INDUSTRIAL WASTE WATER TREATMENT AND DESIGN - A CASE STUDY OF GHEE MILL

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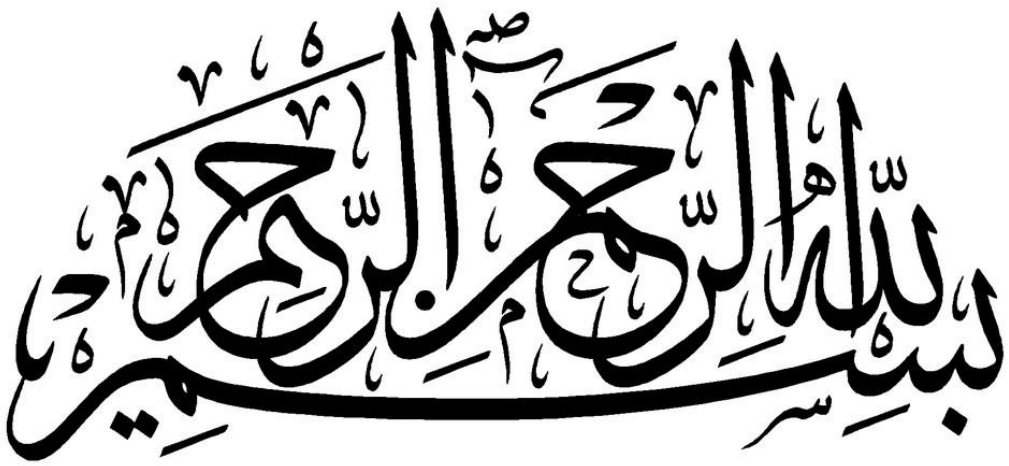
بسم الله الرحمن الرحيم

DEDICATED TO EVERY TEACHER, STUDENT AND STAFF

OF PAKISTAN, WHO ARE WORKING DILIGENTLY

TOWARDS BUILDING NATION

It is to certify that the Research and Development work titled

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ABBREVIATIONS

1.	Effluent	Waste water going out of mill
2.	Alk	Alkalinity
3.	COD	Chemical Oxygen Demand
4.	BOD	Biological Oxygen Demand
5.	WHO	World Health Organisation
6.	TDS	Total Dissolved Solids
7.	DO	Dissolved Oxygen
8.	NTU	Naphlomatric Turbidity Unit
9.	TSS	Total Suspended Solids
10.	mg/l	Milligram Per Litre
11.	ppm	Parts Per Million
12.	NEQS	National Environmental Quality Standards
13.	COND	Conductivity
16.	ppt	Precipitates
17.	EPA	Environmental Protection Agency

ABSTRACT

1. Advent of modern technologies is ushering rapid growth in industry. Environment and eco system are fast depreciating due to adverse effects of industry. There is a greater need to develop better design and procedures for treatment of effluent. The study deals with the determinations of pollutions strength of Shama Ghee Mill in particular to analyze their treatment system's efficacy. The purpose of this study is to present improvements that can make existing treatment procedures more efficient. The prime objective of this study was: -

a. To analyze effluent from Shama Ghee Mill, Nowshehra and to identify the characteristics of wastewater the industrial effluent.
b. To study the environmental impact of waste being discharged into fields and Kabul River.
c. To suggest remedial measures sought to comply with the NEQS.
d. To design a wastewater treatment plant based on the data obtained.

2. For pollution assessment the parameters like pH, TS, TSS, TDS, COD and BOD along with temperature, alkalinity nitrates and phosphates were tested on samples collected from Treatment plant and main drain of Shama Ghee Mill. Analysis was run on entire experimental data and it was concluded that almost all parameters were beyond the safe limits. The following conclusion were drawn: -

    a. Shama Ghee Mill, as a sample of exiting industrial practice, does not comply with global and national standards of water purification, as deduced from testing of samples.
    b. Design of Treatment plant and Procedure needs to be made more effective.

3. We, after having done all research, conclude that the observed issues and their effects can be mitigated by certain treatment design amendments that will be given towards the end of this document. Primarily design parameters and treatment

methodology need to be more effective for effluent characteristics to lie within permissible limits.

CHAPTER NO: 1

INTRODUCTION

1.1 GENERAL

Advent of modern technologies is ushering rapid growth in industry. Domestic and economic lives of people and governments, respectively, rely largely on industries of all types. Notwithstanding the utility this phenomenon has a cost. Environment and ecological system are fast depreciating due to adverse effects of industry. With increasing demand and reliance on synthetic and industrial products natural resource is becoming scarce while adding to environmental pollution. The byproducts of industrial utility include chemically harmful and biologically contaminated waste and toxic smoke. As a result, the air is getting polluted and so is water. Humans are at stake and so are animals, plants and aquatic life. We as inhabitant of earth are slowly and gradually depreciating the overall environment for our generations to suffer. Every year, 1 billion tons of waste is produced in the south Asia and it is increasing by 10% per year, while emission of CO_2 from our houses and vehicles is increasing, as is our consumption of polluting energy. Therefore, the preservation of environment is one of the major challenges that world is facing today than ever before.

Water is abundant and vital resource of planet. It is an essential for the survival of life. Seas and oceans possess more than 65% of the surface of earth and produce nearly 75%of oxygen that we breathe. It is important to all types of lives and makes40-95% of plants by weight and about 65-70% of human bodies (Allan, 1995). It is made of two elements namely hydrogen and oxygen, both being vital to life in all its forms. It is present in human, animal and plants/crops. It carries out all the biological functions in lives stated above. Even though water is covering 70% of earth, clean drinking water still remains scarce. Only 1% of the available water is directly being used by humans, and many human activities have considerable pressure on this resource. Water, in all its forms, can be

contaminated or polluted by various sources. The illegal disposal of waste water contributes towards poor nature of water (Mathuthu*et al.*, 1997). Majority of water resource are being contaminated in poor countries due to effluents discharged from various industries. It has been observed that total number of industries, which are registered in the Pakistan are 630 out of them 1220 are highly polluting industries. These are old records which have presumably been increased many folds by now, although, Pakistan Bureau of Statistics does not show as much of industry growth. An approximated 15-20% increase in registered and nonregistered industrialization and associated contamination of water is expected. Industries and factories are major contributor in water pollution in Pakistan because of massive degree of toxic and organic ingredients in their productions (Ullah et al., 2006).A very meager number of industries is actually treating their waste and many of the industries dispose off their waste water directly into the surrounding nullahs, Rivers and fields. For instance, in Khyber Pakhtunkhwa, river Kabul receives over90,000cubic meters of daily waste and massively contributes in polluting the atmosphere.

Modern researches show that if the impurities in water increase beyond a safe limit, as set by WHO and other National Standards, water is said to be contaminated and consumption of such water has harmful effects on human body and growth of all forms of life. The industrial waste either flows out into Rivers/Seas and used for agriculture and domestic use including drinking or percolates down through soil to become part of ground water, which is again consumed by population for various purposes. Hence all such effluents are essential to be removed through Chemical and Biological treatments. The physico-chemical characteristics of a water body reflect quality of water as well as diversity of aquatic life.

Above in view, there is a greater need to look into conceptual and organizational contours of industrial treatment designs and management systems, so that the adverse effects on atmosphere can at least be mitigated if not 100% curbed or prevented. With development in scientific procedures and technological up gradation of means, the proposal of beefing up industrial

treatment strategy is very much doable for an overall good to humanity and eco system.

1.2 PROBLEM STATEMENT

In Pakistan, environment and ecological system is fast depreciating due to adverse effects of industry. With increasing demand and reliance on synthetic and industrial products,environmental pollution, specifically water pollution, is increasing at a rapid pace. As a result of rapid industrialization, the water is getting polluted and so is air. Humans are at stake and so are animals, plants and aquatic life. Additionally, there is a growing demand and shortage of quality water to meet population surge. Notwithstanding the fact that industry is essential to national growth and economy, there is a pressing need to harness the flawed design and treatment procedures of rendering industrial waste, specifically waste produced by Ghee Mills, less toxic across Pakistan in general and KP province in particular.

1.2.1 Environment Problems

Due to the fact that present procedures and designs to ensure treated effluents are flawed and inadequate resulting in depreciating of environment. Environment is being polluted due toxicity of effluents being waived into water bodies or open lands, which are causing degradation. Foul smell and torn aesthetics are also caused by effluents being left into open or into water bodies (Kulkarni, 1979). The foul odor is a result of decomposition of waste material and this polluted water is eventually being used by population in one form or other.

1.2.2 HEALTH PROBLEMS

Wastewater essentially containsbacteria and parasites, which are forms of pathogenic microorganism.These pathogenshave the tendency to cause harm to all forms of biological life. Human parasites particularly are of special importance, in this regard, as they prove to be mostharmful. These need to be eradicated by treatment or else they cause many diseases. Untreated waters used in agriculture cause diseases, specially, when the agricultural products are used by humans or consumed by soil. Recently, many deadly diseases found their root causes in polluted water used in agriculture.

1.3 SCOPE

We have analyzed effluent of Shama Ghee Mill and basing on experimental results of its wastewater we have suggested design and treatment for efficacy of existing treatment settings. The design proposed is meant to bring parameters, which are in excess of NEQS, in the permissible range. The Physio-Chemical properties like pH, BOD, COD, TSS, TS, TDS, Phosphates and Nitrates are studied in depth towards the attainment of aim of this research. All the tests are performed in the Environmental Engineering Laboratories of MCE, Risalpur.

1.4 OBJECTIVES

Main objectives of this study include following: -

- To study waste water characteristics of local Ghee Mill.
- To design waste water treatment based on the data obtained.

CHAPTER NO: 2

LITERATURE REVIEW

2.1 OVERVIEW OF INDUSTRIAL GROWTH IN PAKISTAN

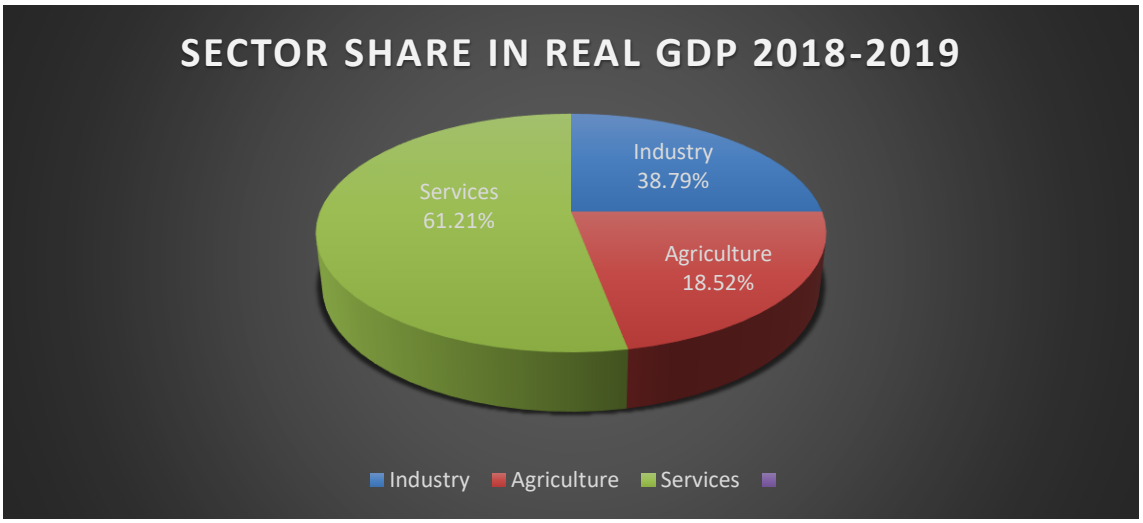
Industrialization performs an enormous function in improvement and growth of a country. Industrialization's mindset emerged in UK, the first industrial property used to be made purposeful in Manchester in 1886.At the time of independence, there was no huge enterprise in Pakistan. It obtained solely 34 industries out of complete 955, while rest was held with India. Such a small range of industrial gadgets have been insufficient for a new country to face the industrial world. As time moved on, Pakistan brought into use all available domestic assets optimally for rapid development of manufacturing sectors. Huge variety of industries have been established after the advent of first five years airplane 1955-1960 which laid focus on the establishment of gaint estates in a country. The production functionality of current units had been raised. Different form of incentives like decrease in obligations of export and export encouragement schemes elevated the export of manufacturing goods. The industrial sector contribution in the GDP rose from 9.7% in 1954-1955 to 11.9% in 1959-1960 notably.

