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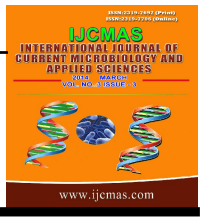

Original Research Article

Physico-Chemical Analysis of Untreated Sewage Water of Ladwa town of Kurukshetra District of Haryana and Need of Waste Water Treatment Plant

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A B S T R A C T

The study under consideration deals with the pollution caused by untreated sewage disposal of Ladwa town of Kurukshetra district of Haryana. There is no water treatment plant in the town. Similar is the situation with most of the towns of the country which are densely populated and there are no water treatment plants for the treatment of sewage disposal. The untreated waste in these towns is directly drained into natural reservoirs and there is no regulatory authority to check the quality of water as a result of which the untreated waste is going on polluting the underground waters of these regions. In reality about 90% of waste water produced globally remains untreated causing wide spread water pollution, especially in developing countries. The study of some physico-chemical parameters of this untreated sewage disposal of the region reveals that amounts of some of the pollutants are present much above the prescribed limits. The present study shows that the treatment of untreated sewage disposal is necessary otherwise the entry of this polluted water in ground water shall be highly harmful to the flora and fauna of the region.

Keywords

Sewage, reservoirs, pollutants, treatment plant, underground water.

Introduction

Comprising over 70% of Earth's surfaces, water is undoubtedly the most precious natural resource that exists on our planet. Without the seemingly invaluable compound comprised of hydrogen and oxygen, life on earth would have been nonexistent. It is essential for the growth, development and prosperity of living organisms on our planet. Although we as human recognize this fact, we disregard it by polluting our rivers, lakes, ponds, reservoirs and oceans. Subsequently, it has been slowly but surely harming our planet to the point where the organisms are facing or will have to face unmanageable consequences. Our drinking water has been greatly affected due to our ability to use water for recreational purposes. In order to combat water pollution, we must understand the problem and become part of the solution.

When toxic substances enter lakes, streams, river, oceans and other water

bodies, they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution of water where the quality of the water deteriorates which affects the ground water deposits.

Although some kinds of water pollution can occur through natural processes, it is mostly as a result of human activities. We use water daily in our homes and industries, about 128 liters per person per day. The water we use is taken from lakes, rivers and from underground water. After our use it gets contaminated and most of it returns back to these locations.

The used water of a community is called waste water, or sewage. If it is not treated before being discharged into waterways, serious pollution is the result. Historically, it has taken humanity quite bit of time to come to the grips of this problem. Water pollution also occurs when rain water runoff from urban and industrial areas, from agriculture land and mining operations makes its way back to the receiving waters into the ground water.

Categories of water pollutants

There are several classes of water pollutants. The first category includes disease-causing agents[1] such as bacteria, viruses, protozoa and parasitic worms which enter sewerage systems and untreated waste. Due to the presence of these microorganisms water act as the chief vehicle of transmission for waterborne diseases like dysentery, cholera, typhoid etc. which are caused by these organisms.

The second category of water pollutants is of oxygen-demanding waste. It includes the biodegradable matter such as animal manure and plant residues which are added to water. The natural process of breaking these down uses the dissolved oxygen present in water and hence can deplete oxygen levels in the water. The oxygen depletion destroys the natural balance of water and ultimately bacteria thrive and fish and other aquatic life die. Once all the oxygen has been depleted, bacteria are able to take over making the water polluted.

The third class of water pollutants is water-soluble inorganic pollutants containing acids, caustics, salts [2] and toxic metals. They do not easily break down and remain there for a long time. Large quantities of these substances make water unfit for drinking and harmful to health.

Another class of water pollutants includes plant nutrients. They are water-soluble nitrates, phosphates and ammoniums salts. Phosphates and nitrates dissolved in water act as nutrients and accelerate the growth of algae that may form a mat on the water surface. This increased productivity of algae is called Eutrophication. [3] The algae use oxygen at night and may deoxygenate the water enough to kill fish and other animals. The algae may die and sink, and feed the oxygen consuming bacteria. It may be pushed on to the shore by wind and decomposes, releasing foul gases such as hydrogen sulphide and the decaying matter may accumulate and finally fill the lake or pond. It is a natural stage in the change of a lake into dry land. Nitrates from fertilizers and detergents contaminate drinking water. It is reduced in the stomach to nitrite which combines with hemoglobin and reduces the oxygen carrying capacity of the blood. Nitrate poisoning may prove fatal in children.

