



STUDY OF WATER POLLUTION IN RIVER JHELUM OF KASHMIR

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ABSTRACT

This study pertains to water pollution in river Jhelum. In order to take stock of water quality, samples were collected from various points along the course of the waterbody and analysed for identification of source, nature and type of pollutants present. The main parameters investigated include pH, alkalinity, acidity, total solids, dissolved oxygen and BOD. It was found that the quality of water was satisfactory at most of the points. However, at some points, minor deviations from International Standards for Drinking Water were observed in respect of BOD, CO₂ and total solids. The growing industrialisation and organisation of Kashmir demands constant monitoring of water quality.

INTRODUCTION

Environmental deterioration is an inevitable result of human activities and a natural phenomenon as well. Therefore, the regulation and control of contamination, so that it does not become pollution, becomes important. A proper management of the contaminants requires the knowledge of the quantity and quality of the contaminants as well as sensitivity of the receptor system (Ref.1). It is in this regard that stream flow assumes paramount significance.

River Jhelum runs all along the length of the valley and then crossing the border it loses its identity in the mighty Sindh in Punjab, Pakistan. All through its course, Jhelum is characterised by a sluggish flow and a tortuous path both arising from the high level nature of the valley (Ref.2). With the rapid industrialisation and urbanisation, the danger of degradation of river Jhelum, the chief waterbody of Kashmir, has increased. Consequently there is an obvious need of water quality determination.

The present study aims at (i) physiochemical analysis of water samples collected from different points, (ii) identification of source, nature and type of pollutants, and (iii) suggestions for suitable preventive techniques, if required.

WATER POLLUTANTS

Foreign material, either natural or otherwise, contaminates water and thereby renders it harmful to mankind because of its toxicity, aesthetically unpalatable effect and disease-causing agents. The pollutants which affect the quality of water may be categorized as:-

1. Physical Pollutants. Colour, temperature, taste, odour, and turbidity.
2. Chemical Pollutants. (a) Organic effluents - Pesticides, herbicides, oil and greases. (b) Inorganic effluents - soluble gases and compounds.
3. Biological Pollutants. Sewage effluents, wastes from slaughter houses, food and vegetable industries.

The industrial wastewater is usually released directly into the river generally in an untreated and unstabilized condition. Such water carries pathogenic organisms which can cause a variety of ailments like dysentery, gastroenteritis, typhoid, giardiasis, hepatitis (Ref.3).

EFFLUENT TREATMENT METHODS

The nature and quality of industrial effluents is as varied as the industries themselves. A general view of the industrial wastes finding way into river Jhelum may be had from Table 1.

Table 1

EFFLUENTS FROM INDUSTRIES AROUND RIVER JHELUM

Type of Industry	Nature of pollutants in raw waste.
1. Leather and Tanneries	Deep colour, high organic and salt soluble and insoluble contents.
2. Dairies	High BOD, High colloidal solids, fats and grease, acids or alkalis, odours on stagnation, iron salts, biodegradation matter.
3. Slaughter houses	High BOD, colour, offensive odours on stagnation, iron salts.

4. Fruit canning	Acids, high BOD, colour and dissolved salts.
5. Agriculture/Horticulture	Organic matter, suspended solids, toxic matter from insecticides and fertilizers.
6. Textiles, Silk/Wool	Alkalis and sodium salts, organic matter, toxic matter and colour.
7. Soap and Detergents	BOD, sulphur, pH, sodium salts.
8. Cement	Suspended and dissolved solids, pH and Heat.
9. Power Plants (steam)	BOD, turbidity, heavy metals, sulphur, heat, COD and dissolved oxygen.
10. Cattle feed	BOD, NO ₂ , dissolved sulphur, E-Coli, phosphorous.
11. Grain Mills	Sulphur, pH, Nitrogen, phosphorous, BOD and heat.
12. Timber products	BOD, dissolved and suspended sulphur, colour, COD, toxic matter.

The great diversity in the nature of pollutants suggests that it is not possible to devise a single unit to treat wastewater from these industries. However, knowing the characteristics of effluents, it becomes simpler to identify the treatment methods to be employed. These could be classified into three main groups as given below.

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|-------------------------|---|
| 1. Physical Treatment | Cutting, grinding, screening and separation. |
| 2. Chemical Treatment | Neutralization, flocculation, coagulation, destruction of toxic substances. |
| 3. Biological Treatment | Anaerobic and aerobic treatments. |

SAMPLING AND TESTING PROCEDURES

A minimum of three water samples were collected at each of the points, representing the maximum concentration of pollutants. Sampling methods and analytical techniques used for determination of the parameters of the study were in accordance with ISI : 3025-1964 (Ref.4).

