the highly algal growth (Eutrophication). Different concentrations of iron sulfide and hydrogen peroxide(F:H): (0.036,0.1);(0.072,0.1);(0.35,0.1);(0.072,0.2);(0.143,0.2);(0.72,0.2);(0.18,0.5);(0.36,0.5);(1.8,0.5);(0.36,1);(0.72,1);(3.6,1);(0.0,0.5);(0.36,0.0),(0,0) ml, respectively, were used to stop the algal growth. These concentrations were exposure to algal culture to test the ability of these two chemical materials to stop their growth. The results showed that two chemical materials have a good ability to stop the algal growth. The microcystine test was depended in order to ensure there is no algal toxin after the treatment with iron sulfide and hydrogen peroxide. The results appears, there is no residues of algal toxins in water after the treatment. So, it can suggest that iron sulfide and hydrogen peroxide are a good algacide.**

**Keywords:** Eutrophication treatment, Chemical treatment of algal growth, Eutrophication solutions.

## 1- INTRODUCTION

An **algal bloom** is a rapid increase or accumulation in the population of algae (typically microscopic) in an aquatic system. Algal blooms may occur in freshwater as well as marine environments. Typically, only one or a small number of phytoplankton species are involved, and some blooms may be recognized by discoloration of the water resulting from the high density of pigmented cells. Although there is no officially recognized threshold level, algae can be considered to be blooming at concentrations of hundreds to thousands of cells per milliliter, depending on the severity. Algal bloom concentrations may reach millions of cells per milliliter. Algal blooms are often green, but they can also be other colors such as yellow-brown or red, depending on the species of algae.

Toxins are often produced from harmful algal blooms in marine, brackish, and freshwater environments. More important, toxins have been implicated as the causative agents of human beings, livestock, wildlife, and domestic animals.

The blooming of cyan bacteria in water will produce large amounts of hepatotoxic or neurotoxin (Furey A et al., 2003; Sangolkar et al., 2006). Hepatotoxins, including cyclic heptapeptides, termed microcystins and nodularins are the predominant cyan toxins (Carmichael WW 1992; Rinehart et al., 1994; Rinehart et al., 1988). Both microcystins and nodularins have been verified as potent inhibitors of protein phosphatases 1 and 2A (MacKintosh et al., 1990) and have tumor promoting properties (Nishiwaki-Matsushima et al., 1992; Ueno et al., 1996),

which can cause both acute and chronic effects in mammals.

## 2- MATERIALS AND METHODS

- Water from Valle de Bravo, (Mexico City)
- Pipettes capable of dispensing between 0.18 and 1.79 ml of liquid
- 15 reaction vessels (conical flasks) of 250 ml
- Sampling vessels
- 2 L filtration flask
- Vacuum filtration equipment (clamps, filter paper)

Chu .10 media was used to culture the algae (Table1):

Table 1. Content of Ch.10 medium

Item	gm\L
K <sub>2</sub> HPO <sub>4</sub>	4
MgSO <sub>4</sub> .7H <sub>2</sub> O	10
CaCl <sub>2</sub>	16
NaNO <sub>3</sub>	8
FeCl <sub>3</sub>	0.23
EDTA-Na	4
NaCl	30
MnCl <sub>2</sub> .4H <sub>2</sub> O	0.028
H <sub>3</sub> BO <sub>3</sub>	0.228
COCl <sub>2</sub> .6H <sub>2</sub> O	0.004
CuSO <sub>4</sub> .5H <sub>2</sub> O	0.08
ZnSO <sub>4</sub> .7H <sub>2</sub> O	0.224
Ammonium molbedate	0.28
Na <sub>2</sub> CO <sub>3</sub>	8
Sodium Silicate	0.025

