

PHYSICOCHEMICAL CHARACTERIZATION OF TEXTILE WASTE WATER

JANANIE GAAVIYA.S

(REG.NO. 15PZO006)

A THESIS SUBMITTED TO AVINASHILINGAM INSTITUTE FOR HOME
SCIENCE AND HIGHER EDUCATION FOR WOMEN, COIMBATORE
IN THE PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE
DEGREE OF MASTER'S IN ZOOLOGY

APRIL 2017



SIGNATURE OF THE
HEAD OF THE DEPARTMENT



SIGNATURE OF THE
SUPERVISOR

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

First and foremost the investigator wishes to thank **God Almighty** for endowing the investigator with immense blessings which helped to overcome the hurdle, paving way for the successful completion of the study.

The investigator also records her profound thanks to **Padma shri. Dr.P.R.Krishnakumar, Chancellor**,Avinashilingam Institute for home science and higher education for women, Coimbatore, for providing opportunity to undertake this research investigation.

The investigator would like to express her sincere gratitude to **Dr.PremavathyVijayan,M.Sc.,M.Ed.,Dip.Spl.Edn.,M.Phil.,Ph.D.(Avinashilingam)**, **Vice chancellor**,Avinashilingam Institute for home science and higher education for women, Coimbatore, for providing facilities to carry out the study.

The investigator would like to express her sincere gratitude to **Dr.Mrs.Kowsalya,M.Sc.,M.Phil.,Ph.D.(Avinashilingam),Registrar**,Avinashilingam Institute for home science and higher education for women, Coimbatore,for providing all administrative support and help required to carry out the project.

The investigator extends her indebtedness to **Dr.Parvathi, M.Sc., Dip.Ed., M.Phil., (Madras),Ph.D.(Bharathiar),Dean, Faculty of Science**,Avinashilingam Institute for home science and higher education for women, Coimbatore, for constant support provided towards the completion of the study.

The investigator expresses her sincere thanks to her guide **Mrs.E.Shanthi, M.Sc.,Dip.Ed.,M.Phil., Associate professor and head of the Department Zoology**,Avinashilingam Institute for home science and

higher education for women, Coimbatore, for her encouragement, constant support and guidance towards the successful completion of the study.

The investigator would like to express her sincere thanks to staff members and non teaching staff in the Department of Zoology for their constant support.

The investigator wishes to thank her parents K.Subramanian and S.Shanthi, and her sibling for their constant prayers, moral support and motivation throughout the study.

CONTENTS

CHAPTER. NO.	TITLE	PAGE.NO.
	LIST OF TABLES LIST OF FIGURES	
1	INTRODUCTION	1
2	REVIEW OF LITERATURE 2.1 CHARACTERISTICS OF THE EFFLUENT	8
	2.2 IMPACT OF THE EFFLUENT ON ENVIRONMENT	33
3	MATERIALS AND METHODS	
	3.1 STUDY AREA	39
	3.2 COLLECTION OF SAMPLE	39
	3.3 ANALYSIS OF THE EFFLUENT	39
4	RESULTS AND DISCUSSION	68
	4.1 TEXTILE EFFLUENT CHARACTERIZATION 4.2 PHYSICAL PARAMETERS 4.3 CHEMICAL PARAMETERS	68
5	SUMMARY AND CONCLUSION	81
6	REFERENCE	84

LIST OF TABLES

S.NO	TITLE	PAGE.NO
1.	PHYSICAL PARAMETER OF THE TEXTILE EFFLUENT	77
2.	CHEMICAL PARAMETER OF THE TEXTILE EFFLUENT	78

LIST OF FIGURES

S.NO	TITLE	PAGE.NO
1.	MAP SHOWING LOCATION OF TIRUPPUR DISTRICT	66
2.	DISCHARGE OF EFFLUENT FROM INDUSTRY	67
3.	PHYSICAL PARAMETERS OF THE TEXTILE EFFLUENT	79
4	CHEMICAL PARAMETERS OF THE TEXTILE EFFLUENT	80

INTRODUCTION

1.INTRODUCTION

Industrialization is an important tool for the development of any nation. Consequently, the industrial activity has expanded so much all over the world. Today, it has become a matter of major concern to the environment causing deterioration. [Kisuet *et al.*, 2000]

During the past few decades Indian industries have significantly grow, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. Consequently, the water quality is seriously affected which is far lower in comparison to the international standards. The surface water is the main source of Industries for waste disposal. Untreated and treated effluents have increase the level of surface water pollution Most major industries have treatment facilities for industrial effluents. But this is not the case with small scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender. As a result in India there are sufficient evidences are available relating to mismanagement of industrial wastes[Jaeel *et al.*,2012,Lokhande*et al.*, 1999, Tariq *et al.*, 2006].

Textile industries are one of the most polluting industries in India due to large consumption of water. With the increased demand for textile products, the textile industry and its wastewaters have been increasing proportionally, making it one of the main sources of severe pollution problems worldwide [Asia *et al.*, 2006, Dos *et al.*, 2007].

Major operations performed in a typical textile processing industry are desizing, scouring, mercerizing, bleaching, neutralizing, dyeing, printing and finishing. The discharge of polluted effluents and use of various raw materials may cause contamination of soil, surface water and ground water which may have adverse consequences on environment in general and local population in particular. Major problem in textile industry is the presence of color due to extensive use of dyes. The wastewater containing dyed effluents has been

found to be hazardous to aquatic ecosystem because it reduces the rate of photosynthesis due to the reduced penetration of sunlight in colored waters. It not only leads to toxicity of fishes and mammals but also inhibits the activity and growth of microorganisms [Qadiret *et al.*, 2015].

Due to rapid industrialization and urbanization, a lot of chemicals including dyes are manufactured and are being used in day-to-day life. About 100,000 commercial dyes are manufactured including several varieties of dyes such as acidic, basic, reactive, azo, diazo, anthraquinone based metal complex dyes with an annual production of over 7×10^5 metric tons are commercially available (Campos *et al.*, 2001).

Textile fabric manufacturing uses mixtures of dyes with various additives including solvents, antifoaming, whitening agents and pH conditioners. The waste water thrown out from industries is either used for irrigation purposes or it runs off into natural sources of water (Ahlawat and kumar, 2009). Waste water from textile industries creates a great pollution problem due to the dye content. The inefficiency in dyeing processes has resulted in 10-15% of unused dyestuff entering the waste water directly (Spadarry *et al.*, 1994). Natural pigments used for coloring textiles have been replaced by “fast colours” which do not fade on exposure to light, heat and water. These features unfortunately go with the perils of harmful effluent quality. About 15% of the dyes used for textile dyeing are released into processing waters (Mishra and Tripathy, 1993).

Dyes used in the textile industries are classified into three classes, (a) anionic (direct, acid, and reactive dyes), (b) cationic (all basic dyes), and (c) non-ionic (dispersed dyes). Basic and reactive dyes are extensively used in the textile industry because of their favorable characteristics of bright color, being easily water soluble, cheaper to produce, and easier to apply to fabric (Karadag *et al.* 2007). Dye production in India is estimated to be around 60,000 tonnes/year, or about 6.6 % of the world production (Central Pollution

Control Board, India). It is estimated that about 40–65 L of textile effluent is generated per kilogram of cloth produced (Manu and Chaudhari 2002). About 15 – 30% of these dyes remain in the effluents for colouring of final products in textile industry. Presence of color or color-causing compounds has always been undesirable in water for any use.

Discharging the contaminated water without pretreatment may directly cause environmental degradation. Direct discharge of contaminated water indisputably declines the soil productivity and negatively affects the level of crop production in the surrounding agricultural lands (Islam et al., 2006). The risky factors are mainly related with the wet processes scouring, mercerizing, bleaching, dyeing and finishing. The dye baths take account of high level of BOD, COD, colour, toxicity, surfactants, turbidity, and at the same time may enclose heavy metals (Wynne et al., 2001). Microbial activity slows down and biological treatment system also fails due to the existence of heavy metals and other dye compounds (Wynne et al., 2001).

Textile effluents contain high BOD due to fiber residues and suspended solids (Yusuf et al., 2004; AEPA, 1998). These can contaminate water with oils, grease, and waxes while some may contain heavy metals such as chromium, copper, zinc and mercury (EPA, 1974). Copper is toxic to aquatic plants at concentrations below 1.0 mg/l where concentrations near this level can be toxic to some fish (Sawyer et al., 1978). In modern economies, various types of activities including agriculture, industry and transportation, produce a large amount of wastes and new types of pollutants. Soil, air and water have traditionally been used as sites for the disposal of all these wastes.

Several structural varieties of dyes including acidic dyes, basic dyes, disperse dyes, azo dyes, diazo dyes, anthraquinone-based dyes and metal-complex dyes are being used by textile industries. Interest in the pollution potential of textile dyes has been prompted primarily due to concern over their possible toxicity and carcinogenicity . Wastewater generated by different

production steps of a textile mill have high pH, color, temperature, detergents, oils, suspended solids, dissolved solids, dispersants, leveling agents, alkalinity, toxic metals and non- biodegradable matter. (Akan *et al.*, 2008)

Due to increased awareness of worldwide environmental issues, there has been a great interest in the development of eco-friendly wet processing textile techniques in recent years. Although the disposal of wastewater has become a significant cost factor, it must be considered in running textile industries (Das *et al.*, 2003)

The dyeing operations release considerable amount of toxic effluents. The complex aromatic frame work of dyes and presence of heavy metals induce toxicity in particular and they may be mutagenic, teratogenic or carcinogenic (Karthikayan, 1990). Dyes are reported to cause considerable variation in the water characteristics like pH, colour, BOD, and COD (Karthikayan, 1990).

Although natural dyes are available, most of the dyes used in various industries are synthetic organic dyes. Synthetic dyes are more difficult to be removed because of their origin and mainly of their complex aromatic molecular structures, resist fading on exposure to sweat, soap, water, light or oxidizing agents (Meenambal, et al. 2006) Colour in wastewater is an obvious indicator of water pollution.

Environmental pollution caused by such industrial effluents results in adverse effects on the general health of the workers, as well as the residents who live near the chemical synthesis industries [Asamudo (2005)] and farmers/field workers[Cappuccino (1992)].

Textile is one of the largest and vital industrial sector of Bangladesh with regard to earn foreign exchange and labour employment. This sector provides 4.5 million jobs of which 80% are women and contributes 13% to GDP (BTMA annual report, 2007). Textile processing employs a variety of

chemicals, depending on the nature of the raw material and product. These chemicals are mostly enzymes, detergents, dyes, acids, alkalies and salts. The quantities and characteristics of discharged effluent vary from mill to mill depending on the water consumption and the average daily product (Saha, 2007). Environmental problems of the textile industries are mainly caused by discharges of wastewater/ effluents. Wastewater could pose threats to public health and/or affect the aesthetic quality of potable water (Aslam et al., 2001).

Textile industries are large industrial consumers of water as well as producers of wastewater. Increased demand for textile products, leads to increase in the generation of textile wastewater, which makes the textile industry as a main sources of severe pollution problems worldwide [Garg et al., 2008]. The process of adding colour to the fibres is known as dyeing which normally requires large volumes of water not only in the dye bath, but also during the rinsing step. The process of dyeing involves the use of different chemicals like salts, metals, surfactants, sulphide and formaldehyde. There are more than 8,000 chemical products associated with the dyeing process and over 100,000 commercially available dyes exist with over 7×10^5 metric tons of dyestuff produced annually [Deepali 2010], . Nearly, 1,000-3,000 m³ of water is let out after processing about 12-20 tonnes of textiles per day. These effluents are rich in dyes and chemicals, some of which are non-biodegradable and carcinogenic and pose a major threat to health and the environment if not properly treated [World Health Organization , 2000].

Wastewater generated in different production steps of a textile mill have high pH, temperature, detergents, oil, suspended and dissolved solids, dispersants, leveling agents, toxic and non-biodegradable matter, color and alkalinity [WHO, (1993)]. Important pollutants in textile effluent are mainly recalcitrant organics, color, toxicants and surfactants, chlorinated compounds (AOX). The textile wastewaters are characterized by extreme fluctuations in many parameters such as chemical oxygen demand (COD), biochemical oxygen demand (BOD), pH and colour.

Colour in the effluent is one of the most obvious indicators of water pollution and the discharge of highly coloured synthetic dye effluents is aesthetically displeasing and can damage the receiving water body by impeding penetration of light[Tüfekciaet *al.*,2007]. Dyes are recalcitrant molecules which are difficult to degrade biologically. Some of azo dyes are either toxic or mutagenic and carcinogenic. Azo dyes are designed to resist chemical and microbial attacks and to be stable in light and during washing.

Textile industry is one of the most important industries and generates enormous volumes of wastewater by virtue of its different operations like sizing, desizing, bleaching, mercerizing, dyeing and printing. (Yusuff and Sonebare,2004). The effluent from textile industry is strongly coloured and characterized by high pH, BOD, COD, chloride and suspended solids. Colour of effluent is attributed to extensive use of dyes which forms the major pollutant. Assessment of textile effluents in terms of physicochemical parameters has been both a subject of national and international repute. Nationally, it was reported that untreated or incompletely treated textile effluent from CETP, when discharged into surface water body rapidly depletes dissolved oxygen which increases BOD manifolds (Desai and Kore, 2011).

Major pollutants in textile wastewaters are high suspended solids, chemical oxygen demand, heat, colour, acidity, and other soluble substance. These effluents released on the land as well as dumped in to the surface water which ultimately leaches to ground water and lead to the accumulation of toxic metallic components and resulted in a series of well documented problems in living beings because they cannot be completely degraded. Untreated effluent are highly toxic to the plant, fish or other aquatic organisms at higher pH and the sulphide in the effluent are of environmental concern⁴ because they can lead to poor air quality of an area if not properly taken care of thus becoming threat to vegetation, human, and materials. The same is applicable to other parameters such as BOD, COD that has been identified to raise health issue if water available for human use is not of the required level.

A huge amount of effluent from textile mills is being discharged on land or into water courses. This effluent is characterized by high biological oxygen demand (BOD), chemical oxygen demand (COD), sodium and other dissolved solids as well as micronutrients and heavy metals. Pollutants of textile effluent (untreated) are likely to be present include suspended solids, biodegradable organic matter, toxic organic compounds and heavy metals. Suspended solids can clog fish gills, either killing them or reducing their growth rate; they also reduce light penetration which reduces the ability of algae to produce food and oxygen. Sulphates are not considered toxic to plants or animals at normal concentrations. In humans, small concentrations cause a temporary laxative effect.

An attempt has been made to analyse the physicochemical parameters of the textile effluent.

The study was carried with the objective-pollution potential of the effluent in polluting the environment.

REVIEW OF LITERATURE

2.REVIEW OF LITERATURE

2.1CHARACTERSTICTS OF EFFLUENT

Sharma *et al.*,2013assessed the physicochemical properties of textile wastewaters and Screened of the Bacterial Strains for Dye Decolourisation .The objectives of present study were to assess the major physicochemical parameters like temperature, pH, colour, DO, BOD, COD, alkalinity, chloride, hardness, nitrate, phosphate, TS, TDS of inlet, primary clariflocculator, aeration tank and outlet .

Mathur and Kumar (2013) carried a study on physico-chemical characterization of Industrial effluent contaminated Soil. The physico-chemical characteristics of the textile effluent contaminated soil samples of Sanganer region were analysed by standard methods and found to have great variation. Soil samples were highly coloured, foul smelling and alkaline and contained trace metal ions with concentration values which were not in compliance with standards. The pH of the samples were (8.0-8.8). The values of electrical conductivity ranged from 0.19- 0.81 mmhos/cm. The amount of organic matter and organic carbon ranged from 0.31 – 0.41% and 0.18 – 0.24% respectively.

The physico-chemical studies of wastewater in Hawassa Textile Industry showed temperature range from 17.80-25.75°C and pH from 8.080-11.21. The experimental analytical values of EC, TDS, TSS, BOD, and COD, of textile effluent were found to be 31.01-46.30, 277.0-900.4, 90.50-147.0, 93.00-188.0, and 189.6-264.0mg/L respectively. Except for temperature the analyzed values of all samples exceeded the prescribed guideline limit. The COD values of all the samples were very high indicating high degree of pollution (Tafesseet *al.*, 2015).

Vyas (2013) studied the physico - chemical parameters of waste water from dyeing units in Ahmedabad city. Wastewater was analyzed for various water qualities like pH, TDS, Alkalinity, Hardness, COD, Sulphate, Na⁺, K⁺ etc. The results arrived were compared with Indian Standards for drinking water to check out their pollution level. Elements and their impact to health of humans were discussed. The results from the analysis of dyeing wastewater showed that most of the parameters were much higher than the MPL and the presence of toxic heavy metals like Pb, Cr, Cd, and Zn in the water samples.

Manikandanet *al.*, (2015) carried out the study on physico chemical analysis of textile industrial effluents from tirupur city, Tamil Nadu, India. The major pollution indicating parameters like COD, BOD, TDS, SS, alkalinity, pH, total hardness, sulfate and chloride levels were analyzed. The effluent was highly turbid and coloured with average organic and inorganic loading. BOD5/COD ratios ranged from 0.2-0.5 which indicates that the effluent contained a large proportion of non-biodegradable organic matter. The effluent also contained high concentration of sulfate, chloride, calcium and magnesium, which are responsible for higher total hardness of effluent.

Vigneshpriya and Shanthi (2015), carried out a study on physicochemical characterization of textile waste water. The results of the physicochemical analysis showed that the textile effluent is characterized by the presence of colour with objectionable odour, high electrical conductivity, high TSS, TDS values, alkaline pH, high BOD and COD, low DO, high amounts of chlorides and sulphates, nitrates and also showed the presence of heavy metals, oil and grease.

Jolly *et al.*, (2009) characterized dye industry effluent and assessed its suitability for irrigation purpose. The average pH values of the untreated and treated effluents were found to be 7.83 and 5.13, respectively. The EC values of the untreated effluent (1.81 mS cm⁻¹) and treated effluent (2.01 mS cm⁻¹) were found to be higher than that of groundwater (0.93 mS cm⁻¹). No significant variation in pH and EC values of monthly collected effluent samples was observed. The average concentrations of trace elements except Fe were found to be lower than their DoE recommended values for irrigation land. The concentrations of Na and K in the untreated effluent were found to be higher and the Ca and Mg concentrations were lower than those of the treated effluents. Assessment of the untreated and treated effluent was made based on their EC, the sodium adsorption ratio (SAR) and soluble sodium percent (SSP), COD and heavy trace metal contents.

