INTRODUCTION

Water is perhaps the most precious natural resource (Ritabrata Roy, 2019) and 71% of total earth surface is covered by water, only a fraction of it is usable for many purposes which includes the potability and makes this resource very limited. This remarkable and precious substance (Martin.F.Chaplin, 2001) therefore, must be utilised with prudence. As water is required for different purposes, the suitability of it must be checked before use. Also, sources of water must be monitored regularly to determine whether they are in sound health or not. Poor condition of water bodies are not only the indictor of environmental degradation, it is also a threat to the ecosystem and directly or indirectly affects the flora and fauna depending on that reservoir. In industries, improper quality of water may cause biochemical environmental issues and severe economic loss. Thus, assessing the water profile is very important in both environmental and economic aspects. Thus, assessing the quality of this highly versatile material (Martin Chaplin, 2006) analysis is much needed for using it in any purpose. After years of vigorous research, water quality analysis is now consists of some standard operating protocols (SOPs) and procedures laid down by many national and international boards and authorities (Ankur Choudhary, 2008). There are guidelines for sampling, preservation and analysis of the samples.

The food and beverage industry is one of the most water intensive industries. Therefore, an effective and efficient water management, based on eco-system related indicators, is crucial. Effluent treatment plant commonly known as ETP or ETP plant, is a waste water treatment process (WWTP) used for treating the waste water & to meet pollution board laid disposal guidelines & norms.

Contaminated water consisting of all the effluents cannot be released without treatment as it contains toxic and non-toxic chemicals (C.J.Kuo& R Smith, 1998). Releasing it may cause contamination of the existing pure water and will affect the environment. As a result ETP's are installed in most manufacturing industries.

It's mostly used in industries like pharmaceuticals, textiles, and chemicals where extreme water contamination is a possibility. Effluent Treatment Plant plays a significant role in the treatment of industrial waste water as well as domestic sewage. Organic matter, inorganic matter, heavy metals, oil & grease, suspended particles, and other contaminants are treated in the wastewater treatment process of an ETP plant. Chemical and biological treatment, their combinations and thermal treatment are the several types of wastewater treatment plants.

The Effluent Treatment Plants (ETP) are used for the removal of high amounts of organic compounds, debris, dirt, grit, pollution, toxic, non-toxic materials, heavy metal ions and polymers etc. from industrial effluent. The ETP plants use evaporation and drying methods and other auxiliary techniques such as centrifuging, filtration, incineration for chemical processing and effluent treatment.

Water quality can be defined as the chemical, physical and biological characteristics of water, usually in respect to its suitability for a designated use. Water can be used for recreation, drinking, fisheries, agriculture or industry. Each of these designated uses has different defined chemical, physical and biological standards necessary to fulfil the respective purpose. For example, there are stringent standards for water to be used for drinking or swimming compared to that used in agriculture or industry.

Water quality analysis is to measure the required parameters of water, following standard methods, to check whether they are in accordance with the standard.

MATERIALS AND METHODS

Water filtration Units

The production of food and beverages is an important, although by no means the largest, component of the separation equipment market (Ken Sutherland, 2010) Spent process water streams containing very different levels of contamination are combined and routed to the mixing and equalizing tank where problems in biological wastewater treatment occur.

Companies in the food and beverage industries generate spent process water with different degrees of contamination. Spent process water can be treated in order to recover products or for desalination purposes while organics can be removed to fulfill the requirements for water reuse. The standards for the food and beverage industries specify that process water, intended for reuse, must be at least of drinking quality. The regulations for other applications such as boiler make-up water or warm cleaning water are even more stringent (H.Chmiel et al, 2002).

The primary water resource for all the purposes within the industry is the ground water which will be further processed and purified. There are two different water filtration lanes wherein the water from the first lane is processed from the series of filters is called CT water and used for the preparation of syrup. The water from this lane is solely from the underground water tanks. And the lane 2 water is called as soft water and specifically used for bottle washing and consists 50% of the water recovered and processed water from effluent treatment plant (ETP) which is topped up with the underground water and again filtered by the series of filtration units.

The filtration lanes consist of a series of units. They are as follows,

1) PSF - Pressurized Sand Filter.

2) ACF – Activated Carbon Filter.

3) Micron Filter.

4) RO – Reverse Osmosis.

These are the principal filtration units which are installed in every lane be t for CT water or for Soft water and even in the effluent treatment plant. But apart from them other treatments like Ultra Violet (UV light), Antiscalent, Chlorine dosing etc are done based on the quality of the water needed for different purposes.

