Study on Nano Material TiO_2/P25 Degussa for the Characteristics of Dairy Wastewater

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Abstract: *Nano Technology is one of the emerging technologies in today's world. The nanomaterial such as TiO_2 can be effectively used in the treatment of Dairy wastewater with good efficiency. In the present study, the nanomaterial TiO_2/P25 Degussa is used as a catalyst using UV treatment by the process of Photocatalysis. Nanotechnology can be an alternative for the treatment of Dairy wastewater rather than the conventional treatment process. The conventional treatment has more units required for the treatment of dairy wastewater. The initial cost, as well as the maintenance cost of the conventional treatment plant i.e Effluent Treatment Plant, is high. The treatment given by Nanomaterials is less costly and efficient one than the conventional treatment as it requires less number of treatment units. So in this paper, the study of TiO_2 is done on the different characteristics of the wastewater of the dairy industry such as the pH, Total Solids(TS), Total Dissolved Solids(TDS), BOD, COD which are the important parameters in the treatment of Dairy wastewater. The samples are collected from the dairy industry and the treatment is given using UV light using the batch process. The treatment was given was mainly for the duration of 12 hrs and 24 hrs under UV light using TiO_2. The samples are also given the treatment using sunlight as the source of UV light by using TiO_2 for the duration of 12 hrs and 24 hrs. Different dosages of TiO_2 are given as 500mg/l,1000mg/l & 1500mg/l for the above duration.*

Keywords: **Ultraviolet light(UV), TiO_2 (Titanium Dioxide), Nano Technology, Dairy Wastewater, P25 Degussa, Photocatalytic Adsorption**

1. INTRODUCTION :

The Dairy Industry is considered as the largest food processing industries in many countries. The water utility is higher in the dairy industry which results in higher wastewater generation. The population is increasing at a higher rate, so the wastewater from the dairy industry would also increase with increasing dairy production rate. With improving treatment standards the processes required should be considered stringently and thoroughly.

All steps in the dairy chain, including production, processing, packaging, transportation, storage, distribution, and marketing, impact the environment. Owing to the highly diversified nature of this industry, various product processing, handling, and packaging operations create wastes of different quality and quantity, which, if not treated, could lead to increased disposal and severe pollution problems. In general, wastes from the dairy processing industry contain high concentrations of organic material such as proteins, carbohydrates, and lipids, high concentrations of suspended solids, high biological oxygen demand (BOD) and chemical oxygen demand (COD), high nitrogen concentrations, high suspended oil and/or grease contents, and large variations in pH, which necessitates "specialty" treatment to prevent or minimize the environmental problem.

1.2 Introduction to Nano Technology :

Nanotechnology is the term which says 'nano' means something which is in the range of 10-9m i.e. very smaller in size, even smaller than micro-sized things and 'technology' means related to the technique of it, so nanotechnology means to be as the things which are in 10-9m range scale and by using them at very minute scale the different work of techniques and things are carried out. The ability to see nano-sized materials has opened up a world of possibilities in a variety of industries and scientific endeavors. Because nanotechnology is essentially a set of techniques that allow manipulation of properties on a very small scale, it can have many applications.

1.3 NanoScale :

Nanoscale materials (nanomaterials) have been described as having at least one dimension on the order of approximately 1 to 100 nanometers (nm). Such materials often have unique or novel properties that arise from their small size. This describes how to determine what is known and what needs to be known about selected nanomaterials as part of a process to identify and prioritize research to inform future assessments of the potential ecological and health implications of these materials.

1.4 Nanomaterial :

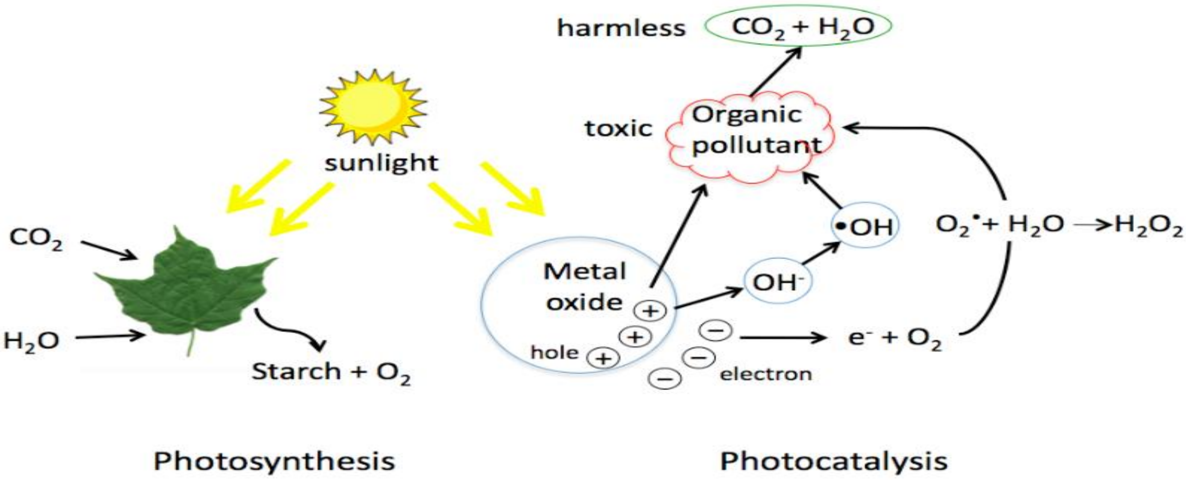
The nanomaterial used for our research work is Anatase (mineral of TiO2)