Kauret *et al.*, (2010) analysed the physico-chemical characteristics of industrial effluents and their impact on the soil microflora. The textile effluents showed the pH of (8.1 – 9.1); TSS of (190 – 163); TDS of (4354 – 5768), BOD of (181 - 306) and COD is (3853 – 4691). The sugar effluents were pH of (7.1 – 9.1); TSS of (301 - 494); TDS of (2560 - 3978), BOD of (2225 - 4526) and COD is (10896 - 16843). The values exceed the NEQS and FMENV values. The microbial flora too is affected by it as compared to the control water sample due to the high BOD and COD values.

A study was carried out on physico-chemical analysis of ground water contamination caused by industrial waste water in Faisalabad, Pakistan. The pH and EC was measured by using portable, direct reading instruments. The value of nitrate of ground water samples were estimated directly by ion meter. The silver nitrate method was used for chloride determination. Alkalinity of water (carbonates and bicarbonates) was determined by titration method. The heavy metals content was estimated by atomic absorption spectroscopy.

pH values of water samples ranged from 7.32-7.57 while the standard value set by WHO is 6-8.5. Electrical conductivity of ground water samples ranged from 3.32-3.98 dS m⁻¹, which is higher than the permissible limit set by WHO 3 dS m⁻¹. The carbonate and bicarbonates values of ground water samples were also within WHO standards. All drinking water samples have chloride concentration higher 17-25 meq L⁻¹ than the permissible limit set by WHO 7.04 meq L⁻¹. The Total suspended solids for drinking water samples were 2124-2515 mg L⁻¹ which were higher than standard values. The Nitrates present in drinking water samples ranged from 22.91- 44 mg L⁻¹ found within permissible limit 50 mg L⁻¹ (LubnaTajet *al.*,2013).

Dubey and Dixit (2012) analysed the pharmaceutical industries. The physical and chemical parameters such as water temperature, turbidity, total dissolved solid, pH, dissolved oxygen, total hardness, chlorides, alkalinity and sulphates. The work was carried on the seasonal basis in order to determine the effect of the climatic factors on the water quality; three samples were collected in every season for two different stations of the pharmaceutical industry.

Idris, *et al.*,(2013) carried out the study on physico-chemical analysis of pharmaceutical effluent and surface water of River Gorax in Minna, Niger State, Nigeria. The physicochemical parameters determined showed highest pH value of 6.89 at S4 whereas the lowest pH value was at sample point S1. The highest temperature value of 46 (oC) was observed at S1 whereas the lowest value of 26oC was observed at S5; the highest electrical conductivity of 1673 (μ S/cm) was observed at S1 whereas the lowest value was at S5; the lowest value of 11.02 (NUT) was abserved at S5 while the highest was at S1 for turbidity; the highest value of 182 (mg/l) was observed at S7 for chemical oxygen demand and the lowest was at point S1.

The anion values of 1.29 mg/l, 15.80 mg/l and 1767 mg/l were observed to be highest at S1 for phosphate, nitrate and chloride whereas the lowest values of 0.69 ± 0.05 mg/l, 7.21 mg/l and 950 mg/l were observed at S5. Most values observed at different sampling points were outside the compliance levels of the NSDWQ, FEPA and WHO tolerance limits for effluents discharge into receiving watersheds. This study reveals the need for enforcing adequate effluent treatment methods before their discharge to surface water to reduce their potential environmental hazards.

Kananet *et al.*, (2014) made a study on the changes in physiochemical parameters of water and soil due to textile effluent. The impacts of textile pollution on agricultural land and water in NarsingdiSadar were analysed a total of 50 water and soil samples were collected from the study area and analyzed the concentration of physiochemical parameters of water and soil were analysed revealed the values of the parameters are as pH 7.56-9.68, EC 17040-38040 $\mu\text{s/cm}$, Temperature 30.24-51.22°C, DO 1.16-4.65 mg/L, COD 810.60-1430.43 mg/L, BOD 305.58-608.16 mg/L and TDS 3456.75-38450.26 mg/L. These values are negatively deviated from the standard values set by the Department of Environment (DOE) for textile effluents. The amount of N 0.217-0.787 $\mu\text{g/g}$, P 27.50-30.70 $\mu\text{g/g}$ and K 0.165-2 $\mu\text{g/g}$ were also found to be deviated from the standard values prescribed by Bangladesh Agricultural Research Council (BARC) for agricultural soil. Major rivers flowing over these industrial regions, like Burigonga, Sitalokka and Turag, have been severely polluted by textile and other pollutants as well as causing serious impact on environment.

Ram ,Lokhandeet *al.*,(2011) carried out a study on physico-chemical parameters of waste water effluents from Taloja industrial area of Mumbai, India. The study reveals that engineering, paper mill, fine chemical, dyes, paint, pharmaceutical, petrochemical and textile industries are some of the major industries responsible for polluting the surrounding aquatic environment. It was observed that pH values of effluent samples collected from paint, pharmaceutical and dyes industries were slightly above and below the limit of 6.5 to 8.5 by ISI and WHO. The effluent samples collected from textile industries showed extremely high Total Dissolved Solid (TDS) content of 12023.6 mg/L and correspondingly high Total Solid (TS) content of 13499.2 mg/L. The chloride content in the effluents from textile industries was 238.4 mg/L which was significantly high than acceptable limit of 200 mg/L set by WHO. The BOD values of effluent samples collected from pharmaceutical, dyes, engineering and paint industries were 1047.3, 776.2, 604.8 and 535.8 mg/L respectively which lie above the maximum permitted BOD content of < 100 to 300 mg/L. The COD values in the different industrial effluent samples were also very much higher than maximum permissible limit of 4.0 mg/L prescribed by USPH Standard. The overall results highlight the discharge of highly polluted waste water effluent from industries of Taloja Industrial area of Mumbai. These industrial effluents have resulted in pollution of nearby Kasardi River thereby affecting the growth of vegetation and aquatic life. The results of the present investigation point out the need to implement common objectives, compatible policies and programmes for improvement in the industrial waste water treatment methods.

Nivruti, Nirgudeet *al.*, 2013carried out a study on physico-chemical analysis of some industrial effluents from Vapi industrial area, Gujarat, India. The parameters analysed include Colour, temperature, pH, electrical conductivity, TDS, TSS, BOD, COD, Chloride, sulphate, Nitrate, Phosphate,

Calcium, Magnesium, Sodium and Potassium ions. The pollution levels from these industries were found to be very high and alarming and hence proper care must be taken for the treatment of these effluents before they are released to the sewage. Many big industries have their own effluent treatment plants, but small scale industries are not following the guidelines prescribed for the industrial effluents. The study has shown that almost all the parameters are on the higher levels than the prescribed limit and hence proper treatment methods are needed.

Tekade *et al.*, 2011 carried out a study on physico-chemical properties of effluents from soap industry in Wardha. In this investigation physico-chemical parameters such as colour, odour, temperature, density, surface tension, viscosity, alkalinity, acidity, chloride, hardness, total dissolved solids, total suspended solid, pH, conductance, sulphate, COD, BOD, DO, pathogen had been analyzed of the effluent collected from the soap industry of Wardha region. Sodium and potassium elements were analyzed flame photometrically.

LubnaTajet *al.*, 2013 carried out a study on physico-chemical analysis of ground water contamination caused by industrial waste water in Faisalabad, Pakistan. Physical parameters included color, odor, taste, pH, electrical conductivity and total suspended solids and chemical parameters included nitrate and concentration of principal anions like chloride were determined. The pH and EC was measured by using portable, direct reading instruments. The value of nitrate of ground water samples were estimated directly by ion meter. The silver nitrate method was used for chloride determination. Alkalinity of water (carbonates and bicarbonates) was determined by titration method. The heavy metals content was estimated by atomic absorption spectroscopy. pH values of water samples ranged from 7.32-7.57 while the standard value set by WHO is 6-8.5.

Electrical conductivity of ground water samples ranged from 3.32-3.98 dS m⁻¹, which is higher than the permissible limit set by WHO 3 dS m⁻¹. The carbonate and bicarbonates values of ground water samples were also within WHO standards. All drinking water samples have chloride concentration higher 17-25 meq L⁻¹ than the permissible limit set by WHO 7.04 meq L⁻¹. The Total suspended solids for drinking water samples were 2124-2515 mg L⁻¹ which were higher than standard values. The Nitrates present in drinking water samples ranged from 22.91- 44 mg L⁻¹ were within permissible to 50 mg L⁻¹. All drinking water samples have nitrate concentration in a permissible limit while the heavy metals content was in trace amounts.

Samuel and Muthukkaruppan (2011) analysed the physico-chemical properties of sugar mill effluent, contaminated soil and its effect on seed germination of paddy (*Oryzasativa L.*) The sugar mill effluents are having high amount of suspended solids, dissolved solids, BOD, COD, chloride, sulphate, nitrates, calcium and magnesium. The continuous use of these effluents harmfully affects the crops when used for irrigation. In the present study, physico-chemical parameters of sugar mill effluent and contaminated soil was determined and the effect of various concentrations (0%, 10%, 25%, 50%, 75 % and 100%) of the effluent on seed germination, germination speed of Paddy (*Oryzasativa L.*) was also studied. The low effluent pH 4.20, total dissolved solids, TDS, 1480mg/L and chemical oxygen demand, COD, 3140mg/L indicate the high inorganic and organic content with an acidic load. Germination percentages and germination values decrease with increasing concentration of effluent in the seeds tested.

Qadir and Chhipa(2015) carried out a comparative study on physicochemical characteristics of raw water and effluents of textile industries of Sitapura, Jaipur. The physicochemical parameters such as pH, total dissolved solids (TDS), electrical conductivity (EC), biological oxygen demand

(BOD) and chemical oxygen demand (COD) of the raw water used and the effluents generated were analyzed. The physicochemical parameters of the effluent samples were compared with those of the raw water (bore well) samples to analyze the pollution load of the effluents. The values of the studied physicochemical parameters were much higher than the permissible limits as prescribed by CPCB and WHO. Higher values of pH, TDS, BOD and COD have detrimental health effects on both humans and aquatic life. Direct disposal of the untreated industrial effluents into the water bodies is very hazardous for both biotic and abiotic components of the environment. Therefore proper remedial measures are to be taken for the treatment of effluents before their discharge into the water bodies.

Yadav *et al.*, (2012) studied the physico-chemical analysis of selected ground water samples of Agra city, India. They assessed the status of the groundwater in Agra city .The range of physicochemical parameters like pH 7.2-7.7, EC 1580-5200 mmhos, TDS 1020-4950 mg/l, Turbidity 1.1-31.4 NTU, Total Alkalinity 330- 525 mg/l, Total hardness 240-1425 mg/l, Chloride 295-1140 mg/l, Calcium 72-436 mg/l, Magnesium 14.6-151.2 mg/l, Sodium 126.5-1254.9 mg/l and Potassium 1.9-60.6 mg/l were found to be higher than the natural background level of groundwater. This indicates the groundwater pollution in selected water samples from 12 sampling sites from Feb. to May 2011 of Agra city. The results considered that the groundwater of the study area in general cannot be considered as good quality.

Roy *et al.*, (2010) characterized the textile industrial effluents and its effects on aquatic macrophytes and algae . Textile industries release huge amount of effluents to aquatic systems, which contain toxic and hazardous pollutants degrading the environment. Total suspended solids (TSS) and total dissolved solid (TDS) was found to be 100 to 336 mg/L and 1856 to 4356 mg/L, respectively. The recorded pH was 9.6 to 11.2 and temperature 40.5 to

43°C. Dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD) was recorded 0.11 to 0.5, 151.24 to 299.1 and 652.8 to 2304 mg/L, respectively. Electrical conductivity (EC) was monitored 2210 to 6020 $\mu\text{s}/\text{cm}$; salinity was found 1.1 to 3.3 ‰, and color 1890.75 to 5625 PCU. Zinc (Zn), cadmium (Cd), copper (Cu) were 0.0838 to 0.596, 0.0 to 0.0006, 0.018 to 0.1727 ppm, respectively. Except heavy metals concentrations of all the physicochemical parameters were found beyond the standard limit set by department of Environment (DOE). Textile industrial effluents showed the toxic effects on aquatic macrophytes and algae, as aquatic macrophytes could hardly survive 2 days on textile effluents and noticeable reduction of algal concentration was found when grown on textile effluents.

Okafor, (2011) carried out study on physico-chemical characteristics of effluents from garri processing industries in Bida, Niger state, Nigeria. Effluent and soil samples were collected from five different garri processing industries in Bida and analysed for conductivity, pH, temperature, alkalinity, total hardness, dissolved oxygen, total suspended solids, total solids, nitrate, sulphate, chloride, sodium, potassium, calcium, cyanide ion, chemical oxygen demand and biochemical oxygen demand using standard methods. Soil samples were obtained five metres away from each discharge point. Results obtained from Efumadami discharge point showed that pH, BOD 5, COD, conductivity, total solids, suspended solid had the highest values of 4.0, 618ppm, 400ppm, 61 $\mu\text{s}/\text{cm}$, 700 ppm and 315 ppm respectively while those from Efumayaki has the lowest values of 4.3, 513ppm 120 ppm, 50 $\mu\text{s} / \text{cm}$, 420 ppm and 183 ppm respectively. Most of the ions tested for in the soil samples increased as the depth of collection increased. The soil and effluent samples were observed to be grossly polluted with cyanide ion. The effluent samples contained 0.29-0.5 ppm cyanide ion while those of soil samples is

0.3-0.62ppm all in contrast to World Health Organization maximum admissible limit of 0.07ppm. A two-way ANOVA showed that as the depth of collection of soil sample increased, cyanide concentration also increased.

Ramesh *et al.*, (2016) analysed the physico-chemical characteristics of industrial effluents in Tirupati, Andhra Pradesh. Physico-chemical characteristics of industrial effluents were collected from three industrial sites in and around Tirupati. Industrial effluents were studied in two years month by month from Jan 2014 - Dec 2015. The important physico-chemical parameters of industrial waste water collected from Tirupati industrial region. Results indicated that pH values of effluent samples ranged from 4.8 to 8.8, it was slightly above and below the limit by ISI and WHO. The average values of Total Dissolved Solids are 2009.8 mg/L in 2014 and 2233.8 mg/L is in 2015 and correspondingly high TSS which was significantly higher than limit set by ISI. The BOD and COD values in all the study sites are above the permissible limit 100 and 200mg/L by ISI and WHO. DO levels more than 4 mg/L is desirable but all the samples show very negligible amount of DO. The study has shown that almost all the parameters are on the higher levels than the prescribed limit and hence proper treatment methods are needed. Some large scale industries have their own effluent treatment plants, but small scale industries are not following the guidelines prescribed for the industrial effluents.

Husain *et al.*, 2014 analysed the industrial wastewater in Aligarh city. The water was analysed for various parameters such as pH, alkalinity, hardness, chloride, COD and BOD so that wastewater characteristics of the area can be found out with the purpose of modifying the existing treatment scheme for the wastewater treatment being presently used. The pH of sample collected from Shah Jamal Ward No. 52 was lowest and its value was 6.3 i.e. more acidic than all other samples. The pH of sample collected from Shah

Jamal Ward No. 54 was highest and its value was 11.5 i.e. more basic than all other samples. Sample collected from Shah Jamal Eidgah Area reported least alkalinity of 180 mg/l as CaCO₃. Sample collected from SaraiRahman reported highest alkalinity of 600 mg/l as CaCO₃. The highest total hardness level of 464.5 mg/l as CaCO₃ was reported from slaughter house existing on Mathura Rd. area. The lowest total hardness value of 200 mg/l as CaCO₃ was reported from Shah Jamal area. The highest values of chloride concentration of 428.3 mg/l were reported from SaraiRahman area. The lowest chloride concentration of 119.5mg/l was reported from Shah Jamal ward No. 54 area. The least BOD₅ value of 57 mg/l at 20° C was reported at SaraiRahman area. Highest BOD₅ value of 85.04 mg/l was reported at Shah Jamal Ward No. 64 area. Shah Jamal Ward No. 54 area has reported lowest COD value of 108.8 . The highest value of COD was recorded as 158.5 mg/l at Shah Jamal Ward No. 52.

Rani *et al.*, 2005 carried out the study on physico- chemical characteristics of waste water from cement units Two major cement industries of the Ariyalur and Reddipalayam were selected, the waste water discharged from these units were collected and subjected to analysis. The values of different parameters were compared with the standard values given by Tamil Nadu Pollution Control Board. The reasons for variations are analysed and remedial measures are suggested.

Kesalkaret *al.*,2012 carried the study on physico-chemical characteristics of wastewater from Paper Industry. The physio-chemical characteristics of wastewater from the paper industry which is using waste-paper as a raw material. The wastewater from the paper industry is characterized by colour ,extreme quantities of COD, BOD, pH ,TDS, DO and SS .The wastewater samples were collected from the inlet and outlet of the effluent treatment plant of paper mill. The samples were analyzed and

compared with the Indian standards of effluent discharge. The raw wastewater consists pH of 6.8-7.1, Suspended Solids of 1160-1380mg/l, Total Dissolved Solids ranges from 1043-1293mg/l, BOD and COD varies 268 - 387 mg/l and 1110 -1272 mg/l respectively. After treatment pH varies 7.1 -7.3, Suspended Solids 322-505 mg/l, Total dissolved solids ranges from 807-984 mg/l, BOD and COD ranges from 176- 282 mg/l and 799-1002 mg/l, respectively. Result shows that the pH and TDS is in the permissible limits and COD, BOD, SS does not meet the permissible standards after treatment. The paper mill does not meet the Standards set by Central Pollution Control Board, India

Dhanushreeet *al.*, 2015, analysed the physico-chemical properties of effluent collected from Mysore Paper Mill, Bhadravathi, Shimoga - Karnataka. The effluent was collected from the inlet of effluent treatment plant and subjected for analysis of various physico-chemical parameters such as pH, biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS) and total solids (TS). Results show that pH - 7.39, TDS - 578 mg/l and TS - 908 mg/l are within the permissible limits, whereas BOD - 108 mg/l and COD - 495 mg/l do not meet the permissible standards.

Varma and Sharma 2010, analyzed the physical and chemical parameters of textile industry such as pH, total dissolved solids (TDS), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), Suspended Solids (SS), oil and grease, calcium, magnesium, iron, manganese, sodium, potassium, total hardness etc. Results indicated that textile wastewater is basic. BOD and COD levels are high. TDS and SS levels exceed the permissible limits. Irrigation with high TDS water will result in decrease in optimal crop production. Sodium levels are quite high in textile effluent, if soil is irrigated; soil becomes poorly drained and tends to crust.

Textile waste water was found to be very hard. Chloride and Sulphate levels are high. Some methods like Electro-dialysis, ion exchange method, biochemical purification etc. can be employed for the treatment of such wastewater.

