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STUDY OF OXYGEN CONSUMPTION VALUE AND BIOLOGICAL PARAMETERS

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Abstract :

The present investigation is carried out using effluent water from the dyeing industries of Bhiwandi city. Most of the chemicals present in the effluent water when discharged into main water bodies consume oxygen for oxidation and decomposition purposes. They reduce the level of oxygen in water which in turn causes mortality of the bio-organisms. The dyeing industry creates water pollution as the waste generated from the different wet processes like scouring, bleaching, dyeing and printing are very harmful. They cause chemical pollution due to discharge of various chemicals and disturb the normal functioning of living organisms (bio-organisms) in water. This research work has been carried out to assess the effect of pollution on the quality of water (which could also be a source of drinking water) and on bio-organisms. Water samples collected from the dyeing industry were analyzed for amount of Oxygen and for biological parameter. It has been observed that reduction in dissolved oxygen concentration is one of the most important factors that directly affect the lifecycle of most of the aquatic animals. The results of oxygen consumed by the chemicals are then compared with the standard values prescribed by the standard bodies.

Keywords: Bhiwandi City, Oxygen Consumption, Biological Parameter.

INTRODUCTION:

The city of Bhiwandi, known for its textile industry, has the largest number of power looms in the country and is called the "Manchester of India." The city is known for power loom, carpets and silk fabrics. The location of Bhiwandi city could be given as:

State: Maharashtra, District: Thane, Coordinate:19.17ºN,73.03ºE, Elevation:24m, Population: 7,11,329.

Monitoring and assessment of water has become an environmental issue and is of great concern not only locally but also on a global level. One of the most important crises of the 21st century is the availability of pure drinking water, a resource basic to our survival and growth. Most of the fresh water bodies all over the world are getting polluted thus decreasing the availability of fresh water.

The area selected to estimate the levels of Dissolved Oxygen and biological parameter like counting of Microbiological Colonies is the effluent samples collected from the dyeing industry of Bhiwandi city, District Thane, Maharashtra, India. Textile processing is a general term that covers processes right from fiber removal to printing of fabric. The various steps a fabric goes into are singeing, desizing, bleaching, dyeing and finishing. Dyeing is a process of applying coloring matter directly on fiber without any additives. Finishing is the final process to impart the required end use finishes to the fabric. The process of printing on fabric is a science as well as an art. Cotton provides an ecologically friendly textile, but more than 50% of its production volume is dyed with reactive dyes. Unfortunately, dyes are unfavorable from an ecological point of view, as the effluents generated are heavily colored, contain high concentrations of salts and exhibit high chemical oxygen demand (COD) values [2].

Another parameter which is measured is counting of Microbiological colonies. Effluent water contains many chemicals that provide a growing bed for several

micro-organisms. This study determines if this effluent water is polluted with various micro-organisms such as bacteria, different viruses or various pathogens which could be very harmful. The effluent water when discharged in the water reservoirs (which may be a source of potable water) could lead to growth of same or different disease causing micro-organisms in these water bodies. Human population could get affected by the water borne diseases resulting in fatalities.

Industrialization affects health and welfare of human beings. Industrial factories with several production processes and usage of raw and synthetic materials produce other unwanted harmful and toxic byproducts like waste water, solid waste and pollutant gases. Heavy metals of the toxic materials that exist in many of the industrialized products can potentially cause cancer and have adverse effect on physical and psychological life of human beings [6].

The textile industry has witnessed several new directions in the era of liberalization. While textile exports are increasing; India has become the largest exporter in world trade in cotton yarn and is an important player of readymade garments, the country's international textile trade constitutes a mere 3% of the total world textile trade. Several mills have opted for modernization and expansion and are going in for export-oriented units focused on production of cotton yarn. It has passed through cyclical oscillations and at present is witnessing a recovery after a downturn[7].

MATERIALS AND METHODS :

This study was carried out on effluent samples collected from three different dyeing industries of Bhiwandi city, District Thane, Maharashtra. A detailed survey of the industries had been done followed by collection of effluent samples in the afternoon period between 12.0pm to 1.0pm.

The effluent samples were collected in a one liter capacity container. The container was pretreated by washing with distilled water then with 3.0% nitric acid solution, rinsing with distilled water and then kept for complete drying in an oven at 30-35^{0}C. Sampling is done in the afternoon at the dyeing industry only. The effluent samples

were directly brought to the laboratory immediately and then analyzed for chemical oxygen demand[3].