1.5 Nano Anatase :

Anatase is one the mineral of Titanium Dioxide out of three minerals: Anatase, Rutile, and Brookite. Anatase is in white powdered form in nanoscale. It is the rarely found mineral of TiO2 as compared with the Rutile mineral of it. Brookite is a highly unstable form of the mineral. All minerals of TiO2 are insoluble in water. Anatase in nanoscale is in the range of approx. 20nm-25nm. It is mainly used in paints, ceramics, tile polishing, varnishes, etc.

1.6 Photocatalysis :

Heterogeneous photo-catalysis is a rapidly expanding technology for water and air treatment. It can be defined as the acceleration of a photoreaction in the presence of a catalyst. The initial interest in the heterogeneous photo-catalysis was started when Fujishima and Honda discovered in 1972 the photochemical splitting of water into hydrogen and oxygen with nanomaterials. From this date, extensive work has been carried out to produce hydrogen from water by this novel oxidation-reduction reaction using a variety of semiconductors.



Dia:1 Fundamental Diagram

The fundamental process during photocatalysis is given as,

$MO + h\nu \rightarrow MO\ (e^- + h^+)$

Where, MO represents a metal oxide photocatalyst like TiO_2, ZnO, etc. Photo-generated electrons lead to the formation of superoxide anions ($\bullet O_2^-$), hydrogen peroxide molecules (H_2O_2), hydroxyl radicals ($\bullet OH$), hydrogen dioxide anion (HO_2^-) and the hydroperoxy radicals ($\bullet HO_2$)

$MO\ (e^-) + O_2 \rightarrow MO + \bullet O_2^-$,

$MO\ (e^-) + \bullet O_2^- + 2H^+ \rightarrow MO + H_2O_2$,

$MO\ (e^-) + H_2O_2 \rightarrow MO + \bullet OH + OH^-$,

$\bullet O_2^- + H_2O_2 \rightarrow \bullet OH + OH^- + O_2$,

$\bullet O_2^- + H^+ \rightarrow \bullet OH_2$,

$MO\ (e^-) + \bullet OH_2 \rightarrow MO + HO_2^-$,

$HO_2^- + H^+ \rightarrow H_2O_2$,

$2\bullet OH_2 \rightarrow O_2 + H_2O_2$

While the oxidation reactions initiated by the photogenerated holes are:

$MO\ (h^+) + H_2O \rightarrow MO + \bullet OH + H^+$,

$MO\ (h^+) + H_2O \rightarrow MO + \bullet OH + H^+$,

$MO\ (h^+) + OH^- \rightarrow MO + \bullet OH$

The reactions are terminated as:

$\bullet OH + H^+ + 2e^- \rightarrow H_2O$,

$1/2\ O_2 + 2H^+ + 2e^- \rightarrow H_2O$

2. LITERATURE REVIEW :

J.J.Murcia et al. (2018)"Study of effectiveness of the flocculation-photocatalysis in the treatment of wastewater coming from dairy industries Photochemistry & Photobiology A: Chemistry" In this paper, the study of the effectiveness of flocculation photocatalysis as combined processes in the treatment of dairy wastewater was evaluated which showed bactericidal activity for E. Coli, total coliforms, and other Enterobacteriaceae. It also showed that light intensity plays a very important role in the treatment of E.coli bacteria from the Dairy industries. The total elimination of E.coli bacteria was found by using a UV light intensity of 60 and $120W/m^2$.

Priscilla de Abreu et al. (2013) "Photocatalytic Oxidation Process ($UV/H_2O_2/ZnO$) in the treatment and sterilization of dairy wastewater" In this paper, the study of UV light treatment was done using ZnO (Zinc Oxide) & H_2O_2(Hydrogen Peroxide) as a catalyst. The Catalysts were studied under different values of pH with reaction rate values and process efficiencies. It was found that using photolysis UV, H_2O_2&ZnO was effective in removing the COD. It was also effective in removing the thermotolerant coliforms from the wastewater.

Mojtaba Afsharnia et al. (2018) "Disinfection of dairy wastewater effluent through solar photocatalysis processes" Water Science and Engineering. In this paper, the study of TiO_2 was done using the UV catalysis process. The microbial disinfection of the dairy wastewater was done in four processes: ph-C S, ph-C CS, ph-L S, and ph-L CS over the radiation time of 240 minutes. It showed that the TiO_2 concentration for 0.5mg/l has an efficiency of about 97%.In the pH-C CS process, almost 97% of the bacteria were killed in 30 minutes. The efficiencies obtained from ph-L S and ph-L CS after 30 minutes were about 10.5% and 68.9% respectively. Also, it was observed that after the photocatalysis process there was no reactivation or regrowth of the bacteria was found.