Water can also be polluted by a number of organic compounds such as oils,

Table1. Types of water pollutants

Category	Examples	Sources	Effects
1.Infectious agents	Bacteria, viruses, protozoa, parasites	Human and animal excreta in sewage	Water borne diseases
2. Oxygen-demanding wastes	Animal manure, animal remains and plant residues	Sewage, agricultural runoff, paper and food processing industries	Death of aquatic organisms
3.Inorganic chemicals	Acids, caustics, salts, toxic metals	Metal, leather, and chemical industrial effluents, household cleansers, irrigation runoff, oil drilling	Metal toxicity, metal fume fever, carcinogenic
4. Plant nutrients	Nitrates, phosphates, ammonium ions	Fertilizers, pastes, detergents, sewage, manure	Eutrophication, nitrate poisoning
5.Organic chemicals	Pesticides, plastics, detergents, oil, grease, gasoline	Vegetables, crops, industrial, household, cosmetics	Diseases in plants, animals and human beings
6.Sediment	Soil, silt	Land erosion due to water runoff, construction, overgrazed rangelands	Harmful to aquatic life, disrupts photosynthesis
7.Radioactive elements	cesium, iodine, radon, thorium, uranium	Radioactive decay, nuclear plants, mining and processing of ores, nuclear weapons	Cancer, birth defects and genetic damage
8. Thermal	Heat	industrial cooling, cold storage, nuclear plants, electric power plants	Make species vulnerable to diseases

pesticides, plastics, [4] detergents, gasoline, etc. which are harmful to humans, plants as well as animals in water. They are suspected endocrine disruptors which cause hormonal effects to many aquatic organisms.

A very dangerous category is suspended sediment containing soil, silt etc. Large quantity of suspended solids can affect fishes in a variety of ways including adversely affecting their swimming, reducing growth, reducing disease tolerance or even causing their death. [5] Even small increase in amount of suspended sediments can reduce the production of aquatic plants [6] by reducing light penetration thereby reducing photosynthesis and primary production. [7] A small increase in suspended solids over longer or continuous duration can affect the quantity and composition i.e. species richness of aquatic invertebrates. [8] [9] .

The most dangerous categories include radioactive and thermal pollution. The radioactive pollution occurs due to spontaneous decay of unstable nuclei. In many industries including nuclear power plants, nuclear weapon industries, medical and scientific research laboratories the radioactive pollution is responsible for a number of diseases [10] such as cancer, birth defects and genetic damage and thus very dangerous pollutants. The thermal pollution increases the temperature of water bodies such as lakes, ponds, streams or rivers and causes chemical, physical and biological effects.[11] The increased temperature fastens the rate of chemical reactions which deplete the oxygen in water.

Sources of water pollution

Water pollution is usually caused by human activities.[12] Different human sources add to the pollutions of water. There are two types of sources, point and non point sources, point sources discharge pollutants at specific locations through pipe-lines or sewers into the surface water. Non point sources are sources that cannot be traced to a single site of discharge. The point sources are factories, sewage treatment plants, underground mines, oil wells, oil tankers and agriculture. The non point sources include acid deposition from the air, traffic, pollutions those are spread through rivers and pollutants those enter the water through ground water. Non point pollution is hard to control because the perpetrators cannot be traced. However the point sources pollution can be controlled by taking suitable and appropriate preventive measures.

The point sources pollution can be broadly classified as municipal, industrial and agricultural. Municipal water pollution consists of waste water from homes and commercial establishments. For many years, the main goal of treating municipal waste water was simply to reduce its content of suspended solids, oxygen demanding materials, dissolved inorganic compounds and harmful bacteria.

In recent years, however, more stress has been placed on improving means of disposal of the solid residues from the municipal treatment process. In treatment plants the waste water is treated to reduce its strength [13] so that it can be made safe for satisfactory disposal. In practice the treatment plants act as unloading stations where all the undesirable and nuisance causing substances [14] in the waste water are removed and the character of waste water is altered [15] and it is acceptable to disposal agencies for safe disposal.

Materials and Methods

Study Area

Water is used for drinking, bathing and irrigation. Due to the increased population, rapid industrialization and uncontrolled urbanization, discharge of the waste is expected to bring about the change in quality of water. The present study was undertaken to study the physico-chemical parameters of water samples taken from sewerage of Ladwa. For this work samples from four different sites of Ladwa sewerage have been selected. These sites are Harijan Basti of Ladwa (Site-I), near Guru Ravidas Mandir of Ladwa (Site-II), the Hinori Chowk(Site-III) and the Babain Chowk(Site-IV). Here large number of effluents is drained into the water sewerage. Water samples from these sites were collected once and brought to the laboratory for analysis. The physico-chemical parameter of water samples were studied using the method described in APHA (1985) and ISI (1965)

Results and Discussion

To ascertain the quality of sewage, it is characterized by a number of tests. The results of these tests give an idea about the deterioration of quality of water. The various physico-chemical parameters studied were compared with the standards. The observed pH values are within the permissible limit which ranges from 5.85 to 6.67 which are little less than the pH of Northern Region which was found to be 8.01. The conductivity values are found to be different for different sample ranging from $0.53x10^{-3}$ to$1.90x10^{-3}$ mho which are quite high indicating the presence of larger amount of salts in the sewage water.

The magnitude of the total suspended solids and total dissolved solids depends on factors like the type of filter and its pore-size, the physical nature and the particle size of the suspended impurities, etc. In drinking water, most of the matter is in dissolved form. The amount of suspended solids increases with the extent of pollution and is maximum in sludges, where the dissolved fraction becomes less important. The amount of total dissolved solids is in the range from 420 ppm to 490 ppm and the amount of total suspended solids varies from 4.5 ppm to 6.0 ppm. The lesser values of these parameters are probably due to the reason that no industrial effluents are added to the sewage of this town.

