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# Impact of Paper Mill Effluents in the Hasdeo River Water

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*Water is a prime natural source and is a basic human need. The underlying assumption in traditional water resources planning process still continues. Fresh water is a gift of god which would continue to be available in perpetuity and in abundance. This is not valid as both quantity and quality of water pose serious problems (Kaul, Mahajan and Nandy (1997) [1]. Rivers are the main source of fresh water. The present fresh water regime is about 2.7 of the total global water regime, out of this rivers and lakes constitute 0.01% , ground water 0.59% and ice glaciers 2.1%.*

*The present study, therefore, provides an opportunity to investigate the following aspects.*

1. *Speciation studies of trace ($Cu^{++}$, $Zn^{++}$) and toxic elements ($Pb^{++}$, $Cd^{++}$)*
2. *Physico-Chemical characteristics of Hasdeo River water along with effluent of Madhya Bharat Paper Limited.*
3. *Study of heavy metals in Hasdeo and Lilager river water sample.*
4. *Toxic effects of specific pollutants.*
5. *Analysis of soil, water, plants and fish samples.*

***Key words: Hasdeo river, pollutants, toxic and trace metals.***

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## I. Introduction

Madhya Bharat Paper mill Limited is situated of the vicinity of Hasdeo River on its Western bank of Champa district. It produces various grade of writing and printing raw materials like paddy straw, hunny waste, waste paper, wood pulp etc. Industrial waste if discharged in to the surface water, can give rise to significant deterioration in its quality. Hasdeo River is the main source of water supply to Madhya Bharat Papers Limited and it receives approximately 3000 $M^3$ untreated effluents per day. Consequently ecology of the river is changed. Many workers have contributed their to the physico-chemical properties of various rivers such as Ganga, Yamuna, Kaveri, Brahmaputra, Gandak, Godawari etc. in India. But the perusal of literature has revealed that vertually no work has been done so for on the speciation studies of pollutants and their toxic effects in the Hasdeo river of Chhattisgarh.

**Geograpic survey of Madhya Bharat Paper Limited**

Geographically, Madhya Bharat Paper Limited is located at the latitude $22^0$4' north and longitude $80^0$43' East In spreads up to 99 acres plot near Champa town. The site is 50 kms, by road from korba coal fields and 67 kms from Bilaspur.

**Geographic survey of Hasdeo river**

The north and central part of Hasdeo basin is pear shaped and the southern part tapers like a funnel and joins the Mahanadi River. It is located between the North latitude $21^0$45' to $23^0$23' and Eastern latitude of $82^0$03', its geographical extent is spread within 104489 sq.kms.

**Sampling stations**

During the course of study seven sampling stations were selected to indentify the pollution status of Hasdeo river, they are as follows:-

S-1 Effluents discharge from Madhya Bharat Paper Limited at Birgahni village.
S-2 Hasdeo river up-stream near road bridge Champa (Unpolluted)
S-3 Hasdeo river, just after the joining of Madhya Bharat Paper Limited effluents at Birgahni village.
S4 Hasdeo river down-stream after the joining of effluents at Pisoud village. (About 1 km distance from Madhya Bharat Paper Limited.)
S-5 Hasdeo River downstream after the joining of effluent at pithampur village. (About 3 kms distance from Madhya Bharat Paper Limited.)

S-6 Hasdeo river down-stream after the joining of effluent at Gaud village (about 5 km distance from Madhya Bharat Paper Limited.)
S-7 Hasdeo river downstream after the joining of effluent at Amoda village (about 10 kms distance from Madhya Bharat Paper Limited).

## II. Materials and Methods

Samples were collected and analyzed as per procedures laid down in the **'Standard Methods for Examination of Water and Waste Water"** of American Public Health Association (APHA) [2].
Composite sampling methods were adopted for collection of Hasdeo River. Sample for chemical analysis were collected in polyethylene containers, Samples collected for metal content were acidified (1.0 ml $HNO_3$ per liter. Of sample.) Some of the parameters like pH, temperature, conductivity and dissolved oxygen were analyzed on site using portable water analyzed at laboratory. Metal concentrations were determined using UV-Visible spectrophotometer.

