EFFECT OF SILVER NANOPARTICLES IN SEWAGE WATER TREATMENT

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***Abstract*:** The sewage water collected from different areas *viz.*, *Varaganeri* and *Thirupangeeli*, Tiruchirappalli District were taken for the synthesis of silver nanoparticles. The characterization of synthesized AgNPs is confirmed using UV-Vis Spectroscopy. The sewage water samples were analysed the Physico-chemical parameters such as Colour, Temperature, Turbidity, pH, EC, Total solids, Total Dissolved Solids, Total Suspended Solids, Total Hardness, Calcium Hardness, Magnesium Hardness, Phosphates, Sulphates, Chlorides, Dissolved Oxygen, Free CO_2, Ammonia, Nitrite, BOD and COD. The results were compared and presented. The effect of AgNPs in treating sewage water help us to apply in larger scale.

***IndexTerms* -** AgNPs, Physico- chemical parameter, Waste water, UV-Vis spectroscopy.

I. Introduction

Water is the essential substances for all survival on earth. Water resources become contaminated from various sources. A variety of physical, chemical and biological treatment processes are used for wastewater treatment. Nanotechnology has a great potential in enhancing water and wastewater treatment. Recently application of nanotechnology is increasing in water and wastewater treatment (Sushma and Sharma, 2015).

Water is a fundamental requirement for life. Most of the natural resources of drinking water are found to be contaminated with diverse toxic materials and pathogenic microorganisms (Baruah *et al.,* 2009).

The physico-chemical properties of water quality assessment give a proper indication of the status, productivity and sustainability of a water body. The changes in the physicochemical characteristics like temperature, transparency and chemical elements of water such as dissolved oxygen, nitrate and phosphate provide valuable information on the quality of the water, the source (s) of the variations and their impacts on the functions and biodiversity of the reservoir. (Djukie *et al*., 1994).

In recent days nanotechnology has induced great scientific advancement in the field of research and technology. The term 'NANO' is derived from Greek word "Dwarf" meaning extremely small and it refers to a length of a billionth of a meter (Begum *et al*., 2009).

Its size range usually from 1-100nm, due to small size it occupies a position in various fields of nano science and nanotechnology. Nanoparticle of gold, silver, copper, silicon, zinc, titanium, magnetite, palladium formation by plants has been reported (Kholoud *et al.,* 2010).

Biologically synthesized silver nanoparticles have a wide range of applications because of their remarkable physical and chemical properties (Jae *et al*., 2009).

Thus to purify the sewage water, the present study with the following objectives:

- Collection of the sewage water samples at their places.
- Conformation with the synthesis of silver nanoparticles *viz.,* U-V Spectrophotometer
- The sewage water samples are tested for physical and chemical parameters.
- Application of silver nanoparticles in the water samples were noted and tabulated.

II. MATERIAL AND METHODS

2.1. Collection of sewage water samples

Water sample were collected in plastic containers (2litres capacity) labelled and brought to the laboratory for analysis. The sewage water samples were analysed for the synthesis of silver nanoparticles under 3 different conditions *viz.*, room temperature, exposed to direct sunlight and boiled at 100^0 C.

2.2. Preparation of 1Mm $AgNO_3$ Solutions

The silver nanoparticles were synthesized following the procedure by treating one ml of sewage water sample and 9 ml of silver nitrate (1mM) solution for bio reduction process and left aside in the a) room temperature, b) exposed to direct sunlight and c) under boiling conditions. Controls were also maintained as 1) sample and 2) silver nitrate. Change in the colour of the sample indicates the production of silver nanoparticles. Therefore, the time taken to colour formation was observed and presented. The samples which had synthesized AgNPs at a faster rate were subjected to UV-Vis spectrum analysis for confirmation.

2.3 UV-Vis spectra analysis

The synthesized silver nanoparticles from the sewage water samples of *Varaganeri* and *Thirupangeeli* were confirmed by measuring the wave length of reaction mixture in the UV-Vis spectrum of the Perkin-Elmer spectrophotometer at a resolution of 1 nm (from 300 to 600 nm) in 2 ml quartz cuvette with 1 cm path length (Smith *et al.*, 2006) at Holy Cross College, Tiruchirappalli.

