

Analysis of water of river Yamuna and its tributaries with reference to Bacteriological Characteristics.

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Abstract

Near the source at Yamunotri and Shyana Chatti, the range of Total and Faecal coliform (TC & FC) varied between 80-101000 nos./100 ml and 18-3500 Nos./100 ml respectively, whereas from Lakhwar dam to Palla these values ranged between 50 to 218 x 10⁵ and 0 to 139000 nos./100 ml with annual average of 3513 to 2328645 and 120 to 29678 nos./100 ml for TC & FC respectively. The minimum bacterial contamination was observed not at source of the river but at the location in the foot hills of Himalaya. The monitoring at Yamunotri and Shyana Chetti was done once in a year in the month of June, when pilgrimage in its peak and bacterial contamination in the river may be contributed by this activity.

Key words: coliform, Yamunotri, foot hills, contamination, pilgrimage.

Introduction

Every human use of water, whether for drinking, irrigation, and industrial processes or for recreation has some quality requirements in order to make it acceptable. This quality criterion can be described in terms of physical, chemical and biological properties of such water (Gore, 1985; Verma, 2010). In many places both surface and ground water is fouled with industrial, agricultural, and municipal wastes. According to the World Commission on water for the 21st century, more than half of the world's major rivers are so depleted and polluted that they endanger human health and poison surrounding ecosystems (Inter-press, 2009). The sources of water pollution vary and involve almost every significant human activity.

Review of literature

India consumes about 86,311 tonnes (t) of technical-grade insecticides annually to cover 182.5 million hectare of its land. Most Indian rivers pass through agricultural areas that use pesticides. This makes leaching from agricultural fields the most serious non-point — unspecified, and therefore, not measurable accurately — source of pollution to the aquatic environment. And now there's a 1995 study that's found traces of isomers (a carcinogenic organochlorine) in Indian rivers, including the Yamuna.

About 57 million people depend on Yamuna waters. With an annual flow of about 10,000 cubic metres (cum) and usage of 4,400 cum (of which irrigation constitutes 96 per cent), the river accounts for more than 70 per cent of Delhi's water supplies. Available water treatment facilities are not capable of removing the pesticide traces. Waterworks laboratories cannot even detect them. Worse, Yamuna leaves Delhi as a sewer, laden with the city's biological and chemical wastes. Downstream, at Agra, this becomes the main municipal drinking water source. Here too, existing treatment facilities are no match for the poisons. Thus, consumers in Delhi and Agra ingest unknown amounts of toxic pesticide residues each time they drink water. The Central Pollution Control Board (CPCB), on its part, had found endosulphan residues — alpha and beta isomers — in the Yamuna in 1991. An earlier study by H C Agarwal (Delhi University) had traced ddt residues amounting to 3,400 nanogram per litre (ng/l). However, later cpcb studies showed reduced ddt levels. To gauge the immensity of the threat, it is necessary to trace the river's flow — divided in five segments on the basis of hydro-geomorphological and ecological characteristics — down to its final reaches.

Material and method

In general, the total coliform numbers were not meeting the designated best use criteria i.e. 5000 nos./100 ml in Yamuna River. Total coliform numbers was below the limit at the locations near the source in the year 2009, 2010, 2010 & 2011 and rarely observed meeting the standard at Palla, Mathura u/s and Agra u/s. After Palla till Allahabad the number always exceeded the limit at Yamunotri and Shyana Chetti. Near the source at Yamunotri and Shyana Chatti, the range of Total

and Faecal coliform (TC & FC) varied between 80-101000 nos./100 ml and 18-3500 Nos./100 ml respectively, where as from Lakhwar dam to Palla these values ranged between 50 to 218 x 10⁵ and 0 to 139000 nos./100 ml with annual average of 3513 to 2328645 and 120 to 29678 nos./100 ml for TC & FC respectively. The minimum bacterial contamination was observed not at source of the river but at the location in the foot hills of Himalaya. The monitoring at Yamunotri and Shyana Chetti was done once in a year in the month of June, when pilgrimage in its peak and bacterial contamination in the river may be contributed by this activity. There was gradual increase in the numbers of both TC & FC from source to Palla. Two peaks of very high values, one in Delhi stretch and another at Agra stretch of Total and Faecal coliforms were observed. After Agra Yamuna River restore its bacteriological quality, though still not suitable for its designated best use.

