

# Analysis of Water Quality of Sirhind Canal using Physicochemical Parameters in Malwa Region of Punjab, India

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## Abstract

Sirhind canal is main source of irrigation in the Malwa region of Punjab. This study was carried out to assess the physicochemical quality of Sirhind Canal to find out whether the water is suitable or not for drinking and irrigation. The samples were collected from different locations comprising five districts (Ludhiana, Sangrur, Barnala, and Mansa & Bathinda) of Sirhind canal. Various physico-chemical parameters like pH, TDS (Total dissolved solids), TH (Total Hardness), Turbidity, EC (Electrical Conductivity), Total alkalinity, Chlorides, Fluoride and nitrate were analyzed. The observed values were compared with BIS (2012) and WHO Standards. The results showed that some of water samples are not suitable for drinking and irrigation purposes due to high concentration of turbidity and Iron. These parameters were found to be above of the permissible limit. The water quality parameters such as EC, TDS, TH, Total alkalinity, chlorides, fluorides, BOD and COD were in the normal ranges in all selected samples. It could be concluded that surface water quality in the study area is better than degraded groundwater quality of Malwa region.

**Keywords:** Physicochemical characteristics, Sirhind canal, Water quality

## 1. INTRODUCTION

Water is an essential natural resource of life. It plays an important role in ecological processes in various ecosystems. Water consists of physical and chemical substances that help to survive the every living thing on the earth [1]. The presence, distribution, movement and composition of the earth's water are deeply connected with the structure and nature of the geographical structures [2]. Clean drinking water is essential for human health everywhere in the world. Being a global solvent, water is a major resource of infections. According to the World Health Organization (WHO), 80% diseases are caused by water. 3.1% of deaths take place due to contaminated and poorer water quality [3]. Rapid urban development areas affect groundwater quality due to excessive use of resources and waste disposal execution. Therefore, there is always a need concerns about safety and management of surface water and groundwater quality [4].

Freshwater availability is one of the major problems facing the world, and almost one third of the world's drinking water needs come from surface sources such as rivers, Dams, lakes and canals [5]. These water sources serve as the best immersion for the disposal of domestic and industrial wastes [6] [7].

Various researchers have already been studied on physicochemical and biological parameters to evaluate the water quality of different Indian rivers and canals. There reviews are discussed [8, 9, 10, 11, 12, 13].

## 2. MATERIAL AND METHODS

### 2.1 Geographical Location

Sirhind canal lies between 30°34'36" north latitudes and 76°04'10" east longitudes. Sirhind canal system is about 150 years old and its distribution network are spread over a length of 3215 km. Canal irrigates more than 2,000 square miles (5,200 square km) of farmland on the large scale. The Kotla branch is the sub stream of Bathinda main branch that originates from Sirhind feeder canal near Doraha in Ludhiana and passes through Sangrur, Barnala, Mansa and Bathinda, before entering Rajasthan

### 2.2 Collection and analysis of samples

Canal water samples were collected in clean polyethylene bottles of 2L capacity. The bottles were rinsed with acid water, followed by washing with double distilled water. The bottles were properly sealed and labeled exhibit sample number, location, sampling time and date. Surface water samples were collected from Kotla branch of Sirhind Canal.

The following is the list of the spots from was the samples were collected:

Sample No.	Source	Area/Location
C-1	Canal	Near Gurthali
C-2	Canal	Near Maksudra
C-3	Canal	Near Sirthala
C-4	Canal	Near Jabomajra
C-5	Canal	Near Mahorana
C-6	Canal	Near Jahagir
C-7	Canal	Near Mander Khurd
C-8	Canal	Near Ralla
C-9	Canal	Near Kotli Kalan
C-10	Canal	Near Pakka Khurd

The samples of various locations were examined for determination of degree of pollution with respect to the physicochemical parameters such as pH, TDS (Total dissolved solids), TH (Total Hardness), Turbidity, EC (Electrical Conductivity), Total alkalinity, Chlorides, Fluoride, nitrate, BOD, COD.

Standard Methods for the Examination of Water and Wastewater' by APHA (2012) and Standard Method of Sampling and Test (Physical and Chemical) for water and wastewater by BIS (1984) were used for analysis of various physicochemical parameters.

