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Effluent of Amalai paper mill: Physico-chemical analysis of water

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Abstract
Industrial pollution poses a serious environmental and economic problem. The Amalai Paper Mill usually produces a large amount of wastewater where proper treatment before entering the environment is essential. The wastewater from the paper mill is characterized by large quantities of COD, BOD, pH, TDS, DO and SS. Samples of wastewater are collected at the entrance and outside of the sewage treatment plant on a paper mill. Samples were analyzed and compared with Indian waste emission standards. The quotations are drawn on the basis of analysis. The result shows that pH, COD, BOD and TDS are within the permissible limits.

Keywords: Amalai paper mill effluent, treated, COD, BOD, TDS, pulp

1. Introduction
Depending on the type of raw material, wastewater is produced by the metric ton of paper produced. Global economic trade includes the paper industry worldwide and its excellent paper quality at low prices. In order to keep up with world-class trade, papermakers are modernizing and developing their crops with increasing vigor. Global demand for paper will be 5-6% per annum and the average production capacity of mills by 2020 will be 14 million tons (Khan *et al.* 2011) [1]. Water consumption per ton of paper is approximately 250-300m^3 (Hoh *et al.* 1999) [2]. Wastewater production is about the same as the same amount of water used. Paper mills contain high BOD and COD due to natural ingredients such as lignin, cellulose, fatty acids, tannins, resin acids, terpenes, phenolic compounds, organic compounds compounds and coal. Inorganic substances such as sodium, calcium, Al_2O_3, Fe_2O_3, silicates, muds, grits, sulfur and sulfur compounds and other salts. Colloidal or suspended solids have a detrimental effect on the available streams as anaerobic decomposition of these solids consumes dissolved oxygen in stagnant water and thus has a detrimental effect on aquatic life. It is also harmful to agricultural crops and humans (Chakradhar and Shrivastava, 2004) [3]. The high volume of waste disposal and economic constraints enable the paper industry to limit itself to the treatment of waste that comes up until the second treatment, when the quality of waste comes within the procedures of waste management boards and other authorities (Mandloi and Singh, 2020) [15]. At this stage, it is equally important to reduce water generation rather than treatment. Internal production of pollution is an indication of individual processes (Yuxing and Jain, 1998) [4]. Groundwater pollution due to industrial pollution and municipal waste in water bodies is a major concern in many cities and industrial crowds in India. There is therefore a need and concern for the protection and management of groundwater quality. A key feature of water physics analysis of water is the identification of various chemical elements, which are present in the aquatic and disruptive ecosystem. Water levels can be affected in various ways due to pollution. The current study aims to analyze water quality from the paper industry's storage with specific reference to Total Dissolve Solids, Total Hardness, Total Acidity, Total Alkalinity, pH, Calcium, Magnesium, Sulphates, and Chlorides.

2. Material and Methods
Analysis samples were collected from the Amalai refurbished mill refinery. Samples were collected at the inlet (raw water) and drainage area (eventually treated with contaminated water) at a papermillation treatment plant for analysis.

Samples are collected twice a day for a month in a plastic container and refrigerated at 20 °C. Collected samples are carefully packaged and used for analysis. Samples were analyzed using standard APA water and wastewater analysis methods (Clescerl *et al.* 1998) [5]. Titrimetric methods were used for the determination of total hardness, calcium hardness, chemical oxygen demand, biological oxygen demand and chlorides. Gravimetric methods used for the analysis of sulphates, calcium, R_2O_3 and magnesium oxides. pH meter, metro ohm 644 conductometer, PFP_7 Flame photometer, Buck scientific Ltd, instruments were used to record pH, conductivity, sodium and potassium. Standard solution of pt.co was used for colour measurements. 1.246 g of potassium hexachloroplatinate and 1g of cobaltous chloride are dissolved in 100 mL of conc. HCl and made upto 1 litre with distilled water. The concentration of this solution is 500 pt.co (ppm) units. 25 ppm to 70 ppm standard colour solution is prepared by diluting the solution of 500 ppm standard solution. Unknown colour is matched with standard solution. Whatmann No.3 filter paper was used for the filtration of dissolved solids and also used for the filtration of effluent in colour measurement. Whatmann No. 40 filter paper was used to filter the precipitates of silica, calcium and magnesium. Whatmann No. 41 was used for the filtration of R_2O_3 and Whatmann No. 42 was used for filtration of Barium sulphate precipitates.