Rama Rao Karri et al. (2019) "Overview of Potential Applications of Nano-Biotechnology in Wastewater and Effluent Treatment" Nanotechnology in Water and Wastewater Treatment.This paper studies the treatment of different wastewater/contaminated water sources such as the olive mill, groundwater, Synthetic wastewater containing Zn^{2+} and Cd^{2+}, cooking wastewater. The treatment given for the different wastewater is the photocatalysis treatment using TiO_2. It showed that form the olive mill the removal efficiencies for color, COD, total phenols, and aromatic compounds were respectively 43%,38%.31%, and 41%.

Alok Tripathi et al. (2018)“TiO2 and TiO2/g-C3N4 Nanocomposite to Treat Industrial Wastewater” Environmental Nanotechnology, Monitoring, and amp; Management. In this paper, the application of Nanotechnology is done by using semiconductor-based photocatalysis for the treatment of tannery wastewater. In this study, the g-C3N4which was prepared by the process of pyrolysis was added with TiO2 to form TiO2/g-C3N4 nanocomposites. By using the catalysis process the performance of TiO2 and TiO2/g-C3N4 were compared with the terms of Phenol, Chemical Oxygen Demand(COD), and color reduction. It was observed that with a concentration of 0.8 g/L and a flow rate of 3 L/h (Litre per hour) the photocatalytic efficiency of TiO2/g-C3N4 composite was more than pure TiO2.

Yuqing Zhang et al. (2018) “TiO2/void/porous Al2O3 shell embedded in polyvinylidene fluoride film for cleaning wastewater” department of Chemical Engineering, Curtin University, Australia. In this research paper, the study of TiO2 Nanomaterials is done for removing the oil from the oily wastewater. The TVAP films were used to immobilize TiO2 powder. When TVAP films were used in the photocatalytic test to treat the COD, Oily wastewater. The efficiencies observed were 61.02% & 69.70% respectively.

E.T.Wahyuni et al. (2019) “Preparation of TiO2/AgNPs by photodeposition method using Ag(I) present in radiophotography wastewater and their antibacterial activity in visible light illumination” Chemo and Biosensors Group, Faculty of Pharmacy, University of Jember.In this research paper, the TiO2/AgNPs were prepared by using photoreduction activity. The visible light activity of TiO2/AgNPs was seen for bacterial disinfection from contaminated well water. It was seen that TiO2/AgNPs photocatalyst showed excellent antibacterial activity by using UV light but very week activity was shown by TiO2. The complete Ecolibacterias from the well water were destroyed by the dose of 0.25g/L in 60 minutes.

P. Fernández-Ibanez et al. (2014)“Solar Photocatalytic Disinfection of Water using Titanium Dioxide Graphene Composites” Chemical Engineering JournalIn this research study has been done using TiO2 and Graphene to improve the photocatalytic activity. The TiO2-RGO composites were used to compare with TiO2 in the suspension reactors for the disinfection of water which was contaminated with E-coli. In this study, it was found that there the inactivation of E-coli was done by TiO2 but there was no change observed with the inactivation rate of TiO2-RGO.

Irene García-Fernández et al. (2014) “Disinfection of urban effluents using solar TiO2photocatalysis: A study of the significance of dissolved oxygen, temperature, type of microorganism and water matrix” Plataforma Solar de Almería-CIEMATThis paper studies the parameters of wastewater like dissolved oxygen concentration, water temperature, water matrix. These parameters were studied on the disinfection efficiencies with a 60L-CPC reactor with a TiO2 dosage of 100mg/l. It showed that by increasing the temperature in the solar reactor the disinfection with TiO2 can be enhanced by the disinfection of E-coli and F.solani spores. The DO should also be considered as an important factor with the disinfection.

S.Murgolo et al. (2019)“Degradation of emerging organic pollutants in wastewater effluents by electrochemical photocatalysis on nanostructured TiO2 meshes” Water Research.This paper studies that the catalyst was prepared by plasma electrolytic oxidation and used for the treatment of wastewater. By using TiO2 and UV photocatalysis process it helped in minimizing the organics from the wastewater. The experiment was with bias (TiO2+UV). The results obtained were very efficient in the treatment of the micropollutants.

M.C.Bordes et al. (2015)“Application of plasma-sprayed TiO2 coatings for industrial (tannery) wastewater treatment” Ceramics Internation.This paper studies the submicrometric and nanometric TiO2 particles for the treatment of Tannery wastewater. In this process, the atmospheric plasma spraying was done on the tannery wastewater. The photocatalytic activity of the coatings was determined by measuring the degradation of the methylene blue dye in the aqueous media. It was found that the removal of color by photocatalysis is good under acidic pH. The developed coatings were efficient in color removal treatment of the tannery industry.