### 3. RESULTS AND DISCUSSION

In order to assess physicochemical study of surface water of Sirhind Canal at different locations were conducted and obtained results of the surface water were compared with BIS (2012) [14] and WHO [15] guidelines. The present study found that parameters revealed considerable variations at various locations. The analyzed values of each parameter are discussed and shown in Table 3(a).

#### pH

The pH range of all water samples lies between 6.8 to 8.07 and found alkaline in nature. Maximum water samples were found within permissible limit prescribed by BIS and WHO standards. The sampling site C-1 has higher pH where as C-6 has lower pH. It has been reported that [16] pH of the water was almost uniform magnitude in all the study samples and it varied between 7.05 to 7.50 which was tolerant of life system. Fluctuations in the optimal pH range may be increase or decrease in toxicity of poisons in water sources.

#### Electrical Conductivity (EC)

Electrical conductivity is a measure of the ability of water to conduct electrical current. Conductivity value ranged from 124-194  $\mu\text{s}/\text{cm}$  at different sampling sites of the Sirhind Canal. The result studied that all water samples are within the desirable limit of BIS and WHO standards [14] [15]. So that canal water is safe for drinking and irrigation purposes. The electrical conductivity of Sirhind Canal was compared with values of the river Narmada. The values of electrical conductivity during the study period have been ranged between of 230-398  $\mu\text{s}/\text{cm}$  [9]. The EC values of river Narmada were high because the electrical conductivity values increased with total dissolved solids and addition of pollution.

#### Total Dissolved Solids (TDS)

The term TDS describes all dissolved solids (usually mineral salts) in water. The acceptable limit of TDS is 500 mg/l (BIS, 2012) TDS of the water sample in the present study varied from 150 mg/L to 196 mg/L. A slightly higher TDS concentration was recorded at sample site C-8. There may be variations in the dissolved solids in water could affect the measurement of conductivity but gives no indication of the corresponding quantity of different components. There is a

relationship between conductivity and total dissolved solids in water [9].

#### Total Hardness

Hardness mainly depends upon the amount of calcium or magnesium salts or both. It is the property of water which prevents the formation of leather with soap and increases the boiling points of water [10]. BIS desirable limit for total hardness is 200 mg/L. In present study, the hardness of analyzed samples fluctuated from 102- 118 mg/L as  $\text{CaCO}_3$ . The highest and lowest values of total hardness were observed at sample C-8 and C10.

#### Turbidity

The turbidity of water is an important parameter that impact on the penetration of light under water and thus affects aquatic life [17]. The turbidity values varied between 27.39 to 180 NTU and found above the permissible limits prescribed by BIS (10500-2012). Most of the sampling sites showed high turbidity values except C-9 sampling site. The increase of turbidity may due to heavy soil erosion and suspended solids which may deteriorate the quality of surface water. It has been studied that [11] maximum turbidity values were recorded in Buckingham Canal. High turbidity is associated with bacteria causing diseases.

#### Total Alkalinity

Alkalinity is ability of water to maintain a relatively constant pH due to presence of hydroxyl, carbonate and bicarbonate ions in water. According to BIS Standards acceptable limit and permissible limit of total alkalinity are 200-600 mg/L. Total alkalinity of water samples ranged from 76 to 86 mg/L. Lower values of total alkalinity in Sirhind Canal water may contribute to algae growth and other aquatic life. It has been observed that [18] alkalinity values act as an indicator of the productive potential of water.

#### Chlorides

Chloride is the major anions found in water and usually combined with calcium, magnesium and sodium. In present analysis, the amount of chloride present in the water samples varied from 12 to 17 mg/L. The chloride content of the water sample when compared with BIS Standards, it was found that all samples showed concentration within permissible limit. The studies on chloride content in various Indian rivers were conducted by different workers. It has been reported that [9] chloride concentration 8.2 to 81.5 mg/l in river of Ganga and 1.2-62.8 mg/l in Damodar river basin were founded

#### Fluoride

Fluoride concentration was found to be between 0.09- 0.16 mg/L and it was lesser than BIS, WHO [19] permissible limits. Sampling sites such as C-2, C-5 were recorded below detection limits (0.05mg/L). Excessive intake of fluoride concentration in drinking water may cause fluorosis on human life.