The values of BOD lie in between 66 ppm to 102 ppm which are higher than the BOD value of treated waste (< 20 ppm) and much higher than that of normal river water (2- 8 ppm). The values of COD of the samples are in compliance to the BOD values.

The amount of dissolved oxygen does not vary much and lie in the range of 0.010 ppm to 0.012 ppm, however it is much less than the standard values which vary from 14.5 ppm at 0^{o}C to about 7.5 ppm at 30^{o}C (under a pressure of one atmosphere) in distilled or fresh waters with low solid concentrations.

The parameter of Total hardness does not indicate much about the degree of pollution of samples of sewage water. The values of this parameter (106.20 ppm to 115.50ppm) are comparable to the standard values of moderately hard waters (75ppm to150ppm). The other parameters of hardness of water viz. Magnesium hardness, Calcium hardness, Temporary hardness and Permanent hardness show similar results.

The Chloride Content of the sewage water samples varies from 301.75 ppm to 340.00 ppm. The chlorides are usually present as NaCl, $MgCl_2$, and $CaCl_2$ in all natural waters. They enter in water by solvent action of water on salts present in soil or from polluting materials like sewage containing the salt used in household and trade wastes containing chloride used in manufacturing. When present at concentrations above 250 ppm, chlorides impart an unacceptable taste to waters although no adverse effects have been observed on human beings regularly consuming waters with much higher concentrations of chlorides. However, exceptionally high concentration of chloride in the water samples as in present case may be considered as an indication of contamination by domestic waste water.

The CO_2 content of the samples are in the range of 180.0mg/l to 233.0mg/l. Most natural waters contain dissolved CO_2. It may enter water either by absorption from atmosphere or may be produced by biological oxidation of organic matter present in contact of water.

CO_2 content of surface waters is normally much less than 10 mg/l but some ground waters may contain between 30 mg/l to 50 mg/l of CO_2. When waters containing high concentration of CO_2 are exposed to atmosphere, most of CO_2 escapes from the solution as the partial pressure of CO_2 in atmosphere is normally less. However because of its corrosive nature and the unacceptable taste it imparts to water, CO_2 is to be removed from municipal water supplies by aeration or by neutralization with lime.

Waste water treatment plants (WWTP) are supposed to make the municipal sewage compatible for disposal into the environment (surface and underground water bodies or land), to minimize the environmental and health impacts of the sewage, and to make the sewage fit for recycling and reuse (agricultural and aqua-cultural uses). However in most of the Indian towns and a number of cities there are no waste water treatment plants employed for treatment of sewage disposal and kitchen waste.

The untreated waste is directly added to the water bodies such as rivers, lakes, ponds, reservoirs etc. which pollutes the fresh water of the region and makes it unfit for usage. The above studies reveal the extent of deterioration in the quality of fresh waters. The calculated values of most of the physico-chemical parameters are much higher than the standard values. Therefore the treatment of untreated waste is necessary by using waste water treatment plant. The waste water treatment plants supplement to the natural purifying power / capacity of water bodies and help in maintaining their utilities. Earlier in many articles related to sewage water pollution and its treatment it has been shown by researcher that by treating the waste / sewage water its strength is reduced and it is safe for satisfactory disposal.

It is concluded that due to rapid and uncontrolled urbanization of Indian towns the load on sewage systems has increased much. The direct addition of untreated waste in these towns to water bodies is creating an alarming situation to the quality of the surface and underground waters. Therefore depending upon the total population of a town the setting up of one or more treatment plants is necessary.

Table.2 Physico-chemical parameters of sewage water of the selected sites

S.No.	Parameter	Site- I	Site- II	Site- III	Site- IV
1.	Colour	Black	Brown	Black	Black
2.	Smell	Unpleasant	Unpleasant	Unpleasant	Unpleasant
3.	pH	6.67	5.85	6.20	6.03
4.	Conductivity	$1.85x10^{-3}$ mho	$1.90x10^{-3}$ mho	$0.72x10^{-3}$ mho	$0.53x10^{-3}$ mho
5.	Total dissolved solid	480 ppm	470 ppm	420 ppm	490 ppm
6.	Total suspended solid	6.0 ppm	4.5 ppm	5.5 ppm	5.7 ppm
7.	BOD	102ppm	66ppm	84ppm	66ppm
8.	COD	112ppm	70ppm	97ppm	68ppm
9.	D O	0.010ppm	0.012ppm	0.011ppm	0.011ppm
10.	Total Hardness	109.30ppm	106.20ppm	112.50ppm	115.50ppm
11.	Mg Hardness	72.50ppm	76.87ppm	73.75ppm	75.60ppm
12.	Ca Hardness	36.80ppm	29.33ppm	38.75ppm	39.90ppm
13.	Cl^-content	337.00ppm	319.50ppm	340.00ppm	301.75ppm
14.	CO_2 Content	194.4mg/l	180.0mg/l	203.0mg/l	233.0mg/l
15.	Permanent Hardness	90.60ppm	93.75ppm	95.60ppm	93.10ppm
16.	Temp. Hardness	18.70ppm	12.40ppm	16.90ppm	22.40ppm

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