Water sample was taken in the conical flask to which fixed volume of Potassium dichromate and 4N sulphuric acid were added. The reaction mixture was refluxed on a water bath for one and a half hours. A blank solution was also prepared using distilled water and the same treatment was carried out. After refluxing, the cold solution was diluted to volume. A fixed volume (containing unreacted $K_2Cr_2O_7$) was titrated against Ferrous Ammonium Sulphate using Ferroin as indicator.

The procedure involves chemical oxidation of material with catalyst using Potassium dichromate in 50% sulphuric acid. The unique chemical properties of dichromate ion make it a specific oxidant in this method as it gets reduced to chromic ion (Cr^{3+}) [1-5].

The amount of unreacted dichromate is estimated by classical techniques with Mohr salt. It represents the amount of the oxygen molecule required by organic compound for oxidation to carbon dioxide, ammonia and water and expressed in ppm.

It is a rapidly measured parameter used to study water quality, satisfactory to determine the organic load in the water and preferable to BOD.

Biological parameter is studied by observing the bacterial colonies. Microbiological colonies are observed to be developed on the agarose gel and counted .The growth of microbiological colonies, very clearly indicates the presence of micro-organisms in the effluent water which is very harmful.

Total Viable Bacterial Count of the samples was enumerated by dilution plate count method on nutrient agar medium. Dilution was carried to the concentration of $1x10^{-3}$ and that solution was aseptically poured into duplicate sterile petriplate, sterile melted nutrient agar was then poured over it, rotated clockwise-anticlockwise, allowed to solidify, and finally, incubated at inverted position at 36°C for 24 hours. After incubation, the plates having well-spaced colonies were taken for counting and the colonies were counted by a Visual Counting Method. Total Viable Bacterial Count were expressed as Colony Forming Units (CFU)[4] .

RESULTS AND DISCUSSION:

The following Chemical parameters were determined in three different industrial effluents:

1) COD :

Oxygen is required by all plants and animals for breathing and living purposes. Oxygen is present in dissolved form in water. Aquatic organisms require oxygen to live. They use gills or other tissues for respiration mechanism. Water moves in their gills and other breathing tissue. Oxygen in the form of microscopic bubbles is then transferred from water into their blood. Oxygen is thus required by all macrophytes, algae and for various chemical reactions which are important in the proper functioning of water reservoir. Production of oxygen takes place during photosynthesis which is utilized during respiration and decomposition.

In water, dissolved oxygen (DO) concentration depends on biological processes of water bodies. Standard Oxygen levels stated by Michigan is 7.0 mg/lit or higher for cold water stream,5.0 mg/lit or higher for warm water stream whereas 3.0 mg/lit or less levels of Oxygen kill the fish. The concentration of DO is more in cold water (in the winter season) and low in warm water (in summer season). Higher concentration of manure and fertilizer in waste water act as nutrients feeding the growth of algae. Disintegration of compounds in water by microorganism consumes the DO thereby decreasing the level of DO. This indicates organic pollution in water.