Siyanbola *et al.*, 2011 study carried out on physico-chemical characteristics of industrial effluents in Lagos state, Nigeria analysed the parameter such as pH, temperature, conductivity, Total Solids (TS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Oil/Grease and Heavy metal determination using Atomic Absorption Spectrophotometer (Spectra AA Varian 400 plus) were carried out. Five industrial effluents discharged at point sources were collected and analysed. The 1.36-4.91 pH range does not conform to the guide line stipulated by Federal Environmental Protection Agency (FEPA). Sample A and E have the highest microbial load which reflects in their high BOD₅ as well as COD values. Unprecedented 10.54 mg/L Cd concentration in effluent B is highly unacceptable by FEPA and World Health Organisation (WHO).

Joshi *et al.*, (2009), studied the physicochemical parameters to assess the water quality of river Ganga for drinking purpose in Haridwar district. The physico-chemical parameters (Temp, velocity, pH, dissolved oxygen, free CO₂, C.O.D., B.O.D., Carbonate, Bicarbonate, total alkalinity, hardness, turbidity, calcium, magnesium, sodium, potassium, nitrate, phosphate, chloride, sulphate, electrical conductivity, total dissolved solids and total suspended solids.) The study area experiences a seasonal climate and broadly divided into three seasons as winter (November to February), Summer (March to June) and rainy (July to October). The samples were collected and analysed for two consecutive years 2007 and 2008. Each parameter was compared with the standard desirable limit of that parameter in river water as prescribed by different agencies. The analytical data of various

physicochemical parameters indicates that some parameters like pH, electrical conductivity, total dissolved solids, total suspended solids, turbidity and sodium are found to be in excess than the prescribed limit in some water samples of the study areas. The WQI- water quality index value indicates that water samples of some sampling stations are quite unfit for drinking purpose because of high value of dissolved solids and sodium.

Amanial Haile Reda (2016), analysed the physico-chemical of drinking water quality of Arbaminch town such as pH, electrical conductivity (EC), total dissolved solids (TDS), total suspended solids (TSS), total solids (TS), total alkalinity (TA), total hardness (TH), chloride (Cl-) and fluoride (F-). The result showed that pH, EC, TDS, TSS, TS, TA, TH, Cl- and F- ranged from 7.13 to 7.76, 210.0 to 230.5 μScm^{-1} , 134.4 to 147.1 mg/L, 11.22 to 15.44 mg/L, 145.62 to 262.45 mg/L, 88.6 to 182.02 mg/L, 119.2 to 135.11 mg/L, 135.22 to 554.46 mg/L and 2.0 to 4.41 mg/L respectively. All the measured parameters were within the standard drinking water quality values of WHO except Cl- content in AMU sampling site and F- in all sampling sites. The level of Cl- in Secha and Sikela sampling sites were within the standard value of WHO (500 mg/L). But the level of Cl- was found beyond the standard value of WHO in AMU sampling site. Similarly the concentration of F- was found higher than the standard limit value of WHO (1.5 mg/L) in all sampling sites but within the maximum permissible values of US-EPA (4.0 mg/L) except in the AMU sampling site which is a little bit higher than the US-EPA. In general the present investigation found that the maximum parameters were not at a level of pollution.

Kawaet *al.*, 2016, analysed the physical, chemical and bacterial of drinking water of Kakua Chiefdom, BO district, Sierra Leone analyzed 10 representative well water systems for 18 quality parameters in Kakua Chiefdom of Bo District, Sierra Leone. The study note among others, well-

water total dissolved solids (TDS), turbidity, electrical conductivity (EC), coliform and nitrate (NO₃-), in the region that are fairly high. The incidence of coliform in well waters is highest in April and those iron (Fe²⁺) and nitrate in May. The Dipha street well is amongst the most contaminated and TDS, Non-faecal and fluoride (F⁻) have the highest scores in a three-category plot along wells. Correlation analysis among the water chemistry shows an interesting results; ranging strong positive (R=1.0) to strongly negative (R=-1.0).

Okeke(2013) studied the water quality study of Ontamiri River in Owerri, Nigeria to seek explanations for the variations of water quality indicators in the river and also tried to evaluate the influence of urban land use activities and season on the water quality. Water sampling and laboratory analyses were carried out using standard procedures to determine the concentrations of selected parameters in the sample. The data obtained ranged from 10.3 to 161.4 μ ohms/cm EC, 18.6 to 882.2mg/l TDS, 42.2 to 160.1mg/l total Hardness, 4.2 to 72.6mg/l NO₃-, 0.8 to 5.6 PO₄, 38.1 to 189.6mg/l SO₄-, and 6.6 to 28.2mg/l Cl⁻. Other results ranged from 2.7 to 5.1 mg/l DO, 2.3 to 18.1mg/l BOD₅, <0.02 to 0.09mg/l. Pb, <0.01 to 0.03 Cd, and 8.0 to 86.0Mpn/1000ml total coliform. There was significant difference (P=0.05) between the dry season and rainy season values, with dry season having higher levels. The results further showed that the midstream area that receive wastes from urban land use activities was polluted with parameters such as EC, NO₃-, PO₄-, Cl⁻, DO, BOD, Pb, Cd and Total Coliform being higher than the permissible limit.

Dhingra 2015.The study on physico - chemical parameters of waste water effluents from Industrial areas of Jaipur, Rajasthan, India reveals that engineering, paper mill, fine chemicals, dyes, paint , pharmaceutical, petrochemical & textile industries are some of the major industries responsible

for polluting surrounding aquatic environment. It was observed that pH values of effluents samples collected from dyes and textile industries shows extremely high total dissolved solid content. Beside this various other parameters are also calculated for waste water samples like pH, Dissolved Co₂, dissolved oxygen, BOD and COD.

Patel *et al.*, (2015) compared the physico-Chemical parameter of textile effluent with the water quality standards of BIS (Bureau of Indian Standard). In this analysis the various physicochemical parameters such as colour, odour, temperature, alkalinity, acidity, chloride, hardness, total dissolved solids(TDS), total suspended solid, pH,DO, COD, BOD, were determined using standard procedures. The study revealed that the direct discharge of untreated Textile effluents poses a health risk to several rural communities which rely on the receiving water bodies primarily as their source of domestic water.

Pandey *et al.*, 2016 assessed the physicochemical properties of cloth dyeing industry in Jaipur (India).The effluent analysis was carried out by following the standard methods of American Public Health Association(APHA, 1998. The objectives of the present study were to assess the major physicochemical parameters like temperature, pH, color, DO, BOD, COD, alkalinity, chloride, hardness, nitrate, phosphate, TS, TDS of the effluent. The present investigation revealed high level of pollution in the city of Jaipur due to the cloth dyeing industry. The experimental data suggests a need to implement common objectives, compatible policies and programmes for improvement in the industrial waste water treatment methods in the city. It also suggests a need of consistent, internationally recognized data driven strategy to assess the quality of waste water effluent and generation of international standards for evaluation of contamination levels.

Ahmad *et al.*, (2012) studied the impact of dyeing industrial effluent on physico chemical properties of soil at Bhairavgarh, Ujjain, MP, India. Soil samples were collected from both areas i.e. contaminated (irrigated with effluent water) and uncontaminated areas (not irrigated with effluent water) at 0-25cm depth for analysis. Three sites were selected in each area for collection of soil samples from ten different locations. Before irrigation the waste water was analysed for selected parameters i.e. pH, electric conductance, bicarbonate, chloride, Ca, Mg, Na and K ions while in soil samples various parameters analysed were pH, electric conductance, water holding capacity, bicarbonates, Ca, Mg, Na, K ions, total organic carbon and organic matter. Results indicate that water was alkaline in nature. Chloride was highest (700mg/l) in W1 samples and lowest (500mg/l) at W2 samples while other parameters also have great variability. Results of soil samples indicate its neutral to slight alkaline nature. Cation and anion concentration, organic carbon and organic matter also shows a wide variation in contaminated soil samples as compared to uncontaminated samples. The study concluded that the continuous application of effluent appears to deteriorate soil quality in the area.

Mohabansiet *al.*, (2011) studied the physico-chemical parameters of textile mill effluent, Hinganghat, Dist. Wardha. Sample of textile industry effluent was collected from Hinganghat, District Wardha (M.S.) India and analyzed for their physicochemical characteristics. The results of this analysis were compared with the water quality standards of BIS (Bureau of Indian Standard). In this analysis the various physicochemical parameters such as colour, odour, temperature, density, surface tension, viscosity, alkalinity, acidity, chloride, hardness, total dissolved solids(TDS), total suspended solid, pH, conductance, sulphate, COD, BOD, were determined using standard

procedures. Elements like Sodium and potassium were determined flame photometrically. The quality of water samples were discussed with respect to these parameters and thus an attempt was made to ascertain the quality of water used for drinking and domestic purposes in the study area.

Wong *et al.*, (2013) studied the physico-chemical investigations of semiconductor Industrial wastewater. The treated and untreated effluents samples from semiconductor industry were collected and their physical characteristics such as temperature, pH, turbidity, total suspended solid (TSS), conductivity and chemical characteristics such as salinity, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), chlorine dioxide, and heavy metal were analyzed. The results obtained showed that the semiconductor industry fulfilled the standards of law that was established in order to protect the environment.

Sankpalet *al.* (2012), analysed the physicochemical parameter of effluent discharge of fish processing industries in Ratnagiri India. Effluents from fish processing industries are the major sources of coastal environmental pollution. The present study represents the characteristics of effluent from fish processing industry. Water samples were collected from different places located at Mirkarwada and Mandavi where waste water discharged in. The periodic physicochemical analysis of effluent to assess the quality of effluent has been carried out. The parameters such as temperature, pH, conductivity, TDS, BOD, COD, DO chlorides and hardness of the water have been studied using standard protocol American Public Health Association (APHA). The physicochemical analysis reveals that all the samples are polluted and having the values higher than the permissible limits. Some remedial steps to be taken for avoiding water pollution.

Osuolale *et al.*, 2015 assessed the Physicochemical Qualities and Prevalence of *Escherichia coli* and *Vibrios* in the Final Effluents of Two Wastewater Treatment Plants in South Africa Ecological and Public Health Implications. The physicochemical parameters assessed ranged as follows both plants. The ranges of values for the physicochemical are: pH (3.9–8.6), total dissolved solids (86.50–336.3 mg/L), electrical conductivity (13.57–52.50 mS/m), temperature (13–28 °C), nitrate (0–21.73 mg/L), nitrite (0.01–0.60 mg/L), orthophosphate (1.29–20.57 mg/L), turbidity (4.02–43.20 NTU), free chlorine (0.05–7.18 mg/L), dissolve oxygen (3.91–9.60 mg/L), biochemical oxygen demand (0.1–9.0 mg/L) and chemical oxygen demand (4.67–211 mg/L). The microbiological assessment for both WWTPs revealed the presence of *E. coli* in counts ranging between 0 and 1.86×10^4 CFU/100 mL and *Vibrio* counts ranging between 0 and 9.93×10^3 CFU/100 mL. We conclude that these WWTPs are important point sources of pollution in surface water with potential public health and ecological risks.

Sonune *et al.*, (2015) Studied the physico-chemical characteristics of domestic wastewater in Vishnupuri, Nanded, India . study focussed on the physico-chemical parameters of wastewater in Vishnupuri, Nanded. All parameter were analyzed as per the standard methods given in American Public Health Association (APHA, 1989). Water quality parameters such as pH, Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonical Nitrogen, Nitrate and Phosphate were analyzed. In our study, it was found that BOD, COD, Ammonical Nitrogen and Nitrate value were above permissible limit whereas TSS, TDS, pH, Phosphate were within the permissible limit.

Iramet *al.*, (2013) assessed the physicochemical parameters of wastewater samples. Water samples from selected locations of Nullah Lai and Koh-e-Noor textile mill in the metropolitan city of Rawalpindi and Islamabad, Pakistan, were collected. The results of the physicochemical analysis at different locations of Nullah Lai and Koh-e-Noor textile mill with an interval of 3 months were obtained in the following range: pH (7.16–8.29), temperature (17.8–28.8 °C), conductivity (1,005–3,347 $\mu\text{S/m}$), TDS (754.3–2,519.5 mg/L), turbidity (272.8–487.05 NTU), total hardness (300–452 mg/L), nitrates (10.11–22.95 ppm), calcium (74.31–139.2 ppm), chloride (127.72–396.16 ppm), sulphate (15.97–87.38 ppm), NaCl (210.5–631.1 ppm), Ni (0.30–0.72 ppm), Cd (0.005–0.03 ppm), Cr (0.2–7.4 ppm), Pb (0.12–0.73 ppm), Zn (0.03–0.08 ppm) and Cu (0.01–0.06 ppm). The highest value of physicochemical parameters (compared with Nullah Lai) was obtained in locations of Koh-e-Noor textile mill. The results obtained exceeded the maximum allowable limit set by the World Health Organization for drinking purpose but can be used for irrigation purposes after suitable treatment and purification.

Shivsharanet *al.*, 2013 Characterized the dairy effluents by physicochemical parameters 4 samples of dairy effluents were collected by composite sampling at the time 9, 12, 3, 6 o'clock per day and stored at 4°C for further analysis. Then on the next day in quintet it was subjected to analyze the physicochemical parameters like Temperature, pH, DO, TDS, TSS, TS, BOD, COD, chloride, Sulphate, oil and Grease. The study revealed that the dairy effluent is slightly alkaline in nature, and high temperature, BOD & COD values obtained by the analysis of dairy effluents indicate the presence of heavy load of organic substances. Also a higher temperature and oils and Greases which lower the dissolved oxygen activities can cause serious problems in disposal of waste water.

Above the standard value suspended and dissolved organic solids are responsible for creating nuisance.

Akan *et al.*, 2010, carried out a study on physical and chemical parameters in Abattoir Wastewater Sample, Maiduguri Metropolis, Nigeria. The physical and chemical parameters in Abattoir wastewater from Maiduguri Metropolis, Nigeria were determined. Abattoir wastewater were collected for the determination of pH, temperature, conductivity, turbidity, chloride, nitrate, sulphate, phosphate, total suspended solid (TSS), total dissolved solid (TDS), dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and heavy metals using standard procedures. The mean concentration of 0.74 mg/l for Cd; 0.36 mg/l Pb and 0.41 mg/l Ni exceeded the WHO/USEPA standard of 0.03 mg/l Cd; 0.10 mg/l Pb and 0.10 mg/l Ni for the discharged of wastewater into river, while the levels of turbidity, nitrate, TSS and TDS were also higher than the WHO limits for the discharged of wastewater into river. The mean values of 2.2 mg/l, 718.0 mg/l and 1421.0 mg/l for DO, BOD and COD exceeded the WHO permissible limit of 4mg/l for DO, 20 mg/l for BOD and 1000 mg/l for COD for the discharged of wastewater from industries into river. From the results of this study, the abattoir wastewater was found to contained high levels of pollutant. Based on these findings, the abattoir wastewater should be monitor strictly by relevant agencies in order to prevent environmental pollution and reduced health hazards caused by activities of abattoir wastewater.

Mlitan *et al.*, 2015 showed the impact of treated wastewater on some physicochemical parameters soil and its fungal content. The Soil physicochemical parameters such as, pH, water content, total soluble salts, Cadmium, Zinc, Lead, Cupper and Iron of soil added treated industrial west water. The results reveal that the some sampling sites were affected by industrial west water pollution.

Soil water content ranged from 7.68 to 19.56. %. Total soluble salts ranged from 272.6 to 300 ppm and soil pH ranged from 7.7 to 8.0. and showed no appreciable differences within localities. The all tested metals increased from first location to the third location except Iron. The irrigation system had a significant effect on Total soluble salts and microbial flora. Isolated microbial flora consists of 4 fungal genera belonging to, Aspergillus, Penicillium, Rizopus and Fusarium. The latter and one of the Aspergillus species (Aspergillus sp3) may consider one of the resistance fungi to industrial waste water due to its large colonies numbers isolated from water contaminated metals area.

Kuzhali *et al.*, 2012, carried out the study on physico chemical and biological parameters of paper industry effluent reported that physico chemical and biological characteristics of paper effluent from the paper mills of Nilakotai Dindigul (Dt), Tamil Nadu, were analyzed from Nov 2010 to Apr 2011 in terms of pH, colour, odour, temperature, EC, TDS, BOD, COD, Na, Ca and Mg. All the parameters were found to be higher than the WHO prescribed discharge limits for effluent.

Kistan *et al.*, (2013) analysed the physico chemical property of Ambattur Lake Water Quality. Drinking water is contaminated through the pipe distribution system of directly through ground water due to addition of waste discharged from domestic, industrial and agriculture sources. The present study was designed to assess the nature and Physico-chemical characteristic of water samples collected from in and around Ambattur Lake, Chennai, Tamil Nadu. The Physico-chemical parameters such colour, pH, odour, Biological oxygen demand (BOD), Chemical oxygen demand (COD), Calcium, Hardness, Alkalinity, chloride, Nitrate and magnesium were studied.

The results obtained showed a fluctuation in this parameter's which gave an idea about the intensity of pollution caused by industrial which is largest area in Asia and also manmade activities. In the present study revealed that the lake water was alkaline. The chloride and hardness concentrations were high. The water quality was found to be hard which was due to excess of calcium and magnesium ions present in lake water in excess quantity. Every parameter showed a significant correlation with increased lake water pollution. The determined Physico-chemical parameters were compared with the BIS and ICMR standards for the drinking water to know about the quality of the groundwater.

Tidjanihisseineet *al.*, (2016) evaluated the physico-chemical of wastewater from Abattoir, Brewery, Soap and Oil Factories, at Moundou City in Southern Chad. The discharge of industrial wastewater in the city of Moundou deteriorates the quality of surface and underground water and soils. In this study the physicochemical quality of industrial effluents was investigated in different seasons (summer, winter and rainy). Three sampling sites were used (Central Abattoir discharge, Cotontchad (soap and oil factory) discharge, and Brewery discharge), for sampling from July 2013 to December 2014. The following physico-chemical parameters were determined: pH, Temperature, EC, dissolved oxygen, COD, BOD₅, NO₃, PO₄, SO₄. Also, the heavy metals: Cu, Cd, Mn, Ni, Pb, As, Zn, Cr, Fe, Al, was analyzed on spectrophotometers and results were compared with World Health Organization (WHO) permissible limits. This study revealed that most parameters were much higher than the permissible limit for wastewater discharges: some parameters were too high: pH (12,6), Temperature (37,8 °C), C.E (4270 µS/cm), organic matters: COD (1200 mg/l), SO₄ (1280 mg/l), PO₄ (4460 mg/l), NO₃ (63,6 mg/l), Fe (63,34 mg/l), Zn (13,27 mg/l), Pb (4,0 mg/l), Cu (25,34 mg/l), Cd (31,78 mg/l), Cr (5,9 mg/l), Ni (39,5 mg/l).

The study concludes that discharge of effluents by the companies; factory and materials from other anthropogenic sources severely pollute the Logone River with heavy metals and other pollutants. We recommended that each industry recycle its wastewater and put in place specific treatment plants, because pollutants to eliminate vary depending on the industry.

