INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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SPECIAL ISSUE FOR
INTERNATIONAL CONFERENCE ON
"INNOVATIONS IN SCIENCE & TECHNOLOGY: OPPORTUNITIES & CHALLENGES"

EFFECT OF SONICATION ON COD OF INDUSTRIAL WASTE WATER

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Accepted Date: 07/09/2016; Published Date: 24/09/2016

Abstract: *In the recent few years ultrasound has resurfaced as a possible method for the treatment of industrial waste. The research in the area of ultrasound is increasing day by day. This can be seen easily from the number of papers published on ultrasound every year. Ultrasound is versatile and energetic method to treat industrial waste in a short duration of time with lesser costs. The method is still in its growing phase hence it's not a process you will see in every industry. The application of the method differs with differing wastes. Still it is a method worth giving a try with respect to the simplicity, cost reduction and time reduction of treatment and finally the efficiencies obtained after treatment. Ultrasound has been tried on many industrial wastes consisting different physical and chemical compositions. It's a most suitable method for the hazardous wastes where the volume is low and polluting power is more. The following work discusses a case study of pharmaceutical waste which has been treated by ultrasound.*

Keywords: *Chemical oxygen demand, oxidation, waste water, ultrasound.*

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Access Online On:

www.ijpret.com

How to Cite This Article:

S. V. Khedkar, IJPRET, 2016; Volume 5 (2): 133-140

PAPER-QR CODE

INTRODUCTION

Earthquakes produce low frequency infrasound before the main shock waves begin which possibly alerts the animals. Frequencies higher than 20 kHz are called ultrasonic sound or ultrasound (Uma Mukherjee 2003). Ultrasounds are high frequency waves. Ultrasounds are able to travel along well defined paths even in the presence of obstacles. Ultrasounds are used extensively in industries, medical purposes and many other applications.

Ultrasound is generally used to clean parts located in hard to reach places, for example, spiral tube, odd shaped parts, electronic components etc. Objects to be cleaned are placed in a cleaning solution and ultrasonic waves are sent through the solution. Due to high frequency, the particles of dust, grease and dirt get detached and drop out. The objects thus get thoroughly cleaned (Gandhi K. S. and Kumar R.1994).

Ultrasound can be used to detect cracks and flaws in the metal blocks. Metallic components are generally used in the construction of big structures like buildings, bridges, machines and also scientific equipment. The cracks and flaws which are invisible from the outside reduce the strength of the structure. Ultrasonic waves are allowed to pass through the metal block and detectors are used to detect transmitted waves. If there is even a small defect, the ultrasound gets reflected back indicating the presence of the flaw or defect (T. J. Mason & J.P. Lorimer 2002). In waste water treatment ultrasound is used as either a probe reactor or it is used as an ultrasonic bath (Parag R. Gogate 2002). The efficiency of the probe sonicator is better than the ultrasonic bath. The probe sonicator is used in places where process intensification is required. The ultrasonic bath maybe used in places where volume of waste is more and lesser efficiencies are required.

Ultrasound is an advance oxidation technology/process (A.S. Stasinakis, 2008) which can be used in a number of industries and processes like mixing, emulsification, crystallization, defoaming, degassing, debubbling, biological and chemical decontamination (Edaoin M. Joyce & T.J.Mason 2008). The use of this technology is in the area of nano material synthesis (Jin Ho Bang and Kenneth S. Suslick, 2010, Aharon Gedanken 2003). A number of types of industrial chemicals like phenols, chlorinated aromatics, chlorophenols, Carbofuran, aromatics, Pharmaceutical drugs etc have been successfully treated by this method. It's identified as a future method of disinfection (Aniruddha B. Pandit et al.2001, Inez Hua et al 2001, Khay Chuan Teo et. Al., 2001, Maria Papadaki et al.,2004, Gogate Parag R. 2007, José González - García et.al 2010, 2012, Ingole. N.W. and S.B. Somani 2011, Ingole. N.W. and Khedkar S.V.,)

MATERIALS AND METHODS

The materials used in this method are industrial waste samples having high chemical oxygen demand. The industrial waste samples were prepared (synthetic) was prepared in the laboratory for different concentrations. The concentrations of the synthetic waste sample are given in the table below. For preparing each sample 350 mg of aspirin was used in 500 ml of deionized water. Deionized water was taken for sample preparation to rule out any possible interference in the water.