**Table 3(a): Results of Physicochemical analysis of surface water of Sirhind Canal**

Sample No	Locations	Parameters												
		pH	TDS (mg/l)	Conductivity (µs/cm)	Total Hardness (mg/l)	Turbidity (NTU)	Total Alkalinity (mg/l)	Chlorides (mg/l)	Fluoride (mg/l)	BOD (mg/l)	COD (mg/l)	Nitrate (mg/l)	Arsenic (mg/l)	Iron (mg/l)
C-1	Gurthali	8.07	160	128	108	43.56	84	16	0.14	<l	8.8	5.6	0.0059	0.3988
C-2	Maksudra	7.78	160	135	108	83.43	84	16	BDL	<l	10.4	5.9	0.003	1.7579
C-3	Sirhala	7.8	150	130	106	42.62	80	15	0.09	<l	9.6	5.5	0.0054	0.9437
C-4	Jabomajra	7.98	150	124	106	95.62	80	16	0.09	<l	7.8	3.8	0.002	1.5189
C-5	Mahorana	7.62	150	126	106	35	82	17	BDL	<l	7.7	5.2	0.002	1.3973
C-6	Jahangir	6.8	165	182	108	50	80	14	0.16	<l	14.2	2.90	0.003	0.009
C-7	Mander Khurd	7.1	193	188	112	175	84	16	0.15	<l	12.5	3.92	0.001	0.005
C-8	Ralla	7.0	196	194	118	94	86	12	0.15	<l	9.8	0.82	0.002	0.020
C-9	Kotli Kalan	7.1	193	188	106	180	78	13	0.15	<l	8.2	3.99	0.003	0.023
C-10	Pakka Khurd	8.02	185	190	102	27.39	76	15	0.13	<l	7.9	3.94	0.002	0.004

BDL- Below Detection Limit

### Biochemical Oxygen Demand (BOD)

The BOD is the requirement of oxygen by microorganisms for the decomposition of organic substances present in water. Therefore, it reflects the amount of organic pollutants in the water. A high BOD value represents the presence of large number microorganisms, which represent high levels of pollution [20]. The results showed that BOD values were less than one in all sampling locations. All investigated water samples were within permissible limit prescribed by CPCB (2000) [21].

### Chemical Oxygen Demand

COD is an important water quality parameter that measures the level of pollution in the aquatic system. High COD may lead to degradation of oxygen on account of microbial decomposition to a level detrimental to aquatic life [20]. As per CPCB Effluent Discharge Standards [21] permissible limit of

COD for disposal into inland surface water is 250 mg/L. In present study, it was found that COD values varied between 7.8 to 14.2 mg/L. Maximum value was recorded at sampling site C-6 and minimum was at sampling site C-4.

### Nitrate

Increased nitrate concentration in ground and surface water reflects various agricultural activities. High amount of Nitrate-Nitrogen causes different problems such as reduced oxygen levels as a result of the impact on aquatic life, plants and algae [22]. The observed level of nitrate during work was recorded between 0.82 to 5.9 mg/L. Maximum and minimum value was at sampling site C-2 and C-8. All investigated samples were within permissible limit that prescribed by BIS [14] (45 mg/l) and WHO [15] (10 mg/l) and safe for domestic and irrigation purposes.

### Arsenic (As)

The observed values showed that concentration of As were ranged between 0.001 to 0.0059 mg/l. All the investigated samples were found to be below the permissible limit of BIS and WHO Standards.

### Iron (Fe)

The present study revealed that Fe metal content was recorded above the desirable limit of BIS standards (0.3 mg/l). Maximum concentration was recorded at sampling sites C-2 (1.7579 mg/l), C-4 (1.5189 mg/l) and C-5 (1.3973 mg/l). It has been observed that Fe is naturally present in rivers, lakes and groundwater. It may also release in water bodies from natural resources, industrial waste, iron ores refining, and corrosion of iron containing metals<sup>[12]</sup>.

### CONCLUSIONS

In Punjab State, surface water resources are being used for irrigation purposes through fully functional canal system. In this study, characterization of the physicochemical parameters of Sirhind canal at 10 different locations was carried. From the above results and discussion, it may be concluded that water quality of canal in the investigation area is safe for domestic and irrigation and industrial activities. Most of water samples were found to be within the permissible limits. But turbidity and Iron metal was not in safe limit at some locations that indicating the need of immediately solutions for the minimization of these parameters to conserve the water resources.

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