Taiwo *et al.*, (2014) analysed the physico-chemical and microbial impact of Abatoir Effluents on Ogun River Cours. There is always need for reduction in the impact of natural and most especially anthropogenic pollution to enhance water quality, food safety and sustainable development. This led to assessing the impact of Lafenwa abattoir effluents on Ogun river course in Abeokuta, Nigeria. Three sample locations were chosen along the river course (up, middle and down streams). Physico-chemical and microbial properties analyzed using standard laboratory procedures were temperature, pH, conductivity, turbidity, total solid (TS), total dissolved solid (TDS), total suspended solid (TSS), dissolved oxygen (DO), acidity, alkalinity, total hardness, calcium and magnesium hardness, chloride, iron and nitrate. Temperature ranged from 26.8-27.0 °C, pH between was 7.92-7.96, Conductivity from 103.7-105.0 $\mu\text{S}/\text{cm}$, Turbidity between 30.9-31.2 NTU, TS, TDS and TSS were between 46-143 mg/L, DO ranged from 5.5-6.0 mg/L, Acidity and Alkalinity were from 0.1-0.5 mg/L, Total, Ca and Mg hardness ranged from 14-50 mg/L, Cl⁻, Fe and NO₃ were from 0.3-52 mg/Kg. Total bacteria count was between 2.5-4.7 x 10² CfU/ml and Escherichia coli was above 160 CfU/ml. All the parameters studied were within the permissible standard limit of WHO and NSDWQ, except turbidity, total suspended solid, magnesium hardness, total bacterial and Escherichia coli counts.

Ogunriver was impaired by the abattoir wash down of effluents therefore, its quality status may pose environmental and health hazards to the end users. To improve and ensure its quality and safety, adequate discharge prevention, management and treatment before use is required.

Patel *et al.*, 2013 analysed the physico-chemical properties of effluents from Havmor ice-cream industry. They evaluate performance of an Effluent Treatment Plant (ETP) Of an Ice-cream industry located in Naroda GIDC area, Ahmadabad Gujarat. An effluent treatment Plant is operating on biological treatment method (Anaerobic Bio-Reactor) with an average wastewater Inflow of 1 lacs/day has been considered for case study. The wastewater is analyzed for the major water quality parameters, such as pH, Chemical Oxygen Demand (COD) and Total Dissolved Solids (TDS), TSS and Chloride. The effluent samples were collected on a daily basis for a period of one month. The raw wastewater pH was highly slightly acidic or almost 7.0 it was then bringing down to neutral which was helpful caustic for biological treatment. The COD and Solids of the treated effluent reduced significantly, where as very good reduction was observed in Plant. Most of all the parameters were within the permissible limits of Gujarat Pollution Control Board, India.

Sreemoyee *et al.*, (2013), assessment of physico-chemical parameters of dairy waste water and isolation and characterization of bacterial strains in terms of cod reduction. Dairy industry is a large scale food production industry and plays an important role in causing water pollution. Waste water coming out from dairy industry is categorized as raw waste and activated sludge which have to be treated by taking various parameters under consideration. This is achieved by assessment of several physico-chemical parameters of dairy waste water with raw waste which includes determination of pH, temperature, acidity, alkalinity, total dissolved solids (TDS), chemical oxygen demand (COD) out of which COD is the most important parameter.

The bacterial isolation was done with activated sludge and then the raw waste was treated with the isolates to observe reduction in COD level. Three bacterial strains were isolated from dairy waste water of which two strains namely *Neisseria* sp. and *Citrobacter* sp. were effective in reducing the level of COD and thus helping in bioremediation.

Onuegbu *et al.*, 2013, analysed the physico-chemical parameters of effluents from Jacobson Chemical Industries Limited, Makers of Bonalux Emulsion and Gloss Paints effluents from domestic and industrial processing activities can be re-used as source of water for irrigation in arid and semi-arid regions where there is limited availability of water. The samples were collected from a discharge point through which it enters the environment and various physico-chemical parameters were determined. Results obtained showed the following average physico-chemical parameters pH 6.25, colour (milky), temperature 35°C, TDS 224 mg/L at 105°C, BOD 182 mg/L, COD 1092 mg/L. Others include TS 723 mg/L, TSS 6.15 mg/L, electrical conductivity 234 μScm^{-1} at 25°C, total alkalinity 952 mg/L, total acidity 43 mg/L and total hardness CaCO_3 353 mg/L. Cl^- 49 mg/L, SO_4^{2-} 30 mg/L and NO_3^- 0.25 mg/L. Results obtained from Atomic Absorption Spectrophotometer analysis (AAS) showed the average metal levels as Ni^{2+} 1.0 mg/L, Cu^{2+} 2.46 mg/L, Fe^{2+} 7.57 mg/L, Cd^{2+} 1.74 mg/L, Pb^{2+} 0.09 mg/L etc. Finally, organic functional groups determination was carried out for the samples by using an IR Spectroscopy and results showed presence of CH_3 , CH_2 stretch of alkane, O-H bend, C=O bend, C_6H_5 stretch of aromatics and -OR undulating functional groups. Results of the physicochemical analysis indicated showed some level of compliance with WHO and NESREA limits except Temperature, BOD and COD.

Sharma *et al.*, 2014 Physico-Chemical Analysis of Paper Industry Effluents in Jammu city (J&K) Physico-Chemical Characteristics of Paper Industry Effluents located in Bari Bramana, District Samba, Jammu and

Kashmir, were analyzed for the parameters such as pH, Turbidity, Total suspended solids, Total dissolved solids and Electrical conductivity for treated as well as untreated effluents. Of all parameters Turbidity and Total Suspended solids for both treated and untreated effluents were above the permissible limits.

Rohit *et al.*, (2013) physico-chemical analysis of textile, automobile and pharmaceutical industrial effluents. Treated and untreated effluents of textile, automobile and pharmaceutical industries were analysed for physico-chemical parameters. All the samples were characteristic odor. The pH values were 7.20, 6.25 and 6.01; respectively in textile, automobile and pharmaceutical industries. The total dissolved solids for the textile, automotive, and pharmaceutical were 528 mg/l, 3150 mg/l and 622 mg/l; respectively. Whereas in treated effluent the total suspended solids of the samples were recorded were 124 mg/l, 132 mg/l and 110 mg/l and the biological oxygen demand was 322 mg/l, 245 mg/l and 410 mg/l. The chemical oxygen demand was 550 mg/l, 635 mg/l and 548; respectively and the dissolved phosphate was 6.73 mg/l, 7.70 mg/l and 6.80 mg/l.

2.2 IMPACT OF EFFLUENT ON ENVIRONMENT

H.S. Surti (2016) analysed the physico-chemical and microbes of waste water from different industry and cod reduction treatment of industrial waste water by using selective Microorganisms. Water pollution is one of the major problem in a todays scenario. Polluted water is a liberated from any industrial place or which contains a high amount of hazardous compounds. The physical, chemical and microbial analysed which include pH, color, TDS, SS BOD, COD, oil and grease, chloride, sulphate, total coliform, fecal coliform, etc. Every industrial effluent contains high amount of organic matter which is hazardous to environment. Microorganisms use organic matter as a nutrient. Composition of waste water works as growth medium supplying sufficient nutrient for biological growth. The waste water plants are constructed to bring down the contamination level to acceptable quality level so that it can be easily discharged. Various physico-chemical techniques such as sedimentation, filtration, flotation, coagulation, etc. Have been studied in vast for waste water treatment but due to the limitation such as partial treatment, high cost, generation of secondary pollutants and use of chemical agents make the biological methods a favorable alternative for the removal of COD. Here, in my study, used *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Enterobactoraerogenes* for COD reduction of pharmaceutical, textile, milk and food industrial waste water. Those organisms are highly efficient in COD reduction of industrial waste water up to 60-65% within few days.

Buveneswariet *al.*, 2013 studied the bioremediation on sugar-mill effluent by selected fungal species. They recognized the environment friendly and less expensive method which involves the natural processes resulting in the efficient conversion of hazardous compounds into innocuous products. This technique involves suitable microbes undergoing various physical and chemical reactions in the polluted water system and during the microbial

metabolism, the pollutants are degraded and removed. Recently microbial bioremediation has emerged as an alternative technique to such traditional chemical treatments..Thiruvannamalai District and were tested for the individual bioremedial efficiency of native fungi present. Three fungi namely *Aspergillusniger*, *Penicillium*sp and *Fusarium*sp were identified and selected for this bioremedial studies. All the three were known to bring about bioremediation which had been confirmed by measuring the % of reduction potential in pH, EC, TDS, OD, BOD, COD and increase in fungal growth. Maximum degrading potential has been observed in the case of *Aspergillusniger* i.e. pH(-38.63%), EC(18.76%), TDS(18.74%), BOD(47.62%) and COD(44.68%) among all.

Thirupathaiah (2012) analysed the water quality by using physico-chemical parameters in lower manair reservoir of Karimnagar district, Andhra Pradesh. They estimated the current status of physico-chemical characteristic of Lower Manair Reservoir at Karimnagar District, Andhra Pradesh. Monthly changes in physico- chemical parameters such as water temperature, pH, turbidity, transparency, total dissolved solids, total hardness, chlorides, phosphate, nitrates, dissolved oxygen and biological oxygen demand were analyzed for a period of one year from September 2009 to August 2010. The results indicated that physico-chemical parameters of the water were within the permissible limits and can be used for domestic, irrigation and pisciculture.

Jan 2014, monitored the water quality by using the parameters to know the suitability of water for fish fauna at River Sardaryab, Khyber Pakhtunkhwa, Pakistan. The physiochemical parameters of River Sardaryab (a tributary of River Kabul) were analyzed in Khyber Pakhtunkhwa (KPK) province of Pakistan. The water quality was studied during the months of March to July

2011. Observed the suitability of River water for fish fauna. Possible sources of contamination were analyzed. The major contaminant found in the River Sardaryab signifying the release of domestic waste water into the River without any treatment. Parameters measured included Water Temperature, pH, Alkalinity, Total hardness, Total Chloride level, Nitrite and Nitrates. All the parameters were within the permissible limit with mean values and standard error include Air Temperature = $330 \pm 5.790\text{C}$; Water Temperature = $30.120 \pm 5.870\text{C}$; pH = 8.22 ± 1.26 ; Chloride = $0 \pm 0\text{mg/l}$; Nitrite = $0.32 \pm 0\text{mg/l}$; Nitrate = $7.1 \pm 2.56\text{mg/l}$; Hardness = $150 \pm 37.14\text{mg/l}$; Alkalinity = $232 \pm 26.41\text{ mg/l}$. The water chemistry of the River reflects the absence of sub lethal pollution rendering the River water fit for fish and other aquatic organisms, livestock and irrigation.

Gati Gupta (2015), Assessed the water quality of Chatta canal affected by textile bleaching, dyeing and printing effluents in Maheshtala Region, South 24-Parganas, West Bengal, India. The surface water samples were collected from various locations of Chatta canal during summer, rainy and winter season for two years (2012-13) for assessment of water quality following standard analytical methods. The study revealed that the chemical parameters like COD (552mg/l), suspended solids (540mg/l), total dissolve solids (3398 mg/l), biological oxygen demand (172 mg/l), carbonate (711mg/l), Chromium (0.10mg/l) and Lead (0.027 mg/l) exceeded the maximum permissible discharge limits laid down by Bureau of Indian Standards (BIS) and WHO (2003) standards. Hence, a comprehensive eco-planning is urgently required to reduce contamination of agricultural fields as well as crops, fruits and vegetables grown for human consumption.

Singh *et al.*, 2012 analysed the physicochemical parameters for the determination of Pollutants in Wastewater in Dheradun. Wastewater was collected from the Dheradun industrial area situated in capital of uttrakhand.

Samples were collected between the periods of November 2010 to Aug.2011 determine the following parameters, pH, temperature, turbidity, chemical oxygen demand (COD), Biological oxygen demand(BOD), dissolved oxygen (DO), conductivity, total dissolved solid (TDS), total suspended solid (TSS), sulphate, nitrate, nitrite and phosphate. In addition, metals (copper, cobalt Chromium, iron, manganese, magnesium, nickel cadmium, lead, sodium, potassium and calcium were determined. Levels of pH, conductivity, temperature, nitrate, nitrite, sulphate ,phosphate, TSS, TDS, DO, BOD and COD were higher than the maximum permissible limits set by Bureo of Indian Standard Delhi. The concentrations of the metals in the wastewater were higher limits set by W.H.O. and the maximum contaminant levels (MCL Thus, the wastewater around the Dheradun industrial highly polluted. Domestic and industrial waste should be properly disposed and or recycled. Relevant agencies should make continuous effort to control, regulate and educate populace on indiscriminate waste disposal from domestic and industries within the study area. Physicochemical Determination of Pollutants in Wastewater.

Patilet *al.*, 2012 analysed the Physico-chemical parameters for testing of water. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Natural water contaminates due to weathering of rocks and leaching of soils, mining processing etc. It is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. It is necessary to know details about different physico-chemical parameters such as color, temperature, acidity, hardness, pH, sulphate, chloride, DO, BOD, COD,

alkalinity used for testing of water quality. Heavy metals such as Pb, Cr, Fe, Hg etc. are of special concern because they produce water or chronic poisoning in aquatic animals.

Ewaet *et al.*,(2011) showed the impact of industrial activities on water quality of omoku creek. The impact of industrial effluent on water quality of Omoku Creek, Rivers State of Nigeria was investigated. The physico-chemical and organic parameters of water samples of the Creek were examined to determine the quality and extent of pollution. Results indicated that TSS (Total Suspended Solid) ranged between 19.8 and 24.9mg/l; while THC (Total Hydrocarbon Concentration) was between 24.2 and 40.4. DO (Dissolved Oxygen) and BOD (Biochemical Oxygen Demand) varied between 38.2 and 41.5mg/l, and 38 and 59 mg/l respectively. The major sources of pollution were observed to be effluents from the industries and dump sites within and around the Creek catchment. These effluents were observed to impact seriously on the Creek ecosystem. In order to maintain the ecological status of the Creek, waste management practice of effluent treatment through the use of retention pond was suggested.

Ahmed *et al.*,(2012) studied the impact of dye industrial effluent on physicochemical characteristics of Kshipra River, Ujjain City, India. The wastewater has greatest potential for polluting the receiving water. River Kshipra is one of the sacred Indian rivers is being polluted by effluents discharged from Bhairavgarh dye industries. The most common textile processing unit consists of desizing, scouring, bleaching, mercerizing and dyeing process. The present study was an attempt for assessment of water quality being polluted by effluents. Selected parameters include pH, temperature, electrical conductivity, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), chemical oxygen

demand (COD), total alkalinity, total hardness and chloride content. These were monitored in the untreated effluent and receiving watershed (River Kshipra) following standard protocol. High levels were observed in COD (73-345 mg/l), pH (7.6-9), TS (2100-6050 mg/l), TDS (1990-5820 mg/l), DO (0-8 mg/l), total hardness (321-880 mg/l), which exceeds the standard levels of BIS and world health organization (WHO). The study revealed that there was an adverse impact on physicochemical characteristics of river Kshipra as a result of direct discharge of untreated effluents from Bhairavgarh dye industries. This poses a health risk to several rural communities which rely on the receiving water bodies primarily as their source of domestic water.

Jadhav *et al.*, 2016, studied the Impact of Industrial Effluents in the Physico- Chemical Parameters of Ground Water of Dhule MIDC (India) Area. A Significant number of today's ground water contamination problems from mans activities is one of the major source of groundwater contamination mainly due to various types of industries as they were disposes waste water effluents without treatment to the ground water bodies. This research work was carried to investigate the contamination level of groundwater by determination of physical and chemical properties of groundwater. It was observed that the groundwater quality is deteriorated because of higher concentration of acidic and alkaline, ions and higher concentration of various salts. Thus the ground water of study area was not useful for the drinking purpose. The industrial effluents also content high concentration of various salts , carbonates, bicarbonates, pH, conductivity. Thus the result suggested that effluents discharged from the various industries showed variable characteristics and potential threat to the ground water contamination.

MATERIALS AND METHODS

3.MATERIALS AND METHODS

The materials and methods for the present study on “Physicochemical Characterization of textile waste water” were presented under the following heads:

3.1. Study area

3.2. Collection of textile effluent

3.3. Analysis of the effluent

3.3.1 Physical parameters

3.3.2 Chemical parameters

3.1 STUDY AREA

The textile waste water for the present study was collected from a textile processing industry in Tiruppur city of Tamil Nadu (Fig.1). Tiruppur is known as a textile city of India. The garment export from Tiruppur touched US \$2500 million in the recent years. More than 10000m³/ day of textile effluent was generated through beaching, dyeing, desizing and through various other process. It contain inorganic chlorine compounds for bleaching. Organic compounds used are dye stuff, bleachers, finishing chemicals, starch and synthetic polymers for desizing.

3.2.COLLECTION OF SAMPLE

To assess the characteristics, the effluent was collected from the textile industry directly(Fig 2).

It was collected in a sterile plastic bottle of 2 liter capacity and stored at room temperature.

3.3 ANALYSIS OF THE EFFLUENT

The physicochemical parameters of the effluent was analysed using standard techniques (APHA, 1992)

3.3.1. PHYSICALPARAMETERS

1. Colour

The colour of the sample was visually observed.

2. Odour

The odour of the sample was noted by directly smelling the sample.

3. Electrical conductivity

The Electrical conductivitywas estimated using conductivity bridge and expressed in ($\mu\text{mhos/cm}$).

4. Temperature

Temperature was measured at the sampling station itself, using mercury filled centigrade thermometer (0°C to 50°C). The readings were made by dipping the thermometer in samples for 2 minutes before constant readings were obtained.

5. DETERMINATION OF TOTAL SUSPENDED SOLIDS

Principle

A well-mixed sample is filtered through a weighed standard glass-fibre filter and the residues retained on the filter are dried to a constant weight at 103°C – 105°C . The increase in weight of the filter represented the total suspended solids. If the suspended material clogs the filter and prolongs filtration, it may be necessary to increase the diameter of the filter or decrease the sample volume.

Procedure

Suspended solids of the sample were estimated by centrifugation method. 50 ml of the sample was centrifuged and after centrifugation the residue was washed with distilled water, recentrifuged and the suspended solids in the centrifuge tube was transferred to a pre weighed silica dish and dried at 105° C. The increase in weight was equal to the amount of suspended solids. The suspended solids present in the sample were calculated by using the formula.

$$\text{Total suspended solids in mg/l} = \frac{\text{Final wt.} - \text{Initial wt. of the crucible}}{\text{Volume of the sample}} \times 1000$$

6. DETERMINATION TOTAL DISSOLVED SOLIDS

Principle

A well-mixed sample is filtered through a standard glass fiber filter and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids.