3. Results and Discussion

3.1 Conductivity: Energy efficiency is the solution for a water solution to carry energy. It is a useful indicator to indicate the salt or salt content of the contaminant. The EC value of the influences was considered to be 7402 µmhos / cm which was significantly higher than that of the fossil sample stored at the end and its EC value was 3552 µmhos / cm. This is higher than the WHO guidelines (e.g.) 1000 µmhos / cm. The increase in EC values indicates the presence of high ion concentration (Deepali *et al.* 2009) [6].

3.2 pH: pH is the ratio of acid to the origin of an aqueous solution. pH measurement helps in waste treatment to obtain composition, type and efficiency. What comes out of a water purification plant is all the acidic and alkaline impurities. Influenced water records a pH of 11.5 with alkaline content as reported [6]. But in the final treatment the pH was found to be 7.8. However the WHO guidelines, however, limit the tolerance value of the pH for paper-based contamination as 6 to 9 (Kirkpatric, 1998) [7]. Exposure of contaminated water into water bodies can cause a decrease or increase in their pH due to the size and activity of small insects. Paper extraction will be a slightly alkaline pH, due to the production of alkaline paper.

3.3 Total hardness: The presence of calcium and magnesium contributes to water retention. The total hardness is higher (633 ppm as in $CaCO_3$) in the final store compared to raw water. The calcium content of the last extract was found to be greater than 200 mg/L (WHO, 1984) [8]. High Ca content in water makes it unfit for human consumption and damages industrial equipment where it is used for cooling (Mnadloi, 2016) [9]. The Magnesium (Mg^{2+}) content of the final extraction (186 mg/L) was more than 50 mg/L which makes water undesirable (White *et al.*) [10]. Calcium and magnesium usually maintain a balance in most water. The presence of too much magnesium in water will adversely affect the quality of the soil to convert it into alkaline and reduce crop yields.

3.4 Sodium: Sodium is an important cation occurs in all natural fresh water sources from 0.1 to 181 ppm (White *et al.*) [10]. In the present observation high sodium content (730 mg/L) was found in the raw water when compared to that of the finally treated effluent.
Sodium essential cation occurs in all new water sources from 0.1 to 181 ppm (White *et al.*) [10]. In the present case the high sodium content (725mg/L) was found in raw water compared to that of the fossils held in the latter.

3.5 Potassium: Due to the disposal of industrial effluent, an increased level (46 mg/L) of potassium was observed in the final outlet.

3.6 Total solids: Total solids affect water clarity. High density reduces the passage of light into the water, thereby reducing the concentration of the image by aquatic plants. Water heats up too quickly and catches more heat, which, in turn, can disrupt the aquatic life that has become accustomed to the state of low temperatures. In the present study solid foods were slightly reduced (1854 ppm) due to the presence of strings in contaminated water.

3.7 Total dissolved solids: The value of total dissolved solids (TDS) in the last store was 1788 ppm which is found to be less than that of raw water. TDS is found to be less than the WHO 2000 ppm level of wastewater discharges. TDS can increase salt water content and therefore make it unsuitable for irrigation and drinking purposes. Consumption of water with a high concentration of complete dissolved solids has been reported to cause disruption of the digestive tract, respiratory system, nervous system, coronary system in addition, resulting in pregnancy and cancer (Reddy and Subba, 2001) [11].

Table 1: Raw and Final outlet of water treatment of Amalai Paper mill.

Parameters	Raw water	Final Outlet of water treatment plant in a paper mill
Conductivity (µmhos/cm)	7402	3552
pH	11.5	7.8
Total hardness (ppm as $CaCO_3$)	42	633
Calcium (ppm as $CaCO_3$)	38	458
Magnesium (ppm as $CaCO_3$)	4	186
Sodium (mg/L)	725	322
Potassium (mg/L)	6	46
Total Solids (ppm)	2520	1854
Total Dissolved Solids (ppm)	2304	1788
Suspended Solids (ppm)	215	62
SiO_2 (ppm)	68	172
COD (mg/L)	16	204
BOD (mg/L)	2	16

