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The Estimation of Physic Chemical Parameters and Heavy Metal Toxicity on Canal System

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Abstract

The present study was carried out on the Indira Gandhi Canal to evaluate the water quality with special reference to physico-chemical parameters like pH, conductance, DO, BOD, COD, TA, TDS, TSS, TS, Total Hardness, Chloride Content, Sulphate Content, Nitrate Content and Calcium Content for ten different sites of selected canal stretch. Average estimated values are compared with BIS. The Comparison is showing that all water quality parameters that are examined are above the BIS's permissible limit. It figures out that it is not suitable for drinking purpose and there is strong need for preservation and monitoring of Indira Gandhi Canal water.

Keywords : **Heavy Metal Toxicity, Canal System, physico-chemical**

Introduction

Water has several other unique physical properties such as water has a high specific heat. Specific heat is the amount of energy required to change the temperature of a substance. Because water has a high specific heat, it can absorb large amounts of heat energy before it begins to get hot. It also means that water releases heat energy slowly when situations cause it to cool. Water's high specific heat allows for the moderation of the Earth's climate and helps organisms regulate their body temperature more effectively (Nelson and Cox 2008).

Water in a pure state has a neutral pH. As a result, pure water is neither acidic nor basic. Water changes its pH when substances are dissolved in it. Rain has a naturally acidic pH of about 5.6 because it contains natural derived carbon dioxide and sculpture dióxido molecules (Vanloon and Duffy 2000).

Water conducts heat more easily than any liquid except mercury. This fact causes large bodies of liquid water like lakes and oceans to have essentially a uniform vertical temperature profile.

Water exists as a liquid over an important range of temperature from 0 - 100 degrees Celsius. This range allows water to remain as a liquid in most places on the Earth.

Liquid water is a universal solvent. It is able to dissolve a large number of different chemical compounds. This feature also enables water to carry solvent nutrients in runoff, infiltration, groundwater flow, and living organisms (Raven *et al.* 2010).

Water has a high surface tension. In other words, water is adhesive and elastic, and tends to aggregate in drops rather than spread out over a surface as a thin film. This phenomenon also causes water to stick to the sides of vertical structures despite gravity's downward pull. Water's high surface tension allows for the formation of water droplets and waves, allows plants to move water (and dissolved nutrients) from their roots to their leaves, and the movement of blood through tiny vessels in the bodies of some animals.

Water is the only substance on Earth that exists in all three physical states of matter: solid, liquid, and gas. Incorporated in the changes of state are massive amounts of heat exchange. This feature plays an important role in the redistribution of heat energy in the Earth's atmosphere. In terms of heat being transferred into the atmosphere, approximately 3/4's of this process is accomplished by the evaporation and condensation of water (Raven *et al.* 2010).

The freezing of water causes it to expand. When water freezes it expands rapidly adding about 9% by volume. Fresh water has a maximum density at around 4 degrees Celsius. Water is the only substance on this planet where the maximum density of its mass does not occur when it becomes solidified.

Water is the most abundant substance in living systems, the first living organisms on Earth doubtless arose in an aqueous environment, and the course of evolution has been shaped by the properties of the aqueous medium in which life began.

The water molecule and its ionization products, H☐and OH☐, profoundly influence the structure, self-assembly, and properties of all cellular components, including proteins, nucleic acids, and lipids. The non-covalent interactions responsible for the strength and specificity of “recognition” among bimolecular are decisively influenced by the solvent properties of water, including its ability to form hydrogen bonds with itself and with solutes

Water possesses a unique position in renewable resources and is the most fundamental substance making life possible on this planet. Water is the only resource that does not have any alternate. The amount of water on earth and its surrounding atmosphere is large enough that it makes 7% of the earth mass but available fresh water is limited to only 1% of total water stored (Deksissa Chuco 2004).

Canal System and Water Pollution

A Canal is defined as a large artificial stream of water emptying into its fed areas. Canal and streams drain water that falls in down-land areas. Moving water, dilutes and decomposes pollutants more rapidly than standing water, but many rivers and streams are significantly polluted all around the world (Bailey et al 2002).

