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Water Quality Index Of Treated Washwater From Distillery After Treatment Using Rotating Biological Contactor

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Abstract: ***Fortnight samples were collected from the inlet and outlet of Rotating Biological Contactor (RBC) used to treat washwater generated from the floor washings, waste water generated after washing the fermentors and waste water from canteen of Trichy Distilleries and Chemical Ltd, Sangalliyandapuram, Trichy, Tamilnadu. The washwater doesn't include the spent wash. Water samples were assessed by analysing the various physico – chemical parameters like pH, Electrical Conductivity, TDS, DO, BOD, COD, Nitrate, Sulphate and Chloride. The above mentioned parameters were utilized to calculate the Water Quality Index (WQI). The WQI reveals the treated washwater generated from the distillery is unfit for human consumption. But it can be used for other activities like pisiculture, horticulture etc.***

Keywords: Water Quality Index, Water Quality parameters, physico – chemical parameters, Ecosystem, Pollutants, Degradation and Environment

I. INTRODUCTION

Human activities may seriously affect the quality of aquatic ecosystems. Pathogenic organisms, nutrients, heavy metals, toxic elements, pesticides, pharmaceuticals and various other organic micro pollutants enter into aquatic environment through a range of point and diffuse sources. The presence of these compounds has adverse impacts on aquatic biota. It is well recognized that the distribution and the abundance of various species in aquatic systems are directly related to the water quality and hydrological conditions (Ray *et al.*, 2000).

Water quality assessment is one of the prime concerns and a major challenge all over the world. Seasonal variation study of water quality parameters provides information about the health of the water over a period of time. Water is vital to health and it influences the socioeconomic development of human beings. Population explosion, agricultural advancements, urbanization as well as industrialization have made water pollution a great problem, depleting the availability of potable water. Many parts of the world face such a scarcity of water (Ray *et al.*, 2000).

Water related diseases are among the most common causes of illness and death, affecting mainly the economically backward people in developing countries. The quality of water at any monitoring location is a reflection of the atmospheric and anthropogenic inputs. Concentrations of all kinds of pollutants have an influence on the water quality and also determine the use of water. It is, therefore, necessary to monitor water quality, understand the chemical characteristics and provide a reliable assessment of water quality (Zhang *et al.*, 2010)**.**

Water Quality Index (WQI) may be defined as the rating that reflects the composite influence of a number of water quality factors on the overall quality of water. It reduces the large amount of water quality data to a single numerical value.

It is one of the most effective ways to communicate information on water quality trends to policy makers, to shape sound public policy and implement the water quality improvement programmes efficiently (Tiwari TN, Mishra M (1985), Jameel AA and Hussain AZ. (2005) and Padmanabha B, Belagali SL. (2005).

The chief objective of this study is to analyse the quality of treated washwater released from Trichy distillery and Chemical Ltd, Sangalliyandapuram, Trichy, Tamilnadu through WQI. This shall be helpful for the efficient improvement in water quality management and policy making.

II. MATERIALS AND METHODS

A. WATER SAMPLING AND ANALYSES

Fortnight samples were collected from the inlet and outlet of Rotating Biological Contactor (RBC) used to treat washwater generated from the floor washings, waste water generated after washing the fermentors and waste water from canteen of Trichy Distilleries and Chemical Ltd, Sangalliyandapuram, Trichy, Tamilnadu. The washwater doesn't include the spent wash.

Various physico – chemical analyses of the washwater samples were done as prescribed by American Public Health Association, (1989) for the Examination of Water and Wastewater. The pH of all the washwater samples was determined on the spot using a pH meter (Model no 101 E, Systonic). Electrical conductivity was measured using a conductivity meter. The chloride, total hardness and total alkalinity were estimated by the standard methods of water and waste water (Nagarajan *et al.*, 1993 and Mittal and Verma, 1970). All the instructions were followed with proper precautions as mentioned in I.S.I Standards for Discharge of Industrial Effluents.

Parameters		
pH	Nitrate (mg/l)	Dissolved Oxygen (mg/l)
Electrical Conductivity (mmho)	Sulphate (mg/l)	BOD (5 days) 20°c
Total Dissolved Solids (mg/l)	Chloride (mg/l)	COD (mg/l)

Table 1: List of Physico – chemical Parameters (APHA, 1989)

WATER QUALITY INDEX

In order to calculate the Water Quality Index, 9 physico-chemical parameters have been utilized.

