

NOTE

Studies on Heavy Metal Pollution of Sone River Water

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In the present investigation the mercury concentration in water and fish samples of different species collected from the river Sone were determined. The levels of mercury range in water were found to be 0.054–0.01, 0.060–0.012, 0.050–0.019 mL/L in summer, monsoon and winter seasons respectively. The concentration of mercury is maximum in *Chela-Untrahi* while minimum in *Labeo-Beata* species.

Key Words: Heavy metals, Pollution, Sone river water.

The effluent generated by the pulp and paper industries causes a wide variety of toxic effects on aquatic animals including fishes^{1,2}. In recent years, much attention has been paid to the possible danger of mercury poisoning in humans as a result of contaminated fish consumption. Information of the distribution pattern of mercury in aquatic environment becomes important to know the accumulation of mercury in aquatic organisms and its meal transfer to man through fish food.

There are several reports on mercury content of fishes from Indian rivers^{3–9}. In this investigation the work has been designed to study the biochemical changes in the pulp and paper mill effluent and its effect on fishes.

The Orient Paper Mill (OPM) is one of the largest paper mills in Asia with an installed capacity of 90,000 tonnes per year by using the sulphate pulping process. The mill is located at Amalai (District Shahdol, M.P.) on the bank of Sone river. Water consumption of the factory for industrial purpose is about 1000–1400 m³/day. Chlor Alkali Industry, one of the most important sources of mercury pollution, is situated adjacent to OPM. The main products of the factory are chlorine gas, hydrochloric acid and caustic soda using mercury cell. About 50% of the chlorine is being supplied to the paper mill.

Sample Collection and Analysis

Twelve sample stations were selected for water quality analysis along the course of the Sone river, *i.e.*, (1) Upstream of the thermal power effluent mixing

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plant, (2) Thermal power effluent mixing point, (3) At the OPM intake point, (4) At the OPM effluent mixing point, (5) Bhatura Ghat, (6) Jarwahi Ghat (I), (7) Jarwahi Ghat (II), (8) Dia-piper Ghat, (9) Dasharath Ghat, (10) Markandaya, (11) Mahanadi mixing point, (12) Deolond.

The sampling area covers a total distance of about 210 km. The water samples were selected in the month of February-March, August-September, October-November (1998) and December-January (1999). The physico-chemical characteristics of the water were analyzed as per standard methods⁸, which are, mainly, temperature TS, SS, pH, carbonate ions, chloride ions, sulphate ions, BOD, COD. Mercury in water was analyzed with mercury analyzer (Table-1). Fishes were collected with the help of gill nets. After the collection of samples, they were preserved in formaline and brought to the laboratory for analysis. Fishes were segregated, identified, dried, digested and mercury detected as per reported method⁹.

TABLE-1
AVERAGE WATER QUALITY OF RIVER SONE

| Station | pH | Temp (°C) | T.S. (mg/L) | S.S (mg/L) | CO ₃ ²⁻ (mg/L) | Cl ⁻ (mg/L) | SO ₄ ²⁻ (mg/L) | COD | BOD |
|---------|-----|-----------|-------------|------------|--------------------------------------|------------------------|--------------------------------------|-----|-----|
| 1. | 7.6 | 29.2 | 562.60 | 105 | 36.30 | 240 | 180 | 10 | 15 |
| 2. | 8.2 | 32.0 | 1134.3 | 482 | 58.70 | 248 | 220 | 80 | 50 |
| 3. | 8.5 | 33.0 | 1278.6 | 426 | 60.80 | 283 | 210 | 205 | 535 |
| 4. | 8.5 | 32.0 | 4075.0 | 620 | 450.2 | 410 | 295 | 430 | 520 |
| 5. | 8.6 | 32.0 | 4320.2 | 627 | 450.2 | 415 | 295 | 445 | 510 |
| 6. | 8.3 | 29.2 | 4490.0 | 645 | 453.3 | 392 | 270 | 440 | 461 |
| 7. | 8.1 | 29.0 | 3492.0 | 630 | 433.0 | 345 | 254 | 400 | 442 |
| 8. | 8.1 | 28.0 | 3314.0 | 580 | 390.0 | 309 | 250 | 380 | 418 |
| 9. | 7.6 | 28.0 | 2960.0 | 475 | 264.0 | 295 | 240 | 360 | 325 |
| 10. | 7.6 | 29.0 | 2760.0 | 420 | 215.0 | 235 | 210 | 245 | 290 |
| 11. | 7.6 | 29.2 | 2056.0 | 405 | 190.0 | 200 | 125 | 170 | 180 |
| 12. | 7.6 | 28.0 | 1420.0 | 320 | 110.0 | 175 | 110 | 90 | 160 |

The concentration of mercury was not detectable in water at above four sampling stations (up-stream). In February-March, the concentration in water of fifth station was 0.050 mg/L and decreased up to 0.015 mg/L at eleventh station. It means after 60 km downstream, concentration of mercury was not detectable due to dilution. In the months of June-July, the concentration of mercury of fifth station was 0.060 mg/L and decreased up to 0.013 mg/L. In the months of October-November, the concentration of mercury at fifth station was 0.058 mg/L and decreased upto 0.020 mg/L at eleventh station. In the months of December-January the concentration of mercury was 0.052 mg/L and decreased up to 0.016 mg/L at Dasharath Ghat.

Mercury Concentration in Species of Fishes Collected from Sone River

The concentration of mercury in species of fishes was analyzed in all three seasons. The concentration of mercury was 0.040, 0.052, 0.034 ng/g dry weight in *Chela untrahi*, 0.078, 0.090, 0.040 ng/g in *Rasbora daniconius*, 0.064, 0.072, 0.033 ng/g in *Anabas*, 0.030, 0.050, 0.025 ng/g in *Otolithus maculatus*, 0.050, 0.055, 0.030, ng/g in *Walgo atln*, 0.035, 0.040, 0.022 ng/g in *Aila colia*, 0.038, 0.042, 0.024 ng/g in *Barbus stigma*, 0.032, 0.046, 0.020 ng/g in *Labeo beta* in summer, monsoon and winter, respectively (Table-2).

TABLE-2
MERCURY CONCENTRATION OF FISHES (DOWNSTREAM)
(Total Mercury Concentration)

| Fishes | Feb.–Mar. (1998) | Aug.–Sept. (1998) | Oct.–Nov. (1998) |
|--------------------------------|------------------|-------------------|------------------|
| 1. <i>Chela untrahi</i> | 0.040 | 0.052 | 0.034 |
| 2. <i>Rasbora dani</i> | 0.078 | 0.052 | 0.034 |
| 3. <i>Anabas</i> | 0.064 | 0.072 | 0.033 |
| 4. <i>Otolithus machulatus</i> | 0.030 | 0.050 | 0.025 |
| 5. <i>Walgo atln</i> | 0.050 | 0.055 | 0.030 |
| 6. <i>Aila colia</i> | 0.035 | 0.040 | 0.022 |
| 7. <i>Barbas stigma</i> | 0.038 | 0.042 | 0.024 |
| 8. <i>Labeo beta</i> | 0.032 | 0.046 | 0.020 |

Concentration of mercury depends upon the size and feeding nature of fishes. Seasonwise analysis also showed that the higher concentration was found in samples collected in monsoon period. The increase in mercury concentration can be attributed to bioability of metal, feeding habit and its bio-magnification.

From the above studies it has been concluded that mercury from Chlor-Alkali plant for Orient Paper Mill factory is causing damage to aquatic population, specially the fishes mentioned.

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