There was drastic shift in 1960 in policy of patron items industries to heavy industries like petro-chemicals, iron and metal mills and laptop tools. There came a shift in boom and export levels and were elevated and industrial area rose GDP to 11.8% in 1960-1965.

From 1970-1977, the industrial growth was at decline by and large due to the separation of Bangladesh and 1971 fighting with India, suspension of overseas aid, flood,recession in world changed the rebate incentives, brought a decline in output of mega industries output. The increase charge reduced to 2.7% during this period.

The GDP of Pakistan typically relies upon three sectors i.e. agriculture, Industry and services.The agriculture area consists of farming,livestock,forestry, fisheries and poultry contribute upto 17% to GDP and 45% of employment of totalwork force and is great supply of earnings for about 55% of population of country dwelling in rural areas.It depends mainlyon the country's exports, presents uncookedraw material to mega industries e.g. sugar and textiles and other industries based on agriculture.

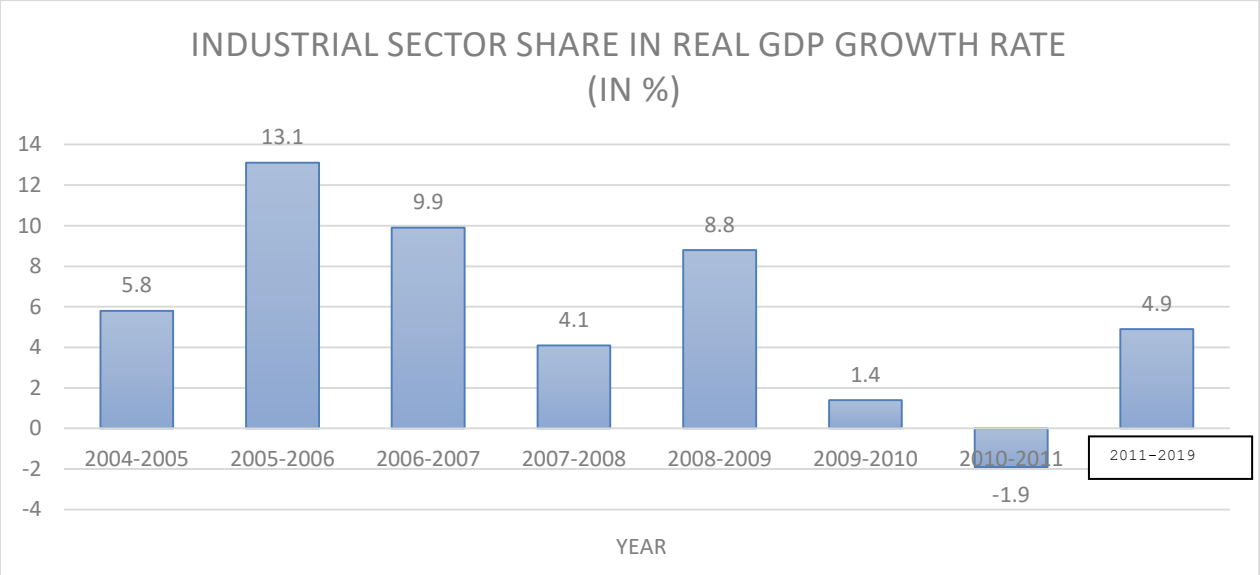
Industry is important and can be regarded as vital for economical sustenance of a nation. For Pakistan, Industry is the 2nd most contributing segment in country's economy and of total GDP, about 37% of GDP. The main sectors in industrial enterprise are small to medium scale quarrying, electricity and distribution, manufacturing and mining of gas. In most industries main source is material coming from native areas there by providing resource and employment to local farmers and labors. The supply and distribution services are vital to sustenance of local population because industry takes a huge share in GDP of a nation. Hence, industrial growth is the lifeline to a considerable segment of population and for an overall good of country. Services to industry contribute 61% in GDP while agriculture contributes about 19% of total related GDP.



Source: Federal bureau of statistics, Pakistan

The industrial contribution in the country's economy kept on fluctuating in past few years. An industrial share was 5.8 percent in GDP growth during 2004-2005, however it increased to 13.1 percent during 2005-2006. It was at its lowest level during 2010-2019.

In Pakistan, so far there are about 39industrial estates that have been set up in all four provinces i.e. Punjab, Sindh, KP and Balochistan. The privatization has additionally elevated the industrial estates in Pakistan.



Source: Federal bureau of statistics

The industrial boom step by step took vicinity however no consideration was once given to the environmental impact assessment (EIA) of these industries. Industries of our country are typically working on imported technology. A huge variety of process second hand machinery was imported from Europe. Environmental laws were nearly non-existent in the country at the time of their induction. Therefore, these industrial gadgets could no longer geared up with environmental gadgets. This resulted in extremely good problems such as uncontrolled environmental degradation, indiscriminate use of treasured resources, deteriorating ecosystems and lousy lacks fear for the environment. It is typically agreed that growth in industrial quarter is inevitable for thefuture economic growth of Pakistan. However, if due importance is not given to the environmental planning and administration in the present and future enlargement of industries then the indiscriminate disposals of the wastes substances will have harmful effect on the environment.

The essential industries responsible for environmental degradation are chemical compounds (including pesticides), textiles, cement, pulp and paper, lathers tanning and meals processing. The unmanaged Arial emissions, liquid effluent and solids waste generated are causing moderate to extreme environmental effects. The industrialists are thinking about investments in treatment of effluent as unproductive. However, environmental defending ordinance (1983) has been made advantageous from July

1996 & National Environmental Quality Standards (NEQs) being formulated. This has forced the industrialists for compliances with these standards

.2.2 MAJOR ENVIRONMENTAL ISSUES OF INDUSTRIES

2.2.1 GLOBAL VIEW.

Northern countries and different parts of the world have gone through an extensive transition in controlling or influencing the effect of industrial activities on fitness and the environment. Initially, efforts have been focused on the formula of legislative and regularity constructions together with enforcement.

The response of industries used to be largely reactive. Industries invested “end-of- pipe” technological solution to ensure compliance with the ever-increasing regulations.Since, the mid-80’s in northern countries, and more these days in the rising and dynamic monetary of the south, industries are taking greater shielding stance. It is a mounted truth that some environmental administration on voluntary foundation can enhance company image, enlarge profits and competitiveness, reduce fee and obviate the want for further legislative measure by means of the authorities. As the development of standards in the environmental field, mainly these being undertaken by way ofthe international business enterprise for standardization (ISO). The emerging set of ISO-14000 requirements is the most complete environmental first-class administration initiative ever undertaken. These standards are predicted to be the worldwide environmental first-rate bench marks for conducting trade in the international market vicinity of the 21st century.

The ISO-14000 will help in reaching the company dreams of compliance with legal requirements, organizing worldwide environmental excellent policies and managing market location expectation.

The non-traffic change barriers by and large regarding the environmental aspects, the export product will pressure commercial enterprise out of world market. The implementation of ISO 14000, which implies compliance to country wide environmental legal guidelines and regulation, will serve to obviate the impact of trade limit emanating from environmental consideration.

As an outcome of these forces, whether or not from pressure corporations of international market conditions, the industrial zone particularly, the export region will have to pull-up their socks and get their act together or out of business.

The sector which would go through maximum, would be the export area, with subsequent effects on state economy. Pakistan has alreadylooked at of what ought to be in store with the ban on surgical goods, carpets and football exports due to high-quality production regulation. The government be-lately at good sized expanse negotiated to make certain future agreement. Such incidences, if no affirmative action is taken, can solely lead to an un-favorable trade balance.

2.2.2 NATIONAL VIEW

Demand for environmental solution received momentum in the industrial zone of Pakistan in 1990 and has been constantly growing. Authorities of Pakistan approved thecountry wide conservation strategy in 1991. It is the environmental coverage of the country. During the identical period, the management hooked up national and provincial environmental protection companies (EPA'S) underneath the Pakistan environmental protection ordinance, 1983.

Environmental motion received the actual step forward after the first assembly of Pakistan Environmental Protection Council (PEPC) in 1983. The council authorized the national environmental high-quality requirements (NEQS) for industrial emission effluents. The accredited NEQS were even requirements applicable to all kinds of industrial

andpublic effluent. A grace duration of one year(12 months) for new and three years of old industrial gadgets were provided for submission with the proposed NEQS. The industries set up after July 1994 had been considered new. For the present industries the deadline was once constant as July 1996. In 1994 the environmental moves secured the political will by means of the promulgation of Pakistan environmental act 1994. The anticipated delivery of felony strength to monitoring institutions enabling them to play an effective role in the implementation of environmental legislation.There are 32 constraints proposing allowable levels of impurities in liquid effluentwhile sixteen parameters for gaseous discharge.

In response, some industrial affiliation such as federation of chamber of commerce and industry (EPPCI), and local chamber mounted its environmental sub committees in 1993. By the stop of 1995, it became clear that EPA's have been dealing with acute issues of ability and capability for the implementation of environmental regulation.

2.3 MAJOR INDUSTRIAL SECTORS OF PAKISTAN

Pakistan rank 41stin the world in manufacture of facility outcomes. The predominant industrial sectors of Pakistan are textile, sports, cement, sugar and fertilizers industries. Other industrial sectors consist of fabricrevolving and weaving, textile processing, leather, pulp and paper, petro-chemicals, industrial chemicals, pesticides and insecticides, dyes and pigments, pharmaceutical, food processing, fit to be eaten oil and fats, dairy, tobacco, steel, automobile, polyester-fibber and yam, wool and processing.Major industrial middle of Pakistan are Karachi, Hyderabad, Tando Adam, Multan, Chunia, Lahore, Gujranwala, Sheikhupura, Sialkot, Faisalabad, Jhang, Rawalpindi, Hattar, Peshawar, and Shama Ghee Mill Nowshehra. Major export markets of Pakistan are Japan, USA, Germany, Saudi Arabia, Kuwait, France, Dubai, South Korea, China, Malaysia and Hong Kong. Biggest export market for Pakistan is USA (15% of whole export).