Pressurized Sand Filter (PSF)

The working principle of a Pressure Sand filter is very straight forward. In a Pressure sand filter, water is gone through multi layers of filter media comprising reviewed sand, rocks and rock layers. The contaminants in the water are caught in the media bed and sifted water goes into the release manifold at the base of the tanks. The following step is discharging, a procedure of adequately expulsion of caught contaminants from the media bed. After back washing, the filter is flushed with raw water and after the required nature of water is accomplished the filter is returned to support.

Sand filtration is frequently used and very robust method to remove suspended solids from water. The filtration medium consists of a multiple layer of sand with a variety in size and specific gravity. Sand filters can be supplied in different sizes and materials both hand operated or fully automatically.

Raw water pump is used for generating necessary operating pressure in the pressure sand filter. Raw water is passed through RWT Pressure sand filter at a pressure of 3.5 kg / cm2 to reduce the suspended solids present in the raw water.

The filter will effectively remove up to 30 - 50 micron of the suspended solids to less than 5 ppm. The filter will have to be washed with raw water for 20 to 30 minutes daily. To filter the partials below 30 - 50 micron cartridge filter is used.

APPLICATIONS:

- Preparation of cooling water
- Treatment of waste water
- Production of drinking water
- Filtration in swimming pools
- Pre filtration for membrane systems
- Filtration of gray or surface water
- Swimming pool water

Pressurized Sand Filter

For the purpose of a proper removal of these substances from water and to obtain the requested quality of output water it is necessary to propose a suitable filtration process. The actual filtration through pressure filters is complemented with aeration, clarification, coagulation, static mixers, and disinfection. The kind of the filtration medium used is very important as well. For once in every 24 hours, the flushing is done.

Activated Carbon Filter (ACF)

Activated carbon is a common coal, made of vegetable or mineral, and activated in special ovens with steam at a very high temperature.

The total available area can reach 1000 m per gram of carbon. This area is created by the activation process that can open the microspores inside the structure of the carbon.

The activated carbon is available in several types and shapes, of different origin (vegetable or mineral), with different average grain-size, and so on.

Physical action - the action of mechanical filtration, the same way, or better, of a sand multimedia filter.

Chemical action- the action of chemical catalysis of reduction with some inorganic groups.

The different size of the granules of the carbon allows the bed of activated carbon to work same way, or sometimes better, than the quartz sand filters, in order to filter the water and remove sludge, mud, lime, etc.

The most important feature of a bed of activated carbon is the adsorption that is the capacity to trap special type of molecules inside the structures of its microspores.

APPLICATIONS

The activated carbon is commonly used in many fields and many applications, in water (also waste and sewage water) treatment, in air treatment, in the industry of sugar of wine production, and so on.

Particularly, the most common applications in water treatment are:

- To remove chlorine
- To remove bad taste and smell
- To remove pollutants
- To remove turbidity

Activated Carbon Filter

Micron Filter

Micron Filtration is a type of physical filtration process where a contaminated fluid is passed through a special pore-sized cartridge to separate suspended particles from process liquid. It is also used in conjunction with various other separation processes such as ultra filtration and reverse osmosis to provide a product stream which is free of undesired contaminants.

The filters are offered in stainless/carbon steel construction compatible to standard cartridges of different micron ratings.

APPLICATIONS

- Potable water
- Mineral water
- Industrial Purpose
- Solid – Liquid Separation

Micron Filter

Industrial RO – Reverse Osmosis

Reverse osmosis (RO) desalination is a treatment process for production of fresh, low- salinity potable water from saline water source (seawater or brackish water) via membrane separation. The mineral/salt content of the water is usually measured by the water quality parameter named total dissolved solids (TDS), concentration of which is expressed in milligrams per liter (mg/L), or parts per thousand (ppt). The World Health Organization and the United Sates Environmental Protection Agency (US EPA) under the Safe Drinking Water Act have established a maximum TDS concentration of 500 mg/L as a potable water standard. This TDS level can be used as a classification limit to define potable (fresh) water.

Typically, water of TDS concentration higher than 500 mg/L and lower or equal to 15,000 mg/L (15 ppt) is classified as brackish. Natural water sources such as sea, bay and ocean waters which have TDS concentration higher than 15,000 mg/L are generally classified as seawater.

Reverse Osmosis is very effective in treating brackish, surface and ground water for both large and small flows applications. Some examples of industries that use RO water include pharmaceutical, boiler feed water, food and beverage, metal finishing and semiconductor manufacturing to name a few.