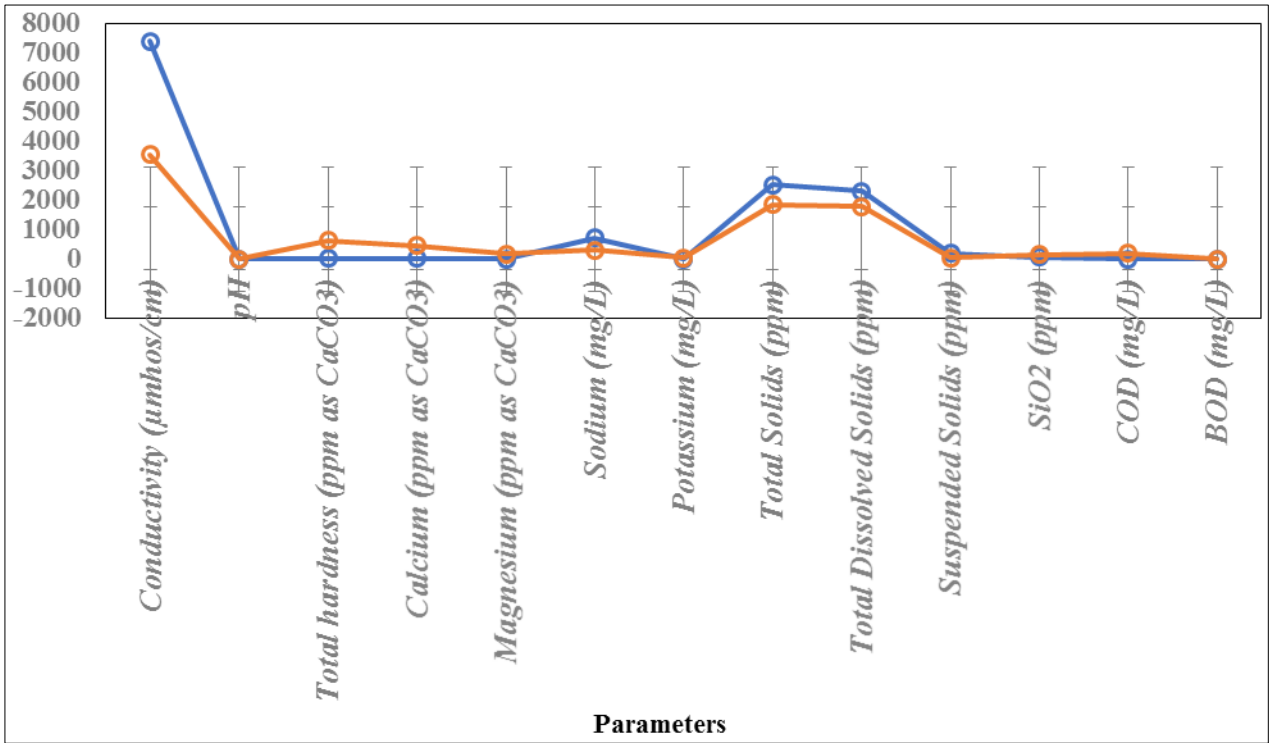

Fig 1: Graph analysis of Raw and Final outlet of water treatment of Amalai Paper mill

3.8 Suspended Solids: The undissolved matter present in water or waste water is usually referred as suspended solids. Suspended solids reduce the photo synthesis activities of water plants by smothering benthic organism. The quantity of suspended solids was greatly reduced from 215 ppm for raw water to 62 ppm of final outlet.

3.9 SiO_2: Silica is mostly found as silicates. The average abundance of silica is 7-80% in rocks, 50-80% in soils and upto 14 mg/l in surface and ground waters. Chronic exposure to silica dust can be toxic. A very high silica content of 172 ppm was observed in the final outlet of the water treatment plant.

3.10 Chemical Oxygen Demand (COD): Dissolved oxygen is a measure of the level of biological pollution, the destruction of organisms and the purification power of a water body. The need for Chemical Oxygen is the ratio of the amount of oxygen needed for the breakdown of both living and non-living things. The COD value of the discharge sample was recorded as 204 mg / L. This sample value was found to be lower than the WHO guidelines of 1000 mg/L (Yusuff and Sonobare, 2004) [12]. High COD levels indicate the toxicity of contaminated water and the presence of biologically resistant organisms (Dutta, 1999) [13].

3.11 Biological Oxygen Demand (BOD): Biological Oxygen Demand is the measure of the oxygen required by microorganisms whilst breaking down organic matter. The BOD measures the loading of live streams and thus measures the dissolved oxygen levels. The results of the BOD help to measure the capacity of streams, by regulatory authorities and to assess the quality of wastewater discharged into rivers. In the present study, the BOD of the final moisture content was 16 mg / L. While the WHO guidelines for the BOD value were 50 mg / L. The high content of BOD and low oxygen content will affect the survival of the respiratory gills of the body of the receiving body of water (Sawyer, C.C. and McCArty, 1978) [14].

4. Conclusion
On the basis of the above discussion it is concluded that the final emissions from the paper industry are not highly polluted and most parameters other than Na, K, Ca and Mg have limited values as determined by WHO standards.

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