RESULTS AND DISCUSSIONS

The mean values of the parameters obtained from analysis are reported in Table 11, wherein all values are in mg/l., excepting temperature and pH. Out of the numerous evaluations carried out, the main parameters of the study include pH, alkalinity, acidity CO₂, DO, BOD and total solids. These results refer to May 1980. The salient features of each parameter are discussed.

1. pH

It indicates the acidity of a solution. In natural water, it is largely dependent on the CO₂ equilibrium and lies between 7.0 and 8.5 the exact desirable range as per the International Standards for Drinking Water (Ref.5). Too low or too high pH makes water distasteful and effects corrosion.

In river Jhelum, a peak value of 9.1 at Shalteng, which is less than the limiting value of 9.2 was observed. It can be explained in terms of many sewers that join the river between Safakadal and Shalteng.

2. TEMPERATURE

Variation in temperature causes changes in pH and increased solubility or precipitation of bottom deposits. At elevated temperature a faster depletion of oxygen in water takes place due to increased rate of biodegradation and loss of solubility (Ref.6).

Water becomes less palatable as temperature rises above 10°C. The most desirable range for public supply is 5° to 10°C and it becomes undesirable above 27°C. Jhelum water even during summer was found markedly below this limit. The steady increase in temperature along its course may be due to a number of factors including higher temperature prevalent in the valley and contribution of submerged springs.

3. CARBONATES AND BICARBONATES

Carbonates and bicarbonates are undesirable foreign materials in water. Many industries such as brewing, distillery, rayon, paper and ice need soft water. In canning, hard water causes toughness of some vegetables, notably beans and peas. In textile finishing, the precipitates formed by lime of water combining with soap leaves spots on the fabrics or reacts unfavourably with dyes. Hard water deposits scale in pipelines and boilers which results in vast economic waste, due to failure of tubes and attendant shut down. So industrial water is softened to reduce its contents of calcium and magnesium.

4. TOTAL ALKALINITY

Alkalinity is caused by the presence of bicarbonates, carbonates and hydroxides of calcium, magnesium, potassium and sodium. These compounds also cause temporary hardness. The values of alkalinity for soft water and that for fair domestic water are 50 and 125 mg/l respectively. No harm is caused even if it is 400 mg/l. As such Jhelum water may be categorised as soft water. The peak value of 220 mg/l at Zainakadal may be attributed to a lot of washing going on around the area when the samples were collected.

5. TOTAL ACIDITY (as mg of CaCO₃)

The most usual cause of acidity is free CO₂ and decomposing organic matter especially of peaty origin. There is no defined limit for acidity of water. pH value in conjunction with other characteristics is used to determine the acidity of water which, in turn, indicates whether it is corrosive or not. All through, very low values of acidity were observed.

6. CARBON DIOXIDE

CO₂ in water is the result of decomposition of organic matter or the metabolism of some organism. Water drawn from iron-bearing formations often contain high quantity of CO₂. At higher concentrations, it poses the danger of bringing toxic metals into solution and damaging pipes.

Carbon dioxide is desirable in water at a concentration known as the carbonate balance. At this concentration, it should impart a desirable taste and should affect the solubility of the carbonates (ref.7).

In the river Jhelum, CO₂ concentration was generally high, as high as 92 mg/l at Banyari, in comparison to the desired limiting value of 10 mg/l. This indicates a high degree of biological activity going on in the river, since oxidation of organic matter furnishes CO₂. However, the BOD results suggest otherwise. The high value of CO₂ concentration may be due to a large number of submerged springs bringing in enough ground-water rich in CO₂.

7. DISSOLVED OXYGEN

Dissolved oxygen (DO) is the content of free oxygen in water. Surface water of satisfactory quality should normally be saturated with oxygen. Undersaturation and oversaturation indicate pollution. There should be an optimal minimum of 5 and minimum of 2 mg/l of DO. Aerobic bacteria consume dissolved oxygen of water. If the consumption is greater than its make-up by freshly dissolved oxygen obtained from the surface, oxygen deficiency is produced in water.

More demanding, high quality fish migrate into other zones. A severe deficiency with oxygen contents less than 2-3 mg/l leads to general fish death.

In the case of the river water, the oxygen content was generally satisfactory, both in regard to human consumption and fish hatching. In certain congested areas, like Habbakadal and Safakadal, DO was rather on the lower side, being 3.6 and 3.2 mg/l respectively, which is still within the safe limit.