**Speciation studies:**
The paper industry is one of the most important industries of the modern age. In India there are more than 379 paper mills with an annual installed capacity of around 37.38 lakh tons.
The water requirement of the paper mill in India is in the range of 250 – 440 m3/ton of product and the requirement depends on the quality of paper made and extent of recycle. This water requirement achieved in several developed countries (Kaul et al 1999).
Pulp and paper industry requires large volume of water, bulk of it comes out as waste water. So the mills are located along or near rivers which provide raw water and receive waste water (Jaiswal 1990) [3]
A pulp and paper mill is regarded as one among the twenty highly polluting industry (Kumar, fatting, vaidya and bal 1999)[4].
Pulp and paper mill effluents contains strong wood, chips, bits of barks, cellulose fibers, dissolved lignin and a complex mixture of chemicals including sulfite phenol and chlorine. The chemicals may destroy the flora and fauna (Manivasakam 1997) [5].
The chemical pulp industry has been traditionally considered as a serious source of environmental pollution.

**TABLE 1**
**Water consumption**

| S.N. | Fresh water requirement | Quantity Aprox.7500$M^3$/day |
|---|---|---|
| 1 | In pulp mill | 2582 |
| 2 | In Paper Machine | 4250 |
| 3 | In Boiler House | 600 |
| 4 | In other areas | 100 |

**TABLE 2**
**Chemical consumption**

| S.N. | Name or raw materials | Quantity used MT Per day | Storage Capacity MT |
|---|---|---|---|
| 1 | Lime | 3.0 | 50 |
| 2 | Caustic lye | 6.5 | 80 |
| 3 | Chlorine | 4.0 | 30 |
| 4 | Resin | 0.3 | 20 |
| 5 | Alum | 3.0 | 45 |

**Black Liquor**
About 80 to 90% water which is consumed in pulp and paper making process reappears as waste water. Black liquor is also a waste water of pulp and paper industry. It is obtained from pit. Approximately 350– 450 $M^3$ of black liquor is diverted to lagoons daily. Black liquor contains mainly coloring particles and vegetative lignin which is not easily bio-degradable. The COD value of black liquor is far more than of BOD (Table 3) which shows that it is highly non bio-degradable.

**TABLE 3**
**PHYSICO – CHEMICAL CHARACTERISTICS OF THE BLACK LIQUOR OF MADHYA BHARAT PAPER LIMITED, CHAMPA**

| S.N. | Parameters | Unit | Result | | |
|---|---|---|---|---|---|
| | | | Range | | Mean |
| | | | Min. | Max. | |
| 1 | Temperature | $^0$C | 30 | 38 | 34 |
| 2 | pH | Mg/L | 3.1 | 4.5 | 3.8 |
| 3 | TDS (Total dissolve solid) | Mg/L | 41000 | 99000 | 72000 |
| 4 | TSS (Total suspended solid) | Mg/L | 4240 | 12100 | 8700 |
| 5 | BOD ( Biological oxygen demand) | Mg/L | 16000 | 25000 | 19000 |
| 6 | COD (Chemical oxygen demand)<br>Chlorine | Mg/L | 33000 | 95000 | 66000 |
| 7 | | Mg/L | 2000 | 4500 | 3300 |

**TABLE 4**
**Heavy and toxic metals**

| S.N. | Heave/Toxic metals | Unit mg/L | Result | | | Permissible limit mg/L |
|---|---|---|---|---|---|---|
| | | | Range | | Mean | |
| | | | Min. | Max. | | |
| 1 | Iron (Fe) | mg/L | 1.30 | 4.29 | 2.79 | 1.0 (58) |
| 2 | Manganese (Mn) | mg/L | 0.02 | 0.08 | 0.05 | 0.1 (58) |
| 3 | Cadmium (Cd) | mg/L | 0.01 | 0.04 | 0.025 | 0.01(59) |
| 4 | Copper (Cu) | mg/L | 0.01 | 0.021 | 0.015 | 0.05 |
| 5 | Zinc (Zn) | mg/L | 0.18 | 2.20 | 1.19 | 0.5 (61) |
| 6 | Lead (Pb) | mg/L | 0.67 | 1.24 | 0.95 | 0.05 (60) |

