International Journal on Emerging Technologies (Special Issue NCETST-2017) **8**(1): 193-195(2017)
(Published by Research Trend, Website: www.researchtrend.net*)*

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

Improved Methodology to reduce polluting effect of soapstone fly-ash on water in and around Haldwani

Ajay Pali[1], Jyoti Singh[2] and Prafull Gururani[2]
[1]*Associate Professor, Department of Chemistry,*
Armapali Insititute of Technology & Sciences, Haldwani, (Uttarakhand), India
[2]*Associate Professor, Department of Chemistry,*
Armapali Insititute of Technology & Sciences, Haldwani, (Uttarakhand), India

ABSTRACT: A novel system was investigated that can be used to cure water degraded by soapstone fly-ash. Water affected by soapstone fly-ash has a significantly higher Chemical Oxygen Demand (COD) (7000 - 15000mg/l) and Biological Oxygen Demand (BOD) than normal water due to catalytic oxidations and microbial effect. In this study, water contaminated thus was treated by stoichliometric amount of hydrogen peroxide (20%), which led to substantially increased oxygenation of the contaminated water. The residue obtained after oxygenation of water was subjected to mineralization activity of a selected microbial consortium to convert the residue into CO_2 and biomass. Results of this study suggest possibility of an improved operational methodology that is capable of reducing the negative impact of soapstone fly-ash on water.

Key words: Soap stone powder effluent, COD & BOD, Magnesium

I. INTRODUCTION

The mines of Uttaranchal are a major source of soapstone for most of India. Soapstone powder is widely used in preparation of toilet soap, bady talcom power, detergents. Among its various uses are polishing of pulses by dal mills, in textitle printing and in the rubber industry. Factories convert soapstone to powder form by grinding it, which leads to generation of soapstone fly-ash that contaminates water. Though effluents from soapstone grinding units are relatively small in volume, they get concentrated in water during the periods when water supply reduces, such as June and July. Soap stone affected water refers to polluted water, with high value of BOD and COD and low value of pH.

Normal level of silicic acid in human blood is below 1$\mu g SiO_2/cm^3$ (Baumann, 1960). In tests, rats given silica flour, powdered sand or magnesium trisilicate orally in large amounts were shown to have developed crystals of these substances (Reimann *et. al.,* 1965, 1966). From this it can be observed that free silica attacked to a variable extent depending on its physical and chemical condition (King & Mcgerge, 1938). Recent reports repeatedly point to an increasing and alarming reduction in the quality of water available for use by human beings and the deleterious effect of poor quality water on fertility of soil across various regions. This is due to contamination of surface and ground water by various pollutants, including effluent from soapstone grinding units.

The chemical composition of soap stone powder is (approx.) as follows:

SiO_2	**-** 62.67%
Al_2O_3	**-** 0.24
MgO	**-** 33.26
Fe_2O_3	**-** 0.30
CaO	**-** 0.20
Loss on ignition	**-** 3.33

II. MATERIALS AND METHODS

Sample were collected in special effluent collecting containers from various factories in the factory of, Kamaluaganja, Haldwani, Uttaranchal. They were analyzed for physical and chemical properties by adopting the routine standard methods mentioned in APHA. Different concentrations (control 5, 10, 25 and 50%) of soapstone effluent were prepared by adding desired volume of distilled water. This water with controlled concentrations of the effluent was used for watering seedlings.

For this purpose, healthy and uniform sized seeds were selected and their surface sterilized with 0.1% $HgCl_2$ for two minutes. They were thoroughly washed with tap water, to avoid surface contamination. These seeds were then placed equidistantly in plastic containers filled with sterilized soil. The seeds were irrigated with equal quantity of different concentrations of effluent mixed water. Simultaneously, some seeds irrigated with distilled water were kept aside and treated as control.

The number of seeds that germinated and the average length of seedlings were measured on 10 day old seedlings. Weight of fresh seedling was calculated by using an electrical single pen balance. Then the seeds were dried in a hot air oven at 80^0C for 24 hours and their weight taken again using the earlier method. The percentage of phyto-toxicity was also calculated. The chlorophyll and carotenoid content of seeding were estimated by following the methods of Arnon (1949) and Kirk & Allen (1965) respectively.

Table 1: Report (Physical, Chemical and bacteriological) for normal water by Uttrakhand Jal Sansthan, Nainital.

S. No.	Parameter	Unit of Parameter	Is. 10500		Sample no. & result
			Desirable	Permissable	1
1	Physical appearance		Colourless	Colourless	Clear
2	Odour		Unobjection able	Unobjection able	Odourless
3	Turbidity	NTU	5	10	<5
4	pH		6.5 to 8.5	NR	8.1
5	Chlorides as Cl	Mg/l	250	1000	10.0
6	Total hardness as CaCO3	Mg/l	350	600	52.0
7	Calcium hardness as CaCO3	Mg/l	187.5	500	24.0
8	Mg hardness as CaCO3	Mg/l	125	416.5	28.0
9	Alkalinity as CaCO3	Mg/l	200	600	52.0
10	Total solids	Mg/l	N.S.	N.S.	184
11	Total dissolved solids	Mg/l	500	2000	180
12	Sus. solids	Mg/l	N.S.	N.S	4
13	Nitrate as NO3	Mg/l	45	N.R.	Traces
14	Nitrate as NO3	Mg/l	N.S.	N.S.	Nil
15	Iron as Fe++	Mg/l	0.3	1.0	Traces
16	Dissolved oxygen	Mg/l	N.S	N.S.	8.2
17	Sulphate as SO4	Mg/l	200	400	2.0
18	Slica as SiO2	Mg/l	N.S.	N.S.	Nil
19	Phosphate as PO4	Mg/l	N.S.	N.S.	Nil
20	Residual chlorine	Mg/l	0.2	-	Nil
21	Total confirm bacteria	M.P.N./100ml	10	N.R.	Nil
22	Fecal coliform	M.P.N./100ml	absent	N.R.	Nil

N.R. = no relaction, N.S. = no specified

III RESULTS AND DISCUSSION

This paper deals with an enhanced Fenton process for oxidative degradation of pollutant in waste water, followed by biological treatment. The chemical process characterized in the oxidation is carried out in the presence of large amount of SiO_2 and Al_2O_3, i.e. higher than 0.09 mol per litre, which is far beyond the amount usually reported for conventional processes.

This chemical treatment, based on the described Fenton reaction, indicates the possibility of effectively abating the polluting load of OOMW up to 10–15% in terms of COD. Sub-stoichiometric amount of the oxidizing reagent leads to partial removal of COD and alters the chemical composition of the Soap stone affected water.

ACKNOWLEDGEMENT

The authors wish to express their deep gratitude to their employers, Amrapali Institute of Technology & Sciences, Haldwani, Uttarakhand, India providing a working atmosphere conducive to research activities. Among the people who have helped the authors in their academic endeavours, of note are Prof. Sanjay Dhingra, and Mr. N. R. Pande.

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