Table 1 for presonication chemical oxygen demand for all concentrations of sample

S.No	Concentration of sample in mg/500 ml	COD in mg/lit
1.	350 mg/500 ml	950.4
2.	700 mg/500 ml	1900.8
3.	1050 mg/500 ml	2851.2
4.	1400 mg/500 ml	3801.6
5.	1750 mg/500 ml	4752.0

The method used for the treatment of the synthetic prepared sample was probe sonication method. This is a batch method and used to carry out study on small scale. The synthetic waste of different concentration was treated for different times at constant amplitude of 100. The amplitude of 100 was chosen because maximum energy dissipation in the synthetic waste takes place at this amplitude. The timings of sonication were 15, 30, 45, 60, and 75 for concentration of 350 mg/500 ml, 700 mg/500 ml, 1050 mg/500 ml, 1400 mg/500 ml and 1750 mg/500 ml respectively. The probe sonicator processor was operated in a continuous mode. The presonication COD was analyzed for each sample and is reported in table 1 above. The post sonication COD was analyzed for each sample after the sonication time as stated above was over. The % COD reduction was plotted against time.

RESULT AND DISCUSSION

The table 2 below shows the % COD reduction in each concentration of sample after the sonication period is over. The results are plotted in the Figs. 1,2,3,4 and 5 for concentrations 350 mg/500 ml, 700 mg/500 ml, 1050 mg/500 ml, 1400 mg/500 ml and 1750 mg/500 ml respectively.

Table 2 for post sonication chemical oxygen demand % reduction with sonication time for all concentrations of sample

S. No	Time in mints.	Amplitude	% COD reduction for 350 mg/500 ml	% COD reduction for 700 mg/500 ml	% COD reduction for 1050 mg/500 ml	% COD reduction for 1400 mg/500 ml	% COD reduction for 1750 mg/500 ml
1	05	100	99.71	93.73	88.59	73.39	54.85
2	10	100	99.81	94.29	90.30	80.99	61.98
3	15	100	99.81	94.86	91.16	84.79	63.88
4	20	100	--	96.2	92.87	88.59	80.51
5	25	100	--	98.83	93.44	89.35	82.41
6	30	100	--	99.23	94.29	90.49	84.31
7	35	100	--	--	94.58	91.63	85.74
8	40	100	--	--	95.72	92.39	86.69
9	45	100	--	--	97.71	93.15	89.54
10	50	100	--	--	--	94.29	90.49
11	55	100	--	--	--	95.81	91.44
12	60	100	--	--	--	96.95	92.39
13	65	100	--	--	--	--	93.34
14	70	100	--	--	--	--	94.29
15	75	100	--	--	--	--	95.24

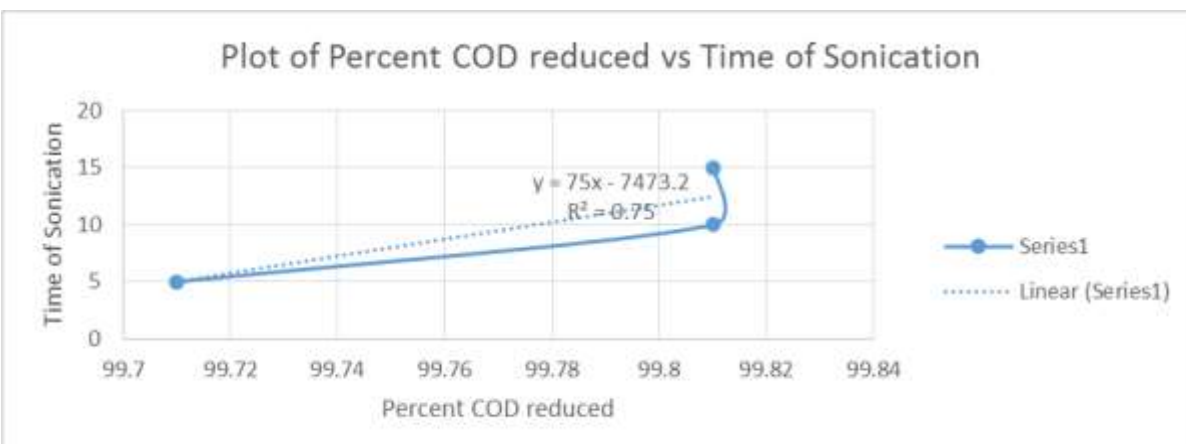

Fig. 1 time of sonication vs % COD reduced for conc. 350 mg/500 ml at amplitude 100.