2.4 PRESENT STATE OF INDUSTRIAL UNITS IN KPK

KPK, nowadays has nearly 1500 industrial units and is engaging some 60,000 people in these units. Many of these industrial gadgets are small industries and are producing consumer goods, butfew giant scales and heavy industries such as sugar, cement, paper, fertilizer, and fabric mills also exist. Sarhad development authority used to be mounted in 1972 to seem after the industrial improvement in the province. Through Sarhad development authority (SDA), three primary industrialstates have been setupand have several large-scale industrial development undertakings. But with the shift in authority's coverage considering that 1990 in the direction of deprivation, delegation and privatization the agency has become many industrial setups over the personal sector and intends to do more of the equal in future. The small industries improvement board (SIDB) is responsible for the upgrade and progress of cottage and small-scale industries. The board manages ten small industrial estates scattered at some stage in the province, it by and large house furniture, metal works, plastic, meals merchandise and leather goods industries. The coverage of absolutely no legislation as resulted in institution of industrial unites on all type of conditions with title consideration for the environment. Most equipment and equipment which werepurchased when environment influences had been not regarded necessary and when energyprices had been low, are nonetheless in use and have no longer been upgraded or changed seeing that then. Even today, the environmental soundness of technologies is in reality a subject when new services are opened.Industrial growth in KPK is lagging the provinces of Punjab and Sindh. The reason for it is remoteness from the market, non-availability of skilled workers and technical exports, power crisis and changing policies of the government. Due to these Reasons, the investors hesitate in installing in this region. At present there are 321 units out of which 124 units are closed, 98 are fully operational, 19 are under construction,10 units are near operational and 70 plots are vacant.(www.sda.org.pk, January 2014)]

2.5 GENERAL INFORMATION ABOUT SHAMA GHEE MILL (SGM, Nowshera)

Shama Ghee Mill situated in district Nowshera is one of the major industrial unit in the province Kpk. Shama Ghee Mill (Nowshera, Amangarh) was established in the year 1960 with the sole objective to develop and accelerate the industrial pace with the establishment of heavy and large-scale industries including paper, steel,chemical, pharmaceutical, stone and marble grinding, oil and ghee, soap and many other industries.Ghee mill provides an opportunity of employment to wide range of individuals and also bears arrangements to handle all its manufacturing products.

IMPORTANT WASTEWATER PARAMETERS

2.7.1 TOTAL SUSPENDED SOLIDS

This parameter analyzes the amount of inorganic particles suspended in water. This shows its value because these substances may be mineral or microbes make water look turbid. How safe may tests results declare this water for domestic or agricultural use, user will always hesitate while using it. It's human instinct to favor clear water. Aesthetically, TSS makes water bodies look unpleasant makes its surroundings prone to garbage disposal eventually converting them into sewerage nullahs. These TSS could be eroded fine particle of rocks. This will eventually settle down and raise bed of water body. Rocks pores can get filled and cause microbe living in them homeless. These TSS can also be microbes ie bacteria, viruses etc that may cause disease like cholera, dysentery, Nausea, kidney failure, diarrhea etc therefore testing it is very important.

Another factor that is caused by these TSS is that they decrease the reach of light till bottom where aquatic plants are present. With no light there is no photosynthesis. This causes lack of DO in water. Which further will affect aquatic life like fishes, aerobic bacteria etc. Sun light when enters such turbid water, it gets absorbed and raise water temperature further threatening aquatic life existence. Lack of visibility makes it difficult to find food and even move through it. These TSS could be useful if minerals in it are known to be good for crops as soil needs it like a fertilizer.

2.7.2 CHLORIDES

Mostly water contains small amount of chlorides. Settlement of marine sediments can cause increase in the amount of existing chlorides due to pollution from sea water, salt water, industrial or domestic waste. Chloride with a reasonable concentration is not harmful to humans but smaller animals and plants can get effected. In areas where salt water and industrial water are discharged, chloride determination provides excellent fore view for regulatory purposes. The amount of chloride in the water used to irrigate crops is generally influenced by the overall salinity of H_2O.

Salinity and chlorides have tendency to rise in roof areas or irrigation plants, making plants difficult in water absorptionbecause of differences in pressure (osmotic) between H_2O outside the plant and inside its cells. That is why, chloride concentrations and total salinity under drinking water parameters are oftenly determined for H_2O used toirrigate salt-sensitive plants. The main flavoring agents that produce salts present in H_2O are sodium chloride and calcium chloride. This odour and taste is due to chloride ions and related ions in H_2O. in some H_2O with only 250 mg/L of chlorides can have real saltiness if cations are in sodium water. In contrast, even though water has a very elevated chloride concentration such as 1000 mg/L, typical salinity may not be present.Chloride in water also has environmental importance. Sodium chloride (NaCl) produces salty when its concentration is greater than 250 mg/L. Chloride is generally limited to 250 mg/L in water supply intended for domestic water supply.

When water resources are scarce in many parts of the world, after the human body becomes accustomed to water, sources containing 2000 mg/L are used for domestic purpose without adverse effects. Chlorides can also destroy the concrete. It is also very important to know the exact amount of chlorides in water to choose the type of desalting device. Chlorides also interfere with the determination of the need for chemical oxygen (COD).

2.7.3 THE pH VALUE

We need PH test to check the acidity and alkalinity of water. These are measures of positive hydrogen ion and negative hydroxyl ion that are in concentration. The pH chart list 7 as neutral e.g. water. Below it acidity increases till one as the most acidic in nature like HCL and H_2SO_4 etc. Similarly, basic or alkaline behavior increases from 8 till 14. And 14 being the toughest base. Parameter of pH affects the efficiency of chlorine by

determining the amount of hypochlorous acid i.e. freely available chlorine that is produced.

a. pH 6.5 : 85-90% of the Chlorine will be Hypoclorous Acid.

b. pH 7.5 : 45-50% of Chlorine will be Hypoclorous Acid.

c. pH 8.5 : 20% of chlorine will be Hypocholorous Acid.

At night water tends to get acidic due to absorb carbon dioxide in water to make carbonic acid due to aquatic plants. Acidic or basic both kind of water is irresistible to life. No plant, fish or microorganisms can survive when it passes the certain limit. Sources of such impurities are industries like soap manufacturers, textile mills, leather tanning and Rubber manufacturers. It gives bitter taste and bad odor. Smells like rotten eggs. Therefore, makes water useless for agriculture or domestic consumption. Alkalinity's only advantage where soil or water is acidic i.e. it can neutralize its effects.

2.7.4 TOTAL DISSOLVED SOLIDS

As visible from name TDS counts for total soluble material that exists in solution. They may include salts and other minerals, in fact anything other than pure water. We determined hardness of water through presence of cations. These cations are part of salts like sulfates and carbonate of Calcium and magnesium etc.

Generally, we calculate water hardness by measuring the quantity of Calcium Carbonate present in it as follow:-

Table 2: Concentration of $CaCO_3$(mg/L) Classification

Mg/L	Water hardness parameters
<74-75	Water is soft
70-150	Water is moderate
150-300	Water is hard
>300	Water is very hard

This Calcium comes in water when in contact with limestone etc. Other elements like magnesium, iron and manganese source from soil and rock erosion but are in fewer concentrations.

Because of hardness use of such water becomes limited and expensive. For temporary hardness we need to boil water or further treat it. Hard water uses more soap and

detergents. It can cause diseases in plants and animals. Water channel through which such water passes by get clogged and deposits can be seen in storage tanks.

Hard water has more tendencies to corrode things it may get in contact with e.g. radiators, water heaters and geysers and pipes etc.

2.7.5 (BOD) BIOCHEMICAL OXYGEN DEMAND

It is the demand of dissolved oxygen required for microbial colonies to decompose organic matter/waste in waste water. Industrial effluent may contain proteins, carbohydrates and fats etc.

These substances are readily biodegradable through the actions of natural microbes. Some quantities of organic matter is oxidized to water and $CO_2$and the rest is assimilated before use for formation of new microbes. Over the extended time these microbes will also die and become food source for decomposers. End state is when all of organic carbon is used up through oxidation. That is the desirable state that is to be achieved by manipulation of biological facts. It has been proven through researches of many biological experts and industrial scientists.

It takes five days for this process to complete through following kind of bacteria:-

- **Aerobic.** Processin which bacteria used in BOD require DO to decomposed organic matter. Such bacteria are called Aerobic bacteria.
- **Anaerobic.** Process includes bacteria that do not need oxygen to decompose organic matter. Such bacteria are called anaerobic bacteria.
- **Facultative.** Processes in which bacteria first use DO for decomposition and when that DO is used they start acting as anaerobic bacteria and continue their work.

Greater amount of DO is the key for success as most of the existing microbes are aerobic i.e. use oxygen to survive

When biodegradable waste is let to flow into water resources as Kabul River or for that matter into streams and Nullahs, dissolved oxygen is consumed by microbes during oxidation process, hence, DO level increases as day rises and gets lower at night as photosynthesis stops. Other nutrients like nitrates and phosphates etc for such bacterial colonies come from minerals and dead plant decaying.

Aerobic bacteria component consumes most of dissolved oxygen at the sake of other aquatic life, which suffocate for shortage of oxygen. This is state of high BOD by a

stream. When oxygen demand of a waste is so high as to eliminate all or most of the dissolved oxygen from a stretch of water bodies, organic matter degradation occurs through the activities of anaerobic organisms, which do not require oxygen (Meertens *et al*., 1995).

Not only does the water then become devoid of aerobic organisms, but anaerobic decomposition also results in the formation of a variety of foul smelling volatile organic acids and gases such as hydrogen sulphide, methane and meracaptans (certain organic sulphur compounds). The stench from these compounds can be quite unpleasant and is frequently the main cause of complaints from residents in the vicinity.

Organisms that are more tolerant of lower dissolved oxygen levels may appear and become numerous, such as carp, midge larvae and sewage worms. Organisms that are intolerant of low oxygen levels, such as caddis fly larvae and may fly and stone fly nymphs, will not survive. As organic pollution increases, the ecologically stable and complex relationships present in water containing a high diversity of organisms is replaced by a low diversity of pollution-tolerant organisms with increasing populations.

2.7.6 (COD) CHEMICAL OXYGEN DEMAND

It is a quick and effective way of decomposition of organic matter by oxidizing agent like potassium permanganate. Unlike BOD it's an effective process in which results can be obtained in hours rather than days. As it includes chemistry therefore we can adjust things as per our desired results but that comes on a cost of economy.

(COD) Chemical oxygen demand test is most adapted way to indirectly measure the amount of organic matter in water. Mostly used application of COD is to determine the amount of organic matter in the form of pollutants found in surface water like rivers and lakes etc, making COD a useful measure of water quality, it is expressed in milligrams mg per liters (mg/L), which indicated the mass/amount of oxygen consumed per liters of solution.

