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Physicochemical Process for Recycling of Pulp and Paper Industrial Effluent by Green Chemistry Development †

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Abstract: : Chemistry is very cooperative to us as its applications are used worldwide for several purposes. We cannot truly envision a world without chemistry and its applications in the pulp and paper industry. However, we should now concentrate on green chemistry or sustainable chemistry, which refers to reducing or discontinuing the damage done to the environment around us. Hence, green chemistry could include anything from reducing waste to even disposing of waste correctly. A combination of primary settling, coagulation–flocculation-aided clarification (lime, aluminum, magnesium sulfate as coagulants) and activated carbon adsorption was employed to treat pulp and paper mill wastewater. Physicochemical processes for recycling revisions were accepted to calculate recycling the effluents from a paper mill. All chemical wastes should be disposed of in the best possible manner without causing any damage to the environment and living beings. We need greener chemistry- that efficiently utilizes renewable raw materials, eliminates waste, and avoids the use of toxic and or hazardous reagents in both products and processes to achieve this noble goal. The results of the laboratory scale study showed that the hydraulic retention time (HRT) of four hours for plain settling was effective in reducing 30% of the pollution load from pulp and board mill wastewater. The secondary treatment reduced turbidity (89%), total suspended solids (90%), color (89%), and Chemical Oxygen Demand (84%) at the mass loading of 3400 mg/L of magnesium sulfate ($MgSO_4$) when the coagulation-flocculation process subsequently treated primary-treated effluent. The combination of primary settling and lime coagulation (optimum dosage of 1400 mg/L) resulted in a turbidity removal of 94%, a COD (Chemical Oxygen Demand) reduction of 86%, a Total Suspended Solids (TSS) removal of 93%, and color removal of 91.6% at an initial pH of 11. The combination of this primary settling and coagulation-flocculation treatment trial indicated that the pollutant reduction efficiency of alum was better than the other two coagulants ($MgSO_4$, lime) because the plain settling and coagulation-flocculation process with alum (optimum dosage of 1200 mg/L) resulted in a turbidity removal of 98%, COD reduction of 93%, TSS removal of 98% and color removal of 96% at the pH 6.0 with the sludge volume index of 156 mg/L. This chemically-treated water required further treatment with activated carbon in a batch reactor for up to four hours to meet the paper mill water quality standards. Pollutant reductions at the rate of 99.5%, 99.1%, 99.4%, and 99.5% were obtained for turbidity, COD, TSS, and color, respectively, with the combination of the sedimentation. Coagulation–flocculation process and activated carbon adsorption meet the production process quality standards. The study revealed that a hybrid end-of-pipe physicochemical treatment effectively reduced the pollutant load of paper mills effluent and met the discharging standards.

Keywords: adsorption; coagulation-flocculation; pulp and paper industry; wastewater treatment; physiochemical treatment.

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Conflicts of Interest

The authors declare no conflict of interest.