Procedure

50 ml of the sample was taken in a preweighed silica crucible and the sample was evaporated to dryness using a water bath. After complete evaporation the final weight of the crucible was taken. The total dissolved solids present in the sample was calculated by using the following formula

$$\text{Total dissolved solids in mg/l} = \frac{\text{Final wt.} - \text{Initial wt. of the crucible}}{\text{Volume of the sample}} \times 1000$$

7. TOTAL SOLIDS

Calculation

Mg/l total solids (TS) = mg/l total suspended solids (TSS)+ mg/L total dissolved solids(TDS)

3.3.2. CHEMICAL PARAMETERS

8. DETERMINATION OF PH

Principle

A glass surface in contact with hydrogen ions of the solution under test, acquires an electrical potential which depends on the concentration of H⁺ ions. A measure of the electrical potential (emf), gives H⁺ ion concentration or pH of the solution.

Procedure

A direct reading pH meter was used. The pH meter was first standardized using buffer solutions of pH 7.0 and pH 9.2. The electrodes were rinsed in distilled water and immersed in the textile effluent samples and readings were noted in the digital display.

9. Estimation of Alkalinity

Principle

When a sample containing carbonate and bicarbonate are titrated against the standard sulphuric acid, phenolphthalein loses its pink colour when half of the carbonate is converted to bicarbonate. Twice this value is a measure of carbonates present in the sample.

To the colourless solution, a few drops of methyl orange is added and titrated against sulphuric acid till straw yellow colour changes to pinkish red colour. This value gives the amount of acid required to neutralize the bicarbonate originally present and that from the carbonates. By subtracting the first titre value from the

second one, acid required to neutralise the bicarbonate originally present in the sample is obtained.

Reagents

1. **Sodium carbonate solution 1N:** 13.25g was dissolved in 250ml water.
2. **Sulphuric acid 1N:** 28ml of conc. sulphuric acid was made up to a litre with distilled water.
3. **Sulphuric acid 0.02N:** Diluted approximate volumes of 1N sulphuric acid to prepare 0.02N sulphuric acid= 1.0mg CaCO₃.
4. **Phenolphthalein indicator:** 500mg of phenolphthalein was dissolved in 50ml of ethyl alcohol and 50ml of distilled water. 0.25N sodium hydroxide solution was added drop wise until a faint pink colour appeared.
5. **Mixed indicator solution:** 20mg of methyl red and 100mg of bromocresol green were dissolved in 100ml of 95% isopropyl alcohol.

Procedure

To 50ml of the effluent equal volume of distilled water and a pinch of phenolphthalein indicator solution was added in a 250ml conical flask. Pink colour appeared which was then titrated with 0.02N sulphuric acid until the solution become colourless. Three drops of mixed indicator solution was added to the solution in which phenolphthalein alkalinity had been determined and titrated against 0.02N sulphuric acid. The colour was changed from emerald green to light pink. (If no pink colouration occurred, it indicated nil phenolphthalein alkalinity).

Calculation

$$\begin{aligned} & \text{ml of 0.02N H}_2\text{SO}_4 \text{ for total alkalinity end point} \\ & \quad \quad \quad \times 50 \times 0.02 \times 1000 \end{aligned}$$

$$\text{Total alkalinity as CaCO}_3 \text{ (mg/l)} = \frac{\text{ml of 0.02N H}_2\text{SO}_4 \text{ for total alkalinity end point} \times 50 \times 0.02 \times 1000}{\text{ml sample taken for titration}}$$

10. ESTIMATION OF TOTAL HARDNESS

Principle

Ethylene diamine tetra acetic acid and its sodium salts (EDTA) form a chelated soluble complex when added to a solution of certain metal cations. If a small amount of dye such as Eriochrome Black – T or calmagite is added to an aqueous solution containing calcium and magnesium ions at a pH of 10.0 ± 0.1 , the solution becomes wine red. If EDTA is added as a titrant, the calcium and magnesium was complexed and the solution turns from wine red to blue, marking the end point of the titration.

Reagents

1. **Buffer solution:** 16.9 g of ammonium chloride and 1.25g of magnesium salt of EDTA is dissolved in 143ml of concentrated ammonium hydroxide and diluted to 250ml with distilled water.
2. **Inhibitor:** 4.5g of hydroxylamine hydrochloride in 100ml of 95% ethanol.
3. **Eriochrome Black– T indicator:** 0.5 g of the dye was mixed with 100g of Sodium chloride to obtain a dry powder mixture.
4. **Standard EDTA titrant (0.02 N):** 3.723g Disodiummethylenediaminetetraacetatedihydrate was dissolved in 1 litre of water. It was standardized against standard calcium solution. 1.0 ml of 0.02 N EDTA \equiv 1.0 mg of CaCO_3 .
5. **Standard calcium solution:** 1.0g of pure calcium carbonate was dissolved in 1 litre of distilled water using 20.5ml of HCL and the contents were warmed. 1.0ml= 1mg CaCO_3 .

Procedure

1. 50 ml of water sample was taken in a conical flask and 2ml of buffer solution and 1ml of the inhibitor were added.
2. After adding a pinch of Eriochrome Black– T indicator it was titrated against standard EDTA, till the wine red colour changed into blue. The volume of EDTA used was noted.

Calculation

$$\text{Total Hardness as CaCO}_3 \text{ (mg/l)} = \frac{\text{ml EDTA titrant} \times 1 \times 1000}{\text{Volume of sample taken for estimation}}$$

11. ESTIMATION OF DISSOLVED OXYGEN

Dissolved oxygen of the water sample was estimated by Winkler's method.

Reagents:

1. **Manganese sulphate:** 480g of manganous sulphate tetrahydrate is dissolved and made up to 1000ml with distilled water (Discarded if it changes colour with starch).
2. **Alkaline iodide-azide reagent:** 500g of sodium hydroxide and 150g of potassium iodide along with 10g of sodium azide (NaN_3) is dissolved and made up to 1000ml with distilled water.
3. Conc. sulphuric acid
4. **Starch indicator:** 0.5g of starch is dissolved in distilled water and boiled for few minutes.
5. **Stock sodium thiosulphate:** 24.82g of sodium thiosulphate pentahydrate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$) is dissolved in distilled water and made up to 1000ml.
6. **Standard sodium thiosulphate (0.025N):** 250ml of the stock sodium thiosulphate pentahydrate is made up to 1000ml with distilled water to give 0.025N.

Procedure:

The samples are collected in BOD bottles, to which 2ml of manganous sulphate and 2ml of potassium iodide are added and sealed. This is mixed well and the precipitate allowed settling down. At this stage 2ml of conc. sulphuric acid is added, and mixed well until all the precipitate dissolves. 203ml of the sample is measured into the conical flask and titrated against 0.025N sodium thiosulphate

using starch as an indicator. The end point is the change of colour from blue to colourless.

Calculations

203ml because $(200) (300) / (200-4) = 203\text{ml}$.

1ml of 0.025N Sodium thiosulphate = 0.2mg of Oxygen

$$\text{Dissolved Oxygen (as mg/L)} = \frac{(0.2) (1000 \text{ ml of Sodium thiosulphate})}{200}$$

12. Estimation of Biochemical Oxygen Demand (BOD)

Principle

BOD determination involves the measurement of dissolved oxygen content of the sample, before and after 5 days incubation at 20°C. The reduction in oxygen content is due to the demand exerted by the microbiological population and it is a measure of oxidisable organic matter in the sample.

When manganous sulphate is added to the sample containing potassium iodide, manganous hydroxide is formed, which is oxidized by the dissolved oxygen of the sample to basic manganic oxide. On addition of sulphuric acid, the basic manganic oxide liberates iodine, equivalent to that of dissolved oxygen originally present in the sample. The liberated iodine is titrated with a standard solution of sodium thiosulphate using starch as indicator.

Reagents

1. **Phosphate buffer solution:** 33.4g disodium hydrogen phosphate, 8.5g potassium dihydrogen phosphate, 21.75 g dipotassium hydrogen phosphate, 1.7 g ammonium chloride in 1000 ml of distilled water in a volumetric flask and pH was adjusted to 7.2.

2. **Dilution Water:** Double distilled water taken in a glass container was aerated for half an hour using an aerator. 1 ml of phosphate buffer, 1 ml of $MgSO_4$ (22.5 g/l) 1 ml of $CaCl_2$ (27.5 g/l) and 1 ml of $FeCl_3$ (0.25 g/l) were added.

Procedure

1. Water sample was diluted (measured dilution) with dilution water (Dilution is not necessary for unpolluted waters and seeding is unnecessary for surface waters).
2. Water sample was taken in two BOD bottles. D.O content (D1) of one bottle was analysed and the other was incubated in BOD incubator at 20° C for 5 days.
3. Two other bottles were filled with dilution water D.O content was analysed immediately in one bottle and the other was incubated.
4. D.O was analysed in the incubated water sample (D2) and dilution water after 5 days of incubation.

Calculation

$$BOD \text{ (mg/l)} = \frac{(D1 - D2 - BC) \times 100}{\text{Percentage dilution of sample}}$$

BC – Blank Correction

13. Estimation of Chemical Oxygen Demand (COD)

Principle

Chemical Oxygen Demand (COD) is defined as the amount of a specified oxidant that reacts with the sample under controlled conditions. The quantity of oxidant consumed is expressed in terms of its oxygen equivalence. Because of its

unique chemical properties, the dichromate ion ($\text{Cr}_2 \text{O}_7^{2-}$), the specified oxidant is reduced to the chromic ion (Cr^{3+}).

COD often is used as a measurement of pollutants in waste water and natural waters. Most types of organic matter are oxidized by boiling the mixture of chromic and sulfuric acids. A sample is refluxed in strongly acid solution with a known excess of potassium dichromate. After digestion, the remaining unreduced potassium dichromate is titrated with ferrous ammonium sulfate to determine the amount of potassium dichromate consumed and the oxidizable matter is calculated in terms of oxygen equivalent.

Reagents

1. Standard potassium dichromate solution (0.250M): 12.25g of potassium dichromate dried at 103°C for about 2 hours is dissolved in distilled water and made up to 1000ml.

2. Standard ferrous ammonium sulphate (FAS) 0.25N: 98g of FAS is dissolved in minimum distilled water to which 20ml of conc. sulphuric acid is added and made up to 1000ml using distilled water to give 0.25N of ferrous ammonium sulphate.

3. Ferroin indicator: 1.485g of 1,10-phenanthroline monohydrate and 695mg of ferrous sulphate is dissolved in 100ml of distilled water.

4. Conc. sulphuric acid

5. Silver sulphate crystals

6. Mercuric sulphate crystals

Procedure

15ml of conc. sulphuric acid with 0.3g of mercuric sulphate and a pinch of silver sulphate along with 5ml of 0.025M potassium dichromate is taken into a Nessler's tube. 10ml of sample (thoroughly shaken) is pipetted out into this mixture and kept for about 90 minutes on the hot plate for digestion. 40ml of distilled water is added to the cooled mixture (to make up to 50ml) and titrated against 0.25M FAS

using ferroin indicator, till the colour turns from blue green to wine red indicating the end point. A reagent blank is also carried out using 10ml of distilled water.

Calculations

$$\text{COD (mg/l)} = \frac{(\text{Blank reading} - \text{Sample reading}) \times N \times F \times 1000}{\text{Sample taken, ml}}$$

To calculate F,

$$F = \frac{10000}{\text{Titre value of blank}}$$

14. ESTIMATION OF CHLORIDES

The amount of chlorides was estimated by silver nitrate titrimetric method.

Principle

Silver nitrate reacts with chloride ions to form silver chloride. The completion of reaction is indicated by the red colour produced by the reaction of silver nitrate with potassium chromate solution which is added as an indicator.

Reagents

1. **Potassium chromate indicator:** 25 g of potassium chromate was dissolved in 100 ml of distilled water. Silver nitrate solution was added till a

definite precipitate was formed. After 12 hours the solution was filtered and diluted to 500 ml with distilled water.

2. **0.0282 N silver nitrate solution:** 4.791 g of AgNO_3 in 1000 ml of distilled water. The solution was standardized against 0.0282 N sodium chloride.

3. **0.0282 N sodium chloride:** 1.648 mg of sodium chloride in 1000 ml of distilled water.

Procedure

1. 50 ml of sample was taken and pH was adjusted between 7.0 and 8.0.
2. 50 ml of this sample was taken and 1 ml of potassium chromate was added.
3. The sample was titrated against standard AgNO_3 solution taken in a burette until a brick red precipitate was formed and the volume used was noted.

Calculation

$$\text{Chlorides (mg/l)} = \frac{V \times N \text{ of } \text{AgNO}_3 \times 35.45 \times 1000}{\text{Volume of the sample}}$$

15. ESTIMATION OF SULPHATE

Gravimetric method was used for the estimation of sulphate.

Principle

Sulphate ions are precipitated as barium sulphate crystals of uniform size in acid medium. Light absorbed by the precipitate is measured using a spectrophotometer.

Reagents

1. **Methyl red indicator:** 50 mg methyl red indicator in 50 ml distilled water.
2. **Barium chloride solution:** 100 g of barium chloride was dissolved in 1000 ml of distilled water and was filtered through Whatmann N0.1 filter paper.
3. **Silver nitrate solution:** 0.5 ml conc. HNO_3 and 8.5 ml AgNO_3 in 500 ml distilled water.
4. **Hydrochloric acid (50%):** Hydrochloric acid and distilled water in 1:1 ratio.

Procedure

1. To 100 ml of sample in an Erlenmeyer flask, 2-3 drops of methyl red indicator was added.
2. pH was adjusted to about 4.5 to 5.0 by adding Hydrochloric acid until the colour was changed from red to orange. 2 ml of HCl was added in excess.
3. The solution was boiled and warm barium chloride was added slowly until the precipitation was completed. The solution was heated in water bath for 2 hours and filtered through Whatman No. 42 filter paper.
4. The precipitate was washed with warm distilled water until the filtrate showed no traces of chloride. It was tested by adding AgNO_3 solution. Absence of white turbidity on addition of AgNO_3 indicated the absence of chlorides.
5. The filter paper with precipitate was dried in an oven at 105°C for an hour, and weighed.

Calculation

$$\text{Sulphate (mg/l)} = \frac{\text{Wt. of precipitate in mg.} \times 0.4116}{\text{Volume of sample taken}} \times 1000$$

16. ESTIMATION OF PHOSPHATES

The amount of phosphate was estimated by stannous chloride method.

Principle

Ammonium molybdate reacts with phosphate to form molybdophosphoric acid which is reduced to a blue coloured complex (molybdenum blue) by the addition of stannous chloride.

Reagents

1. **Phenolphthalein indicator solution:** 500 mg of phenolphthalein was dissolved in 50 ml of ethyl alcohol and 50 ml of distilled water was added.
2. **Sulphuric acid – nitric acid solution:** 75 ml Conc. H_2SO_4 was added to about 150 ml. distilled water and cooled. 1 ml conc. HNO_3 was added and diluted to 250 ml with distilled water.
3. **Ammonium molybdate solution:** 2.5 g ammonium molybdate was dissolved in about 200 ml. distilled water. 280 ml conc. H_2SO_4 was added to 400 ml distilled water and cooled. Molybdate solution was added to the diluted acid and dilute to 1000 ml.
4. **Stannous chloride solution:** 2.5 g fresh stannous chloride was dissolved in 100 ml glycerol and heated in a water bath.
5. **Phosphate stock solution:** 439 mg potassium dihydrogen phosphate was dissolved in distilled water and made up to 1000 ml in a volumetric flask. Two drops of toluene was added as a preservative.
6. **Phosphate standard solution:** 10 ml phosphate stock solution was pipetted into a 1000ml volumetric flask and made up to the mark with distilled water and should be prepared freshly. $1.0 \text{ ml} \equiv 1 \text{ mg P}$

Procedure

1. 50 ml of the sample was taken in a Nessler tube and 1 drop of phenolphthalein indicator was added. The pink colour developed was destroyed by adding one or two drops of Sulphuric – nitric acid solution.

2. Phosphate working solution was pipetted in to a series of 100 ml Nessler tubes covering the range up to 20 μg P and made up to 100 ml with distilled water. A Nessler tube containing 100 ml distilled water was kept as a blank.
3. To the blank, standards and sample 4 ml ammonium molybdate solution and 0.5 ml stannous chloride solution were added.
4. Between 10 – 12 minutes the colour developed was measured at 690nm against the reagent blank using a spectrophotometer.
5. A calibration curve was prepared and amount of phosphate equivalent to the observed optical density was calculated and the result was expressed as mg phosphate per litre of sample.

17. Estimation of Nitrate nitrogen

Principle

Nitrates react with phenoldisulphonic acid and produce a nitrate derivative, which in alkaline solution develops yellow colour due to rearrangement of its structure. The colour produced is directly proportional to the concentration of nitrates present in the sample.

Reagents

Nitrate stock solution

722 mg potassium nitrate was dissolved in distilled water and made up to 1000 ml in a volumetric flask.

Nitrate standard solution

100 ml nitrate stock solution was pipetted in to a 1000 ml volumetric flask and made up to the mark with distilled water.

Brucine – Sulphanilic acid solution

1 g brucine sulphate and 100 mg sulphanilic acid was dissolved in 70 ml hot distilled water 3 ml conc. HCl was added cooled and diluted to 100 ml with distilled water.

Sulphuric acid solution

500 ml conc. H_2SO_4 was added to 75 ml distilled water and cooled to room temperature.

Procedure

1. 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 ml of nitrate standard solution were taken in a series of 50 ml beakers and diluted to 5 ml with distilled water.
2. A beaker containing 5 ml of distilled water was used as a blank.
3. 2 ml of the sample was taken in a 50 ml beaker and diluted to 5 ml with distilled water. 1 ml of brucinesulphanilic acid solution was added to the blank, standards and sample are mixed well.
4. 10 ml of Sulphuric acid solution was taken in a second series of 50 ml beakers. The contents of the first series of beakers were poured in to each of the second series of beakers and mixed well. Beakers were kept in the dark for 10 minutes.
5. 10 ml of distilled water was added to all the beakers. Beakers were allowed to cool for 20 – 30 minutes. The colour development was read in a colorimeter against 510 nm. Using the calibration curve the mg. equivalent of nitrate nitrogen in the sample was found out.

Calculation

$$\text{Nitrate (mg/l)} = \frac{\text{mg. Nitrate X 1000}}{\text{ml. Sample taken for estimation}}$$

18. ESTIMATION OF LEAD

Principle

Lead can be determined at a wavelength of 283.3 nm by AAS with aspiration of the sample into the oxidising air-acetylene flame. When the aqueous sample is aspirated, the sensitivity for 1% absorption is 0.5 mg/L and the detection limit is 0.05 mg/L.