### 2.1 Procedure

#### 2.1.1 Preparation for media: (Ch.10 medium (Chu SP 1940) and modified by (Kassim TI 1998)

- 1- Stock 1: add 4gm from **K<sub>2</sub>HPO<sub>4</sub>** to 1 liter of distilled water.
- 2- Stock 2: add 10gm from **MgSO<sub>4</sub>.7H<sub>2</sub>O** to 1 liter of distilled water.
- 3- Stock 3 add 16gm from **CaCl<sub>2</sub>** and 8 **NaNO<sub>3</sub>** gm to 1 liter of distilled water.
- 4- Stock 4: add 0.23gm from **FeCl<sub>3</sub>** to 1 liter of distilled water.
- 5- Stock 5: add 4gm from **EDTA-Na** to 1 liter of distilled water.
- 6- Stock 6: add 30gm from **NaCl** to 1 liter of distilled water.

7- Stock 7: add 0.028gm from **MnCl<sub>2</sub>.4H<sub>2</sub>O**; 0.228 gm **H<sub>3</sub>BO<sub>3</sub>**; 0.004 gm **COCl<sub>2</sub>.6H<sub>2</sub>O**; 0.08gm **CuSO<sub>4</sub>.5H<sub>2</sub>O**; 0.224 gm **ZnSO<sub>4</sub>.7H<sub>2</sub>O** and 0.28 gm **Ammonium molbedate** to 1 liter of distilled water.

8- Stock 8: add 8gm from **Na<sub>2</sub>CO<sub>3</sub>** to 1 liter of distilled water.

2.1.2. Add 2.5 ml from each stock to 1 liter of distilled water to prepare the suitable media for algae.

Add 100 ml of algae to 1 liter of medium to begin the experiment (the number of conical flasks which be according the number of concentrations that try to exposure the algae to them.

2.1.3 Preparation different concentrations of oxides solution

2.1.4. Exposure the algae to different concentration of oxides.

2.1.5. Notice the results and records

### 3.1 Preparing stock solution with Fe<sup>2+</sup>

1. Measure 14.6 g of EDTA and add in 1 L conical flask
2. Measure 13.9 g of FeSo<sub>4</sub>.7H<sub>2</sub>O and add in 1 L conical flask
3. Place on a magnetic stirrer and leave overnight
4. Take a picture of the solution
5. Stop the mixing and take a picture
6. Allow the un dissolved EDTA to settle
7. Take a picture

Safety: Make sure PPE is used all times

Table 1. Molecular weights

Molecular Weights	g/mol
MW EDTA	292
MW FESO <sub>4</sub> .7H <sub>2</sub> O	278

Table 2. Reagents Fe-EDTA stock solution

Reagents	Mass reagents, g	mg/L	mol
EDTA	14.6	14600	0.05
FeSO <sub>4</sub> .7H <sub>2</sub> O	13.9	13900	0.05

### 1.1 Preparing stock solution with hydrogen peroxide

1. Add 10 ml of 50% of hydrogen peroxide in a 100 ml flask
2. Add 40 ml of distilled water
3. Mix thoroughly

**Table 3.** Reagents H<sub>2</sub>O<sub>2</sub> stock solution

Reagents	mg/L	mol
Concentration, H <sub>2</sub> O <sub>2</sub>	100000	2.94

**Table 4.** Concentrations and volumes of stock based on 100 ml of reaction vessel

Reactions	mg/L H <sub>2</sub> O <sub>2</sub>	mg/L Fe <sup>2+</sup>	ml Fe Stock	ml H <sub>2</sub> O <sub>2</sub> stock
1	100	5	0.036	0.1
2	100	10	0.072	0.1
3	100	50	0.35	0.1
4	200	5	0.072	0.2
5	200	10	0.143	0.2
6	200	50	0.72	0.2
7	500	5	0.18	0.5
8	500	10	0.36	0.5
9	500	50	1.79	0.5
10	1000	5	0.36	1
11	1000	10	0.72	1
12	1000	50	3.6	1
13	500	0	0.00	0.5
14	0	10	0.36	0
15	0	0	0.00	0
Total			9.64	5.90