3. MATERIALS & METHODS:

3.1 Materials :

3.1.1 Sampling :

The wastewater is collected from the Dairy Industry. The Sample Collected is the Grab Sample. The Sample is collected from the collection tank of the Effluent Treatment Plant (ETP) of the Dairy Industry.

3.1.2 Ultraviolet Light Source :

The source for UV light for the process of Photocatalysis used is a wooden Box so that the UV rays do not permeate through and come in direct contact with wastewater as UV rays are carcinogenic after the extent of exposure.

Fig -1 UV Box

3.1.3 Titanium Dioxide :

It is Anatase in the nanoscale powdered form used as a Catalyst for the treatment of Dairy wastewater.

3.1.4 Jar Test Apparatus :

It is used to mix TiO2 powder which is insoluble with the wastewater so that it gets distributed throughout the solution.

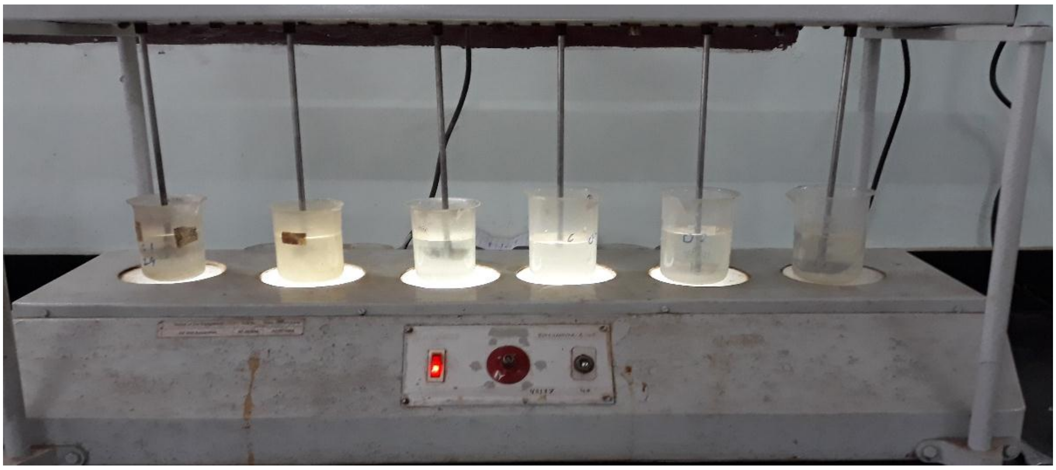


Fig - 2 Jar Test Apparatus

3.2 Methodology :

Taking the TiO2 (Titanium Dioxide) Powder and using it with different dosages of 500mg/l,1000mg/l & 1500mg/l with the wastewater the solutions are made. These solutions are mixed thoroughly by using different beakers by using the Jar test apparatus so that the powder gets uniformly distributed throughout the solution. After taking these solutions are kept in the UV box under a UV light source for a period of 12hrs and 24 hrs. The same samples are also kept in the sunlight so that they are also exposed to sunlight as the UV light source for the duration of 12hrs.

Fig-3 Samples kept under the box for UV Light exposure

3.3 Physico-Chemical Analysis :

The analysis was carried out with the untreated wastewater and the wastewater after treatment using UV light.The parameters analysed are pH,total solids(TS),TDS(Total Dissolved Solids),BOD5,COD.The results were found out and the efficiencies were calculated and used for the comparison between UV Treatment in Box for the duration of 12hrs & 24 hrs. The results before treatment and after treatment were obtained. The standard procedures were used for the analysis of the treated and untreated wastewater.

4. Results of Analysis:

4.1. Results obtained from conventional Treatment units :

Parameters (mg/l) Except pH	**Sample -1**		**Sample-2**		**Sample-3**		**Average Values**		**Average Efficiencies**
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Outlet
pH	8.2	7.6	8.9	8.4	8.5	8.1	7.85	7.44	--
Total Solids	1400	1050	1455	1080	1214	920	1356	1016	30%
Total Dissolved Solids	1130	800	1100	850	1052	730	1094	794	27.42%
BOD5	910	100	980	120	955	150	949	124	80.19%
COD	1200	218	1325	280	1275	255	1267	251	86.96%

Table-1 Treatment by Conventional method

4.2 Results of analysis using UV Light treatment in Box:

4.2.1 Treatment after 12 hrs duration and using Dosage-500mg/l of TiO2 :

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.8	8.48	--	8.75	--
Total Solids	1481	798	46.12%	1480	4.29%
Total Dissolved Solids	1095	514	53.06%	1050	5.11%
BOD5	950	97	89.79%	885	6.84%
COD	1200	155	87.08%	1192	6.7%