Reagents

1. **Ammonia solution, approximately 0.5N:** Dilute 3.5ml ammonia solution to 100ml with water.
2. **Dithizone stock solution, 0.1% (in chloroform):** keep it in an amber bottle and store in a refrigerator.
3. **Dithizone working solution (in water):** Transfer 12ml of stock dithizone solution into a 100ml separating funnel. Add 20ml 0.5N. ammonia solution and shake well. Allow the phases to separate and reject the lower chloroform layer. Filter the aqueous layer through a wetted filter paper (to remove droplets of chloroform) into a 50ml amber bottle.
4. **Sodium hexameta phosphate solution 10%:** Dissolve 10g sodium hexameta phosphate in 100ml distilled water. Remove traces of lead by extraction with stock dithizone solution (0.1% chloroform solution) after adjusting the pH to 9 with conc. Ammonia solution. Acidify the aqueous layer in the separating funnel using 1+1 HCl and then extract with chloroform to remove free dithizone until the chloroform layer becomes colourless. Reject the chloroform layer. Adjust the pH of the aqueous solution to 9.5.
5. **Hydroxyl- amine hydrochloride solution 1%:** Dissolve 1g. of $\text{NH}_2\text{OH}\cdot\text{HCl}$ in 100ml distilled water.
6. **Alkaline cyanide solution:** prepare a mixture of solution containing 340ml. ammonia (sp. gr 0.88) and 680ml water. Dissolve 3.0g sodium sulfite $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$ in the mixture. Add 30ml 1% potassium cyanide solution and mix well. Keep it in a tightly stoppered bottle.

7. **Lead stock solution:** Dissolve 1.599g lead nitrate, $\text{Pb}(\text{NO}_3)_2$ in small amount of water. Add 10ml conc. Nitric acid and make up to 1000ml. 1ml= 1.0mg. Pb
8. **Lead intermediate solution:** dilute 10ml of the above lead stock solution to 1000ml. with distilled water (prepare freshly). 1.0ml= 10 μg . Pb
9. **Lead working solution:** Dilute 10ml of the lead intermediate solution to 100ml. with distilled water (prepare freshly). 1.0ml= 1.0 μg . Pb

Procedure

Standards

1. Place 50ml. of lead free distilled water in to a series of short stem separating funnels. Pipet 0.0, 1.0, 2.0, 3.0, 4.0.....10.0ml of lead working solution in to them.

2. Add the following reagents in order with shaking after each condition, (i) 1.0ml sodium hexametaphosphate solution, (ii) 1.0ml hydroxylamine hydrochloride solution, (iii) 30ml alkaline cyanide solution, (iv) 0.5ml dithizone working solution and (v) 10ml chloroform.

3. Shake the funnel vigorously and allow the layers to separate. Dry the stem of the funnel with filter paper strips. Draw the chloroform layer in the optical cell.

4. Measure the optical densities using a spectrophotometer at 540nm or filterphotometer with a green filter using a 10mm cell, plot a calibration curve.

19. Estimation of zinc

Principle

Zinc reacts with dithizone to form a co-ordinate compound which when extracted with carbon tetra chloride is red in colour and is used to measure the zinc content.

Reagents

1. **Sodium citrate solution:** dissolve 50g sodium citrate in 450ml distilled water.
2. **Zinc stock solution:** dissolve 100mg. zinc metal (30 mesh) in about 1ml + 1 HCL, make up to 1000ml in a volumetric flask using distilled water. 1.0 ml= 100 μ g zinc
3. **Zinc working solution:** pipette 10ml zinc stock solution into a 1000ml volumetric flask and make up to the mark with distilled water. 1.0ml= 1 μ g zinc
4. **Methyl red indicator solution:** dissolve 100mg methyl red in distilled water and dilute to 1000ml.
5. Conc. Ammonia solution
6. **Potassium cyanide solution, 5%:** dissolve 5g potassium cyanide in 100ml distilled water.
7. Con. Acetic acid
8. Carbon tetra chloride
9. **Bis(2- hydroxyl ethyl) dithiocarbamate solution:** mix 4.0g. diethanol amine and 1ml carbon disulphide with 40ml methyl alcohol. Prepare freshly.
10. **Dithizone solution, 0.005%:** dissolve 5mg dithizone thoroughly in alittle carbon tetra chloride an dilute to 100ml with CCl₄.
11. **Sodium sulfide solution I:** dissolve 3.0g Na₂S.H₂O or 1.65g Na₂S. 3H₂O in 100ml distilled water.
12. **Sodium sulfide solution II:** dilute 4.0ml of sodium sulfide solution I to 100ml with distilled water. Prepare just before use.

Procedure

1. Pipette 1.0, 2.0.....10.0ml of zinc working solution into a series of 125ml separating funnels and dilute to 20ml with distilled water.
2. Include a separating funnel containing 20ml distilled water as the blank.
3. Place in a separating funnel an aliquot of the sample containing not more than 10 μ g Zn and dilute to 20ml with distilled water.
4. To the blank, standards and sample, add 2 drops of methyl red indicator solution and 2ml sodium citrate solution. If the colour is not yellow at this point, add conc. ammonia solution drop wise to the separating funnels, until the indicator just turns yellow.
5. Add 1ml potassium cyanide solution and then conc. acetic acid solution until the solution becomes neutral peach in colour.
6. Add 5ml carbon tetrachloride to each separating funnel to extract the methyl red and discard CCl₄ layer.
7. Add 1ml of bis (2- hydroxyl ethyl) dithiocarbamate solution. Mix well by shaking, and then add 10ml dithizone solution. Shake well and draw off the CCl₄ layer into another separating funnel. Extract the aqueous solution in the first separating funnel with 5ml portions of dithizone solution until the last CCl₄ extract remains green. Combine all the CCl₄ extracts in the second separating funnel.
8. To the combined extracts in the second separating funnel, add 10ml sodium sulfide solution II. Shake well and discard the aqueous layer. Wash the CCl₄ layer with further 10ml of sodium sulfide solution II until the unreacted dithizone has completely been removed as shown by the colour of the aqueous layer either colourless or very pale yellow.
9. Draw off the CCl₄ layer into a 50ml volumetric flask after removing the water adhering to thje stem of the funnel using a cotton swab. Make up to the mark with CCl₄.

10. Determine the absorbance of the blank, standards and sample at 535nm. Plot a calibration curve. Find out μg equivalent of zinc to the optical density.

20. Estimation of nickel

The amount of nickel was estimated by dimethyl glyoxime method.

Principle

Nickel reacts with dimethyl glyoxime in the presence of an alkaline oxidising agent to form a characteristic red colour complex which can either be measured visually or photometrically.

Interferences

Iron, manganese and copper interfere and if they are present in concentration thrice that of nickel, their interference is suppressed by the addition of sodium citrate. If they are present in excess concentrations, nickel dimethyl glyoxime complex alone is separated by extraction with chloroform and preceded further.

Reagents

Nickel stock solution

447.9 mg Nickel sulfate ($\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$) was dissolved in distilled water and the volume was made upto 1000 ml. in volumetric water ($1.00 \text{ ml} = 100 \mu\text{g Ni}$).

Nickel working solution

10.0 ml of nickel stock solution was pipetted into a 100 ml volumetric flask and made upto the mark with distilled water ($1.00 \text{ ml} = 10 \mu\text{g Ni}$).

0.5N Hydrochloric acid

50ml conc. HCl was diluted to 1000 ml with distilled water

Sodium citrate solution

125g sodium citrate was dissolved in 500 ml distilled water.

0.05 N Iodine solutions

20g potassium iodide, was dissolved in 5 ml. distilled water. 6.4 g iodine was dissolved in this solution, and the solution was diluted to 1000 ml.

Dimethyl glyoxime solution

1g dimethyl glyoxime was dissolved in 100 ml of concentrated ammonia solution. 100 ml distilled water was added and filtered if necessary.

Additional reagents for the removal of interferences

Dilute ammonia solution - 10 ml. concentrated ammonia solution was diluted to 500ml with distilled water.

Chloroform

Procedure

1. Appropriate volumes of nickel working solution covering the range up to 100 μg was taken in a series of 50ml Nessler tubes. 50 ml Nessler tube with distilled water was kept as the blank.

2. A suitable aliquot of the neutralised (acid digested sample containing not more than 100 μg nickel) was taken in a 50ml Nessler tube.

3. To the blank, standards and sample 20 ml of 0.5 N. HCl was added.

4. Then following reagents were added in order with mixing after each addition:

- (i) 10 ml. sodium citrate solution
- (ii) 2 ml. iodine solution and
- (iii) 4 ml. dimethyl glyoxime solution

5. The volume in all the flasks were made upto 50 ml. with distilled water and allowed to stand for 20 minutes.

6. Optical density was measured in a spectrophotometer at 470 nm against the reagent blank. A calibration curve was prepared and the microgram of nickel equivalent to the observed optical density was determined. The result was expressed as mg nickel per litre of the sample.

21. Estimation of chromium

Principle

Under acidic conditions, hexavalent chromium reacts with s-diphenylcarbazide to form a reddish violet colored complex which can be determined either visually or photometrically.

Reagents

1. Chromium stock solution: Dissolve 283mg dried potassium dichromate in distilled water and make up to the mark with distilled water. 1.0ml= 100 μ g Cr

2. Chromium working solution: pipette 10ml chromium working solution into a 500ml volumetric flask and make up to the mark with distilled water. 1.0ml= 2.0 μ g Cr

3. Sulfuric acid: 5%- carefully add 50ml conc. H₂SO₄ to 950ml distilled water and cool.

4. Phosphoric acid, 85%

5. Diphenylcarbazide solution: Dissolve 500mg s- diphenylcarbazide and 8g phthalic anhydride in 200ml. 95% ethyl alcohol. Keep it in a refrigerator.

Procedure

1. Place appropriate volumes of chromium working solution in 50ml volumetric flasks or nessler's tube containing 25ml distilled water as the blank.

2. Place 25ml or an aliquot (containing not more than 50 μ g. Cr) of the neutralized sample in a volumetric flasks or nessler's tube.

3. To the blank, standards and sample add the following reagents were added in order with mixing after each addition:

(i) 10ml. 5% sulfuric acid

(ii) 0.4ml. Phosphoric acid and

(iii. i) 4ml Diphenylcarbazide solution.

4. Dilute to the mark with distilled water, mix well and set aside for 5minutes.

5. Measure the optimal densities of the blank, standards and sample using a spectrophotometer at a wavelength of 540nm taking water as the reference.

6. Prepare a calibration curve. Find out the mg. Cr equivalent to the observed optical density.

22. Estimation of copper

Principle

Copper is reduced with hydroxyl- amine hydrochloride and the pH is adjusted to 4.0 to 6.0. The cuprous ions react with neocuproin to form a yellow coloured complex which is extracted with chloroform and measured colorimetrically.

Reagents

1. Conc. HCL

2. **Hydroxylamine- hydrochloride solution, 20%:** Dissolve 50g Hydroxylamine- hydrochloride, $\text{NH}_2\text{OH}\cdot\text{HCl}$ in re- distilled water and dilute to 250ml.

3. **Neo cuproine solution:** Dissolve 200mg. neo cuproine (2, 9 dimethyl- 1, 10 phenanthroline hemihydrate) in 200ml methyl alcohol. Keep it

in a refrigerator. The reagent is stable under ordinary storage conditions for a month or more.

4. **Sodium citrate solution, 25%:** Dissolve 125g sodium citrate dehydrate in re- distilled water and dilute to 500ml. transfer to a 1000ml separating funnel, add 10ml hydroxylamine- hydrochloride solution and 10ml neo cuproine solution. Extract with 50ml chloroform to remove copper impurities and discard the chloroform layer.

5. **Copper stock solution:** place 100.0mg polished electrolytic copper in a conical flask. Add 10ml re- distilled water and 3ml conc. nitric acid. After the reaction is subsided, warm gently for complete dis-solution and then boil to expel oxides of nitrogen. Cool and add about 50ml re- distilled water. Transfer quantitatively to a 1000ml volumetric flask and make up to the mark with re- distilled water. 1.0ml=100 μ g Cu

6. **Copper working solution:** pipette 50.0ml of stock solution and make up to 1000ml in a volumetric flask.

Procedure

1. Into a series of 125ml separating funnels, pipette 1.0, 2.0, 4.0, 10.0ml of copper working solution. Dilute to 50ml with re- distilled water. Include a separating funnel containing 50ml re- distilled water as the blank.
2. Place an appropriate aliquot of the sample and dilute to re- distilled water if necessary.
3. Add 0.1ml conc. HCl to each separating funnel and mix well.
4. Add the following reagents in the order with shaking after each addition.
 - (i) 5ml hydroxylamine- hydrochloride solution
 - (ii) 10ml sodium citrate solution
 - (iii) 10ml neocuproin solution
5. Add 20ml chloroform and shake the funnel vigorously. Allow the phases to separate and drain the chloroform layer into 50ml nessler tubes if photometric

comparison is made. Extract with another 20ml portion of chloroform and combine with the first chloroform extract. Make up to 50ml with isopropyl alcohol.

6. Compare the colour of the sample with that of the standards visually or measure the absorbance of standards and samples using blank as the reference at 457nm using a light path of 1cm. Find out the mg equivalent of the sample to the observed optical density. Express the result as mg/l copper (Cu).

23. OIL AND GREASE

Principle

Oil and grease are dissolved in a suitable solvent and extracted from the aqueous phase. The solvent layer is then evaporated and the residue is weighed as oil and grease.

Reagents

1. Magnesium sulphate ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$)- 1% aqueous solution
2. Milk of lime - 2% aqueous solution
3. Dilute HCL – 25ml of conc. HCL was added to 75ml of distilled water and mixed well.
4. Petroleum ether- Boiling range 40° C to 60° C.
5. Anhydrous sodium sulphate

Procedure

1. 500 ml of well mixed sample was taken in a beaker and 5 ml of magnesium sulphate solution was added. Small amounts of milk of lime were added with continuous stirring until flocculation occurs.
2. The precipitate was dissolved in dilute hydrochloric acid and transferred to the separating funnel. The beaker was washed with 50 ml of petroleum ether and poured into the separating funnel.
3. The aqueous layer was transferred to another separating funnel and again extracted with 50 ml of petroleum ether.

4. Two ether extracts were taken in a 200 ml beaker 2 g of anhydrous sodium sulphate was added. The beaker was covered with a watch glass and the contents were mixed at frequent intervals for about 30 minutes.
5. The contents were filtered into an evaporating dish using Whatmann No. 42 filter paper containing sodium sulphate in its cone, moistened with the solvent. The beaker was washed with two 20 ml portions of petroleum ether and filtered through the same filter paper.
6. Petroleum ether was evaporated by keeping it on a water bath. The dish was weighed. The difference in weight corresponded to the amount of oil and grease present in the aliquot of the sample.



FIG . 1- MAP OF TIRUPPUR DISTRICT



**FIG. 2 DISCHARGE OF EFFLUENT FROM THE
INDUSTRY**

RESULT AND DISCUSSION

4. RESULTS AND DISCUSSION

Increased population and modernized civilization trend have resulted in blooming of textile sector in India. The report from ministry of textiles has given an estimate that textiles account for 14% of India's industrial production and around 27% of its export earnings. There are about 10,000 garment manufactures and 2100 bleaching and dyeing industries in India. Majority are concentrated in the states of Tamil Nadu, Punjab, and Gujarat . Many textile processing units in Tamil Nadu use a number of unclassified chemicals that are likely to be from the red list group which is said to be harmful and unhealthy(Ravikumar and Dutta, 1996).

Dyeing is a combined process of bleaching and colouring which generate voluminous quantities of waste water and in turn causes environmental degradation. Over the last several years, water quality in urban locale and villages adjoining dyeing industrial areas has deteriorated owing to effluent inflow into land and water bodies.(Meena*et al.*,2004)

Textile industries are the major sources of pollution due to the nature of their operations which requires huge volume of water that eventually results in higher waste water generation (Nemerow, 1978). The effluent from the dyestuff manufacturing and textile industries, in particular are highly coloured with a large amount of suspended organic solids and considered as important source of water pollution (Hebeish*et al.*, 2011). Discharging of unfixed dyes into receiving water may cause a negative impact on the ecosystems, such as reduction of photosynthetic activity, causing of aesthetic problems, and toxicity to life (Daneshvare*et*

al. 2012). Therefore, an attempt has been made to analyse the physical and chemical characteristics of the textile effluent.

4.1 TEXTILE EFFLUENT CHARACTERIZATION

The textile effluent sample was found to be dark brown in colour with objectionable odour. The temperature of the sample was 35°C. The values of total suspended solids (TSS), Total Dissolved Solids (TDS), were found to be 2053 and 357 mg/L respectively.

The effluent showed a pH of 9.5. Total hardness recorded was 756 mg/L. Biological Oxygen Demand (B.O.D) and Chemical Oxygen Demand (C.O.D) were 340 and 750 mg/L respectively.

The amount of chlorides, sulphates, phosphates, and nitrates were 28, 458, 558 and 7.8 mg/L respectively. The amount of lead, zinc, chromium and copper recorded values of 0.87, 14.98, 0.98 and 0.99 mg/L respectively. The amount of oil and grease estimated was 2054 mg/L.

The results of the physicochemical analysis showed that the textile effluent is characterized by the presence of colour with objectionable odour, high TDS, TSS values, alkaline pH, high BOD and COD, high amount of chlorides and sulphates, phosphates and also showed the presence of heavy metals, oil and grease.

4.2 PHYSICAL PARAMETERS

COLOUR

The colour of the effluent sample typically depends upon the different industrial processes. Due to usage of dyes and chemicals, effluents are dark in colour, which increases the turbidity of water body. This in turn hampers the photosynthesis process, causing alteration in the habitat (Joseph Egli, 2007). The colour is usually the first contaminant to be recognized in wastewaters that affects the aesthetics, water transparency and gas solubility of water bodies. Colour is a very

important factor for aquatic life for making food from sun-rays. This reduction in photosynthetic activity due to dark colouration affects other parameters like temperature DO and BOD. (Azbar *et al.*, 2000)

ODOUR

The bad odour could be due to volatile compounds. Unpleasant or pungent odour for textile effluent was reported (Aruna *et al.*, 2012).

HARDNESS

Divalent metallic cations particularly Ca, Mg, Sr, and Fe are responsible for hardness in textile effluents. Total hardness is the sum of calcium and magnesium concentrations, both expressed as calcium carbonate in mg/L. Water is conventionally classified as hard or soft from the following classification; 50 – 100 mg/l (Soft), 100 – 250 mg/l (Moderately hard) 250 – 350 mg/l (Hard), and > 350 mg/l (Excessive hard). According to WHO, the maximum allowable limit of hardness is 500 mg/L. (Anilkuma *et al.*, 2003)

In the present study the effluent exceeds the WHO standard and falls in the range of excessive hardness.