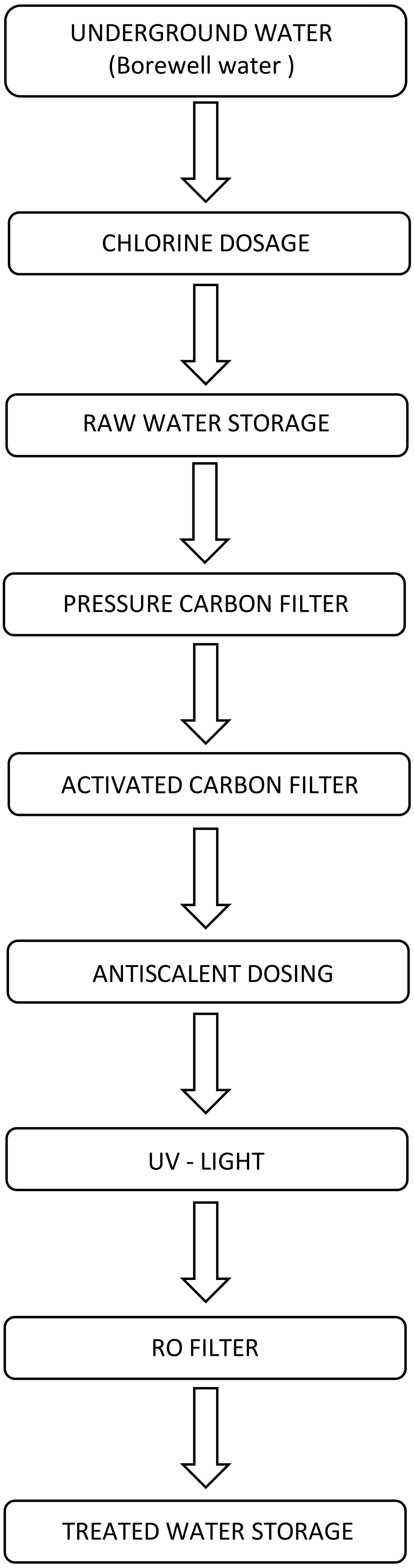
SAFIENT FEATURES :

- Produce high-quality dematerialized water
- Most modern membrane technology
- Modular design
- Low water-rejection rate
- Low operational and maintenance costs

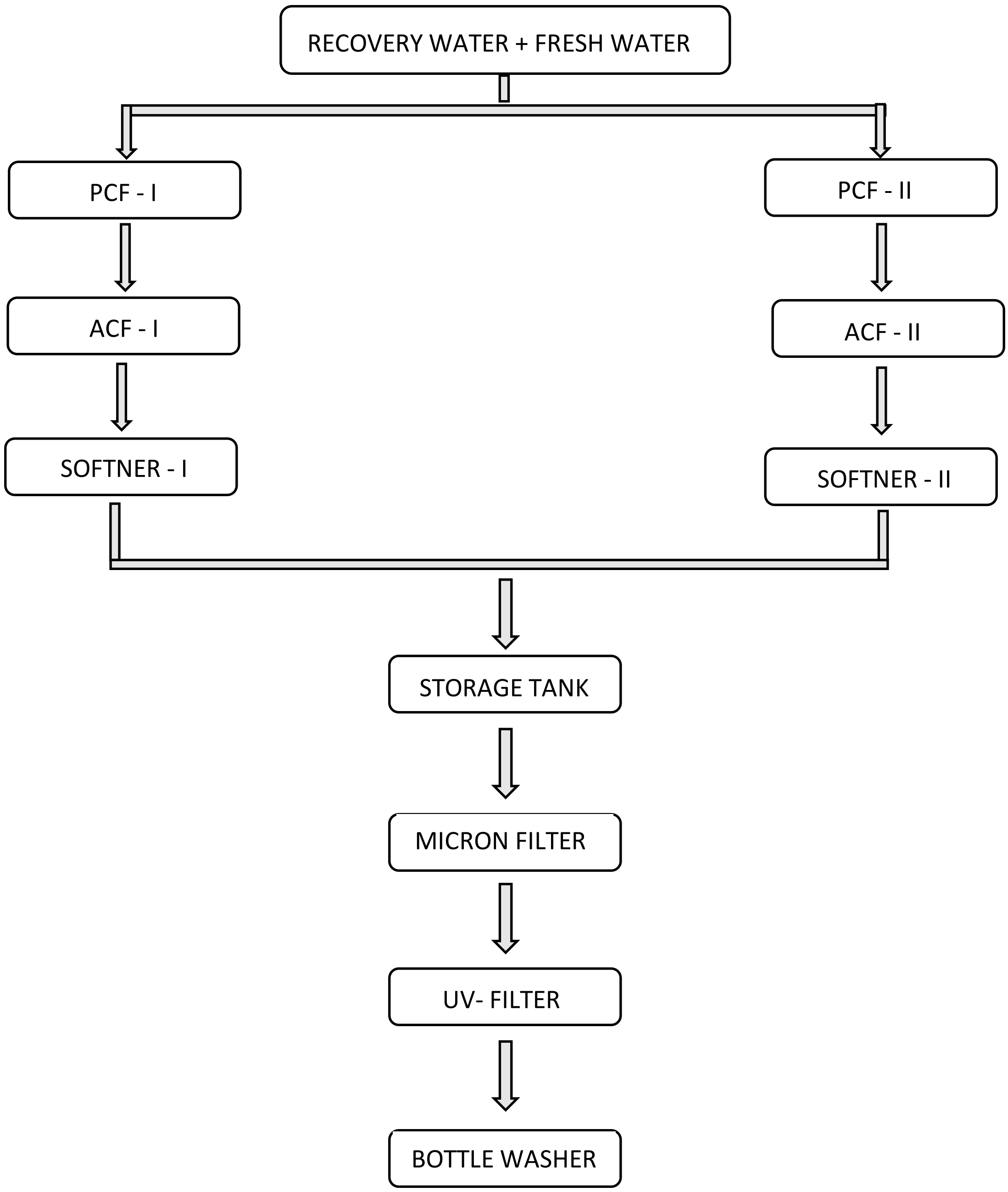
Industrial Reverse Osmosis (RO)