8. BIOCHEMICAL OXYGEN DEMAND

Biochemical oxygen demand (BOD) is a measure of the amount of oxygen required in 5 days by living organisms in water to oxidise organic matter present as food. The BOD test suffers from the following severe limitations. First it requires a long time and then only a fraction of biodegradable compounds are determined. Also inorganic pollution may be there even if BOD is low. This calls for a judicious interpretation of BOD data.

If the load of organic matter does not exceed a moderate level at which the aerobic bacterial life is maintained, the organic pollutants are partly degraded by the bacteria through oxidation and partly used for the growth of new living biomass. This self-purification process requires the regulation of organic load into the stream.

The most desired level of BOD in water for domestic supply is zero and should not be above 0.5 mg/l. A higher content is a pointer to the higher number of living organisms like bacteria etc. in water. In general, the BOD of Jhelum water was not high indicating its suitability for public consumption. Slightly higher BOD values at Athwajan, Rajbagh, Habbakadal and Zainakadal do cause concern and indicates organic loading at these points.

9. CHLORIDES

High concentrations of chlorides affect the taste of water and result in corrosion in hot water systems. Its main source in water is sewage. This is also evident from the analysis of water samples collected from the source points of the river like Pahalgam and Verinag, which are completely devoid of chlorides. All along the length of the river Jhelum, the chloride level was found, in general, to be very low, with a maximum of 5.2 mg/l at Zainakadal which is well below the desirable limit of 200 mg/l.

10. TOTAL SOLIDS

A high concentration of solids in water deteriorates its taste and causes gastrointestinal irritation. The desirable level of total solids in water is 500 mg/l, and the maximum permissible in household water is 1500 mg/l. The total solid content in Jhelum water has been found to be mostly within the permissible limit. However, it varied widely in the range 90 to 1990 mg/l. This variation may be appreciated in its proper perspective if we take into account the fact that so many Nallah from highland areas open into the river bringing in a lot of hill soil. This causes a high level of total solids in the river. The amount of solids is primarily dependent on the amount of rainfall experienced prior to the collection of samples. This explains the high solid content at Habbakadal and Banyari.

11. DISSOLVED SOLIDS

The predominant constituents of dissolved solids are cations such as calcium, magnesium, sodium and potassium and the anions as bicarbonate, sulphate, chloride and nitrate. Higher concentrations are detrimental to public health and also these result in excessive scaling on boiling. The amount of dissolved solids in Jhelum water was generally not very high. The peak value of 11600 mg/l at Banyari can be explained in terms of excessive agricultural run-off finding way into the river. At Shalteng, the low value of dissolved solids especially in view of higher total solids may be ascribed to the greater contribution of rain-water towards the solid content.

CONCLUSION

In the light of the above discussion it is evident that pollution in river Jhelum is yet to gain dimensions. Certain parameters indicate no pollution whereas some like BOD, CO_2 and total solids do pose concern. Should the remedial measures be initiated now, possibly the evil could be contained.

Sewage systems, tourism, industry, agricultural run-off, industrialization and urbanization of Kashmir valley will add new dimensions to the quality of water entailing greater efforts both from public and government. Constant monitoring of the quality of river water in conjunction with planned development of the industry in the valley seem to be the need of the hour so that problems of pollution do not aggravate further.

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TABLE - II
Mean Values of Different Parameters

Sampling Stations Parameters	Pahal- gam	Veri- nag	San- gam	Athwa- jan	Raj- bagh	Habba- kadal	Zaina- kadal	Safa- kadal	Shal- teng	Ban- yari	Ningli
Temperature °C	8.5	11	13	21.7	19.6	22.3	19	22	23	19	20.2
pH	8.3	8.2	7.9	7.6	8.1	7.5	8.5	7.5	9.1	8.2	8
Carbonates	0	0	0	0	0	0	0	0	0	0	0
Bicarbonates	2	3.7	1.3	1.7	1.5	3	10.4	2.3	1	1.6	1.3
Total Alkalinity	10	22.3	9.2	17	9	10	22.2	9.3	2	4	3
Total acidity	2	3.0	4.3	3.5	3.6	2.7	1.8	2	10	10	11.3
CO ₂	15	32.5	59.3	15.3	20.6	29.1	6.2	26	21.8	92	82.3
DO	5.4	5.3	4.7	4.5	5.9	3.6	4.8	3.2	6.7	7.4	9.1
BOD	0.6	0.4	1.1	1	2.6	1.9	1.1	0.6	1.5	0.9	0.8
Chlorides	0	0	0.7	2.5	2	1	5.2	1.3	1	2.3	1
Total solids	90	92.5	286.6	1474	1370	1696.7	930	403.3	1466.7	1986.7	506.7
Dissolved solids	80	87.5	210	582	277.5	473	266	183.3	66.7	1160	86.66