TEMPERATURE

Temperature is basically important because of its effect on chemical reactions, reaction rate, aquatic life and the suitability of water for beneficial uses/ industrial uses. Temperature is one of the most important physiological parameters which govern the aquatic system. Temperature of 40.5 to 43°C was reported by Roy *et al.*, 2010 and 40° C was reported by Vigneshpriya and shanthi 2015.

BIOLOGICAL OXYGEN DEMAND

BOD is the most important parameter which is used to determine the pollution load of an effluent. BOD is a measure of organic material contamination in water, specified in mg/L. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic

compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites). Typically the test for BOD is conducted over a five-day period (Milacron 2000.).

The BOD value recorded for the effluent () higher than the prescribed standards stipulated by CPCB(150mg/ L). Higher values of BOD indicate the extent of biodegradable substances present in the effluent. Greater the decomposable matter, greater is the oxygen demand and thus greater the BOD values (Igbinosa *et al.*, 2009). Excessive values of BOD are harmful to the aquatic animals like fish and microorganisms. It also imparts bad taste to drinking water [Savinand Butnaru R. (2008)].

CHEMICAL OXYGEN DEMAND

The COD test determines the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. COD is a test which is used to measure the pollution of domestic and industrial wastes. It is measured in terms of equality of oxygen required for oxidation of organic matter to produce CO₂ and water. It is a fact that all organic compounds with a few exceptions can be oxidizing agents under the acidic conditions. COD test is useful in pinpointing the toxic condition of wastes and the presence of biologically resistant substances (Dhere *et al.*, 2008).

The higher values of COD recorded in the present study may be attributed to the use of large quantities of dyes in textile processing (Daniel *et al.*, 2009). This is highly undesirable because its continuous discharge not only affects the receiving water body to some extent but also have negative effects on water quality which subsequently causes harm to aquatic life especially fish (Nese *et al.*, 2007). If the BOD : COD ratio is lower than 0.3 then, the wastewater may either have some toxic components or it may require acclimatized microorganisms for its

stabilization (Krishnaswamy *et al.*, 2009). COD is another measure of organic material contamination in water specified in mg/L. Both BOD and COD are key indicators of the environmental health of a surface water supply. They are commonly treated in waste waters but rarely in general water treatment. (Milacron 2000.).

TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) in the raw effluent revealed that it is much higher than the CPCB standards. The cause of high TDS is due to the presence of large number of dissolved salts as chlorides, carbonates, bicarbonates, sulphates, phosphates, nitrates of sodium, potassium, calcium, magnesium, manganese and iron (Ghaly, 2014). The source of TDS in water is attributed to natural sources, domestic wastewaters, municipal runoffs and industrial wastewaters.

Water containing TDS concentration below 1000 mg/l is usually acceptable to consumers, although acceptability may vary according to circumstances. The TDS may increase salinity of the water and thus may render it unfit for irrigation and drinking purposes. Consumption of water with high concentrations of total dissolved solids has been reported to cause disorders of alimentary canal, respiratory system, nervous system, coronary system besides causing miscarriage and cancer. The presence of high levels of TDS in water may be objectionable to consumers owing to the resulting taste and to excessive scaling in water pipes, heaters, boilers and household appliances. The index of solid present in dissolved form and estimated as being 0.5 to 0.9 times the conductivity in mS/cm (BIS limit : 500-2000 mg/L) decreases palatability and may cause gastro-intestinal irritation. High content of TDS affects the density of water, reduces solubility of gases (oxygen), influences the osmoregulation of freshwater organisms,

utility of water for drinking and irrigation purposes (Ogunfowokan *et al.*, 2005).

Water can be classified based on the concentration of TDS (Brown 1996 and Rani2007);drinking(up to 500 mg/lit), useful for irrigation (up to 2000 mg/lit) is not useful for irrigation and drinking (up to 3000 mg/lit)

TOTAL SUSPENDED SOLIDS

Total suspended solids play an important role in waste water treatment. TSS test results are routinely used to assess the performance of conventional treatment processes and the need for effluent filtration in reuse applications.

The TSS values of effluent were found to differ significantly with Industries as well as with sampling days. The increased amount of TSS is due to increased chemical dosing for dye fixation and partial dissolution of fibre materials. TSS affect the light intensity of water; suspended solids are the cause of suspended particles inside the water body, influencing its turbidity and transparency.(Devi 1998) .

The increased in the amount of total suspended solids increases the demand for gases such as oxygen (Hong *et al.*, 1996) .Oxygen, carbon dioxide, hydrogen sulfide, and nitrogen are examples of gases that dissolve in water. Gases dissolved in water are important to aquatic life. Carbon dioxide is important because of the role it plays in pH and alkalinity. Carbon dioxide is released into the water by microorganisms and consumed by aquatic plants. DO is not only important to most aquatic organisms, but it is also an important indicator of water quality. Like terrestrial life, aquatic organisms need oxygen to live. As water moves past their breathing apparatus, microscopic bubbles of oxygen gas in the water, DO, are transferred from the water to their blood(Karim *et al.*, 2006). Like any other gas diffusion process, the

transfer is efficient only above certain concentrations. In other words, oxygen can be present in the water, but at too low a concentration to sustain aquatic life. Oxygen also is needed by virtually all algae and macrophytes, and for many chemical reactions that are important to water body functioning (Khaled *et al.*, 2010).

CHEMICAL PARAMETERS

pH

pH is a measure of acidity or alkalinity of water. pH is the value expressed as the negative logarithm of hydrogen ion concentration.

pH of the effluent is a very important parameter in the determination of water quality since it affects other chemical reactions such as solubility and metal toxicity (Fakayode, 2005). pH changes soil permeability which results in polluting underground resources of water [Akpoveta *et al.*, 2010]. Anything either highly acidic or alkaline would kill aquatic life (Pimple *et al.*, 2011) because all metabolic processes are pH dependent (Wang *et al.*, 2002). The toxicity of heavy metals also gets enhanced at particular pH. Thus, pH is having primary importance in deciding the quality of wastewater released from textile industries. pH is important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity (Gupta 2009).

WHO standard value for pH ranges from 6-8.5 and the pH of more than 7(9.5) represents basicity of the effluent. Waters with pH value of about 10 are exceptional and may reflect contamination by strong base such as NaOH and Ca(OH)₂ (D. Langmuir, 1997).

CHLORIDE

Chloride in wastewater comes mostly from raw water taken for dyeing and also it may added as a fixing agents for some of the dyes (Neşee *et al.*,2010).Chlorides are generally present in natural water. The presence of chloride in the natural water can be attributed to dissolution of salt depositions discharged in the effluent from chemical industries.

Chloride is generally present at low concentration.High concentration of chloride(BIS limit: 250 to 1000 mg/L) may impart undesirable taste to drinking water. The tolerance of chloride by human being varies with climate, exertion and loss through perspiration. The presence of high levels of chloride in water samples may be objectionable to consumers owing to the resulting taste and to excessive scaling in water pipes, heater, boilers and household appliances (Padma *et al.*, 2006).

The chloride content may add TDS which also indicates that water is polluted. The chloride is a conservative species that generally does not degrade in natural ground water. Due to the high chloride content of wastewater disposed to the environment, leaf margins become scorched, leaves become smaller and thicker and overall plant growth is reduced. Chloride was found to be positively correlated with EC, TDS, TSS, alkalinity and sulphate.Chlorine dioxide is formed from the chlorine gas that is used in the treatment of raw materials in textile processing (Salami *et al.*, 1997). Chlorine dioxide is as effective as chlorine in destroying coliform populations in wastewater effluents.Unlike chlorine, chlorine dioxide does not hydrolyze in water. Therefore, its germicidal activity is relatively constant over a broad pH range. [Venkateswara(2011)].

SULPHATE

Sulphates are used in dyeing and desizing processes in textile industries (Rani et al., 2007).Most natural water supplies contain sulphates (SO_4^{2-}), which is a colorless and odorless compound of sulfur and oxygen and exists as a dissolved salt in water. Sulphates can be more troublesome because they generally occur in greater concentrations. According to WHO, the maximum permissible concentration of sulfate is 400 mg/L. As reported by [Agarwal 1996] the industrial wastewater containing sulfate ions should not be discharged into any water body from where water is supplied for drinking, as higher concentration of sulphate ions cause taste change in water, have a laxative effect on livestock and humans, and are usually associated with high hardness levels.

NITRATE NITROGEN

Nitrate nitrogen comes from the process of desizing in the textile industries(Deepali et al., 2010). Knowledge of nitrogen in waste water is important when it is used as an irrigant. Nitrogen both in the form of nitrate, nitrite, or ammonia can be a health hazard and its presence in textile effluent is credited to extensive use of different types of dyes(Ajaoet *al.*, 2011). Nitrate content of raw textile effluent in lesser range (13.35 ± 3.13 mg/l) has been reported. This reduction in nitrate content of treated effluent may be attributed to the heterotrophic nitrifying bacteria which forms a part of indigenous microflora. Some of the most important microorganism-mediated and human activities chemical reactions in aquatic and soil environments are those involving nitrogen compounds. They are key constituents of the nitrogen cycle, which take place in the atmosphere, a cycle that describes the dynamic processes through which nitrogen is interchanged among the

atmosphere, organic matter, and inorganic compounds (Salami,*et al.*, 1996).

PHOSPHATE

The value of phosphate was recorded as 28mg/L. The value is more than the permissible limit (WHO., 2000). The phosphorus in the wastewater comes from the phosphor detergents(Akan *et al.*, 2008). It causes eutrophication of surface water, therefore, it needs to be controlled

CHROMIUM

Chromium is used in the dyeing of fabrics, and as a tanning agent to produce leather(Rani *et al.*, 2007).Chromium causes cancer, dermatological disorders and anemia. The discharge from anthropogenic activities have high concentration than the permissible limit recommended by WHO which is 0, 0.1 mg/L (Benedetto, 1999, and Rodierand *al.*, 2009). Chromium content in the effluent was 0.98mg/L which exceeds the WHO standard.

LEAD

Lead is used in cloth as a stabilizer, colour enhancer, or anti-corrosive agent(Rani *et al.*, 2007).Exposure to lead causes a variety of health effects, and affects children in particular. Water is rarely an important source of lead except where lead pipes, for instance in old buildings, are common. Lead in water originate from industrial and domestic discharge of wastes in the river and is non-essential for plants and animals and is toxic by ingestion-being a cumulative poison, producing damaging effects on the kidney, liver, tissues, blood vessels, nervous system and depresses sperm count (Anglin-Brown *et al.*, 1995; Tijani *et al.*, 2004). Lead poisoning also causes neuromuscular and central nervous system disorders (Kaur, 2012).

ZINC

Zinc is used in textile processing to increase the weight of the fabrics (Jose et al., 2005). Zinc is an important component of white and red pigments used in the printing of fabrics. Its low concentration in the effluent sample (0.25mg/L) may be due to low dosage of white and red pigments during paint formulation and also as a result of strong binding of pigment with other ingredients. Toxicity to fish occurs from a few milligrams per litre. For agricultural use, the deterioration of the plants can occur from 5 mg/L (WHO., 1996).

COPPER

Copper is used as a bleaching agent in textile industry (Rani et al., 2007). Copper in the effluent was 0.98mg/L which is above the WHO standards (0.5mg/L). Copper in the dissolved form is potentially very toxic to aquatic animals and plants, especially to young life-stages such as fish larvae. The toxicity of copper is however greatly reduced when it is bound to particulate matter in the effluent. Copper is a trace element required by plants in a very minute quantity for growth and development. Excess of it could be very detrimental to humans. The industries and public should recognize the need to monitor the concentrations in discharges and in rivers closely, to ensure that water quality objectives are not exceeded (Cappuccino, 1992).

OIL AND GREASE

The value of oil and grease in the effluent was 2054 mg/L which is higher than the recommendations of WHO (2003). Oil and grease if present in excess amount it interferes with aerobic and anaerobic biological processes. Akan et al. (2008) showed a comparatively less value

of 680mg/L in untreated effluent. Trivedi et al., (1986) reported oil and grease in textile industry effluent varying from 230 to 1897 mg/L.

From the present study it could be concluded that the studied textile effluent has high potential and warrants an urgent need to follow adequate effluent treatment methods before discharge into the surface water for reducing potential environmental hazards.

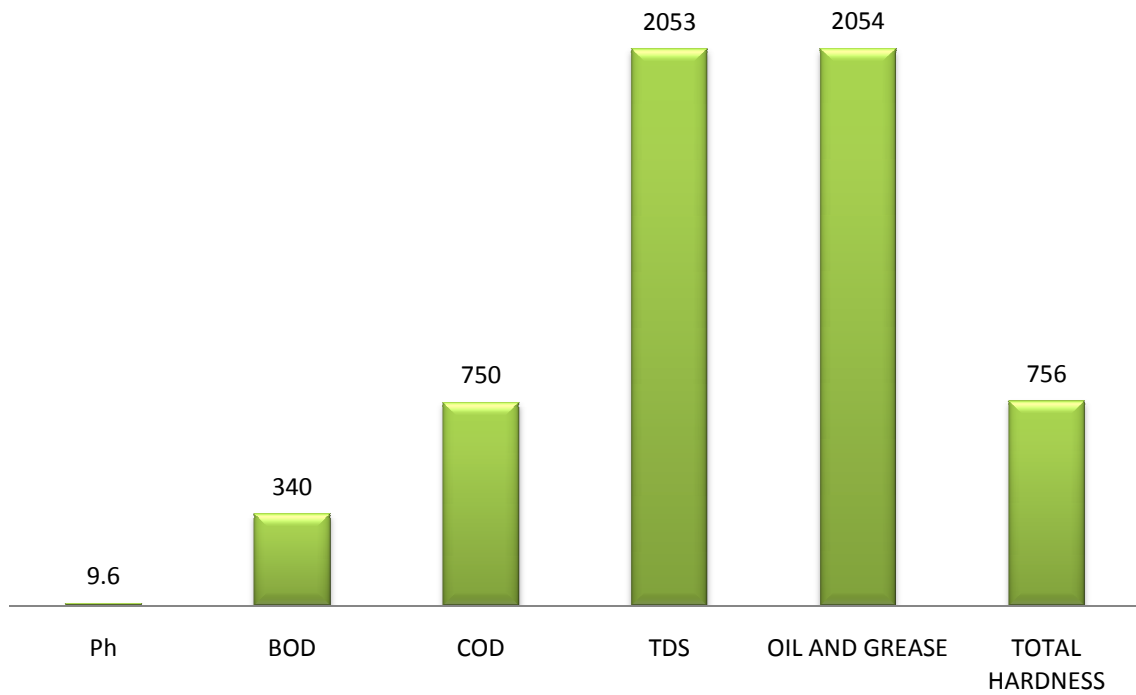
PHYSICAL PARAMETERS

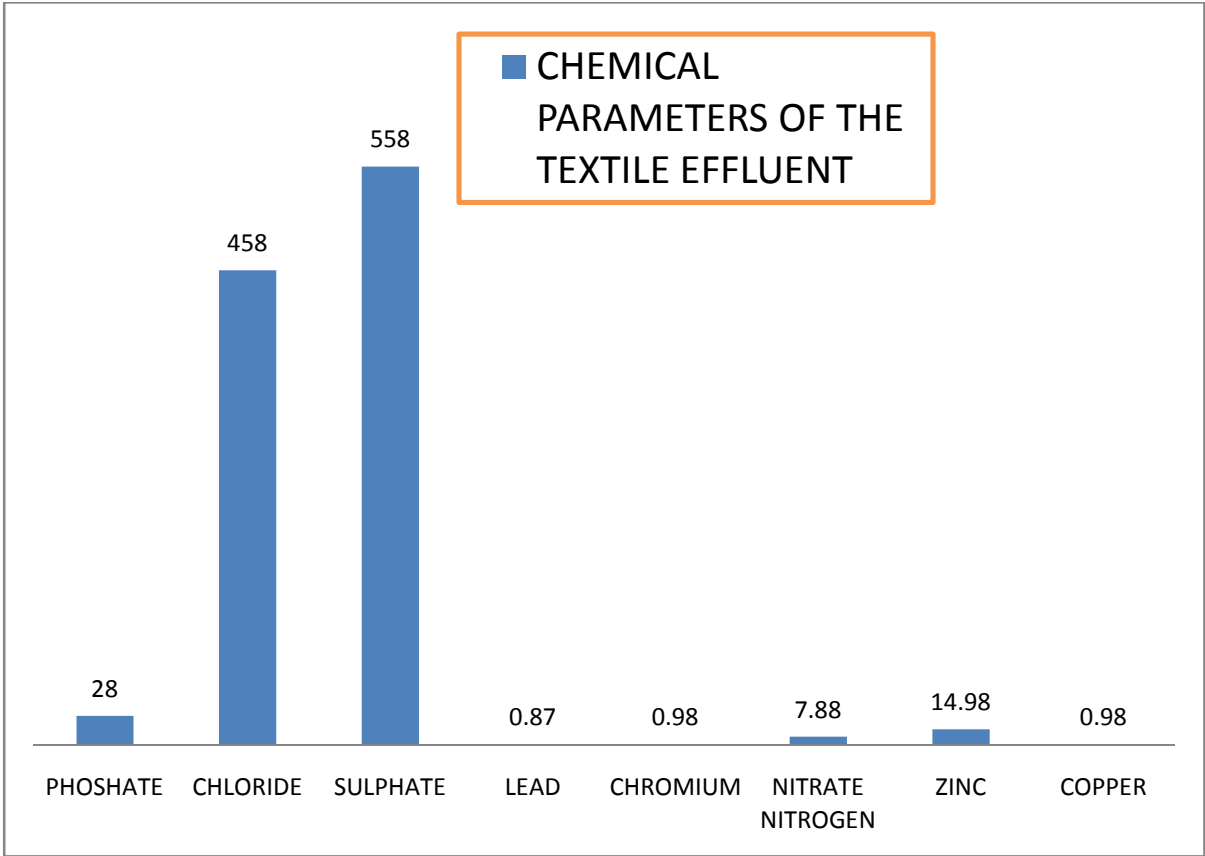
1.	Ph	9.5
2.	BOD	340
3.	COD	750
4.	TDS	2053
5.	TSS	357
6.	TEMPERATURE	35°C
7.	OIL AND GREASE	2054
8.	TOTAL HARDNESS	756

CHEMICAL PARAMETERS

1.	POSPHATE	28
2.	CHLORIDE	458
3.	SULPHATE	558
4.	LEAD	0.87
5.	CHROMIUM	0.98
6.	NITRATE NITROGEN	7.88
7.	ZINC	14.98
8.	COPPER	0.98

PHYSICAL PARAMETERS OF THE TEXTILE EFFLUENT





SUMMARY AND CONCLUSION

5. Summary and conclusion

- An attempt has been made to assess the physicochemical parameters of the textile effluent.
- The effluent was collected from a textile industry in Tiruppur city.
- Tiruppur is famous world wide for textile garments. It is one of the developing city in Tamil Nadu and textile industries are the dominating industries.
- The effluent was collected in precleaned 2L plastic bottle from the industry and stored at room temperature.
- Physicochemical parameters were analysed using the standard methods (APHA, 1992)
- The physical parameters analysed were colour, odour, temperature, total suspended solids, total dissolved solids.
- The chemical parameters analysed were pH, total hardness, BOD, COD, chlorides, sulphates, nitrate nitrogen, lead, zinc, copper, oil and grease.
- The present study showed the high value of temperature total suspended solids, total dissolved solids.
- The textile effluent sample was found to be dark brown in colour with objectionable odour. The temperature of the sample was 35°C.
- The values of total suspended solids (TSS), Total Dissolved Solids (TDS), were found to 2053 and 357 mg/L respectively.
- The effluent showed the pH of 9.5. Total hardness recorded was 756mg/L.
- Biological Oxygen Demand (B.O.D) and Chemical Oxygen Demand (C.O.D) were 340 and 750mg/L respectively.
- The amount of chlorides, sulphates, phosphates, and nitrates were 28, 458, 558 and 7.8mg/L respectively.