## III. Discussion

**pH :**
Very low cause abdominal disorders affect mucous membrane. High pH induces the formation of trihalomethanes which are toxic (Trivedi and Goal (1984).

**Chlorides:**
Excess cause abdominal disorders (Lewis 1970).

**Iron:**
The undesirable effects beyond the desirable limit include astringent taste, discoloration. Turbidity growth of iron bacteria. Long term exposures cause aplastic anaemia, siderosis and iron pigmentation (Kamavisdar and Patel 1997, Oehme 1979).

**Copper:**
Heamolytic anaemia, hepatic necrosis in cattle and sheep and Wilson's disease. (Schein berg & Devis 1969).

**Zinc:**
Excess intake may cause dermatitis. Zinc may be associated with some chronic arterial disease, lung cancer and other chronic disease. (Trivedi and Goel 1984).

**Cadmium:**
Cause of the terrible Itai-Itai disease, lung disease similar to emphysema and increased blood pressure, increased incidence of atherosclerosis.

**Manganese:**
Liver, heart, and lungs damage excess may effect of central nervous system. (Khursid et al 1998 & Keuper et al 1990).
**Lead:** Cumulative poison which interferes with synthesis of hemoglobin and reduces red blood corpuscles reticulocytosis, neurological eye function and renal impairment. (Sharma 2000)

## IV. Conclusion:

The waste water of the mill is highly colored due to Lignin and forms sludge bank in the river bed. The dark brown colour of the effluent is due to the presence of lignin and mixture of waste from caustic extraction of the pulp (Sastry Khare Raoi 1972 and Subrahmanyam1987)[6]

Lignin and its derivatives present in agro-industrial wastes fall under this group and have become major pollutants (Buwell 1991)

Pulp and paper mill industries release huge amount of lignin bearing wastes in to the environment. The discharge of these waste in to water bodies impart colour to the receiving water and result in Oxygen depletion and emission of faul odour. (Boominathan and Reddy 1991) [7]

The excess amount of calcium and magnesium in irrigation water causes injuries to the plants and it might have affected the seeding growth ( Subrahmanyam, juwarka and sundarsan 1984)[6]

Caustic and chlorine are major raw material for paper and pulp industries (Komerwar, Ashoka, Krishnamurthy, subbiah, Yadav and Udupa 1878)[8]

Several constituents of pulp and paper industries waste water are known to be toxic to fish and other aquatic organisms (Prasad and Gupta 19970)[9]

Pulp and paper industry waste water characteristically contains very high COD and color which originate mainly from lignin degradation products produce during the bleaching of the pulp. Discharge of untreated waste water will there for create serious water pollution problem, like toxicity to aquatic life, deterioration in water quality.

The toxicity of 10 phenolic compounds occurring in pulp mill effluents to three organism bacteria, protozoa and crustasea, pentachloro phenol and tetrachloro phenol were the most toxic for all bio indicators whereas phenol and guaiacol were the least toxic. Chlorine derivatives were at least 10 times more toxic than phenolic (Notecz-Jawecki et al 2000)

Pulp and paper mill effluents contains strong wood, chip, bits of bark , cellulose fiber, dissolved lignin and a complex mixture of chemicals including sulphite, phenol and free chlorine. The chemicals may destroy the flora and fauna of receiving water. Further the setteliabe material sink to the bottom and blanket fish spawning ground and destroy surtain types of aquatic life. The effluent may also contain methyl mercaptains, Pentachlorophenol and sodium pentachlorophenate which are considered highly toxic to fish (Manivasakam 1984)[5]

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