The water samples for our analysis haven been collected from each of these filtration units from both the lanes ie, filtration plants used for soft water and CT water. 8 Water samples have been analyzed in our study.

WATER TREATMENT



SOFT WATER TREATMENT



Water analysis parameters and procedures

1. pH :

The term “pH” refers to the measurement of hydrogen ion activity in the solution.Since the direct measurement of the pH is very difficult, specific electrodes areneeded for quick and accurate pH determination. pH is measured on a scale of 0 to14, with lower values indicating high H+ (more acidic) and higher valuesindicating low H+ ion activity (less acidic). A pH of 7 is considered as neutral.Every whole unit in pH represents a ten-fold increase in or decrease in hydrogenion concentration.

pH is measured using pH meter, which comprises a detecting unit consisting of aglass electrode, reference electrode, usually a calomel electrode connected by KCl bridge to the pH sensitive glass electrode and an indicating unit which indicates the pH corresponding to the electromotive force is then detected. Before measurement, pH meter should be calibrated by using at least two buffers.

Procedure:

- Plug in the pH meter to power source and let it warm up for 5 to 10 minutes.
- Wash the glass electrode with distilled water and clean slowly with a soft tissue.
- Note the temperature of water and set the same on the pH meterturning the Calibrate knob on the meter.
- Take out the electrode, wash with distilled water and clean.
- Dip the electrode in the pH 4 buffer solution.
- Adjust the value on the pH readout meter by the Slope switch .
- Repeat with pH 7 and pH4 buffers till a correct andstable reading is displaced.
- While moving and cleaning the electrode, put the selector switch on standby mode.
- Turn to pH mode for recording the pH.
- Now place the electrode in the water sample whose pH is to be determined. We can take a number of simultaneous readings for different samples

Tabular column :

Sl.no.	**Water sample**	**pH**
1.	Settling Tank	11.21
2.	Sand Filter	11.06
3.	ACF	10.58
4.	Cation exchanger	6.32
5.	PSF - I	7.25
6.	ACF - I	6.95
7.	Softner	7.11
8.	Storage Soft Water	7.31

Determination of pH using pH meter

TURBIDITY :

Turbidity is the technical term referring to the cloudiness of a solution and it is a qualitative characteristic which is imparted by solid particles obstructing the transmittance of light through a water sample. Turbidity often indicates the presence of dispersed and suspended solids like clay, organic matter, silt, algae and other microorganisms.

Turbidity is based on the comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. The turbidity of the sample is thus measured from the amount of light scattered by the sample taking a reference with standard turbidity suspension. The higher the intensity of scattered light the higher is the turbidity. Formazin polymer is used as the primary standard reference suspension.

Procedure :

- Switch on the turbidity meter atleast 30 minutes before the test.
- Prepare 400 NTU solution :Mix 5 mL of hydrazine sulphate solution and 5 mL of Hexamethylenetetramine , solution in a 100 mL standard measuring flask.Allow the mixture to stand for 24 hours.After 24 hours, make up the volume to 100 mL using turbidity free distilled water. The standard 4000 NTU solution is ready.
- Calibrate the turbidity meter to 400 NTU using the standard solution by adjusting the calibrating knob.
- Calibrate the turbidity meter to 0 NTU using distilled water by adjusting the calibration knob.
- Read the turbidity meter by inserting the sample.