**1.2 Preparing for reactions**

1. Place all 15 reaction vessels on the bench – take a picture
2. Dispense the required amount of Fe+EDTA solution – take a picture
3. Thoroughly mix – take a picture
4. Dispense the required amount of hydrogen peroxide and thoroughly mixed
5. Take a picture after all are dispensed
6. Place the reaction vessels on a circular shaker
7. Leave for 3 hours
8. Take a picture
9. Place all in a refrigerator if measurements cannot be performed

**1.3 Measurements and Sampling**

**3. Test the algal toxins (Chu et.al., 1989; Chu et.al 1990):**

- 1- Add a sample containing microcystine to a test tube, incubate, and then add microcystin –enzyme conjugate. The enzyme conjugate competes with the microcystine for antibody binding sites.
- 2- Wash away any unbound molecules.

**3-** Add a clear solution of chromogenic substance to the test tube. In the presence of bound microcystin-enzyme conjugate, the substance converts to a compound which turns blue. One enzyme molecule can convert many substance molecules.

The color is inversely proportional to microcystine concentration:

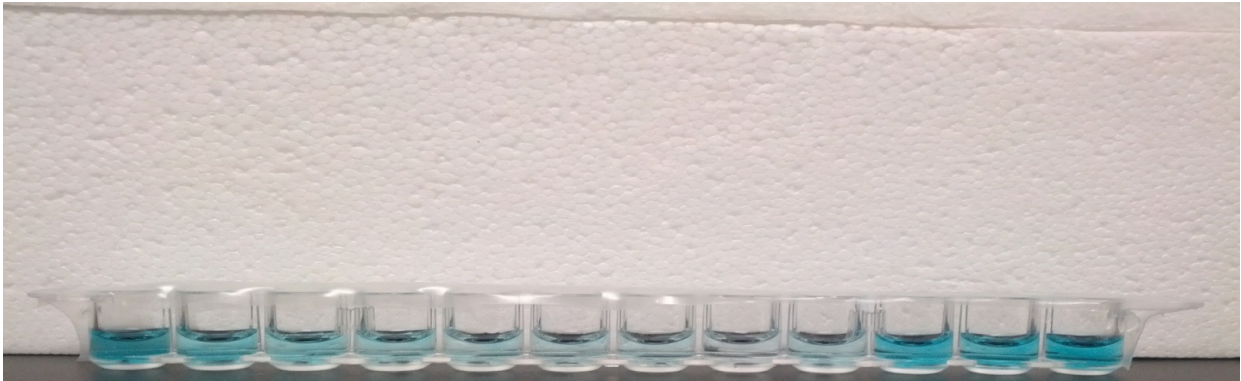
**Darker color** = lower concentration

**Lighter color** = higher concentration

**RESULTS AND DISCUSSION**

Many studies were discuss algal blooming problem (Fleming et al., 2002; Pierce and Kirkpatrick 2001), and many researchers try to find suitable solutions for this environmental problem and its bad effects in both environment and human health, by suggests some chemical materials to solve this problem (Jr Lynch WE 2009; Chemical Control of Algae (information sheet 2004).

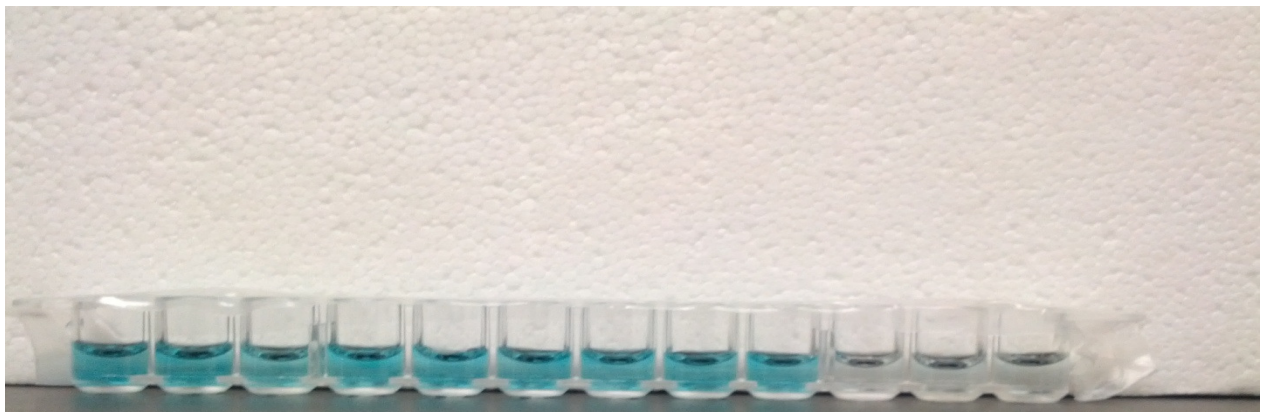
In this study, it was found that the hydrogen peroxide and ferric sulfide have a good effect to stop the growth of algae, and there is no residue of these chemical materials may have a bad effect on human health,



