Design of Canal from STP, Delawas to Bombay Hospital,Sitapura, Jaipur alongwith the Comparative Study of Water Quality Parameters of Water used for Irrigation

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***Abstract*—RIICO is one of the largest industrial areas in Jaipur. Not only the industries, it also contains main agricultural lands of Jaipur. But the water used for irrigation does not possess the equivalent water quality parameters of ideal irrigation water. The present study deals with the comparative study of treated water with water used for irrigation and also about the need of a canal for efficient irrigating process.**

Keywords: Sewage Treatment Plant, Water Quality, Irrigation

I. INTRODUCTION

Irrigation waters either from springs, or diverted from streams, or by pumping from wells, contain appreciable quantities of chemical substances in solution that may minimize the crop yield and diminishes soil fertility. In addition to the dissolve salts, irrigation water always carries additional substances originated from its natural environment or from the waste products of man (either domestic or industrial effluents) [1]. The quality of the irrigation water can affect both crop yields and soil physical conditions either physically or chemically, even if all other conditions and cultural practices are favorable /optimal. In addition, different crops require different irrigation water qualities as well as practices. The parameters by which the determination of the irrigation water quality are divided to three categories: chemical, physical and biological. In this review, the chemical properties of the irrigation water are discussed [2]. The chemical characteristics of irrigation water refer to the content of salts in the water as well as to parameters derived from the composition of salts in the water; parameters such as EC/TDS (Electrical Conductivity/ Total Dissolved Solids), SAR (Sodium Adsorption Ratio) alkalinity and hardness [3].

Jaipur district with geographical area of 11,061.44 sq. km forms east-central part of the Rajasthan State is also popularly known as Pink city. In the present study area between STP Delawas to Bombay Hospital, Sitapura, Jaipur as this region comprises of main agricultural land of Jaipur. The total area of study is about 3.4km in length.

II. PROBLEMS RELATED TO IRRIGATION

Sanganer,a nearby town, is very famous for a special type of printing, the process involves the use of various kinds of chemical dyes such as rapid indigo, direct aniline black, which also includes many metal based dyes used for fastening colors. Printing involves use of large amount of water and thus large quantity of waste water is also generated. The untreated sewage water and waste water from textile industries (which contains variety of chemicals such as Aniline, Caustic soda, Acids, Bleaching powder etc. including heavy metals) is used in irrigating agricultural fields located in Amanishah Nala, for growing vegetables and other crop plants.

Voluminous liquid wastes are generated by the dyeing and printing industry and are disposed off in carrier channels (canals). In addition, some industrial units are also pouring their effluents into the Amanishah Nala. These liquid wastes are also being used for irrigation purposes. The unused part of effluent water is allowed to accumulate near the bunds in the peripheral areas giving adequate time period to this effluent water to percolate and reach the saturated zone. Thereby degrading and deteriorating ground water quality. Maintaining the Integrity of the Specifications. It is therefore recommended that the liquid effluents should be treated and beneficiated to remove the hazardous constituents before their disposal and also to encourage / motivate to use vegetable dyes. Alternatively, the dyes having higher concentration of fluoride should be replaced by alternative dyes.

III. EFFECTS OF INDUSTRY USE ON WATER QUALITY

Table 1. Water Quality Analysis

S. No.	Parameters	Desired limits	Permissible limits
1.	pH value	6.5	8.2
2.	TDS	50	3000
3.	Fluoride mg/l	0.2	1.0
4.	Nitrate mg/l	15	30
5.	Chloride mg/l	25	200

The water quality used for irrigation is essential for the yield and quantity of crops, maintenance of soil productivity, and protection of the environment. Another aspect of agricultural concern is the effect of dissolved solids (TDS) in the irrigation water on the growth of plants. Dissolved salts increase the osmotic potential of soil water and an increase in osmotic pressure of the soil solution increases the amount of energy which plants must expend to take up water from the soil. As a result, respiration is increased and the growth and yield of most plants decline progressively as osmotic pressure increases.

Study of these parameters is necessary because of following reasons as pH is an indicator of the existence of biological life as most of them thrive in a quite narrow and critical pH range. Whereas the total dissolved solids (TDS) in water consist of inorganic salts and dissolved materials. In natural waters, salts are chemical compounds comprised of anions such as carbonates, chlorides, sulphates, and nitrates (primarily in ground water), and cations such as potassium (K), magnesium (Mg), calcium (Ca), and sodium (Na). In ambient conditions, these compounds are present in proportions that create a balanced solution. If there are additional inputs of dissolved solids to the system, the balance is altered and detrimental effects may be seen. Inputs include both natural and anthropogenic source. Fluoride is harmful in industries involved in production of food beverages, pharmaceuticals and medical items. Nitrates is injurious to dyeing of wool and silk fabrics and harmful in fermentation process for brewing, Nitrate in some water protects metal in boilers from inter-crystalline cracking. Chlorides is significantly affect the rate of corrosion of steel and Aluminium.