Table-2 Analysis of Sample -1

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.6	8.3	--	8.59	--
Total Solids	1546	815	47.28%	1480	4.27%
Total Dissolved Solids	1180	620	48.05%	1145	2.97%
BOD5	900	260	71%	869	3.44%
COD	1360	305	77.17%	1312	3.53%

Table-3 Analysis of Sample-2

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.1	7.81	--	7.99	--

Total Solids	1426	715	49.85%	1395	2.17%
Total Dissolved Solids	1070	642	40%	1010	5.61%
BOD5	980	270	72%	955	2.55%
COD	1415	321	77.31%	1376	2.75%

Table-4 Analysis of Sample-3

4.2.2 Treatment after 12 hrs duration and using Dosage-1000mg/l of TiO2 :

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.8	8.35	--	8.73	--
Total Solids	1481	692	53.27%	1397	5.67%
Total Dissolved Solids	1095	465	57.53%	1082	1.19%
BOD5	950	80	91.57%	923	2.84%
COD	1200	132	89%	1175	2.08%

Table-5 Analysis of Sample-4

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.6	8.21	--	8.57	--
Total Solids	1546	825	46.63%	1526	1.29%
Total Dissolved Solids	1180	550	53.39%	1167	1.10%

BOD5	900	76	91.55%	875	2.78%
COD	1300	230	82.30%	1282	1.38%

Table-6 Analysis of Sample-5

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.1	7.74	--	7.97	--
Total Solids	1426	801	43.82%	1350	5.33%
Total Dissolved Solids	1070	505	52.80%	992	7.29%
BOD5	980	82	91.63%	963	1.73%
COD	1415	210	85.15%	1385	2.12%

Table-7 Analysis of Sample-6

4.2.3 Treatment after 12 hrs duration and using Dosage-1500mg/l of TiO2 :

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.8	8.29	--	8.69	--
Total Solids	1481	654	55.84%	1391	6.08%
Total Dissolved Solids	1095	415	62.10%	1075	1.83%
BOD5	950	76	92.11%	823	13.36%
COD	1200	170	85.83%	1150	4.17%

Table-8 Analysis of Sample-7

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.6	8.18	--	8.56	--
Total Solids	1546	770	50.19%	1502	2.85%
Total Dissolved Solids	1180	460	61.11%	1145	2.97%
BOD5	900	68	92.44%	864	4.00%
COD	1300	150	88%	1270	2.31%

Table-9 Analysis of Sample-8

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.1	7.65	--	8.08	--
Total Solids	1426	723	49.29%	1411	1.05%
Total Dissolved Solids	7070	411	61.58%	1055	1.40%
BOD5	980	78	92.04%	945	3.57%
COD	1415	210	85%	1385	2.12%

Table-10 Analysis of Sample-9

4.2.4 Treatment after 24 hrs duration and using Dosage-500mg/l of TiO2 :

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.8	8.2	--	8.72	--
Total Solids	1481	685	53.75%	1367	7.7%

Total Dissolved Solids	1095	610	44.29%	1045	4.57%
BOD5	950	150	84.21%	870	8.42%
COD	1200	185	84.58%	1150	4.17%

Table-11 Analysis of Sample-10

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.6	8.1	--	8.57	--
Total Solids	1546	690	55%	1432	7.37%
Total Dissolved Solids	1180	575	51.27%	1130	4.24%
BOD5	900	210	76.71%	820	8.89%
COD	1360	256	81.17%	1280	5.88%

Table-12 Analysis of Sample-11

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.1	7.65	--	7.97	--
Total Solids	1426	672	52.85%	1360	4.63%
Total Dissolved Solids	1070	593	44.78%	980	8.41%
BOD5	980	140	85.71%	885	9.69%
COD	1415	287	79.71%	1325	6.36%

Table-13 Analysis of Sample-12

4.2.5 Treatment after 24 hrs duration and using Dosage-1000mg/l of TiO2 :

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.8	8.46	--	8.72	--
Total Solids	1481	632	57.33%	1385	6.48%
Total Dissolved Solids	1095	436	60.18%	1046	4.47%
BOD5	950	150	84.21%	870	8.42%
COD	1200	185	84.58%	1150	4.17%

Table-14 Analysis of Sample-13

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.6	8.25	--	8.57	--
Total Solids	1546	690	55%	1432	7.37%
Total Dissolved Solids	1180	575	51.27%	1130	4.24%
BOD5	900	85	90.56%	820	8.89%
COD	1360	236	82.65%	1280	5.88%

Table-15 Analysis of Sample-14

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.1	7.75	--	7.97	--
Total Solids	1426	672	52.85%	1360	4.63%

Total Dissolved Solids	1070	593	44.78%	980	5.29%
BOD5	980	83	91.53%	885	9.69%
COD	1415	235	83.39%	1325	6.36%

Table-16 Analysis of Sample-15

4.2.6 Treatment after 24 hrs duration and using Dosage-1500mg/l of TiO2 :

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.8	8.27	--	8.68	--
Total Solids	1481	623	57.93%	1303	1.20%
Total Dissolved Solids	1095	370	66.21%	995	9.13%
BOD5	950	75	92.10%	895	5.79%
COD	1200	154	87.17%	1150	4.17%