After Palla the number of total and faecal coliforms varied from 1300 to 171x10⁷ nos./100 ml and 50 to 203 x 10⁶ nos./100 ml respectively. At Agra downstream maximum bacterial contamination was observed followed by Nizamuddin Bridge and Agra Canal. At Agra downstream the range of total coliforms and faecal coliforms varied from 58000 to 171 x 10⁷ nos/100 ml and 2800 to 203 x 10⁶ nos./100 ml with annual average of 1952083 – 332341667 and 442899 to 34578167 nos./100 ml respectively. At Nizamuddin bridge it was in the range of 15500 to 89 x 10⁷ nos./100 ml and 2540 x 199 10⁶ nos./100 ml with annual average of 88 x 10⁵ to 10250883 and 437917 to 1836333 nos./100 ml in terms of total and faecal coliform respectively. The total and faecal coliform in Chambal River at Udi varied from 60 to 145 x 10⁵ and 0 - 220090 nos./100 ml with annual average of 97836 to 2542583 nos./100 ml and 280 to 20476 nos./100 ml respectively.

The faecal streptococci (FS) in the river water was monitored since 2009. The faecal streptococci have been used with faecal coliforms to differentiate human faecal contamination from that of other warm blooded animals. The ratio of FC & FS could provide information, though not accurately, about the source of contamination. A ratio of greater than 4 is considered indicative of human faecal contamination whereas a ratio of less than 0.7 indicative of nonhuman contamination. In the river Yamuna and its biggest tributary i.e. in River Chambal at Udi this ratio was always above the 0.7 and generally much higher than 4 only at few locations, sometimes this ratio ranged between 1 to 4. This indicates that the bacteriological contamination in the Yamuna River was predominantly contributed by the human beings. The Enterococcus group of bacteria was monitored once during the month of June, 1991 in the entire river stretch from Hathnikund to Juhika (Annexure-III). The Enterococcus is considered as the most efficient bacterial indicator of water quality generally used for bathing or recreational purpose. A count of enterococcus / 100 ml (APHA, Standard Method for examination of water and wastewater, 20th edition) in river water is considered fit for recreational uses. On the basis of Enterococcus standard, Yamuna River in the year 2009 (Enterococcus ranged between 3-26 nos./100 ml) upto Palla and at Juhika, in the year 2009 from Mathura upstream to Agra upstream (10 to 30 nos./100 ml) and in the year 2011 at Hathnikund (Enterococcus 10 nos./100 ml) was fit for bathing purpose. The Yamuna River water quality with these exceptions one not matched with the enterococcus standard during the study period because the count varies between 50 to 870000 nos./100 ml. The Chambal River water having very low count of this bacteria i.e. 2 to 16 nos./100 ml.

To estimate the number of live heterotrophic bacteria in river water, the total plate counts was also done once in a year in the Yamuna stretch from

Hathnikund to Juhika. The total plate count varies from 6000 (Hathnikund –

2009) to 198 x 10⁷ nos./100 ml (Agra downstream – quarter stream; 2010) in the selected stretch of Yamuna. In Chambal at Udi this count varies from

25000 (2009) to 23 x 10⁵ (2009).

Conclusion;

A ratio of greater than 4 is considered indicative of human faecal contamination whereas a ratio of less than 0.7 indicative of nonhuman contamination. In the river Yamuna and its biggest tributary

i.e. in River Chambal at Udi this ratio was always above the 0.7 and generally much higher than 4 only at few locations, sometimes this ratio ranged between 1 to 4. This indicates that the bacteriological contamination in the Yamuna River was predominantly contributed by the human beings.

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