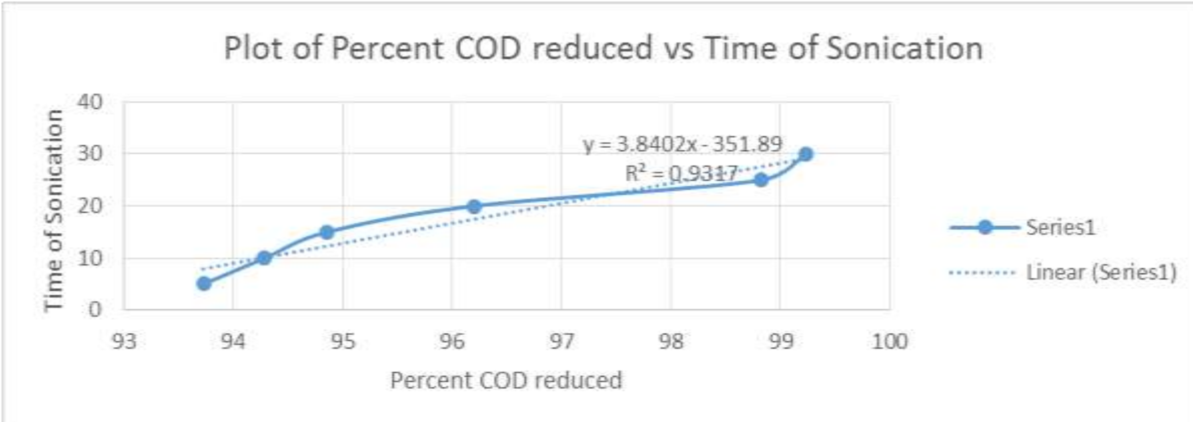

Fig. 2 time of sonication vs % COD reduced for conc. 700 mg/500 ml at amplitude 100.

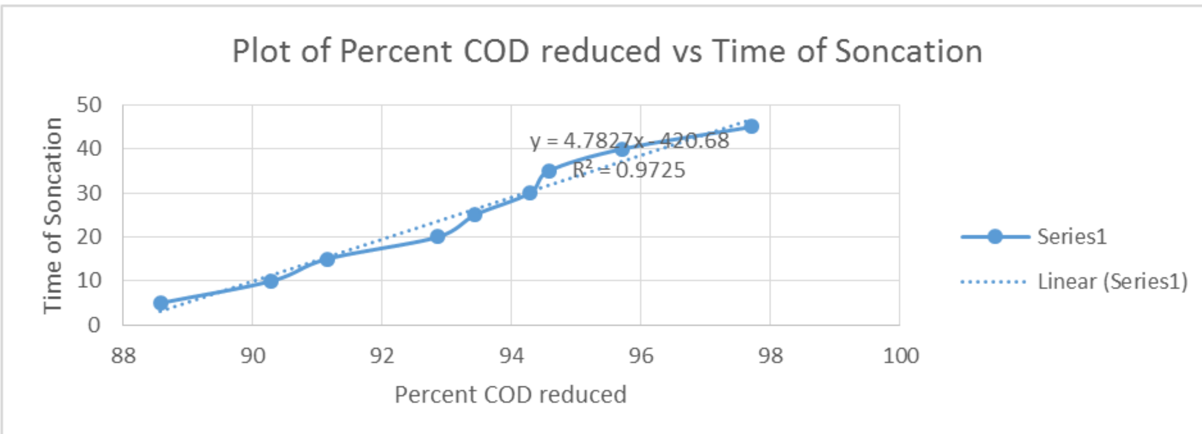

Fig. 3 time of sonication vs % COD reduced for conc. 1050 mg/500 ml at amplitude 100.