Table-17 Analysis of Sample-16

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.6	8.25	--	8.57	--
Total Solids	1546	610	55%	1405	9.12%
Total Dissolved Solids	1180	503	57.37%	1108	6.10%
BOD5	900	70	92.22%	820	8.89%
COD	1360	203	85.07%	1280	5.88%

Table-18 Analysis of Sample-17

Parameters (mg/l) Except pH	Untreated Sample	Treated Sample	%Reduction using dosage of TiO2	Blank Sample without dosage of TiO2	% Reduction of Blank Sample using TiO2
pH	8.1	7.75	--	7.97	--
Total Solids	1426	623	52.85%	1360	4.63%
Total Dissolved Solids	1070	518	44.78%	980	8.41%
BOD5	980	75	92.35%	885	9.69%
COD	1415	212	85.02%	1325	6.36%

Table-19 Analysis of Sample-18

4.3 Comparison between the Dosages :

Parameters (mg/l)	Dosage-500mg/l Average % reduction	Dosage-1000mg/l Average % reduction	Dosage-1500mg/l Average % reduction
Total Solids	47.39%	49.90%	51.77%
Total Dissolved Solids	45%	52.07%	61.59%
BOD5	72.45%	88.58%	91.19%
COD	79.68%	82.48%	85.75%

Table-20 Average % Reduction for 12 hrs Duration

Parameters (mg/l)	Dosage-500mg/l Average % reduction	Dosage-1000mg/l Average % reduction	Dosage-1500mg/l Average % reduction
Total Solids	53.86%	55.06%	55.26%
Total Dissolved Solids	46.78%	54.57%	56.12%
BOD5	78.64%	91.52%	92.22%
COD	81.79%	85.53%	88.77%