Water pollution is a global problem that varies in magnitude and type of pollutant from one region to another. In many locations, particularly in developing countries, the main water pollution issue is lack of disease-free drinking water. Water pollutants are divided into eight categories: sewage, disease-causing agents, sediment pollution, inorganic plant and algal nutrients, organic compounds, inorganic chemicals, radioactive substances, and thermal pollution. These eight types are not exclusive; for example, sewage can contain disease-causing agents, inorganic plant and algal nutrients, and organic compounds.

Rivers are the lifelines of many big cities but these big cities are now killing its lifeline by polluting its water. Rivers become polluted with the assortment of waste, including untreated or partially treated municipal sewage, toxic industrial effluents, harmful chemicals and ground waters from agricultural activities. A polluted water supply not only limits; quality water availability but also put millions at risk of water-borne diseases. In India nearly 16% of the world population resides but it possesses only 4% of world water resources, so pressure on freshwater resources in India is very high that is forcing to preserve the quality, quantity and availability of freshwater resources (HRD Report 2008). In India more than 20 major Rivers basin and its tributaries supposed to carry 16,45,000 million meter cube water annually are present which are modified on the name of development, these River basins provide water for a wide variety projects, including agricultural diversions, hydropower generation and containment assimilation from industry and logging (Mall *et al.*2003).

A primary reason for this is that all three major sources of pollution (industry, agriculture and domestic) are concentrated along the rivers. Industries and cities have historically been located along rivers because the rivers provide transportation and have traditionally been a convenient place to discharge waste. Agricultural activities have tended to be concentrated near rivers, because river floodplains are exceptionally fertile due to the many nutrients that are deposited in the soil when the river overflows (Wetzel et al 2006).

India's fourteen major, 55 minor and several hundred small rivers receive millions of litters of sewage, industrial and agricultural wastes. Most of these rivers have been degraded to sewage flowing drains. There are serious water quality problems in the towns and villages using these rivers as a source of their water (CSE Report 2008).

Industrial survey statistics tells that more than 36.3% of the total value added by to the raw materials through manufacture in the factory sector of the country. But statistics do not tell us the real story of thousands of workers and farmers, who are depended upon these industries (CSE Report 2008).

Oxygen is the most well established indicator of water quality. Dissolved oxygen is in fact essential for the survival of all aquatic organisms. Moreover, oxygen affects a vast number of other water indicators, not only biochemical but aesthetic ones like odour, clarity and taste. Economic analyses seem to indicate that higher levels of income tend to improve oxygen levels. Oxygen levels of some of the major rivers have nowadays returned to their previous high levels after decades of low levels (Vanloon and Duffy 2000). This has improved the possibility of life. Rivers in the richer countries have become steadily cleaner over the past decade. But when measured for nitrates, fewer than one in ten European rivers are any longer natural: most have nitrate levels four times the norms found in nature. As cities expand to support larger populations, roofs, highways and parking lots increasingly replace permeable soils and vegetation. Rainwater in urban areas is channelled into sewers and drain systems instead of filtering into the ground to raise the water table. In developing countries the picture is very different. Rivers in the poorest countries have shown a substantial drop in the level of dissolved oxygen. Nine-tenths of all sewage in developing countries runs directly into rivers, lakes and seas without treatment (UNEP Annual Report 2006).

Many types of pollution are discharged into rivers, and the purification processes remove them at various speeds. Some heavy metals for example, are removed relatively quickly because suspended clay and organic particles have a slight electric charge and adsorb the metal atoms. When the clay or organic particles settle out of the water, they take the metal atoms with them. Unfortunately some pollutants are very persistent in the water and can accumulate downstream, causing great hazard (Vanloon and Duffy 2000).