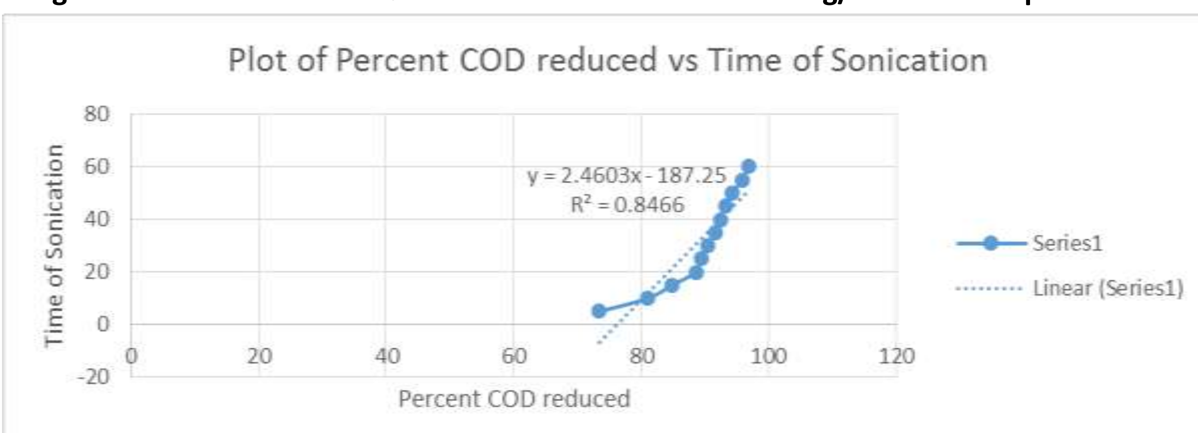

Fig. 4 time of sonication vs % COD reduced for conc. 1400 mg/500 ml at amplitude 100.

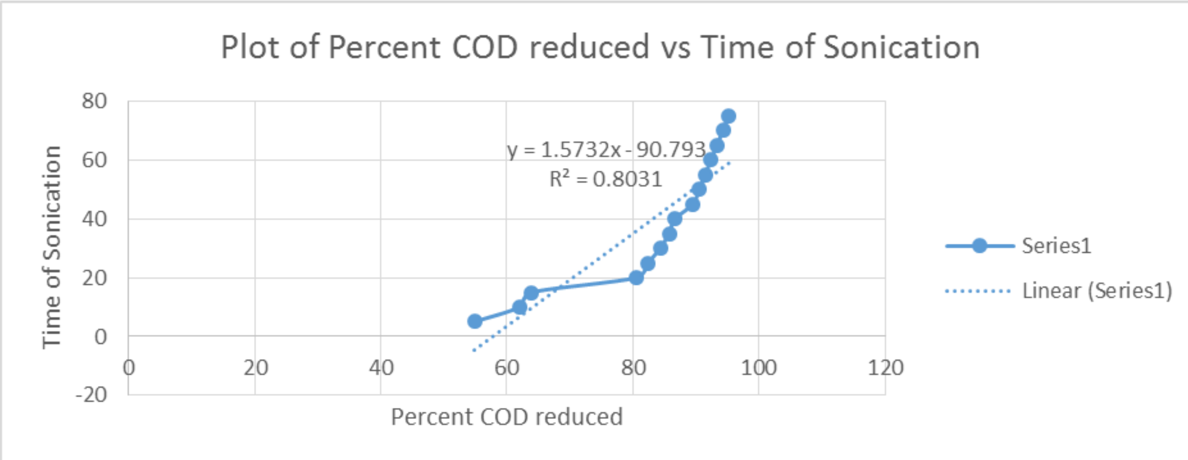

Fig. 5 time of sonication vs % COD reduced for conc. 1750 mg/500 ml at amplitude 100.

RESULT AND DISCUSSION

The table 2 above shows the % reduced COD for concentrations shown in the table. It is seen that the % of COD reduced is almost same irrespective of the concentration. The reduction of COD does not follow the same path but final reduced values are almost same. This may be possible because of experimental conditions. The experimentation shows there is huge reduction in COD within a short span of time hence sonication seems to be a good method for such types of wastes.

CONCLUSION

The industrial wastes especially hazardous industrial wastes which are smaller in volume and higher in strength can be successfully treated. The results may vary from case to case but most of wastes tried and tested have shown positive result for the ultrasonic waste. The method can be implemented for high strength wastes. The figures show there is good inter relationship between the factors studied. The R^2 value is above 0.74 for all figs.

ACKNOWLEDGEMENT

I sincerely thank principal College of Engineering and Technology Akola Dr. S.K. Deshmukh for providing us with a platform for presentation of our research papers & necessary facilities. My thanks are also due towards Dr. N. W. Ingole for continuously encouraging me during the period of my experimental study.

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