Physico-chemical parameter of treated and control samples were analysed using (APHA, 1992) standard method.

III. RESULTS

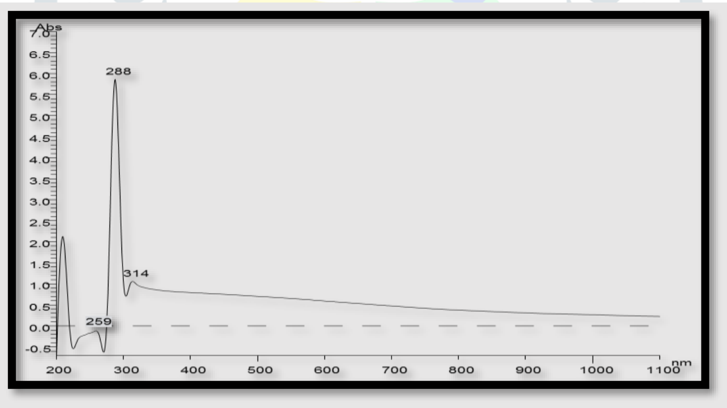
Table 1: Synthesis of AgNPs in Sewage Water Samples under different conditions

S.No.	Sample	Time taken in minutes		
		Boiling	Room Temperature	Sunlight
1	*Varaganeri*	3	3	1
2	*Thirupangeeli*	3	3	3

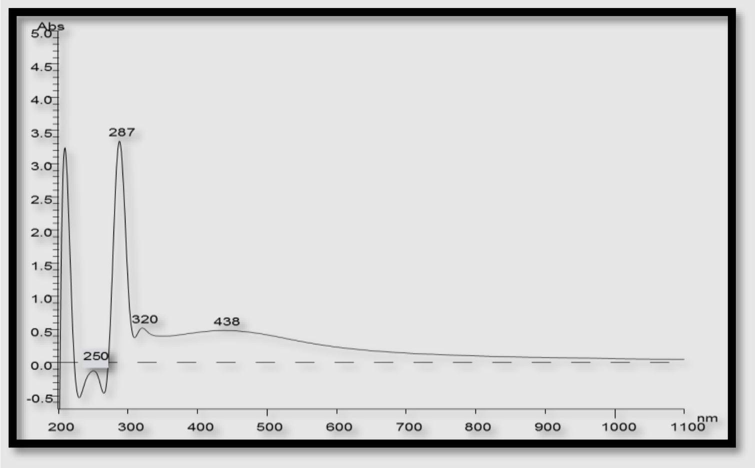
3.2: UV-Vis Spectroscopy

The reduced silver nano particles of *Varaganeri* and *Thirupangeeli* under direct sunlight were subjected to UV-Vis spectroscopy for the confirmation of nanoparticles and the spectrum are presented in Figs. 1 & 2.

Fig. 1. Synthesis of AgNPs in *Varaganeri* sample (UV-Vis Spectroscopy)



SFig. 2. Synthesis of AgNPs in *Thirupangeeli* sample (UV-Vis Spectroscopy)



The results clearly indicate that the UV absorption peak of silver nanoparticles range from 250- 438nm. The UV- Vis spectrum of sample *Varaganeri* showed three peaks at 259, 288 and 314nm (Fig. 1). And the sample of *Thirupangeeli* showed four peaks at 250, 287, 320, 438nm (Fig. 2).

3.3: PHYSICO-CHEMICAL PARAMETERS

Table 2: Physical Parameters of the sewage water samples with $AgNO_3$

Parameters	***Varaganeri***		***Thirupangeeli***	
	Control	Treated with $AgNO_3$	Control	Treated with $AgNO_3$
Colour	Blackish	Brownish	Greenish	Greyish
Temperature (°C)	31.1 ± 0.3	-	30.2 ± 0.4	-
Turbidity (NTU)	130.0	3400	103	420

Table 3: Chemical parameters of the sewage water samples with $AgNO_3$ (Mean ± SEM)