COD depends on a fact that mostly all of the organic matter can be fully oxidized to create carbon dioxide CO_2 with a strong oxidizing agent under lower pH levels. For many decades, the strong oxidizing agent was potassium per magnate ($KMnO_4$) used for measuring chemical oxygen demand. Measurements were called oxygen consumed for permagnate, rather than the oxygen demand of variety of organic matter that has the wide range and in many cases BOD measurements were often much higher than

results from COD measurements. This showed that potassium permagnate was not able to effectively oxidize all organic matter in H_2O, proving it to be a relatively poor oxidizing agent for determining chemical oxygen demand.

This lead to other oxidizing agents like potassium dichromate and potassium iodide, which were used afterward for determining of COD. From all of these agents, potassium dichromate ($K_2Cr_2O_7$) is the most effective i.e. it is relatively easy to procure, economical to purify and is able to closely complete oxidizing majority organic matter.

2.7.7 TEMPERATURE

Temperature is a physical parameter in determining the effluent characteristics but largely effects other parameters of effluent. Wastewater temperature is usually higher than that of clean water (H_2O) for domestic use. It is important to measure temperature because mostly treatment schemes of wastewater include biological lives which are dependent on it. The wastewater temperature changes depending upon weather conditions and climate of the region.

Temperature will vary from -14 to 25 degree Celsius in cold places, while temperature will vary from 12 to 45 degree Celsius in warmer regions (Ron and George, 1998).Many aspects of chemical and biological reactions depend on temperature of water. Much needed catalytic effects are rendered by water teperature. Bad effects, such as odor and taste will result due to non-solubility of gases like sulphides and oxygen (Hariharan et al., 2010).

2.7.8 PHOSPHATES

Phosphorous may cause aquatic biological activity to be enhanced and hence putting strain on dissolved oxygen. That means a high BOD at the sake of other essential functions of aquatic life (Perry et al., 2007). Although Phosphorous may have a positive effect for nutrients of aquatic life but it does increase COD and BOD to the adverse side of it (Mahdieh and Amir hossein, 2009). The study carried out on sedimentation and Georgia's fishes revealed that nitrogen concentration of 0.5 mg/L are toxic to rainbow trout (Barnes *et al*, 1998).

Naturally phosphorous never exist in pure form and available as phosphates. Phosphorous is a key growth element for of animals and plants. Phosphorus in its pure form it exists in white color which is extremely poisonous. Industries use white phosphorous to make other chemicals and when the military uses it as

ammunition.Phosphates are used in special glasses, in steel manufacture, sodium lamos, in military applications like special ammunition i.e. smoke screen and incendiary bombs etc, and in other applications such as toothpaste, detergents, pyrotechnics and pesticides. Phosphates enter streams from animal and human waste, laundry cleaning, fertilizer runoff and majorly industrial effluents. These phosphates become hazardous when they are in abundance in aquatic plants.

Effluents have morephosphorous compounds. Organisms use phosphorous as a nutrient for their growth. This happens in wastewater and natural clean water bound to oxygen to form phosphates. Phosphates come from variety of industrial sources like agricultural fertilizers, domestic wastewater, geological formations, Mills waste process and detergents.

This may cause algae growth at a rapid pace decreasing DO. High phosphorus quantity causes badodor and taste problems in drinking water. If the presence of phosphate is higher in H_2O, the algae and weeds will grow rapidly, may block the waterway, and may use excessive amount of precious oxygen (in the presence of photosynthesis and as the algae and plants die and are consumed by aerobic bacteria). The result may be the end of lives of many aquatic organisms (USEPA, 1986) such as the fish.

That’s whyit is critical to test for phosphorous effluent because phosphorous removal is an essential role of wastewater treatment plants. Phosphates are classified as organic Phosphates, orthophosphates and polyphosphates respectively.

2.7.9 NITRATES

Nitrates are as vital a component for water as well as aquatic life as any other factor but on the flip side its concentrations need to be controlled or it can adversely effect many water parameters. Due to aerobic decomposition phenomenon, the most lethal nitrogenous compounds are produced which assist in oxidation. Water which is good to use has minimal amounts of nitrates essential to its wellbeing (Jaji et al., 2007). Many environmental magazines and researchers agree that Nitratesare the most dangerous form of nitrogen from pollution point of view where these percolate down the surface and cause eutrophication process and apart from risks to animal life it has severe to moderate health hazard indicator to human life aswell.Plants and microbes readily absorb nitrates, which are not at all stable, as part of their food protein requirement. It can be broken down to nitrogen gas, nitrous oxide or nitric oxide through

de-nitrification process. Historical medical and biological study line shows that the reason why nitrates are toxic are the fact that these reduce to nitrites. The major biological effect of nitrite in humans is its involvement in the oxidation of normal hemoglobin to met-hemoglobin which is unable to transport oxygen to the tissues. This condition is called met-hemogloninaemia or blue baby syndrome. Young infants are more susceptible to met-hemoglobin than older children and adults(Australian Drinking Water Guidelines ADWG, 1996).

AVAILABLE OPTIONS FOR TREATMENT OF WASTE WATER

A lot of scientific knowledge pertaining to fields of chemistry, Physics, biology and mathematics is involved before the effluent is let into environment.Basically, there are two types of treatment plants, as follows: -

- Biological Plant
- Physical and Chemical Plant

In general, Biological plants are used for more severe cases or where the probability of domestic use is higher. Primarily these plants purify water off bacterial impurities and bring the biological aspects into permissible limits as laid down by NEQs/WHO.

Chemical/Physical purification plants are essential for most of the wastes generated at industries/cities might not be in capacity of microorganisms to be removed. Some of the industries that process wastes generated from biodegradable materials may combine biological treatments along with chemical.

2.8.1 A CONVENTIONAL TREATMENT PLANT

It consists of an assembly of units in sequential order as per their functions, in such a way that output of one unit serves as the input of other.In the beginning of treatment process physical aspects are treated e.g. floating objects and subsequently waste is treated for chemical and biological aspects.

Ideally, processes deal following aspects: -

- Convert dissolved impurities into gaseous/solid form, so that they can bephysicallyeliminated.
- The second way is to physically convert impurities into sludge/solids which remain a part of waste but are not considered harmful.The residual solids also need to be treated before these could be put to domestic use.

The conventional sequence or set of processes or purifying units that are usually part of a wholesome treatment plant are as following: -

2.8.1.1 **PRELIMINARY TREATMENT**. Initial and foremost step is treatment for physical impurities/aspects and involves regulating incoming flow and removal of floating objects, grits, sandy material, plastics, settle able inorganic stuff, vegetation etc. Preliminary treatment forindustries includes all impurities that are not present in domestic effluents.Preliminary treatment includes: -

2.8.1.1.1 **Screening.** For getting rid of large floating objects, like plastics or vegetation, angled bars are installed at the inlet channel/pipe. These objects may cause stoppage in the pipe of sewage pumps. The waste accumulated can be disposed of as per policy guidelines or can be used as fertilizer in some cases. Screening and Grit Chambers may follow each other. The waste is cleaned off periodically.

2.8.1.1.2 **Equalization.** The effluent collection points receive effluents of varying volumes and strength hence there is a need to stabilize the effluent stream for efficient working of all subsequent processes. Equalization tanks are used to for batch treatment systems so that full batch volumes are available for treatment.

2.8.1.1.3 **Comminutors.** Comminutors are sewage grinders used to break down incoming large solids into process able smaller particles for efficient processing. These may be of the form of revolving slotted drums, though which the sewage is passed and crushed or Cutters mounted on the drum.

2.8.1.1.4 **Grit Chamber.** Grit is gravel, sand and mineral matter they have diameter of 0.15-0.20 mm or larger and has specific gravity of about 2.65. it is the system designed to settle inorganic material of size given above and let organic matter stay

suspended. It can be in the form of a tank or a chamber/basin. Three basic kinds of grit chambers are used, as following: -

- Vortex Grit Chamber
- Aerated Grit Chamber
- Gravity Flow Grit Chamber

Aerated Grit Chambers are more viable option for industries to suit the wide flow range of effluents. They are versatile and allow quick addition of chemical admixtures and quick flocculation. It removes smaller particles. Grit hence removed does not cause excessive wear and tear of subsequent units.The influx of air doesnot allow lighter organic impurities from settling while at the same time reduces bad odor. Settled grit is eventually pumped out of the system to be disposed of according to laid policy (Jern, 2006).

2.8.1.1.5 Skimming Tank. Skimming tank is a mechanism to extract greasy matter from effluent. If not skimmed, grease may block trickling filter and may also cause biological flock. The effluent enters the tank from top and stays there for some time after which it is exited from a bottom hole/slot.

2.8.1.1.6Primary sedimentation/Settling Basin. The specific gravities of much of suspended impurities is not much larger than water hence sedimentation tanks are designed to give them enough time before they could be made to settle. Scrapers are given at the bottom of these tanks, to collect sludge and dump it into appropriate bins for further disposal, along with skimming mechanism to collect grease and other substances that float up to surface.

2.8.2 SECONDARY TREATMENT. In general, Biological Treatment purifies waste water from dissolved or colloidal solids. Biological Treatment system is installed at place where oxygen and natural environment interaction is easy and in abundance. This achieves economy and more effective mean of

getting less harmful biproducts. Presently, there are two kinds of systems for secondary treatment. As given below: -

2.8.2.1 ATTACHED GROWTH PROCESS

This is the kind of treatment system in which micro-organisms are responsible for reduction of organic matter, present in waste, into gases and cellular tissues. Which subsequently get attached to any inert material, as plastics and stones. The effluent from thesystemis usually discharged to a clarifier to settle and remove thesolids. Generally, this process is efficient in terms of low cost, low maintenance and economy.

2.8.2.2SUSPENDED GROWTH PROCESS

In this method, as well, microorganisms convert biological impurities to gases and cell tissues. Examples of this process are: -

- **Activated Sludge Process.** In this process micro-organisms are used as part of bacterial input as mean of food, to treat water aerobically. Involves waste water mixing with air to reduce organic component of water into microbial tissues and CO_2 as biproduct of the process. This system as evident is cost efficient and simple. Aerated tanks are used for interaction of waste and air.
- **Oxidation Ponds.** These are ponds which are used to treat water by giving interaction with sunlight. Some forms of Algae and Bacteria get treated through oxidation by this mean.
- **Aerated lagoon.** These are ponds similar to oxidation ponds and these have exactly the same function as oxidation ponds. Often called Biological Lagoons.

CHAPTER NO: 3

SAMPLING AND METHODS USED

3.1 STUDY AREA

The layout and the sample collection site are shown in figure. A sample was collected from various exit points of the Shama Ghee Mill's effluent and from main drain of mill. The sample was collected from the main drain at multiple times.

SAMPLE NO	INDUSTRY: SGM	ACTIVITY
W 1-2	Influent Drain	In Situ Preliminary tests/Lab Test
W 3-5	Effluent Drain	In situ/Lab Tests

3.2 METHODOLOGY OF CONDUCT

The study involved sample collection of effluents from main drain. This industry discharges its effluents into nearby streams. The effluent is mainly used for irrigation purposes, and that too illegally. The flow ends subsequently at River Kabul. The

locations of samples collection are shown in figure above. Methodology adopted includes collection of 2 representative samples per week and a total of 12 samples over a period of 2 months.The tests results are included for 5 of most representative samples.