IV. PERFORMANCE OF STP WATER OF DELAWAS

The present study has been undertaken to evaluate the performance of Sewage Treatment Plant (STP) located at Delawas, Pratap Nagar of Jaipur district which is based on Sequential Batch Reactor (SBR) process. Performance of this plant is an essential parameter to be monitored as the treated effluent is discharged into Amanishah Nala, and using treated water for irrigation purpose.

Sewage samples were collected from different locations i.e. Inlet,

Distribution Chamber and Outlet of the Treatment Plant and analysed for the major waste-water quality parameters, such as

pH, Electrical conductivity, calcium & magnesium hardness, total hardness ,chloride, alkalinity, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) & Total Phosphates. Results revealed that pH variation between 7.70-8.28 Electrical conductivity between 0.65-1.16 mmhos/cm, Total solids between 686-910 mg/l, DO between 4.4-6.0mg/l, Alkanity between 740-830 mg/l. Thus treated water found suitable for irrigation purpose.

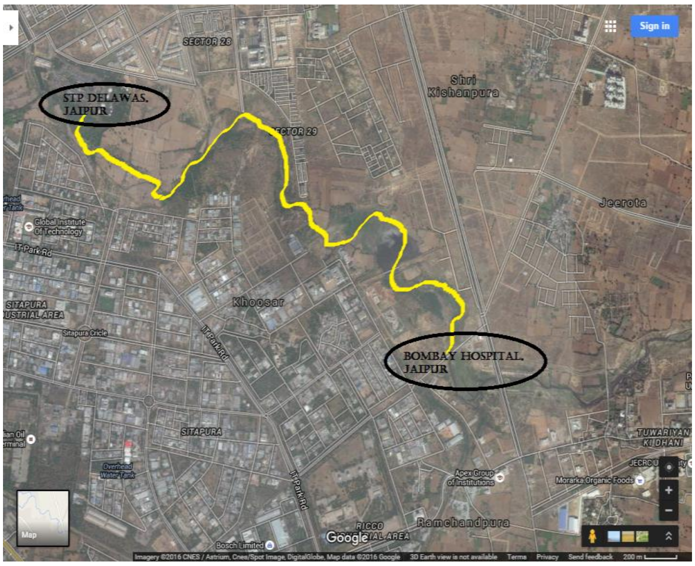

Figure 1. Working Area Descritiption (Siurce Google Maps)

V. ROUTE OF CANAL PROPOSED

Length of canal :-4.6 km

Type of terrain: - non regular, natural drainage
Origin of canal: - STP Delawas Discharge Unit
Destination of Canal: - Bombay Hospital, Jaipur

Desiging Methods: The two types of channels considered are

(1) Lined or non-erodible
(2) unlined, earthen, or erodible

There are some basic issues common to both the types and are presented in the following paragraphs.

1. Shape of the cross section of the canal.
2. Side slope of the canal.
3. Longitudinal bed slope.
4. Permissible velocities - Maximum and Minimum.
5. Roughness coefficient.
6. Free board.

Table 2. Curve Radius for Lined Canals

Radius of curves for lined canals Discharge (m^3/s)	Radius (minimum) in m
280 and above	900
Less than 280 to 200	760
Less than 200 to 140	600
Less than 140 to 70	450
Less than 70 to 40	300

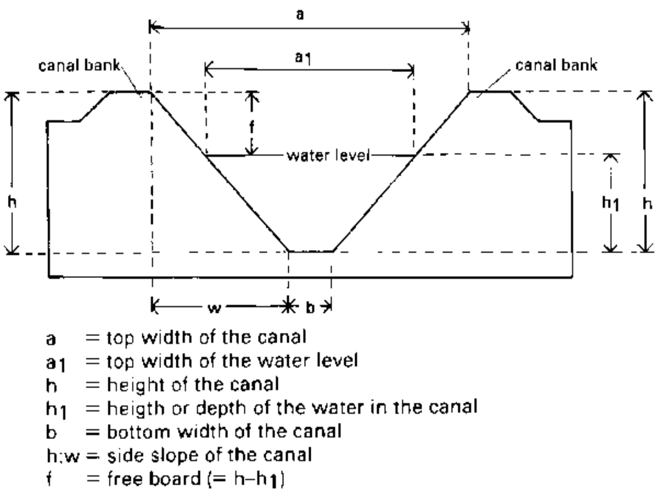

Figure 2. Proposed Shape of Canal

The lined canals are not designed making use of Lacey or Kennedy Theory because the section is rigid. Generally Manning's equation is used in design. To carry a certain discharge number of channel sections may be designed with different bed widths and side slopes. But it is clear that each section is not equally good for the purpose.