Table-21 Average % Reduction for 24 hrs Duration

5. Comparison between Dosages :

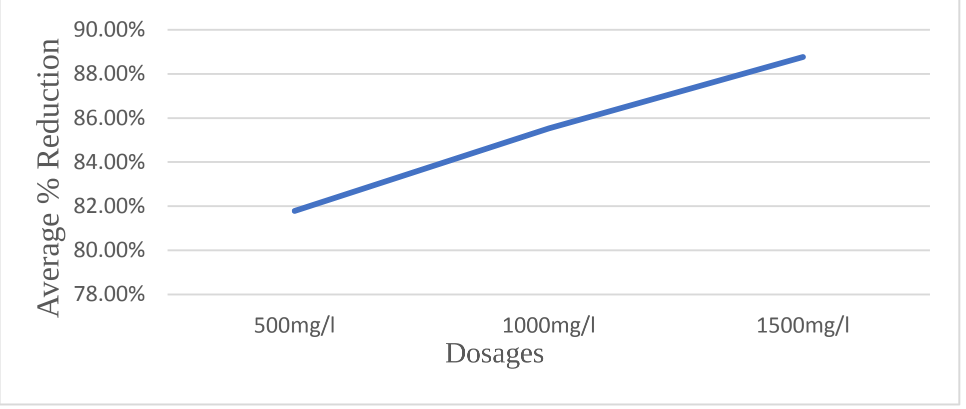


Fig-1 Total Solids Reduction after 12 hrs Duration

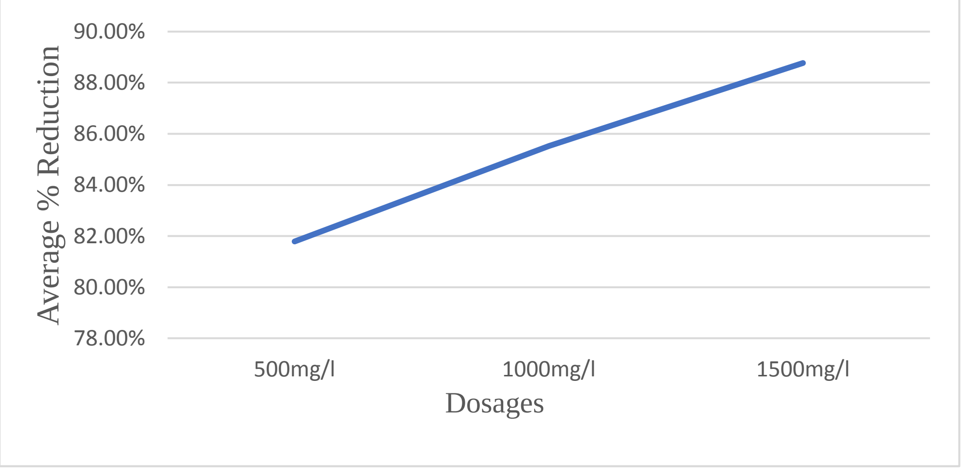


Fig-2 Total Dissolved Reduction after 12 hrs Duration

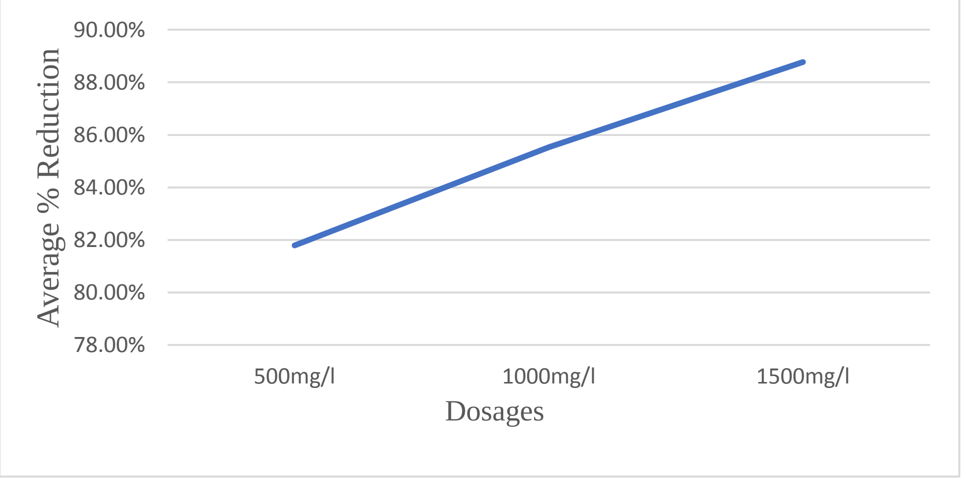


Fig-3 BOD5 Reduction after 12hrs Duration

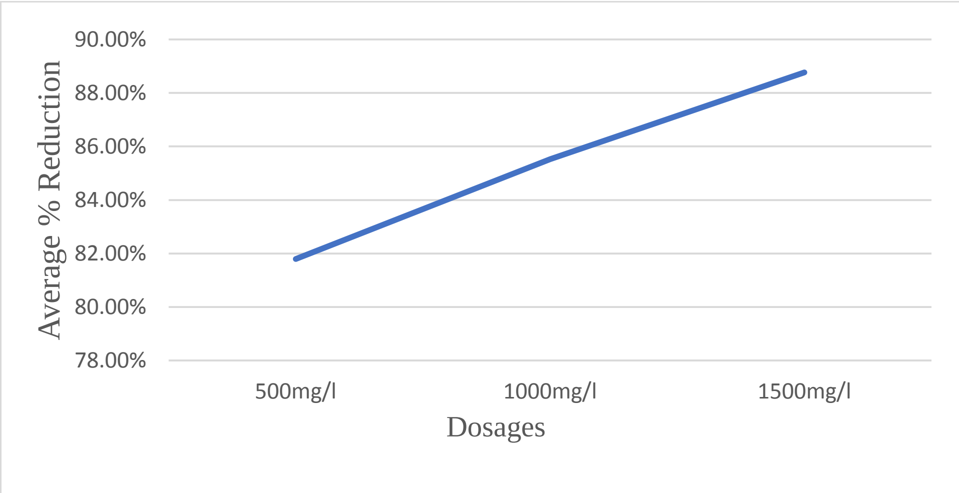


Fig-4 COD Reduction after 12hrs Duration

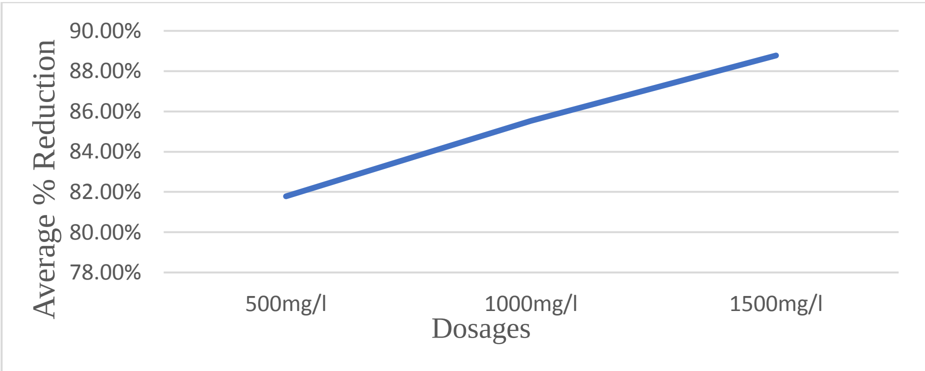


Fig-5 Total Solids Reduction after 24hrs Duration

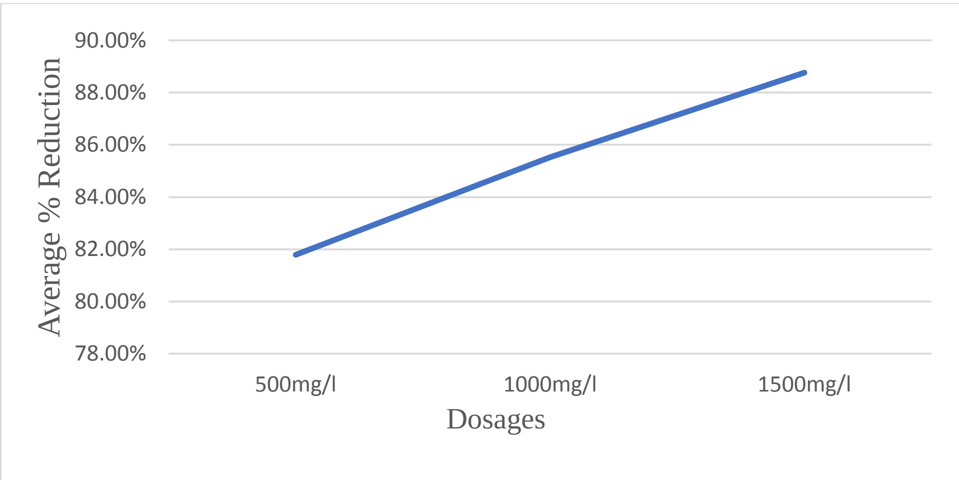


Fig-6 Total Dissolved Solids Reduction after 24hrs Duration

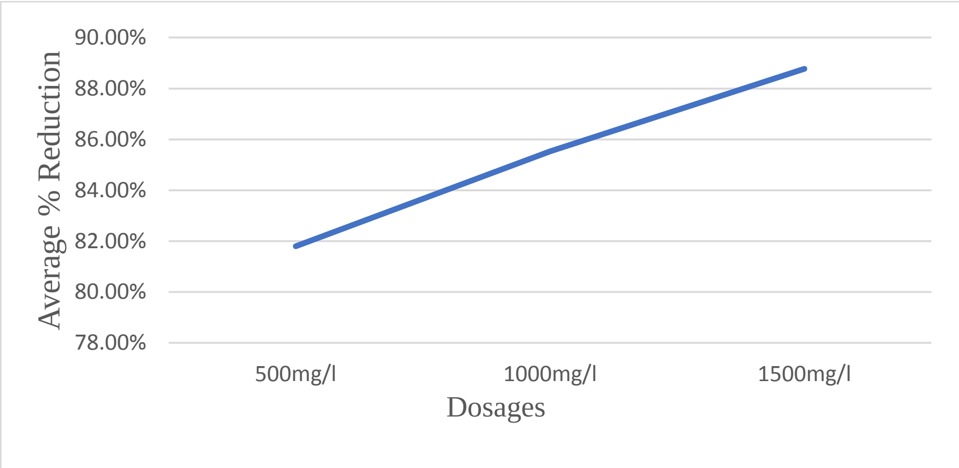


Fig-7 BOD5 Reduction after 24 hrs Duration