3.3 GENERAL CONSIDERATION

Modern wastewaters fluctuate essentially in contamination attributes. Great consideration is essential in the assortment, transportation and capacity of tests that are delegates of the predominant conditions. Tests ought to be gathered and put away in a manner in order to keep it from pollution.

Careful consideration must be given to the location, type, frequency and duration of the sampling to be done in the field. Samples are so collected that the tests performed give results for original effluent, as a representative. Volume to be collected, the treatment agent that is added and holding time before tests are all essential considerations to be kept in mind.

Sample was collected from effluent channels. The samples was collected and stored into thoroughly cleaned one and half liter plastic bottle and was washed with drinking water. A bit of washing was done with sample before actually taking volume of sample. These sample were placed in cool box and kept under 4^{o}Cand and then transported into lab for tests.

3.4 TYPES OF SAMPLES

availability of funds, variability of water flow and quality are some of main factors taken into mind before selecting the type of sampling method. Some of the types are as follows: -

Three main types of samples are

- Grab samples
- Composite sample
- Integrated samples

GRAB SAMPLE

grab sample is taken discreetly from a source after 15 minutes. It can be simoly taken by scooping up a bucket or cup. The assortment of a get test is suitable when this is wanted to: -

- Know water quality at a particular time.
- Information about minimum and maximum time.

3.4.2 COMPOSITE SAMPLE

A combined sample by mixing grab samples taken over a period of time interval i.e. 24 hrs. Number of grab samples to be mixed depend upon the concentration of flow.

3.4.3 INTEGRATED SAMPLES

It is similar to composite but the depth of taking sample varies rather than time. The grab sample collected at various points and at different depths across the width may be mixed in proportion to relative flows at these points.

3.5 SELECTION OF SAMPLE TYPE

- The grab sample is used when: -
- The flux is not continuous.
- The properties of water or wastewater are relatively stable.
- The parameters to be analyzed may change with storage such as dissolve.
- Gasses, residual chloride, soluble sulfide, oil and grease, microbiological, organic, and pH parameters, etc.
- Maximum, minimum or variability details needed.
- The history of water quality is to be established based on relatively short time.

- The spatial parameter variability is to be determined, for example, the parameter variability throughout the cross section and or depth of a stream of large body of water.

3.6 SELECTION OF SAMPLING LOCATION

The following consideration were taken into account while selecting location for sampling: -

- It must be a location upstream or downstream of a significant outlet of an industry.
- At most representative points such as before entering into tank 1 and after entering into exit drain.
- From several industrial exit locations to obtain the required information.
- Keeping in view the intensity of flow and temperature.

Keeping in view the above consideration we have selected the SGM main drain and exit points from mill.

3.7 METHOD OF SAMPLING

As stated above, the pros and cons of each sampling method and type is considered. Generally speaking, manual technique is more suited for small scale and one-time collection effort but if the repeated samples are required at continuous or random intervals, automated sampling type may be more efficient. The care exercised during taking samples is of more importance over the technique or method adopted. Great care and precautions must be exercised in order to take samples and maintain their integrity.

3.8 VOLUME OF SAMPLE

The volume to be taken must fulfill two basic requirements. One, that it must be in sufficient quantity for all tests to be performed. And second that quantity must be able

to take into account the quality control requirements. Since the SGM was at a far distance and repeated approvals were to be taken from MCE authorities hence whenever the visit was made for sample collection, 1.5-2 liters of samples were obtained to forestall any eventualities and to be sufficient for unforeseen requirements of lab work.

3.9 HANDLING AND ITS PRESERVATION OF SAMPLES

Once the sample has been collected, it must be analyzed immediately or stored in a container with a condom to preserve the integrity of the sample, complete preservation of samples, domestic sewage, industrial waste or natural waters.No matter the nature of the sample, complete stability can never be achieved for every constituent. Techniques of best conservation can only be used to prevent the chemical and biological changes that occur in a sample after the sample has been removed from the parent sourceTo maintain the sample's infirmity, appropriate container selection, container pretreatment is required, and holding times make the sample preservation program an integral part of it.

Preservation, holding times, and samplingrelated materials depend on the parameters to be analysed. In general, the shorter time between sample collection and analysis will elapse, the more reliable the analytical results will be.It is difficult to say precisely how much time between collecting the sample and analyzing it; this depends on the characteristic of the sample, the specific analysis to be performed, and the storage situation.

3.9.1 METHODS OF PRESERVATION

Methods of preservation are relatively limited and generally intended to cause biological retardation, to lessen the effects of hydrolysis of chemical compounds and also in parts reduce the volatile tendencies of compounds under study. Preservation is most vital of all sampling measures and it must be ensured at all times to not jeopardize that entire collection effort. Analysis is as good as the input sample. Many techniques are used of which pH control, Icing or refrigeration, chemical preservative addition and freezing are most common. The volume to be preserved, the

distances from labs to factory and then most importantly the nature of waste sample would indicate the use of any of preservation means. Whatever the preservation method and mean used, care must be taken that the integrity of required characteristic must be maintained. We did not use any preservative since the type of analysis that was run did not foresee any need for refrigeration. Other than that, the distances or time lapse between testing and collection was also not great.

3.9.2 Chemical Addition

A particular chemical substance can be added into the sample to preserve an intended quality of sample, which can be retained for considerable time. After which the lab should reach lab for tests.

3.9.4 FREEZING

Freezing primarily is used to increase holding time. Sample can then be taken to lab over extended distances or lab tests performed after desired period of time. This is a credible mean of preserving samples.

3.9.5 REFRIGERATION

To maintain integrity of sample vis a vis increasing holding time, a sample can be put in refrigerator or iced. It is most common method in use.

3.10 EXPERIMENTS PERFORMED

PARAMETRES	TECHNIQUE
COD	Open Reflux
pH	pH meter
BOD	Dilution method
TSS	Gravimetric meter
TDS	Gravimetric meter

Table 3.2: Water quality parameters analyzed and technique used

3.10.1 EXPER1MENT NO: 1

To determine PH value of given water Sample.

3.10.1.1 Apparatus:

Stand, beaker and colorimetric examination of paper and water, buffer tables (PH4, PH7), normal PH solution, pH meter probe.

3.10.1.2 Procedure

3.10.1.2.1 Colorimetric Method

Dip calorimetric paper into samples of water. Calculate the color of the table paper and not the pH of the water against this colour, this is the sample's PH.Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused duie to faulty procedural technique or faulty reading may jeopardize the entire analysis effort.

3.10.1.2.2 Electrometric Method

Press PH meter key "01" to get the meter in working condition. Press pH key and calibrate key to display 00.00 readings in the screen. Put the probe into standard solution and press the key to get standard value of 7. Dip the sample in a water sample and press the"dispersed" button and pH key to get the sample pH. Read the pH value from a tablet.Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused duie to faulty procedural technique or faulty reading may jeopardize the entire analysis effort.

3.10.2 EXPERIMENT NO: 2

To Determine the demand for biochemical oxygen demand from a given sample.

3.10.3.1 Apparatus

B.O.D bottle, desk, pipit filter, graduated plug, manganese sulphate, alkali iodide acid, H2SO4 concentrate, star itch indicator.

3.10.3.2 Procedure

Take two B.O.D tubes, and fill them half with water distilled. Using pipit, add 3ml of waste water (polluted water) to the B.O.D tubing. Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused duie to faulty procedural technique or faulty reading may jeopardize the entire analysis effort. Now fill the distilled water tube and fasten a stopper on it. Put one of the tubes in an incubator for 5 days at 20 ° C. Use pipit, apply 2ml of Manganese sulfate (MnSo4) to other tubes, and shake well. Add 2ml alkali iodide oxide and shake well (if there is oxygen, otherwise the color will be brown white). Add 2ml of concentrate H2SO4 and shake well to give a mustard oil-like color. Take 200 ml of this solution in a graduated cylinder and add 1 ml of a starch indicator to it. Placed a graduated cylinder under the desk

containing regular sodium sulfate solution and note the initial reading. Fill the dissolved oxygen with the substitution of the initial reading from the final reading. The dissolved oxygen is measured in similar ways after incubation of the first pipeline. Find the B.O.D. by using the formula: -

B.O.D (mg/L)= (zero day D.O -5 days D.O) X 300/ml

3.10.3 EXPERIMENT NO: 3

To determine suspended solids of a given water sample.

3.10.3.1 Apparatus

Filter media paper, filter glass, beakers, funnels, washing cloth, suction motors, pumps.

3.10.3.2 Procedure

Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused duie to faulty procedural technique or faulty reading may jeopardize the entire analysis effort.Take a filter glass of known size and weight. Let its weight be W1. Pour waste water sample of 50ml over the filter glass and switch on the water pump. Find out the weight of the filter glass along with the sample remain on the filter, let it would be W2. Find the amount of suspended solids by using the formula: -

Weight of suspended solids :

{(weight of filter + sample)- (weight of filter)X 100}/W1

$$V = ((W_2-W_1) X 100)/W_1$$

3.10.6 EXPERIMENT NO:4

To determine total dissolved solids.

3.10.6.1 Apparatus:

Evaporation dish, water bath, oven, desiccators, analytical balance, graduate, cylinder, filer, dish tongs, vacuum pump, crucible tongs, forceps smooth-tipped.

3.10.6.2 Procedure:

Take weight of empty dish in balance.Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused duie to faulty procedural technique or faulty reading may jeopardize the entire analysis effort.Weight noted be called w1. Now mix well the sample and stir and pur into funnel with paper.Pour upto 100 ml of sample. Upto 75 ml of sample be poured separately into some dish by using pipette.Now oven temperature is made to reach 105 degrees.Desired temperature must be maintained in ovens at all times since fluctuations van be devastating on results. Place the dish into oven and care should be taken to avoid splattering during oven procedure or during boiling. Now carry out drying to get the mass of residue. Dry for upto 2-2.5 hrs in controlled environment to not instigate any un wanted impurities. Standard dryness is achieved through use of desiccators. Weight the dish as soon as it is cooled down to preclude any chances of environmental interaction causing any additions or absorptions. Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused duie to faulty procedural technique or faulty reading may jeopardize the entire analysis effort.

3.10.7 EXPERIMENT NO: 5

Determine COD of water sample.

3.10.7.1 Apparatus

Reactor COD, Potassium Dichromate, Silver Sulphate, H_2SO_4, indicator for ferrous, Ferrous Ammonium Sulphate.

3.10.7.2 Procedure

Keep in mind that all precautions and procedures must be adopted before the start of any tests or taking any reasons. An error caused due to faulty procedural technique or faulty reading may jeopardize the entire analysis effort.Take a measured amount of waste water sample in one tube and distilled water in another tube. Admeasured amount of potassium dichromate (K2Cr2O7) say 1.5ml in both the tubes in the presence of sulfuric acid (H2SO4) and is boiled for 2 hours at 120 OC. Then after cooling it to room temperature the samples are transferred to the conical flask. Add 2 drops of Ferrous indicator in the content and titrate the contents against standard ferrous ammonium sulfate.The dichromate gives a measure of oxygen required for oxidation of organic matter.