- The amount of lead, zinc, chromium and copper recorded values of 0.87, 14.98, 0.98 and 0.99 mg/L respectively.
- The amount of oil and grease estimated was 2054mg/L.
- The results of the physicochemical analysis showed that the textile effluent is characterized by the presence of colour with objectionable odour, high TDS, TSS values, alkaline pH, high BOD and COD , high amount of chlorides and sulphates, phosphates and also showed the presence of heavy metals, oil and grease.
- The colour of the effluent sample typically depends upon the different industrial processes.
- The bad odour could be due to volatile compounds. The Unpleasant or pungent odour for textile effluent was reported.
- Divalent metallic cations particularly Ca, Mg, Sr, and Fe are responsible for hardness in textile effluents.
- The cause of high TDS is due to the presence of large number of dissolved salts as chlorides, carbonates, bicarbonates, sulphates, phosphates, nitrates of sodium, potassium, calcium, magnesium, manganese and iron.
- Total suspended solids play an important role in waste water treatment. TSS test results are routinely used to assess the performance of conventional treatment processes and the need for effluent filtration in reuse applications.
- BOD is the most important parameter which is used to determine the pollution load of an effluent.
- The COD test determines the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant.

- pH of the effluent is a very important parameter in the determination of water quality since it affects other chemical reactions such as solubility and metal toxicity.
- Chloride in wastewater comes mostly from raw water taken for dyeing and also it may added as a fixing agents for some of the dyes.
- Sulphates are used in dyeing and desizing processes in textile industries. Nitrate nitrogen comes from the process of desizing. The phosphorus in the wastewater comes from the phosphor detergents.
- Chromium is used in the dyeing of fabrics, Lead is used in cloth as a stabilizer, colour enhancer, or anti-corrosive agent. Zinc is used in textile processing to increase the weight of the fabrics. Copper is used as a bleaching agent in textile industry
- The study revealed the high pollution potential of the studied textile effluent and warrants an urgent need to follow adequate effluent treatment methods before discharge into the surface water for reducing potential environmental hazards.

REFERENCE

6.REFERENCE

- A.AbdulJaeel, J. Sirajudeen& R. Abdul Vahith, (2012) "studies on heavy metal pollution of ground water sources between Tamilnadu& Pondicherry, India online journal of applied sciences research, 3(1),424-429.
- Abdel-Shafy HI, Abdel-Basir SE, 1991.Chemical treatment of industrial wastewater. Environmental Management of Health., 2: 19-23.
- Adekunle, A. S. (2008) and Eniola, I. T, K. (2008) Impact of Industrial Effluents on Quality of Segment OfAsa River within an Industrial Estate in Ilorin, Nigeria. New York Science Journal, 1 (1): 17-21
- Adelegan JA (2002). Environmental Policy and Slaughterhouse waste in Nigeria, Proceedings of the 28th WEDC Conference Kolkata (Calcutta) India. pp. 3-6.
- Akan JC "Physicochemical determination of pollutants in waste water and vegetable samples along the Jakara waste water channel in Kano Metropolis" Kano State, Niigeria, European Journal Scientific Research 2008, PP 122-23..
- Altman SJ, Parizek RR, Dilution of nonpoint source nitrate in ground water. Journal Environ. Qualit,1995, 24,707-717.
- Andre dos BS., Francisco JC., Jules van BL. (2007). Review paper on current technologies for decolourisation of textile wastewaters: Perspectives for anaerobic biotechnology. Bioresource Technology. 98: 2369- 2385.
- AnilkumarYadav ,P.K.Jain and SundarLal, (2003).Geochemical study of fluoride in ground water of Behror Tehsil of Alwar district(Rajasthan) Research Journal of Chemistry and Environment. 7(3):

- APHA,(1985) Standard Methods for the examination of water and waste water 18th Edition :American Public Health Association ,Washington D.C
- APHA.(1998). American public health association.Standard methods for the examination of water and wastewater.20th edn. DC. New York
- Aruna U. Kakade. 2012. Biodegradation of tannery effluent by using tannery effluent isolate, International Multiple disciplinary Reasearch Journal, 2(3) : 2231 – 6302.
- Asamudo, N. U., Daba. A.S.andEzeronye, O.U. 2005. Bioremediation of textile effluent using Phanerochaetechrysosporium.African J. Biotechnol. 4: 1548-1553.
- Asia IO., Oladoja NA., Bamuza-pemu EE. (2006). Treatment of textile sludge using anaerobic technology.African Journal of Biotechnology. 5(18): 1678-1683.
- Azbar N, Yonar T, Kestioglu K. (2000)Comparison of various advanced oxidation processes and chemicaltreatment methods for COD and color removal from a polyester and acetate fibre dyeing effluent. Chemosphere. 2004;55:35–43. [PubMed]
- B. N. Yadav , B. N. Singh (2009), Physico-chemical Studies on pollution potential of river Ganga at Kanpur, ACTA CientiaIndica. 25(C)(2): 285-290
- Babu, B.R., S.R. Parande and T.P. Kumar, (2007). Cotton Textile Processing: Waste Generation and Effluent Treatment. J. Cotton Sci., 11: 141-153.

Bahar K Ince, Zeynepcetecioglu, OrhanInce(2009) "Pollution prevention in the pulp and paper industries" Institute of Environmental Science and Environmental Engeneering, Istanbul, Turkey.

Bhatia, S.C. (2009). Environmental Pollution and Control in Chemical Process Industries. New Delhi, Khanna Publishers, Pp 164-431.

Bhuvaneshwari K. and Devika R., (2005). Studies on the physico-chemical and biological characteristics of Coovumriver. Asian Journal of Microbiology, Biotechnology and Environmental sciences, 7:449-451

Campos R, Kandelbauer A, Robra KH, Artur CP, Gubitz GM. (2001) Indigo degradation with purified laccases from *Trametes hirsuta* and *Sclerotium rolfsii*. J Biotechnology. ;8:131–139. [PubMed]

Cappuccino, J.C. and Sherman, N. 1992. Microbiology: A Laboratory Manual, New York, USA, pp. 125.

Chanda DK (1999) Hydrology Journal 7: 431-439.

Chung KT, Stevens SE, Cerniglia CE. 1992 The reduction of azo dyes by the intestinal microflora. Critical Rev Microbiology;18:175–190. [PubMed]

Clarke E. A., Anliker R.O. (1980). Organic dyes and pigments. In The Handbook of Environmental Chemistry, Vol. 3, Part A. Anthropogenic Compounds, ed. O. Hutzinger. Springer, Heidelberg. 181-215.

Crini G. 2006 Non-conventional low-cost adsorbents for dye removal: a review. Bioresource Technol.;97(9):1061–85. [PubMed]

- D. FreedaGnana Rani and A. Arul,(2009) A comparative study of surface water and ground water sources from villages of different Talukas of Ariyalur Area, Tamil Nadu. *Pollution Research*. 28(1): 133-135.
- D. Langmuir, (1997).Aqueous Environmental Chemistry, Pren-tice-Hall, Inc. New Jersey.
- Das J, Acharya BC 2003. Hydrology and assessment of lotic water quality in Cuttack city, India, *Water Air Soil Pollution*, 150, 163-175.
- Deepali and K. K. Gangwar, (2010) Metals Concentration in Textile and Tannery Effluents Associated Soils and Ground Water, *New York Sci. J.*, 3(4) 82-89.
- Dhere, A.M., Pawar, C.B., Pardeshi, P.B. and Patil, D.A., (2008).Municipal solid waste disposal in Pune city- An analysis of air and groundwater pollution. *Current Science*, 95(6): 774- 777.
- Dubey, S., (2013).Analysis of Physico- Chemical Parameters of Kshipra River Water at Ujjain, India. *International Research Journal of Environment Sciences*, 2(7), 1-4.1
- E Brown, M.W skougstad, M.J fishman(1970) "methods for collection and analysis of water samples for dissolved minerals and gases". *Techniques for water resources investigation of U.S geological survey vol. 160 book 5 chapter A1, 1970*
- Eichlerova I, Homolka L, Nerud F. (2006) Synthetic decolorization capacity of white-rot fungus *Dichomitussequalens*.*Bioresource Technol*;97:2153–2159. [PubMed]
- Eye, J.D.and Lawrence, L. (1971). Treatment of waste from sole leather tannery. *Journal of WaterPollution Control Federal*, 43:2291-2303.

- Fakayode, S. O. (2005) Impact of Industrial Effluent on Water Quality of Receiving Alaro River in Ibadan, Nigeria. *AJEAM-RAGEE*, 10: 1-3.
- Federal Environmental Protection Agency (1991) Guideline and Standard for Environmental Pollution Control in Nigeria.
- Food and Agricultural Organisation (2004), The Global Cassava Development Strategy, Published by Food and Agricultural Organisation.
- Fu Y, Viraraghavan T. (2002) Removal of Congo red from an aqueous solution by fungus *Aspergillusniger*. *Advance Environ Res.* 2;7:239–247.
- Galindo C, Kalt T. UV/H₂O oxidation of azo dyes in aqueous media: evidence of a structure - degradability relationship. *Dyes Pigments.* 1999;42:199–207.
- Garode, A.M., and Sonune, N.A., 2014. Screening and Identification of lipase producing bacteria from Domestic wastewater. *Int. J. Pharm Bio Sci.*, 5 (2): 265 268.
- Gray, N. F. (1989) *Biology of Water Treatment*. New York: Oxford University Press, UNESCO (2006) *Water a Shared Responsibility* .The United Nations World Water Development Report 2 (WWDR 2).
- Harikumar, P. S., Madhavan, K., Lakshmi, E., Shimjida . P., and Bindu , K.R. (2006). , Environmental Status of Kol Wetland system of Thrissur District with special references to water and sediment, quality : *Ecology, Environmental & Conservation* 12(2): 263- 273
- Hong, Y.C., Azad, H. R. And Cooksey, D. A., (1996).A chromosomal locus required for copper resistance, competitive fitness and cytochrome c biogenesis in *Pseudomonas fluorescences* . *Proc. Natl. Acad. Sci. USA*, 93: 7315-7320

- Irina-Isabella Savin, RomenButnaru, Wastewater Characteristics in Textile Finishing Mills, Environ. Eng. Manag. J, 7(6) (2008), 859-864.
- IshtiyakQadir., R. C. Chhipa. (2015). Critical Evaluation of Some Available Treatment Techniques for Textile & Paper Industry Effluents: A Review. American Chemical Science Journal. 6(2): 77-90.
- Joseph Egli Italia srl (2007).Wastewater treatment in the textile industry. Dyeing Printing Finishing 10(2007)60-66.
- Karim, M.M., A.K. Das and S.H. Lee, 2006. Treatment of Colored Effluent of the Textile Industry in Bangladesh using Zinc Chloride Treated Indigenous Activated Carbons' AnalyticaChimicaActa, 576: 37-44
- Kegley, E.S. and Andrew, J. (1998).The Chemistry of Water. 2 nd Edition, California: University Science Books, Pp 13-162.
- Khaled E, Hassan G, Khider M, Mandour R.2010 Safe biodegradation of textile azo dyes by newly isolated lactic acid bacteria and detection of plasmids associated with degradation. J Biored Biodegrd.;1(3):1–6.
- Kisu, G.C., Barman S.C and Bhargava, S.K. (2000)Contamination of soil and plants potentially toxic elements irrigated with mixed industrial effluent and impact in the environment.. Water Air Soil Pollut., 120: 121- 137.
- Kulkarni, T.T. 1992. Source and characteristics of dairy wastes from a medium size effluent on microorganisms plant growth and their microbial change. Life science of Advance, 3: 26 - 28.
- Kumar P, Prasad B, Mishra IM, Chand S. (2007). Catalytic thermal treatment of desizing wastewater. J. Hazard. Mater. 149: 26-34.

- Lokhande, R.S., and Kelkar, N.,1999 , Studies on heavy metals in water of Vasai Creek, Maharashtra, Indian J. Environ. Protect, 19(9), 664-668
- M.Tariq, M.Ali& Z. Shah, (2000) "Characteristics of Industrial effluents &their possible impact on quality of underground water",online journal on soil & Environment 25(1):64- 69,200.
- Meena, sarojpaiaawat and ramya, R. (2004), Occupational health hazards of textile dyeing effluent on environment , Journal of Pollution Control, 25 (4): 847-853.
- Morrison GO, Fatoki OS and Ekberg A, 2001. Assessment of the impact of point source pollution from the Keiskammahoek sewage treatment plant on the keiskamma river. Water.SA. 27: 475-480
- Muthuswamy A. and Jayabalan N.,(2001) Effects of factory effluents on physiological and biochemical contents of *Gossypiumhirsutum* L.J. Environ. Biol. 22 (4) : 237-247.
- Narayana P. (2009). Environmental Pollution.Principles, Analysis and Control. CBC Pub. Limited, New Delhi.Pp 124 – 154.
- NeşeTüfekci, NüketSivri and İsmail Toroz, Pollutants of Textile industry Wastewater and Assessment of its Discharge Limits by Water Quality Standards, Turkey. Journal of Fishier Aquatic Science,7 (2007) 97-103.
- Njoku G. and Osondu A (2007).New Standard for Drinking Water Quality in Nigeria to Ensure the Safety of Drinking Water and Project Public Health.
- Ogedengbe, K. and Akinbile, C. O. (2004) Impact of Industrial Pollutants on Quality of Ground and Surface Waters at Oluyole Industrial Estate,

- Ibadan, Nigeria. Nig. J. of Technological Development, 4(2) 139-144.
- Okafor, J.O. and Egwim E. (2004). Effect of Chemically and Physically treated Adsorbents on wastewater from Garri Processing Industry, 27th Annual International Conference of Chemical Society of Nigeria, Benin City, Nigeria. 21st to 22nd August.
- Olayemi, A.B. (1994) Bacteriological Water Assessment of an Urban River in Nigeria. Inter. Journal of Environmental Health Research, 4:156-16
- Padma, S.V., Rakhi, S., Mahanta, D., And Tiwari, S.C. (2006): "Ecofriendly Sonicator dyeing of cotton with *Rubia Cordifolia* Linn using Biomordant". Dyes and Pigments. 11:1-6. 9.
- PandeySandeep K, Tiwari S, , (2009) Physico-chemical analysis of ground water of selected area of Ghazipur city-A case study. Nature and Scienc e,7(1).
- PiyushMalaviya, Rathore V.S (2007) "Bioremediation of pulp and paper mill effluent by a novel fungal consortium isolated from polluted soil" Bioresource technology, PP 3647
- Rajamohan N, Karthikeyan C.(2011) Kinetic studies of dye effluent degradation by *Pseudomonas stutzeri*.
- Rani Faryal, FaheemTahir and abdulhameed (2007) effect of waste water irrigation on soil along with its micro and macro flora pak. J. Bot.
- Rathore, D.S., Rai, N., and Ashiya, P., 2014. Physico Chemical Analysis of Water of Ayad River at Udaipur, Rajasthan (India).International Journal of Innovative Research in Science, Engineering and Technology, 3(4), 11660- 11667.

- Robinson.,Mcmullan G., Marchant R, Ningam P. (2001). Remediation of dyes in textile effluent: A critical review on current treatment technologies with a proposed alternative. *Biores.Technol.*
- Salami, S.J. and Egwin I.N. (1997). Impact of Tannery Effluents on the Quality of Receiving Stream, *African journal of natural science*,, 2(1) pp 17- 20.
- Sangodoyin, A.Y. (1991) Groundwater and Surface Water Pollution by Open Refuse Dump in Ibadan, Nigeria. *J. of Discovery and Innovations*, 3 (1) 24-31 .
- Sangu, R. P. S., and Sharma, S. K., (1987).An assessment of water quality of river Ganga at Garmukeshwar. *Industrial Journal of Ecology*, 14(20), 278-287.
- Sekar P, Hariprasad S and Deccaraman M,(2008), *Journal of Applied Science Research.*, 4(11), 1526 3.
- Suryavathi V, Sharma S, Sharma S, Saxena P, Pandey S, Grover R, Kumar S, Sharma KP (2005) Acute toxicity of textile dye wastewaters (untreated and treated) of Sanganer on male reproductive systems of albino rats and mice. *Reproductive Technology*;19:547–556.
- Tiwari, T.N., and Mishra, M., (1986). *Life Sciences Advances* . 5: 130
- Uberai N.K.,(2003) *Environmental Management*. Excel Books, New Delhi. pp. 269.
- Usharani K, Umarani K, Ayyasamy PM, Shanthi K, Lakshmanaperumalsamy P. Physico- chemical and bacteriological characteristics of Noyyal river and ground water quality of Perur, India. *J ApplSci Environ Manage*. 2010; 14(2): 29-35.

V. K. Garg and P. Kaushik, (2008) Influence of textile mill wastewater irrigation on the growth of sorgum cultivars, *Appl. Ecol. Environ. Res.*, 6(2) 1-12.

Venkateswara BR (2011) Physicochemical analysis of selected ground water samples of Vijayawada rural and urban in Krishna district, Andhra Pradesh, India. *International Journal of Environmental Sciences* 2: 710-714.

WHO. (1993). *Guidelines for Technologies for Water Supply Systems in Small Communities*, World Health Organization, CEHA.

WHO.(2000) *WHO Air Quality Guidelines, 2nd Edition*, World Health Organization, Europe Regional Office, Copenhagen, Zollinger H. (1987). *Colour chemistry-synthesis, properties and application of organic dyes and pigments*. VCH Publishers. New York. 92-100.

Zollinger H. (1987). *Colour chemistry-synthesis, properties and application of organic dyes and pigments*. VCH Publishers. New York. 92-100.