The section to be adopted should be economical and at the same time it should be functionally efficient. It has been found that the most suitable cross-section of a lined canal is a circular section with sloping sides. That is, the bed is not flat but it is an arc of a circle. This arc is tangential to the sloping sides

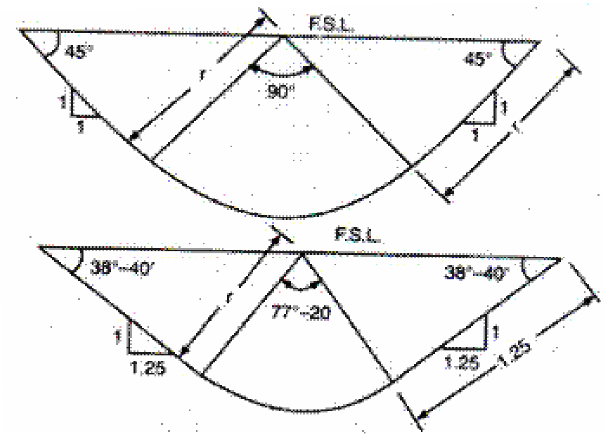

Figure 3. Cross Section of Canal

The cross section of an open irrigation channel can trapezoidal, rectangular or triangular in shape. The longitudinal sections assume a slope (typically ranging between 5-30 cm/km) to ensure the necessary water flow velocity to meet required water needs. Channels constructed with a fixed cross section and bed slope are called prismatic channels, while those with irregular cross sections and bed slopes are called non-prismatic channels. Channels are usually designed with regular cross-sectional shapes. The trapezoidal cross section is most commonly used for unlined channels, primarily because it is the most stable shape for the sides and banks of the canals.

Irrigation channels are lined for the following purposes:

- To reduce water leakage losses;
- To protect the channel sidewalls from collapse;
- To prevent the growth of canes;
- To decrease the growth of weeds;
- To reduce erosion resulting from high flow velocities;
- To reduce the required maintenance costs;
- To increase the channel's water conveyance capacity.

a. R.L. of the various points of proposed canal

Table 3. Reduce Level of Site

S.No.	Points	LHS RL(m)	RHS RL(m)
1.	Origin	361.5	360
2.	A	358	359.2
3.	B	352	351.2
4.	C	351	351.5
5.	Destination	347.3	347.5

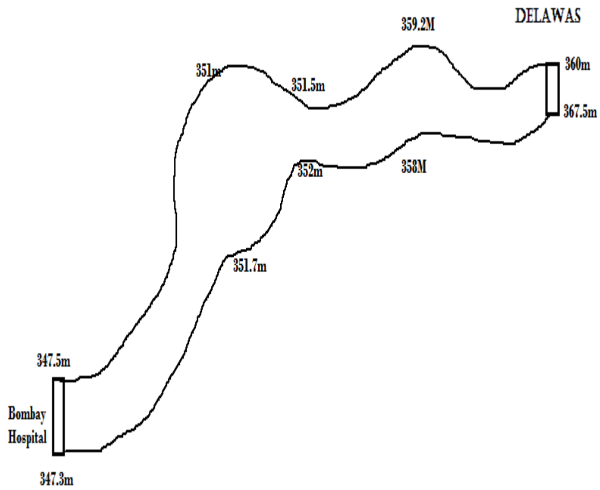

Figure 4. Drawing Design of Canal

Table 4. Comparative study of Water Quality Parameters

S.No.	Parameters	Untreated Water	After Treatment
1.	pH	6.7	6.5-9.2
2.	Conductivity (µmho/cm)	1770	300µmho/cm
3.	TDS (mg/l)	1350	500-1500
4.	Alkalinity (mg/l)	932	50-200
5.	Acidity (mg/l)	288	-
6.	Chloride (mg/l)	178.92	200-600
7.	Total Hardness (as CaCO3 mg/l)	550	100-500
8.	Ca Hardness (as CaCO3 mg/l)	262.5	75-200
9.	Mg Hardness (as CaCO3 mg/l)	287.5	30-150
10.	Fluoride (mg/l)	0.659	1.5

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