Parameters	***Varaganeri***		***Thirupangeeli***	
	Control	Treated with $AgNO_3$	Control	Treated with $AgNO_3$
pH	7.2 ± 0.02	7.0 ± 0.09	7.1 ± 0.03	7.0 ± 0.05
E.C (m S /cm)	2990	3020	462	1775
Total Solids (TS) mg/l	388.64 ± 1.6	418.06 ± 1.02	349.02 ± 2.72	350.64 ± 3.83
Total Dissolved Solids (TDS) mg/l	313.13 ± 0.84	342.33 ± 2.25	367.21 ±3.47	249.97 ± 1.63
Total Suspended Solids (TSS) mg/l	75.52 ± 0.76	75.73 ± 1.23	18.19 ± 1.2	100.67 ± 2.19
Total Hardness (TH) mg/l	140	220	100	308
Calcium Hardness (CH) mg/l	79.8	88.2	46.2	58.8
Magnesium Hardness (MH) mg/l	60.2	131.8	53.8	249.2
Chlorides (Cl)	0.085 ± 0.2	0.047 ± 1.2	0.056 ± 1.47	0.067 ± 2.69
Dissolved Oxygen (DO)	1.4 ± 0.57	2.25 ± 0.43	0.95 ± 0.4	1.3 ± 0.43
Free Carbon Dioxide (CO_2)	176 ± 0.12	252 ± .019	24 ± 0.20	384 ± 0.16
Biological Oxygen Demand (BOD)	985.11	972.51	457.7	553.56
Chemical Oxygen Demand (COD)	2265.75	2625.78	1098.48	1549.96

Table 4. Nutrients of the sewage water samples with $AgNO_3$

Parameters	*Varaganeri*		*Thirupangeeli*	
	Control	Treated with AgNO3	Control	Treated with AgNO3
Phosphates (PO_4^{-3}) mg/l	32.1	30.95	37.03	64.63
Sulphates mg/l	12.38	63.88	4.03	15.50
Ammonia mg/l	342.1	276.7	143.46	174.15
Nitrite mg/l	2.69	14.52	0.56	0.10

IV. DISCUSSION

Aquatic organisms depend on certain temperature range for their optimal growth (APHA, 1992). TS is a very useful parameter indicating the chemical constituents of the water and can be considered as a generator of edaphic relations that constitute to productivity within the water body (Goher, 2002). TDS, the sum of cations and anions concentration expressed in mg/l. elevates the density of water influencing osmoregulation in fresh water organisms. It reduces solubility of gases (like oxygen), utility of water for drinking purpose and also enhances eutrophication of the aquatic ecosystem (Mathur *et al*., 2008). As discussed for TS, maximum TDS recorded during hot period may be correlated to the elevated water temperatures which lead to the increase in rate of evaporation as well as increase in dissolved salts in water. Indeed, high concentration of TDS enriching the nutrient status of water body (Singh and Mathur, 2005) beyond limit may enhance eutrophication (Mathur *et al*., 2008).

pH regulates most of the biological processes and bio-chemical reactions. In a balanced ecosystem pH is maintained within the range of 5.5 to 8.5 (Chandrasekhar *et al*., 2003). Due to diurnal variations in the water temperature of a system, pH of a water body is a diurnally variable property (Ojha and Mandloi, 2004). Kaul and Handoo (1980) and Satpathy *et al*. (2007) have reported that increased surface pH in water bodies is due to increased metabolic activities of autotrophs, because in general they utilize the CO2 and liberate O2 thus reducing H+ ion concentration. However, pH, with free CO2 and ammonia are more critical factors in the survival of aquatic plants and fishes than the oxygen supply (Sculthorpe, 1967).

Oxygen content of a water body is important for direct need of many organisms. Majority of chemical and biological processes undergoing in the water body also depend on the presence of oxygen. It is also essential to maintain the higher forms of biological life and balance the populations of various organisms. Further, Oxygen is also known to affect the solubility and availability of many nutrients and hence, it is one of the most significant parameter affecting the productivity of aquatic systems (Wetzel, 1983).

Chloride is one of the most important parameter in assessing the water quality. Higher concentration of chlorides indicates higher degree of organic pollution (Munawar, 1974; Ramakrishna, 1990).

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