Available online at www.sciencedirect.com
ScienceDirect
Journal of Cleaner Production 16 (2008) 330–334
Journal of Cleaner Production
www.elsevier.com/locate/jclepro

Pollution prevention pays off in a board paper mill

Sohair I. Abou-Elela [a,*], Fayza A. Nasr [a], Hanan S. Ibrahim [a], Nagwa M. Badr [a], Abdul Raziq M. Askalany [b]

[a] *Water Pollution Research Department, National Research Center, 33 El-Tahrir Street, Dokki Giza, Egypt*
[b] *Delta Board Mills, Badr Industrial City, Cairo, Egypt*

Received 20 April 2006; accepted 24 July 2006
Available online 12 October 2006

Abstract

Environmental problems caused by recycling wasted paper at a board paper mill provide the material of this study. Two scenarios have been investigated: The first being the treatment of the end-of-pipe, and the second being the control and management of pollution problems through the application of in-plant control and pollution prevention measures. Comparison between the two alternatives, based on a cost-benefit analysis and compliance with National Environmental Laws was done. From this study it was apparent that the implementation of the pollution prevention measures such as the recovery of fiber, reduction of fresh water consumption, and optimization of white water usage proved to be very cost effective. All the implemented solutions have short payback periods and resulted in great savings compared with the treatment of the end-of-pipe.

Keywords: Board paper mill; Cleaner production; Pollution prevention; Recovery of fiber; Dissolved air flotation

1. Introduction

The management of wastewater is becoming a major concern. Due to increasing environmental awareness associated with industrial waste, companies must now incorporate waste management and prevention strategies into industrial processes [1]. A wide range of pollution prevention opportunities could be implemented with significant financial advantages for factories, as well as reducing environmental pollution [2].

In the pulp and paper industries, environmental problems vary with both the size and category of the mill. In recent years, pulp and paper manufacturers have faced additional constraints to modernization, namely; raw water availability and limitations on wastewater discharge. This, in turn, means that the conventional wisdom of the end-of-pipe treatment for pollutant discharge may not be sufficient. Additional in-plant water conservation efforts are becoming necessary to reduce the volume of effluents discharged, and to minimize solid waste for disposal [3]. Recently, many mill modernization programs (with the implementation of cluster rules compliance programs) are being designed to address this area to become more efficient in terms of water usage and volume of effluent discharged to the treatment plant.

In recycling wasted paper mills, zero discharge is possible through wastewater reuse after suitable treatment. But due to poor or no wastewater treatment and old fiber recovery technologies, the industry is unable to recycle the effluent.

Environmental problems associated with a board paper mill provide the material of this study. The plant produces 25 ton/day board paper from recycling wasted paper. Wastewater discharged from the mill amounted to 1000 m^3/day was dumped into a pond nearby the factory without any treatment. The wastewater produced was highly contaminated with suspended solids and organic pollutants as well. The different processes in the plant were operated in an open circuit manner. Fig. 1 shows the manufacturing processes, water usage and wastewater discharged.

* Corresponding author. Tel./fax: +20 2 336 7319.
E-mail address: sohair@frcu.eun.eg (S.I. Abou-Elela).

0959-6526/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jclepro.2006.07.045

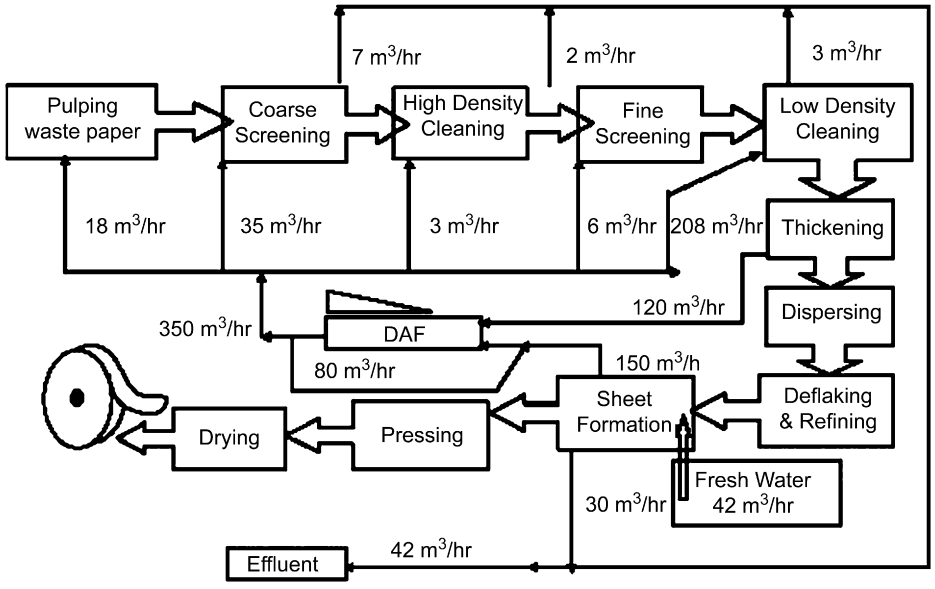

Fig. 1. Process, water usage and wastewater discharged from the board paper mill.

The objective of this study was two folds:

- To technically and economically evaluate the treatment of the end-of-pipe approaches in order to comply with the Egyptian Environmental Legislations.
- To evaluate the implementation of the pollution prevention and cleaner production approaches versus the treatment of the end-of-pipe.

2. Materials and methods

In this study two approaches have been investigated to manage and control the industrial effluent produced from this plant. The first approach was the treatment of the end-of-pipe, while the second approach was the implementation of any possible pollution prevention measures.

2.1. Pollution prevention measures

In order to determine the opportunities for any pollution prevention measure, industrial auditing of the plant under investigation has been carried out. The audit was conducted using a systematic review of the company's processes and operations designed to identify and provide information about opportunities to reduce waste, reuse and recycling of water, recovery and reuse of materials, and to improve the operational efficiency [4]. The industrial auditing guidelines were prepared for application in Egypt as presented in "Guidelines for Industrial Audits," prepared by Entec/TCOE [5].

All the improvement measures were documented by a cost/benefit analysis whenever possible.

2.2. Collection of samples and analysis

Due to the great variation in the quality and quantity of wastewater produced, a continuous monitoring program was carried out for almost two months. Composite samples from the end-of-pipe were collected and analyzed according to "Standard Methods" [6].

2.3. Treatability studies

End-of-pipe was treated via physico-chemical processes namely; coarse screen, screening followed by sedimentation for two hours or screening followed by chemical coagulation/floatation under pressure. Screening was already available in the factory. It is a cylindrical in shape with a diameter of 1.25 meters, 2.40 meters length and mesh size 20/cm^2. The coagulant used for chemical coagulation was alum aided with cationic polymer. The optimum coagulant doses and the pH, were determined.

3. Results and discussions

3.1. Characteristics of wastewater

Analysis of the end-of-pipe indicated that it carries significant quantities of fiber, fines, filler and other wet-end additives that contribute to the total suspended solids (TSS), chemical oxygen demand (COD) and biological oxygen demand (BOD). Their average corresponding values were 242 Kg TSS/ton product, 411 Kg COD/ton product and 124 Kg BOD/ton product, respectively. It is noteworthy that the concentration of TSS in the final effluent discharged from any paper mill varies based on the first pass retention time, white water system design, clarification equipment, equipment arrangement and system constraints in terms of water reuse [7].

3.2. First approach: treatment of end-of-pipe

The efficiency of the different treatment processes of the end-of-pipe is shown in (Table 1). It is obvious that utilization