Table 1: Amount of COD

Sr.No	Sample	COD in ppm
1	Effluent I	375
2	Effluent II	180
3	Effluent III	275

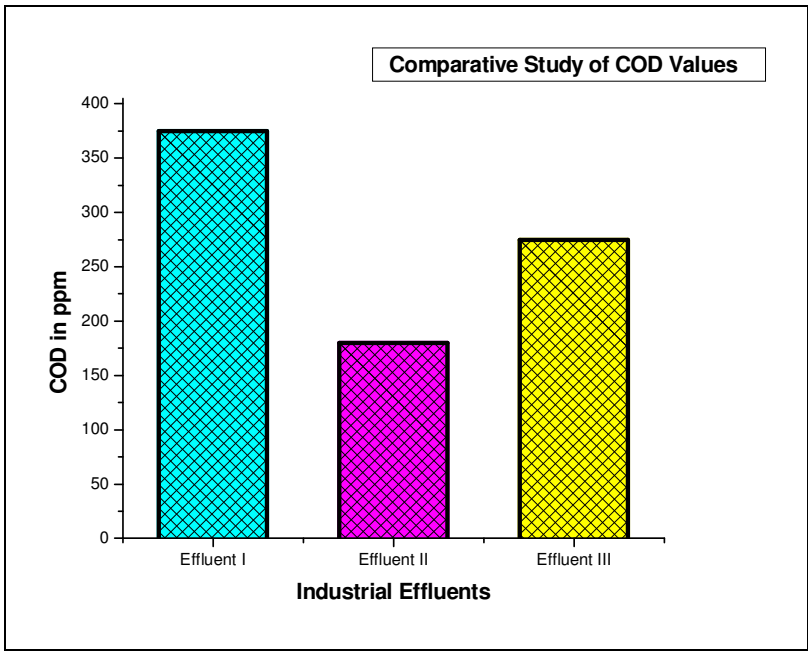

Figure 1: Graph of COD in ppm VS. The Dye Effluents

There is difference in the chemical oxygen demand values of all the three effluent discharged from the three different dyeing industries in Bhiwandi city. Effluent I and III, discharged from the two industries are not safe for discharge in to the surface water and marine water as the amount of oxygen consumption value is greater than standard value (250ppm).Whereas in one of the dyeing effluent II, the COD value is less than 250ppm which is safe for discharge in to the surface water and marine water. However according to the Pollution Control Committee, effluents discharged from all three industries are not safe for disposal in to the surface water and marine water. Under the guidelines of the Pollution Control Committee (PCC) under the category of industry, in the effluent water samples, COD values should be around 120 mg/l and should not exceed 400 mg/l.

Table 2: Technique used for determination of COD

Sr.No	Parameters	Technique used	Maximum Permissible Limit by PCC Standards
1	COD	Potassium Dichromate Digestion; Closed Reflux	400.0 ppm

Table 3: Quality of Industrial Effluent with the Standard Limits and Guidelines

Sr.No.	Parameters	Central Government , Environment Protection Rule 1986, for Dye Industry	
		Disposal in surface water	Disposal in Marine water
01	COD	250.0 ppm	250.0 ppm

2) Counting of Microbiological Colonies:

Microbiological Colonies were developed on a petridish. These colonies which appeared in different colours were counted and the numbers are as given in Table 4.

Table 4: Number of Microbiological Colonies

Sr.No.	Sample	Number of Microbiological Colonies (CFU)	Colour of the Colonies
01	Effluent I	$2.2x10^4$	Brown
		$3.9x10^4$	White
		Total= $6.1x10^4$	---
02	Effluent II	$2.6x10^4$	Half White
		$1.5x10^4$	Yellow
		Total=$4.1x10^4$	---
03	Effluent III	$2.8x10^4$	Half White
		$1.3x10^4$	Yellow
		$1.6x10^4$	Brown
		$0.1x10^4$	Black
		Total=$4.8x10^4$	---

The total number of Viable Bacteria observed during the study period ranged from $0.1x10^4$ to $4.8x10^4$.

Different colour of the colonies indicate different types of bacteria.

The micro-organisms present in the effluent I ($6.1x10^4$ CFU) is more in number than effluent III ($4.8x10^4$ CFU) which is more in number than effluent II ($4.1x10^4$ CFU).This variation in the number of different colors of the organisms are represented by following graphs.