CHAPTER NO: 4

RESULTS AND DISCUSSIONS

4.1 OVERVIEW ON THE RESULTS OBTAINED. One fact that needs to be understood right here is that test results differ from sample to sample for multiple reasons, one of which is variation in manufacturing and methods of production that may vary according to scale and demand.The results are as good as the accuracy of human work involved and the accuracy of sampling and how good and representative the samples could be. The analysis can be only as efficient and accurate as the data on which it is being run. Their can be a multitude of unknown inaccuracies involved despite the utmost care that was exercised during the process of taking readings and samples. The discussions are based on researches off the internet, the comprehensive individual study taken by syndicate, the literary sessions conducted with our sponsor instructor, the technical and conceptual advice that was taken from experts working in SGM and lastly, it is based on previous credible deductions by a number of authors on the subject.

4.1.1 THE pH OF WASTE WATER

The pH ranged is from 5.4-8.5. The most pH of PVC and marble enterprise whilst the minimal value is recorded in the ghee industry. The pH show that the waste is broadly speaking acidic in behavior however in some industries it is alkaline. The permissible NEQS limits for pH are 6 - 10. This suggests that most of the industrial effluents of a variety of industries are appropriate for aquatic lifestyles and do no longer require pH treatment without the ghee industry. The decrease value of pH in the ghee enterprise is probable due to the presence of natural materials. The pH can be reduced with the aid of the carbon dioxide launched through the microbe breaking down the natural wastes (Matovu, 2010). Carbon dioxide thaws into water and form carbonic acid. As it is a light acid, massive quantities will decrease, pH and waters with low pH come into interaction with positive chemical mixtures and metals, this frequently creates them extra toxic than usual. When pH is under permissible limits, fish arise as tending to fungal contagions and different bodily damage. When pH of water cascades, the mixing of calcium carbonate is lowered, impeding shell increase in aquatic organisms.

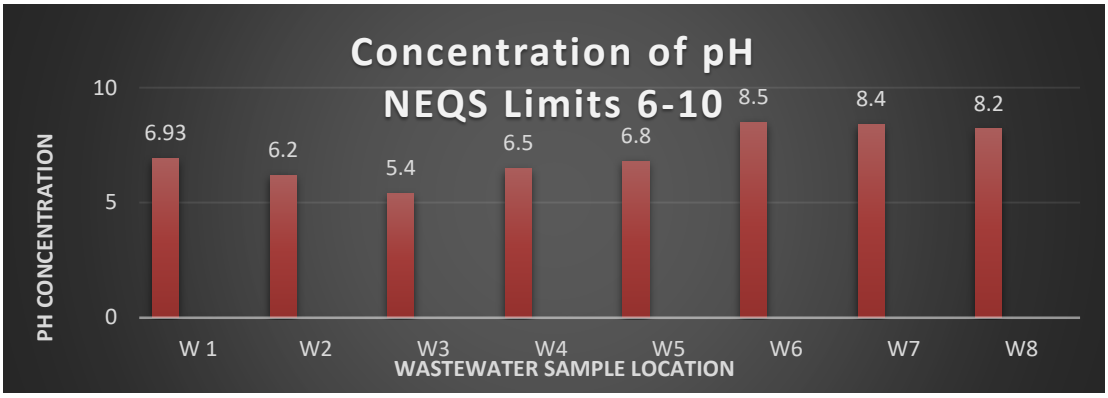


Figure 4.1: Concentration of pH

4.1.2 BOD OF WASTE WATER

BOD is a chemical method for reckoning out the amount of dissolved oxygen desiredby means of cardio organic organisms in a structure of water to destroy down natural cloth current in specified water pattern at a positive heat at a particular time period. The BOD values of a number industrial effluents are proven in the chart below. BOD assorted appreciably alongside sampling web sites and ranged from 30-415 mg/L. The permissible NEQS restrict for BOD is eighty milligram/litter.

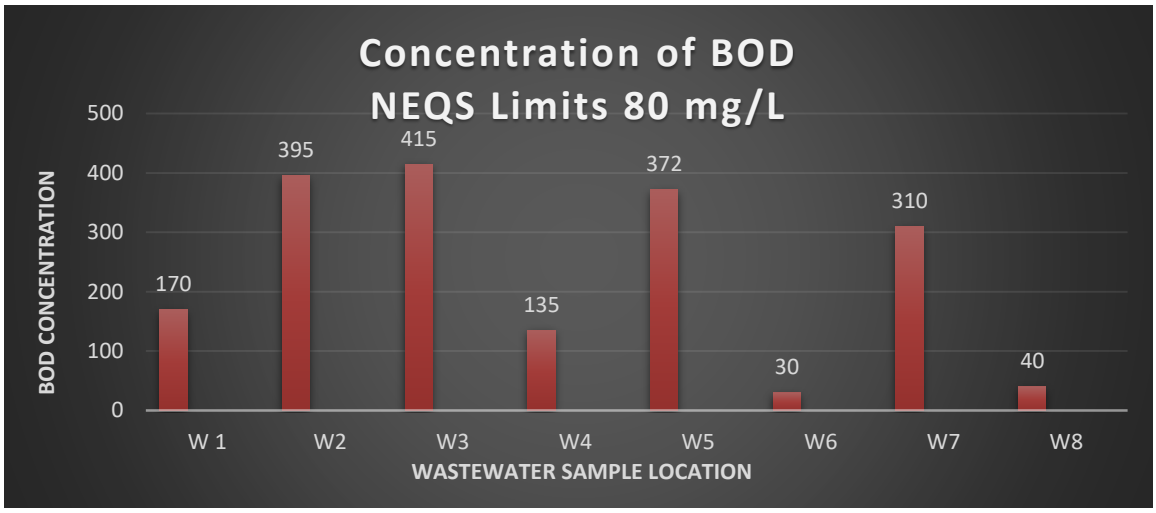


Figure 4.2: Concentration of BOD

BOD values bought from the pattern analyzed are plenty greater than permissible limits without in PVC enterprise and fundamental drain-2.Wastes containing excessive BOD are accountable for a substantial reduction of oxygen ranges in the precise region of the flow or soil. The excessive BOD in Ghee enterprise

suggests the presence of excessive content material of biodegradable natural pollution and fatty substances in the effluent from this industry. The excessive BOD additionally creates contaminated stipulations producing obscene sensing hydrogen sulfide, which in flip can impulsive iron and any thawed salts, twisting water black and appealing toxic for river lifestyles. Furthermore, if these wastes are freed into civic manure and used for irrigation, this will use additional BOD load on the manure. The microbes existing in the mess will minimize the nitrate into nitrite plus ammonia, sulfates into sulfides plus ferric iron into ferrous iron at very low foci of oxygen. So, they will create a terrific irritation for the environment. Hence the BOD of these effluents renders them unfit for irrigation. Also if waste water containing excessive BOD is discharged into move it will have an effect on the aquatic lifestyles owing to reduction of oxygen.

4.1.3 COD OF WASTE WATER:

It is a measure of the ability of water to ingest oxygen during the decay of organic matter and the oxidation of lifeless chemicals such as ammonia nitrite. COD extents are usually made on trials of waste waters or of natural waters polluted by local or manufacturing wastes. COD of the wastes, depicted in chart below, displays that all the effluents had higher COD than the acceptable NEQS limits (150mg/L). High concentration of COD indicates a heavy load of organic and inorganic pollution that require more oxygen for oxidation under higher thermal conditions. Effluents need further elimination of COD through proper treatment methods before irrigation (Totawal et al., 1996) and disposal into

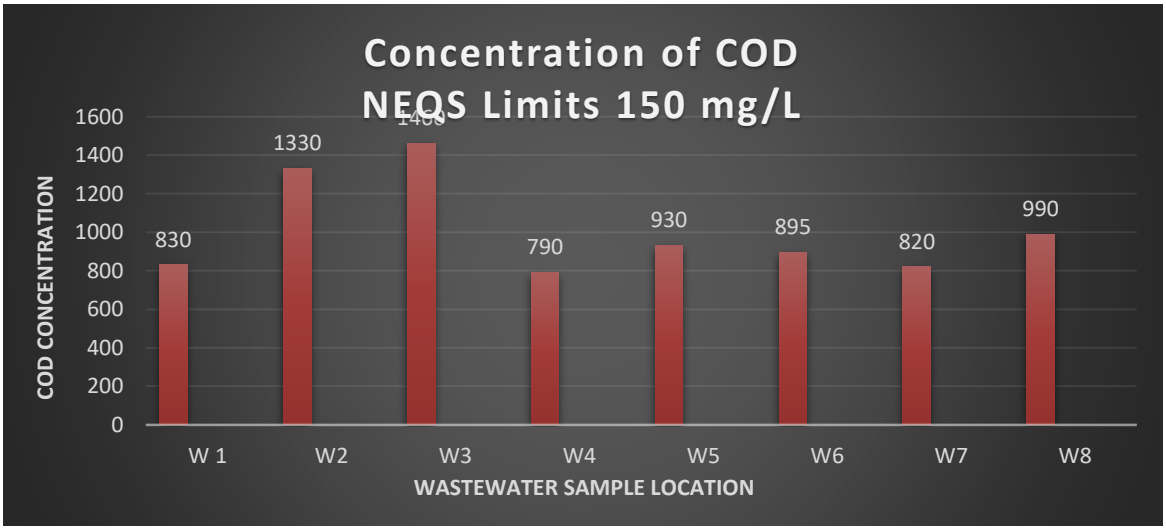


Figure 4.3: Concentration of COD

Streams. The data also discovered that the effluents in stated situation are not fit for release to terrestrial water bodies, as it would be harmful for human and aquatic life due to the high concentration of toxicants.

4.1.4 TSS OF WASTE WATER

The NEQS vary for total suspended solids is one hundred 50mg/L. The TSS of industrial effluent fluctuated as of 125-1125mg/L with a propose price of 340mg/L. The ultimate consequence assuredly suggests that the TSS of all industrial effluents are overhead the allowable NEQS limits without cleaning soap & detergent and textile industries. The total best fee was once logged of Marble and PVC enterprise whereas the lowest used to be that of a fabric mill. The concerns advise that these effluents will purpose coping with troubles if used at once in grounds or tending of in the river will reason harm to the aquatic lifestyles as it will decrease visibility and take in light. TSS will diminish photosynthesis. Fine particles can also additionally block and graze fish and insect gills tissue and intervene with egg and larval growth.