Suspended solids in a moving body of water will settle out at various points or be carried longer distances, depending on their size and the rate of the flow. The higher the amount of suspended solids is the cloudier or more turbid in the water. Suspended matter can affect the amount of light entering water and therefore restrict the amount of photosynthesis that can occur and therefore the growth of plants. Small particles settling out in large amount on the bottom of a water body can prevent some organisms from living there as well as preventing green plants from photosynthesizing. How fast the water body moves affects the degree of mixing of water and how much molecular oxygen it will carry. Thus, fast-flowing highly agitated streams will not only be saturated with oxygen but also carry well-mixed nutrients, which will be ultimately carried to a river (Bailey et al 2002). The temperature of a water body is crucial to the amount of dissolved molecular oxygen it can contain. The warmer the water, the less molecular oxygen it contains.

Effluents from textile, leather, tannery, electroplating, galvanizing, pigment and dyes, metal- surgical and paint industries and other metal processing and refining operations at small and large-scale sector contain considerable amounts of toxic metal ions. The toxic metals and their ions are not only potential human health hazards but also to another life forms.

Toxic metallic ions can cause physical discomfort and sometimes life-threatening illness including irreversible damage to vital body system. From the eco-toxicological point of view, the most dangerous metals are mercury, lead, cadmium and Chromium (VI). In many instances, the effect of heavy metals on human is not well understood (Borgaonkat and Gokhble 1992).

Sources of pollution

Municipal liquid and solid wastes are the significant sources for the riverside water pollution an Indian scenario. Instead this, chemical waste products from industrial processes are sometimes accidentally discharged into rivers. Examples of such pollutants include cyanide, zinc, lead, copper, cadmium and mercury. These substances may enter the water in such high concentrations that fish and other animals are killed immediately. Sometimes the pollutants enter a food chain and accumulate until they reach toxic levels, eventually killing birds, fishes and mammals (Atlas and Bartha 1998).

Factories use water from rivers to power machinery or to cool down machinery. Dirty water containing chemicals is put back in the river. Water used for cooling is warmer than the river itself. Raising the temperature of the water lowers the level of dissolved oxygen and upsets the balance of life in the water (Bailey et al 2002).

Farmers put fertilisers and pesticides on their crops so that they grow better. But these fertilisers and pesticides can be washed through the soil by rain, to end up in rivers. If large amounts of fertilisers or farm waste drain into a river the concentration of nitrate and phosphate in the water increases considerably. Algae use these substances to grow and multiply rapidly turning the water green. This massive growth of algae, called Eutrophication, leads to pollution. When the algae die they are broken down by the action of the bacteria that quickly multiply, using up all the oxygen in the water, which leads to the death of many animals, and create hypoxic water condition to other aquatic animals (Spiro and Stigliani1996). The people are also careless and throw rubbish directly into rivers.

Water quality

Water quality determines the ‘goodness’ of water for particular purposes. Water quality tests will give information about the health of the waterway. By testing water over a period of time, the changes in the quality of the water can be seen.

The quality of natural water in rivers, lakes and reservoirs and below the ground surface depends on a number of interrelated factors. The water has the ability to react with the minerals that occur in the soil and rocks and to dissolve a wide range of materials, so that its natural state is never pure. It always contains a variety of soluble inorganic and organic compounds. In addition to these, water can carry large amounts of insoluble materials that are held in suspension. Both the amounts and type of impurities found in natural water vary from place to place and by time of year and depends on a number of factors. These factors include geology, climate, topography, biological processes and land use. The impurities determine the characteristics of a water body.

Water quality testing is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well. These properties can be physical, chemical or biological factors. Physical properties of water quality include temperature and turbidity. Chemical characteristics involve parameters such as pH and dissolved oxygen. Biological indicators of water quality include algae and phytoplankton. These parameters are relevant not only to surface water studies of the ocean, lakes and rivers, but to groundwater and industrial processes as well.

Water quality monitoring can help researchers predict and learn from natural processes in the environment and determine human impacts on an ecosystem. These measurement efforts can also assist in restoration projects or ensure environmental standards are being met.

Parameters that may be tested include Temperature, pH, EC, Turbidity, DO, BOD, COD, Total Alkalinity, Salinity, TDS, TSS, Chloride content, Total Hardness, Calcium, Nitrates and Phosphates.