Sl. no	Parameters	I.S.I Standards
1	pH	9
2	Electrical Conductivity (µS/Cm)	2250
3	TDS (mg/l)	2100
4	DO (mg/l)	6
5	BOD (mg/l)	30
6	COD (mg/l)	250
7	Nitrate (mg/l)	10
8	Sulphate (mg/l)	1000
9	Chloride (mg/l)	1000

Table 2: I.S.I Standards for Discharge of Industrial Effluents

The relative significance of each of the factor in the overall water quality and it depends on the permissible level in discharge of industrial effluents, as suggested by I.S.I (Indian Standards Institute, 1977). Factors which have higher permissible limits are less harmful and have low weightings. Therefore, Wi = K/Sn

Where,

Wi - Unit weight of chemical factor, K - constant of proportionality and is given as:

$$K = \frac{\frac{1}{i}}{VS1} + 1 + \frac{1}{VS2} + \cdots + 1/VSn$$

Sn - standard value of i^{th} parameter

Rating scale: Each chemical factor has been assigned a water quality rating to calculate WQI.

Qi = 100 [(Va-Vi)/(Vs-Vi)]

Where,

Va - average of measured values in the water sample for three months at one place

Vs - standard value of ith parameter

Vi - ideal value for pure water (0 for all parameters except pH and DO)

The above equation becomes: Qi = 100 (Va/Vs)

For dissolved oxygen (DO): The ideal value = 14.6 mg/l; permissible value = 6 mg/l, QDO = 100 [(Va-14.6)/(6-14.6)].

For pH: The ideal value = 7.0; Max. Permissible value = 8.5, QpH = 100 [(Va- 7.0)/(8.5-7.0)]

Water Quality Index (WQI) = [Σ (QiWi)/ΣWi]

Where,

Σ(QiWi) - Qi (pH) X Wi (pH) + Qi (DO) X Wi (DO) + ……+ Qi (Ca) X Wi (Ca).

ΣWi - total unit weight of all chemical factors.

Using the water quality index and based on their suitability (Swarnalatha *et al.*, 2007), all the samples were categorized into the following five classes:

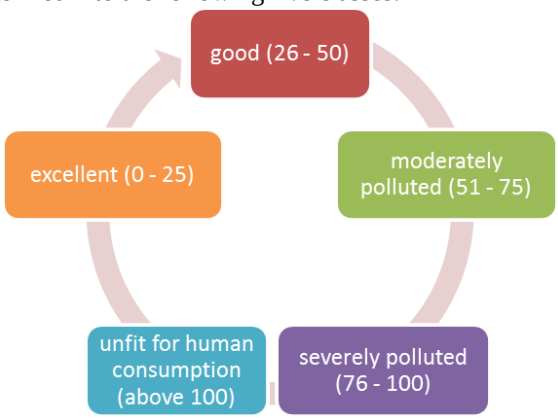

Figure 1: Category of Water Quality Index

According to Padmanabha and Belagali (2005), 0 < WQI < 100 indicates that the water is fit for human use and 0 > WQI > 100 reflects its unsuitability for use.

III. RESULTS AND DISCUSSIONS

Water is essential for all known life forms, still, water pollution and the destruction of ecosystems continue to

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increase. Water contamination is now a major problem in the global context as a consequence of industrialization, globalization, population growth, urbanization and warfare combined with increased wealth and more extravagant lifestyles UN-Water, (2005).

Parameters	Va	Wi	Qi	QiWi
pH	8.26	0.265796	63.0	16.75
Electrical Conductivity	2790	0.001062	124.0	0.13
TDS	13300	0.001138	633.3	0.72
DO	7.17	0.398333	119.5	47.60
BOD	150.59	0.079667	502.0	39.99
COD	558	0.00956	223.2	2.13
Nitrate	0.11	0.1195	1.1	0.13
Sulphate	0.03	0.00239	0.0	0.00
Chloride	789.67	0.00239	79.0	0.19

Table 3: Water Quality index

$\sum Wi = 0.88$ $\sum QiWi = 107.64$ $WQI = \sum QiWi/\sum Wi$ WQI = 122.34

The index result represents the level of water quality in a given water basin, such as a lake, river, or stream. It is important to monitor water quality over a period of time in order to detect changes in the water's ecosystem. The WQI can be used to monitor water quality changes in a particular water supply over time, or it can be used to compare a water supply's quality with other water supplies in the region or from around the world.

The value of WQI of the washwater sample is 122.34. It is unfit for human consumption. But it can be used for other activities like pisiculture, horticulture etc.

IV. CONCLUSION

The WQI results of the washwater sample indicated that the washwater treated by RBC though it is unfit for human consumption, it can conveniently be used for other activities like pisiculture, gardening etc.

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