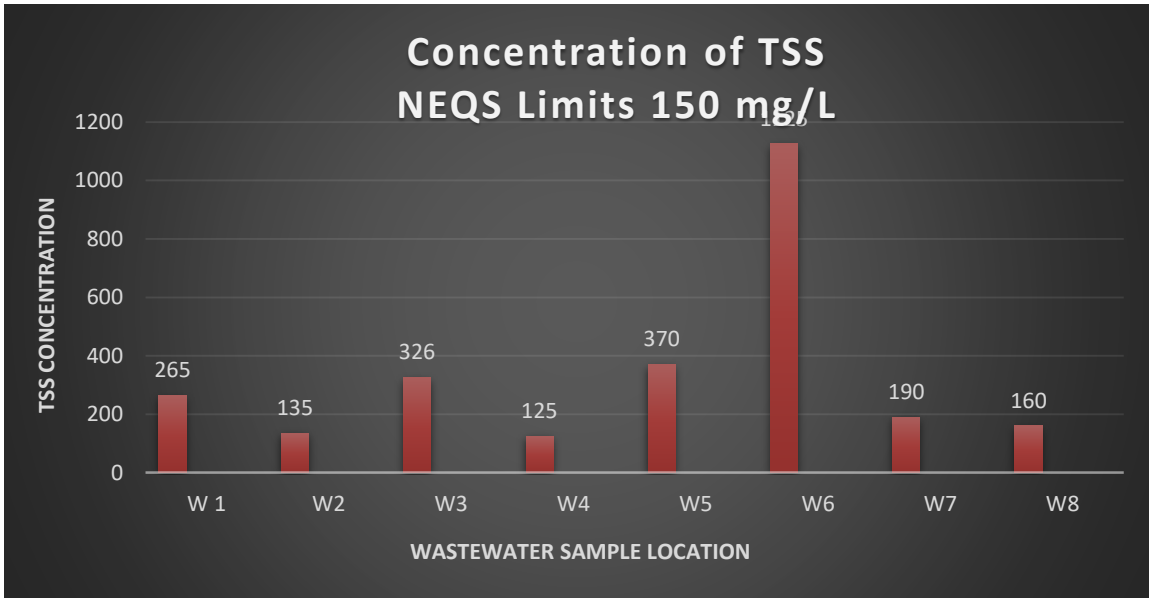


Figure 4.4: Concentration of TSS

4.1.5 TOTAL DISSOLOVED SOLIDS (TDS).

The TDS in a numeral of manufacturing wastes oscillated from 230-1500mg/L with imply of 815mg/L. The most value used to be recorded marble and PVC enterprise and the minimal price was once that of a material mill. When in contrast with the NEQS, it used to be located that the TDS in wastes of all the industries have been inside the allowable limits. The wastewater with excessive TDS cost can reason salinity hassle if discharged in irrigation water. It may additionally add a laxative effect to the water or reason the water to have a disagreeable mineral flavor.

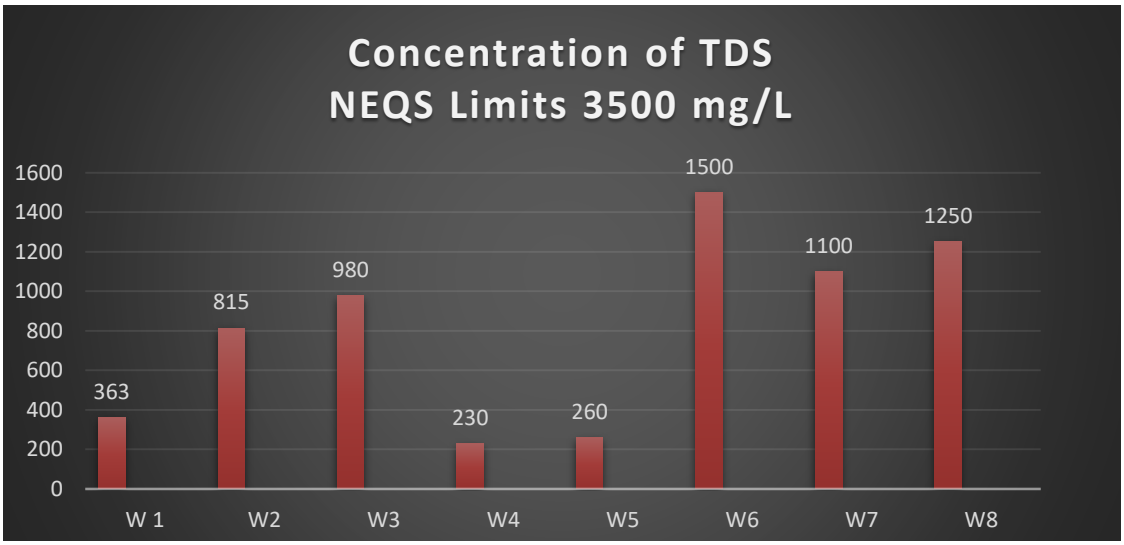


Figure 4.5: Concentration of TDS

4.1.6 CHILORIDES OF WASTE WATER:

The chloride values of effluent ranged from 27–283mg/L with a imply worth of 109mg/L. The most of the ghee enterprise and minimal fee of cleaning soap & detergent manufacturing. The allowable restriction of chlorides is a 1000mg/L which shows that all the values are nicely inside limits. However excessive chloride standards can motive metallic rust and have an effect on the style of meals products. Fish and aquatic organisms additionally can't maintain excessive chlorides.

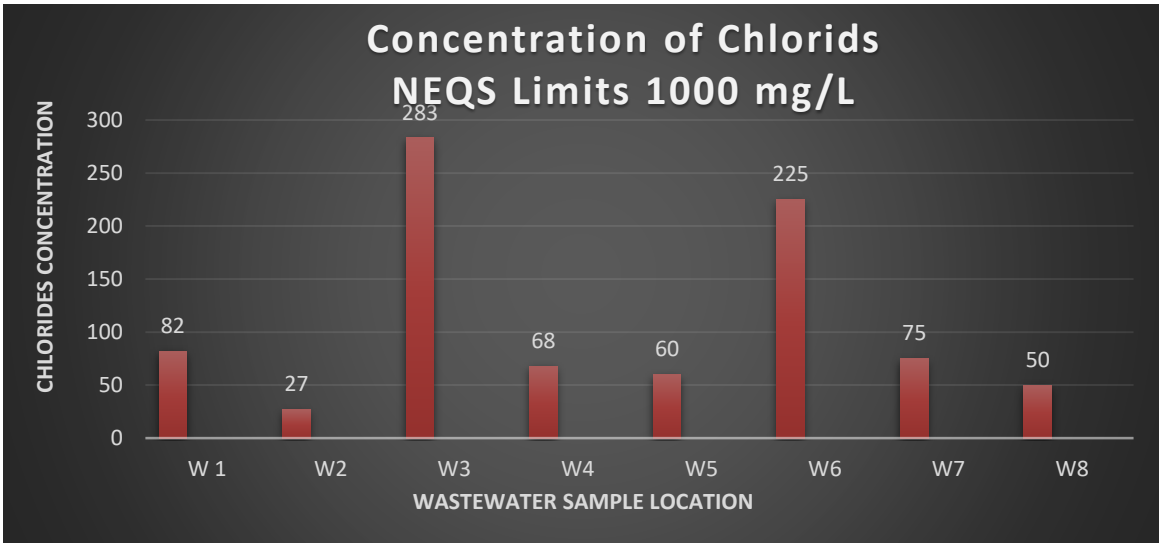


Figure 4.6: Concentration of Chlorides

4.1.7 NITRATES AND PHOSPHATES OF WASTEWATER

The nitrates and phosphates attention recorded at a number of places is proven in the chart below. These values fall nicely under the allowable WHO limits. However, in water pleasant revisions, nitrogen and phosphorus are the vitamins most normally recognized as toxins. Nitrogen in the shape of ammonia (NH3) and nitrates (NO3) and phosphorus are vital vitamins to herbal life, however when discovered in useless quantities; they can excite immoderate and undesirable plant increase such as algal flowers. Eutrophication should badly have an effect on the use of rivers and dams for endeavor functions as the giant areas will be protected by means of macrophysics that should forestall get admission to waterways and may want to reason ugly and smelly scum which should lead to the increase of blue-green algae and launch poisonous substances (cyan toxins) into the water structures. Furthermore, it is nicely acknowledged that eutrophication should expand the remedy value of consuming water via filter clogging in water therapy works.

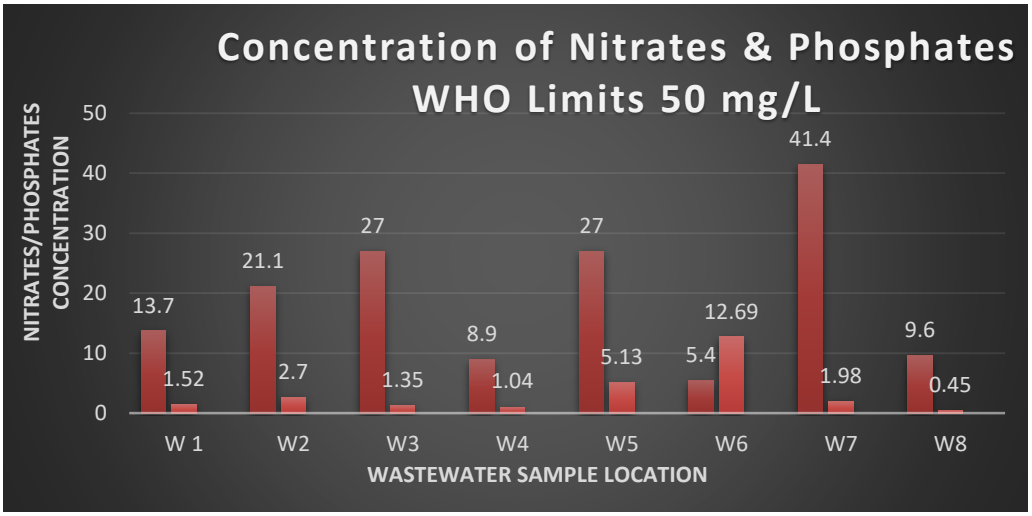


Figure 4.7: Concentration of Nitrates and phosphates

4.1.8 TEMPERATURE The temperature of a number of industrial effluent is proven in the chart below. The trade in temperature influences the wastewater in these succeeding ways: -

• As temperature increases, its gluiness will increase with a equivalent extend in its leaning to go precipitous. Extremely low temperatures have an effect on badly the efficiency of sedimentation. Furthermore, the microbial regeneration will increase with increase in temperature up to about 60°C.