Temperature of a waterway is significant because it affects the amount of dissolved oxygen in the water. The amount of oxygen that will dissolve in water increases as temperature decreases. Water at Oo C will hold up to 14.6 mg of oxygen per litre, while at 30o C it will hold only up to 7.6 mg/L. Temperature also affects the rate of photosynthesis of plants, the metabolic rate of aquatic animals, rates of development, timing and success of reproduction, mobility, migration patterns and the sensitivity of organisms to toxins, parasites and disease. Life cycles of aquatic organisms are often related to changes in temperature. Temperature ranges for plants and animals can be affected by manmade structures such as dams and weirs and releases of water from them (Hill M.K. 2000).

Salinity is a measure of the dissolved salts in the water. Salinity is usually highest during periods of low flows and increases as water levels decrease. Salinity is measured as either TDS (Total Dissolved Solids), which measures the amount of dissolved salts in the water, or as EC (Electrical Conductivity), which is the property of a substance which enables it to serve as a channel or medium for electricity. Salty water conducts electricity more readily than purer water (Vanloon and Duffy 2000).

Sources of salinity include urban and rural run-off containing salt, fertilisers and organic matter. Land use issues related to high levels of salinity include clearing of vegetation and the resultant rise in the water table, excessive irrigation, groundwater seepage and runoff containing dissolved solids from industry, sewage, agriculture and stormwater. Areas in the tidal limit of rivers which flow into the sea will experience fluctuations in salinity between high and low tide. While an appropriate concentration of salts is vital for aquatic plants and animals, salinity that is beyond the normal range for any species of organism will cause stress or even death to that organism. Salinity also affects the availability of nutrients to plant roots. Water containing a TDS level of over 500 mg/L is unsuitable for irrigation of many plants and tastes unpleasant to drink. Some of the maximum levels of TDS which different plants can tolerate are in the following table. Due to the sensitivity and tolerance of different plants to TDS, plants can be used as indicators of soil salinity (Hill M.K. 2000).

Objective of the Work

The basic objectives for water quality analysis of canal systems of Sri Ganganagar district, are: -

- To compile the information about the trends and concentrations of the various physico-chemical parameter under pollution load.
- To establish base line information for pollution load caused by the hidden sources.
- Identification and demarcation of the potential effect on quality water caused by the Heavy metals.

Importance of the work

The results and conclusions produced from the present research work will help to the Government to check out the discharge of industrial units and municipal authorities of Punjab to Indira Gandhi Feeder canal. The ultimately it will help to improve the health status of the population residing in the catchment area of IGNP. The outcome of the study will also help to create awareness in human community for water pollution and water conservation.

Review of literature

Tahir (2000) carried out a study assess arsenic in ground water of Attock and Rawalpindi district in collaboration with UNICEF. Water samples of both districts showed presence of arsenic ranging 0-17ppb, eight, out of 117 samples were found to exceed the arsenic level recommended by W.H.O.

Aher *et al.* (2000) investigated the status of ground water quality of pravana area in Maharashtra, where molasses were given continuously as fertilizers. They concluded that ground water quality of this area was degrading due to percolation process with time duration.

Patel *et al.* (2005) estimated the Impact of use of effluent water in agriculture on various factors as perceived by the farmers. The result revealed that over use of contaminated effluent water not only creates anxiety to the soil health but also creates massive problems to the quality of ground water.

Shailaja *et al.* (2006) investigated heavy metal contamination in the ground water of some area of Hyderabad district. Twenty-four samples were collected during pre and post monsoon seasons and analyzed for various heavy metals. It was concluded that heavy metals in all the round water samples were below the prescribed maximum permissible limits.

Physiographic of the Area

The area selected for the present study is Sri Ganganagar district of Rajasthan. Sri Ganganagar is the northern most district of the Rajasthan. It is considered as irrigated-desert and is dominated by agriculture and agriculture-based industries. Historically it was the estate of Maharaja Ganga Singh and its name was given as Sri Ganganagar by Maharaja Ganga Singh. Some documents provide the evidence that Maharaja Ganga Singh established this city on the theme of Paris (www.en.wikipedia.org). Sri Ganganagar is also known as Food basket of Rajasthan because of its crop potential (The Times of India, July 27, 2003)

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