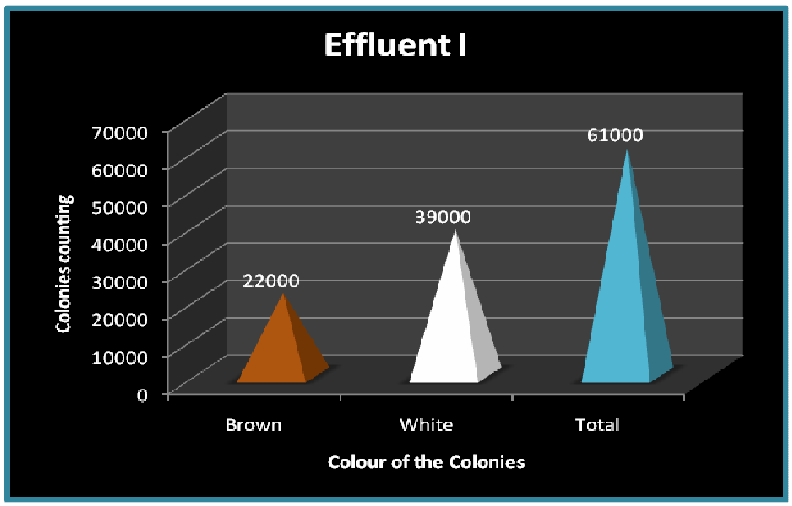

Figure 2:Number of Microbiological Colonies

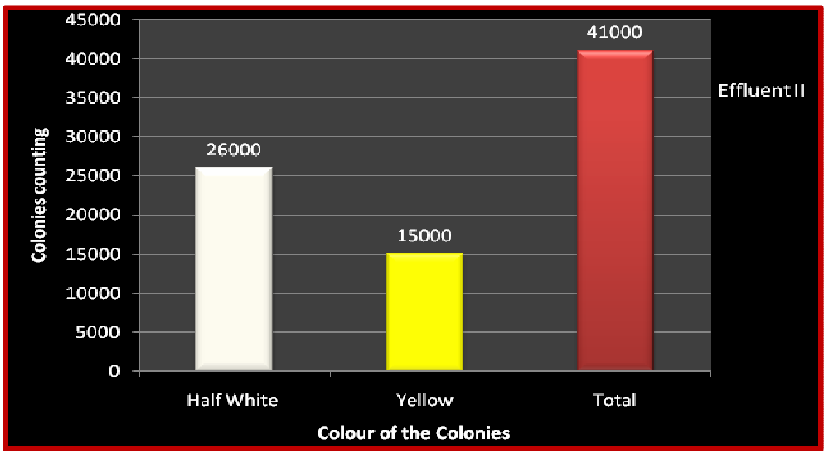

Figure 3:Number of Microbiological Colonies

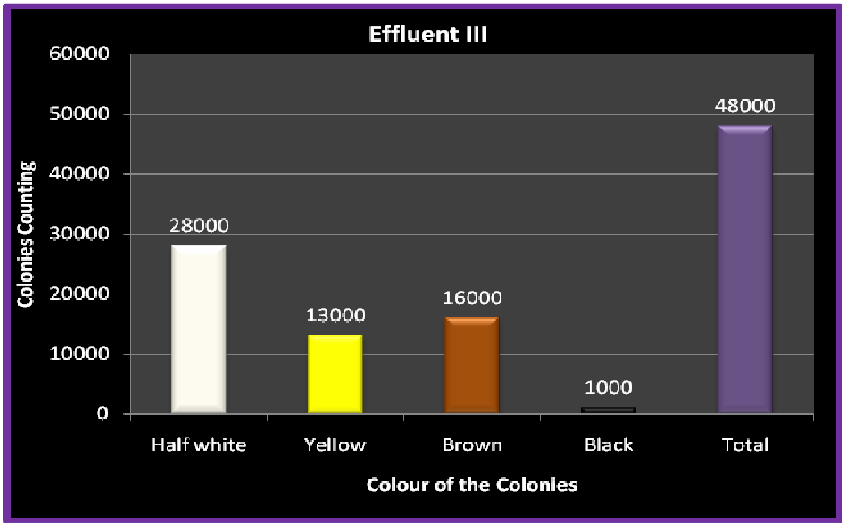

Figure 4:Number of Microbiological Colonies

CONCLUSION:

All oxygen demanding chemicals have a marked effect on the aquatic flora and fauna which in turn indirectly affect human beings.

The level of COD in all three effluent water samples is below 400ppm but it is above 120ppm. When these effluents are discharged into the water bodies (which provide drinking water and edible Bio-Organisms), they cause serious hazardous effects on the health of human beings. The chemical load in the effluent water samples indicate the chemical toxicity which varies at different dyeing industries. Most of the chemical substances if present beyond permissible limits in water are toxic to human beings, aquatic flora and fauna. Increase in COD could be attributed to an increase in the addition of both organic and inorganic contaminants entering the systems from the municipal sewage treatments plants.

In the present study, it has been determined that the chemicals present in the effluent water samples have concentrations greater than the permissible limits set by PCC. As this effluent water make their way into the various water bodies (through the ground) which may provide the edible fishes and drinking water, then it is quite evident that these chemicals may enter the food chain, and thus through bio magnifications enter the human body as well.

Growth of microbiological colonies indicates the presence of Bacteria, Virus and disease causing pathogens in the effluent water. When this water is discharged in to the water reservoirs, it spreads various diseases among human population.

The textile industries, especially dye manufacturers are facing regulations and standards for their discharged effluents. The study shows a need for a continuous pollution monitoring program for the dyeing effluents discharged into the adjoining natural water bodies. In addition to this provincial, government and private sectors should evolve measures to check and ensure that discharged effluents must comply with the specifications [4].

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