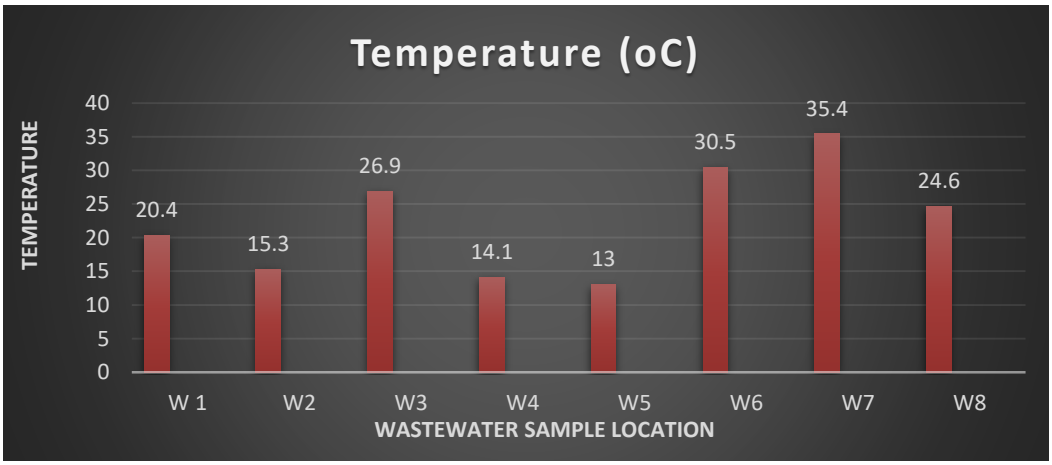


Figure 4.10: Temperature

4.1.9 LAST WORD It is again iterated that, the results are as good as the accuracy of human work involved and the accuracy of sampling and how good and representative the samples could be. The analysis can be only as efficient and accurate as the data on which it is being run. Their can be a multitude of unknown inaccuracies involved despite the utmost care that was exercised during the process of taking readings and samples. The discussions are based on researches off the internet, the comprehensive individual study taken by syndicate, the literary sessions conducted with our sponsor instructor, the technical and conceptual advice that was taken from experts working in SGM and lastly, it is based on previous credible deductions by a number of authors on the subject.

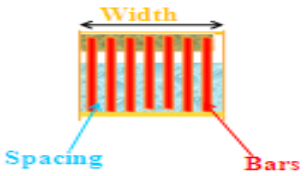
CHAPTER NO: 5

TREATMENT PROPOSALS, CONCLUSIONS AND RECOMMENDATIONS

5.1 DESIGN OF WWT UNITS FOR SHAMA GHEE MILL-NOWSHERA

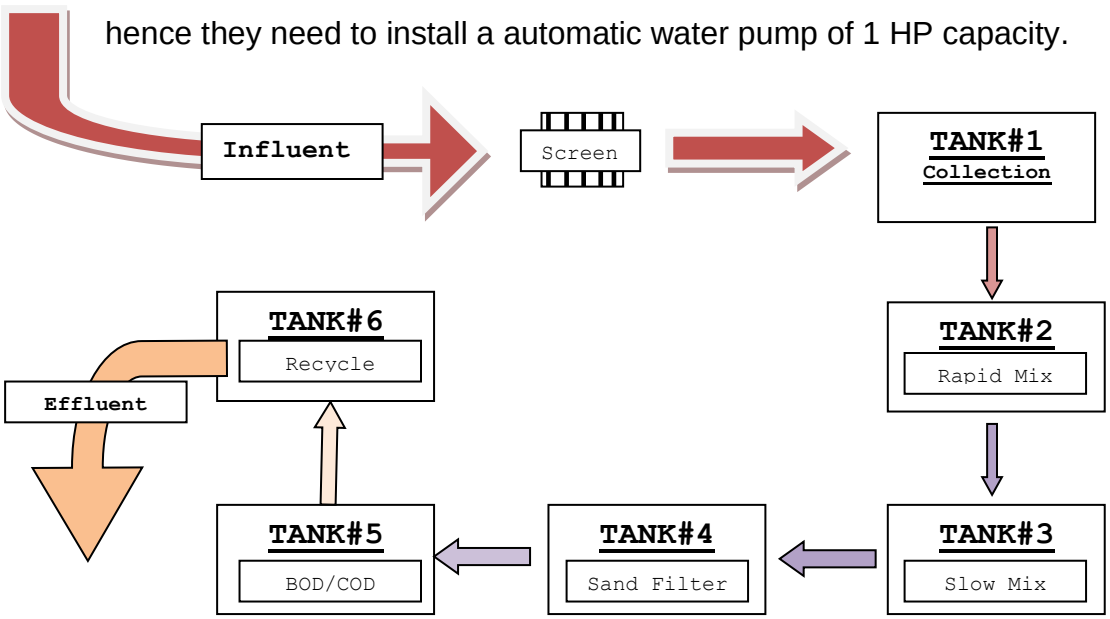
Design wastewater flow rate, $Q_{(design)}$ = 350 m^3/day

- **Screening Chamber Design**. According to the flow rate and nature of effluent the screening chamber must have following in order to prevent floating objects at the effluent inlet: -
  - Bar sizes**:** 40mm x 40mm
  - Spacing**:** 70mm



- **Tank-1: Wastewater collection well**. This will be the first tank where all influent will accumulate at first. As provided by SGM following are existing features: -
  - Existing dimensions: 11.2’ x 13’ x 11’ (Given by SGM)
  - Modifications Required are as following: -

Since SGM is reluctant to change the entire drainage and tanks set up hence they need to install a automatic water pump of 1 HP capacity.



Tank-2: Rapid Mix Basin. The SGM had existing sewage treatment tanks which needed improvements as following: -

- Existing dimensions: 10’ x 6’ x 5.5’ - with 4” partition wall.
- Modifications Required**: -**
  - ✓ Remove the existing partition wall
  - ✓ Increase depth to 3 feet.
  - ✓ Install Sprinkle Inlet System by using 1.5” dia pipe approx 6” above the basin surface.
  - ✓ Use of mechanical agitators at the rate of 110-120rpm, at least 10” above the bottom of the basin.
  - ✓ Increase dia of outlet pipes to at least 4”.
  - ✓ Use the exact type and dosage of coagulant suggested by jar tests.

- **Tank-3: Slow Mix Basin**
  - Existing dimensions:25’ x 10’ x 11.75’ (Given by SGM)
  - Modifications Required**: -**
    - ✓ Split existing single basin into two i.e. Basin#1 and Basin#2
    - ✓ **Basin#1.** Following changes be made in this tank: -
      - ➢ Dimensions: 10’x10’x 5’ (Depth reduced from 11.75’)
      - ➢ 3x 4” Diameter inlet pipes from rapid-mix basin be made available.
      - ➢ Height of partition wall between both basins should be 3’ instead of 5’.
      - ➢ Insert three zig zag baffles of size 7’x3’ with 3.25’ C/C distance between all.

    - ✓ **Basin#2.** The changes required in 2nd basin are given: -
      - ➢ Dimensions: 14.25’ x 10’ x 11.75’
      - ➢ Construction of 5’ partition wall, at a distance of 10’ from the inlets with rising rough slope of 0.35 towards

the partition wall.

- ➢ Installation of 0.75hp motor pump, at the end portion.

- **Tank-4: Sand Filter**
  - Existing dimensions: 25’ x 10’ x 11.75’ (Given by SGM)
  - Modifications Required**: -**
    - ✓ Perforated 1.5” inlet pipe at the center, 1.0’ above the tank.
    - ✓ Install Sprinkle Inlet System by using 1.5” dia pipe approx 6” above the basin surface.
    - ✓ Give rising slope of 30% throughout the length.
    - ✓ Give 11x 4” diameter outlet pipes, at a distance of approximately 2’c/c at 1.0ft above the bottom of the tank.
    - ✓ Provide Gravel of size ranging from 0.5”-2.5” upto a length of 4’ at least over bottom surface.

- **Tank-5: Recycling**
  - Existing dimensions: 25’ x 10’ x 11.75’ (Given by SGM)
  - Modifications Required**: -**
    - ✓ Already Redundant this tank can be used for chemical/Biological treatment i.e. BOD removal or for that matter it can be put to use for recycling.
- **Tank-6: Further Recycling**
  - Existing dimensions: 25’ x 4’ x 11.75’ (Given by SGM)
  - Modifications Required**: -**
    - ✓ This tank can be used for recycling.

5.3 CONCLUSIONS. Based on the design that was established for SGM, the values of overshooting parameters are brought under permissible limits. The detailed calculations have been not been attached but the design itself is considered sufficient. The primary source of surface and ground water pollution is illegal disposal of untreated industrial waste directly/indirectly into the surface water bodies resulting in serious surface/ground water pollution. There are policies and standards laid for the treatment of industrial waste but due to noncompliance by local industries the effluent gets mixed with Rivers or drain waters and hence becomes a source for a multitude of health and environmental issues. SGM, as an example of local industry, had many wastewater characteristics violating permissible limits. While SGM, and all such industries, has partially complying treatment infrastructure and methodology, they needed to be improved. Based upon analysis of experimental results, this research gave SMG the amendments and suggestions on how to bring over shooting chemical and biological aspects of effluent into the permissible range. It is again iterated that, the results are as good as the accuracy of human work involved and the accuracy of sampling and how good and representative the samples could be. The analysis can be only as efficient and accurate as the data on which it is being run. There can be a multitude of unknown inaccuracies involved despite the utmost care that was exercised during the process of taking readings and samples. The discussions are based on researches off the internet, the comprehensive individual study taken by syndicate, the literary sessions conducted with our sponsor instructor, the technical and conceptual advice that was taken from experts working in SGM and lastly, it is based on previous credible deductions by a number of authors on the subject.

PARAMETER	NEQS	OLD VALUES	NEW VALUES
pH	6-10	8.5	7.5
BOD	80 mg/l	250 mg/l	70 -80 mg/l
COD	150 mg/l	900 mg/l	140 -150 mg/l
TSS	150 mg/l	200 mg/l	130 -140 mg/l
Chlorides/Phoshates	-	Within Range	Within Range

5.4 RECOMMENDATIONS. The following technical and at the same time environment friendly steps can be made part of treatment regime being followed by all, industries in general and ghee mills in particular, for a compliant effluent discharge: -

a. There is a need to inculcate moral and social sense of responsibility among CEOs, Managers and Engineers about their roles to keep effluents in compliance for humanity and earth itself.
b. More stringent governmental policies and strict checks from Food/Environmental watch authorities is needed as, by and large, all industries are violating procedures and specifications to prevent degradation of atmosphere.
c. Study on treatment of sludge and its subsequent use as fertilizer may be conducted. Presently sludge is being taken by civil contractors and there is no firm knowledge on what they use it for. Strict control over usage of sludge after due treatment may be put in place.
d. Farmers in the vicinity of such industries are vehemently using effluent for irrigation. In this regard, farmers must be educated on adverse effects of this practice and should be forced to stop such practices. Government should step forward and establish alternate irrigation water sources i.e. tube wells at cheap rates for the farmers who are presently relying of industrial effluents.
e. The haphazard setting of drains and tanks must be put into discipline and must be covered to reduce emissions and odors and to prevent atmospheric matter getting mixed into drain water.
f. Industries must be made to cooperate with research teams so that a link is established between graduating young minds and needs of industry. Instead of shying away and showing reluctant attitude towards visits and samples for experiments, industries must welcome any such study that helps both the industry and the atmosphere.
g. This research did not touch upon environmental impacts of gaseous matter being let into atmosphere. Being of main cause of air pollution,

a separate research should be conducted to evaluate implications of such emissions.

h. This study may be extended to include impacts of heavy metals like arsenic, which is used in manufacturing process.

i. Economic aspects of this study may be considered by industries themselves or by further studies.

j. The toxic and cancer-causing ingredients i.e. Arsenic, that are used in micro quantities, need the strict control by Regulating/Food-Control Authorities, since a minute increase in their usage can be devastating for the consumer. Although it does not come within the purview of our study but we learnt during the course of our study that this aspect was too critical from health point of view.

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