1 2 3 4 5 6 7 8 9 10 11 12

Picture 1: The microcystine test, where:

- 1= negative control
- 2= 0.1 PPb microcystine
- 3=0.2PPb microcystine
- 4=0.4 PPbmicrocystine
- 5=0.56PPb microcystine
- 6=0.8PPbmicrocystine
- 7=1.6PPbmicrocystine
- 8= water sample without treat with Fe and H<sub>2</sub>O<sub>2</sub>
- 9=Diluted water sample without treat with Fe and H<sub>2</sub>O<sub>2</sub>
- 10=Treatment with (Fe= 0.036 + H<sub>2</sub>O<sub>2</sub>=0.1)
- 11=Treatment with (Fe= 0.072+ H<sub>2</sub>O<sub>2</sub>=0.1)



13 14 15 16 17 18 19 20 21 22 23 24

Picture 2: microcystine test (13-24), where:

- 13=Treatment with (Fe= 0.072+ H<sub>2</sub>O<sub>2</sub>=0.2)
- 14=Treatment with (Fe= 0.143+ H<sub>2</sub>O<sub>2</sub>=0.2)
- 15=Treatment with (Fe= 0.72+ H<sub>2</sub>O<sub>2</sub>=0.2)
- 16=Treatment with (Fe= 0.18+ H<sub>2</sub>O<sub>2</sub>=0.5)
- 17=Treatment with (Fe= 0.36+ H<sub>2</sub>O<sub>2</sub>=0.5)
- 18=Treatment with (Fe= 1.79+ H<sub>2</sub>O<sub>2</sub>=0.5)
- 19=Treatment with (Fe= 0.36+ H<sub>2</sub>O<sub>2</sub>=1)
- 20=Treatment with (Fe= 0.72+ H<sub>2</sub>O<sub>2</sub>=1)
- 21=Treatment with (Fe= 3.6+ H<sub>2</sub>O<sub>2</sub>=1)
- 22=Treatment with (Fe= 0.00+ H<sub>2</sub>O<sub>2</sub>=0.5)
- 23=Treatment with (Fe= 0.36+ H<sub>2</sub>O<sub>2</sub>=0.00)
- 24=Treatment with (Fe= 0 + H<sub>2</sub>O<sub>2</sub>=0)

because Hydrogen peroxide is most commonly available as a solution in water. For consumers, it is usually available from pharmacies at 3 and 6 wt% concentrations. The concentrations are sometimes described in terms of the volume of oxygen gas generated; one milliliter of a 20-volume solution generates twenty milliliters of oxygen gas when completely decomposed (Steidinger and Baden 1983).

Some algal species are harmful because they produce toxic compounds, generally described as phycotoxin, red tide to toxin, or HAB(Harm Algal Bloom) toxins (Yasumoto et al., 1995; Jennifer et al., 2009).

According to microcystine test, it was found there is no residue of toxins can be detection in tested samples after using of ferric sulfide and hydrogen peroxide to stop the growth of algae (the samples 10-24) comparative the samples (8 &9) that do not treat with these two oxides (Pictures 1 & 2).

So, it can suggest that iron sulfide and hydrogen peroxide are a good algaecide.

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