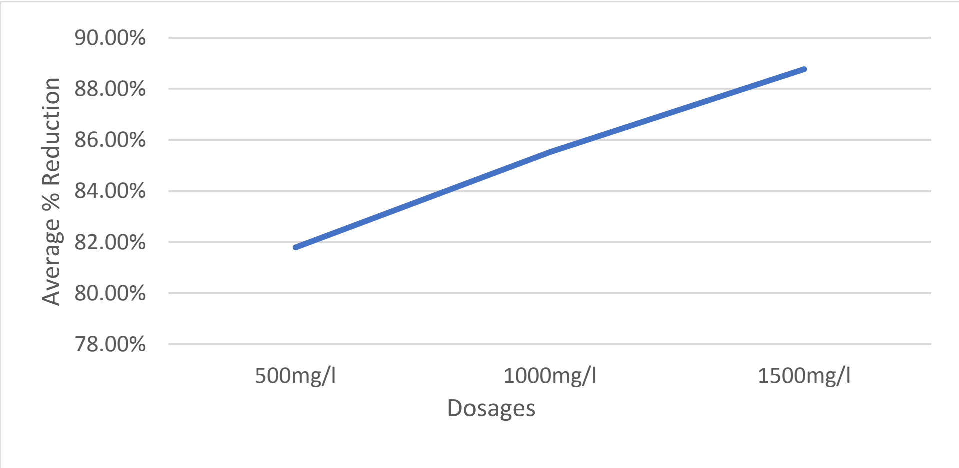


Fig-8 COD Reduction after 24 hrs Duration

6. CONCLUSIONS:

From the comparison done using a model, it has been having concluded that the efficiency of dosage of 1000mg/l & 1500mg/l is nearly the same for 12 hrs. So we can use 1000mg/l as the dosage for the treatment of dairy wastewater.The treatment by Nano-materials is more efficient than the present conventional treatment of the dairy industry.The treatment by using Nanomaterial TiO2 can be effectively used for the treatment of Dairy wastewater.The treatment units used for Nanotechnology are less as compared to the conventional treatment units of the Dairy Industry hence it is cost-efficient.

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