Tabular column :

Sl.no.	Water sample	Turbidity (TDS)
1.	Settling Tank	1.045
2.	Sand Filter	1.047
3.	ACF	1.052
4.	Cation exchanger	0.701
5.	PSF - I	0.706
6.	ACF - I	0.681
7.	Softner	0.677
8.	Storage Soft Water	0.621

Determination of turbidity by Digital turbidity meter

HARDNESS :

Hardness in water is due to the presence of dissolved salts of calcium and magnesium. It is unfit for drinking, bathing, washing and it also forms scales in boilers. Hence it is necessary to estimate the amount of hardness producing substances present in the water sample. Once it is estimated, the amount of chemicals required for the treatment of water can be calculated. The estimation of hardness is based on complexometric titration.

Hardness of water is determined by titrating with a standard solution of ethylene diamine tetra acetic acid (EDTA) which is a complexing agent. Since EDTA is insoluble in water, the disodium salt of EDTA is taken for this experiment. EDTA can form four or six coordination bonds with a metal ion.

Two type of hardness is present in water first is temporary hardness and second is permanent hardness. Temporary hardness is due to the presence of bicarbonates of calcium and magnesium ions. It can be easily removed by boiling. Permanent hardness is due to the presence of chlorides and sulphates of calcium and magnesium ions. This type of hardness cannot be removed by boiling.

Procedure :

- The burette is filled with standard EDTA solution to the zero level.
- Take 50ml sample water in flask. If sample having high Calcium content then take smaller volume and dilute to 50ml.
- Add about 1ml of Ammonia buffer solution.
- Add 5 to 6 drop of Erichrome black – T indicator. The solution turns into wine red colour.
- Note the initial reading and titrate the content against EDTA solution.
- At the end point colour change from wine red to blue colour.
- Note the final reading and record it.
- Repeat the process till we get concordant value

Tabular column :

Sl.no.	Water sample	Hardness (ppm)
1.	Settling Tank	9
2.	Sand Filter	13
3.	ACF	15
4.	Cation exchanger	Nil
5.	PSF - I	217
6.	ACF - I	211
7.	Softner	15
8.	Storage Soft Water	16

Determination of hardness by simple titration method

ALKALINITY :

Alkalinity is primarily a way of measuring the acid neutralizing capacity of water. In other words, its ability to maintain a relatively constant pH. The possibility to maintain constant pH is due to the hydroxyl, carbonate and bicarbonate ions present in water. The ability of natural water to act as a buffer is controlled in part by the amount of calcium and carbonate ions in solution. Carbonate ion and calcium ion both come from calcium carbonate or limestone. So water that comes in contact with limestone will contain high levels of both Ca 2+ and CO3 2-ions and have elevated hardness and alkalinity.

The alkalinity of water can be determined by titrating the water sample with Sulphuric acid of known values of pH, volume and concentrations. Based on stoichiometry of the reaction and number of moles of Sulphuric acid needed to reach the end point, the concentration of alkalinity in water is calculated.

Procedure :

- Clean the burette and fill almost to the top with N/50 sulfuric acid.
- Then run some acid to waste until the "zero" mark is reached. This should leave the stopcock and tip of the burette full of the solution.
- Measure out 100 mL of the water to be tested and pour into a clean white porcelain evaporating dish.
- With a dropping bottle, add 2 or 3 drops of methyl orange or methyl purple indicator to the sample and stir.
- When alkalinity is present, the solution becomes yellow when methyl orange is added or becomes green when methyl purple is added.
- Slowly and carefully add N/50 sulfuric acid from the burette to the contents of the dish until the faintest pink coloration appears - that is, until the colour of the solution is no longer yellow.
- While adding the acid, the solution should be gently stirred with the stirring rod. It is often advantageous to set up two 100 mL samples, adding methyl orange to each and acid to only one while the other is held alongside so that the colours may be compared and the colour change to pink can be better recognized. Record the volume of sulfuric acid used to reach the endpoint.

Tabular column :

Sl.no.	Water sample	Alkalinity (ppm)
1.	Settling Tank	207
2.	Sand Filter	295
3.	ACF	378
4.	Cation exchanger	105
5.	PSF - I	267
6.	ACF - I	250
7.	Softner	220
8.	Storage Soft Water	195

Determination of alkalinity by simple titration method