# Waste Water Treatment in Recycled Paper Mill - A Case Study of Rama Newsprint And Papers Ltd.

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## ABSTRACT

*A Brief description of effluents enumerating from conventional pulp and paper industry and review of recycled paper mill effluent characteristics, treatment method and reuse are discussed.*


## INTRODUCTION

Water is matrix of life. All biological reactions occur in water and leading to bio-diversity, without water earth would be barren. Since paper making is water intensive process water pollution is a major environmental concern. Conventional pulp and paper mills consume large amount of water ranging from 30 to 300 $m^3$/mt depending upon the type of the process, raw materials, various recovery systems and their efficiencies. The conventional paper making involves unit operations like chipping, delignification by chemical, mechanical or combination of both processes, followed by screening, cleaning, bleaching, chemical recovery and paper making. The pulp and paper industry ranks third in terms of fresh water withdrawl and ranked fifth among the major industries in its contribution towards the water pollution problem. Pulp and paper industry effluents are classified into three major categories. They are (a) gasseous effluents (b) liquid effluents (c) solid effluents. Generally effluents of pulp and paper industry broadly classified pollutants into eight types. (1).

1) Oxygen demanding substances

2) Disease causing agents

3) Synthetic organic compounds

4) Plant nutrients

5) Inorganic chemicals and mineral substances

6) Sediments

7) Radioactive subtances

8) Thermal Discharges

The effluents may or may not cause pollution. Most industrial nations have imposed standards on waste water discharges for ensuring that the society should not bear any cost arising from industrial waste. In conventional pulp and paper process the pollutants generated and their impact is briefly mentioned below. The digester and evaporator condensate of kraft mills have BOD producing compounds that cause water pollution and odorous compounds and air pollution. The TMP mill principal pollutants are derived from wood extractives including resin acids.

In pulp and paper industry most 'DIOXINS' are formed by the action of active chlorine during bleaching process. Process not using elemental chlorine do not produce high levels of dioxins (3). TOCl and dioxins are considered very toxic pollutants. Total reduced sulphur compounds include hydrogen sulphides, mercaptans, methyl sulphide and are formed during pulping in digester, evaporators, smelt

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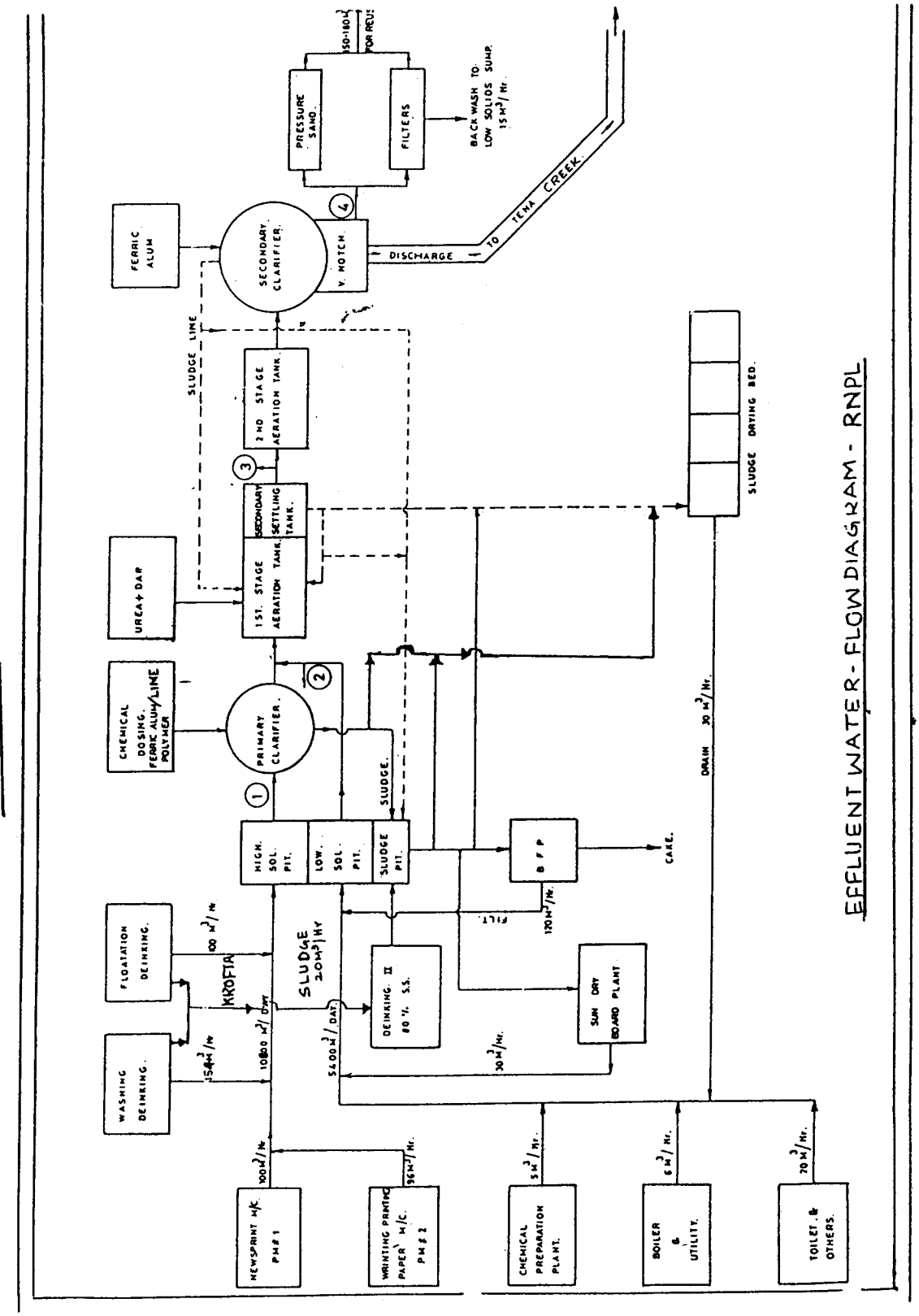
**ANNEXURE-I**

ANNEXURE - I



dissolving tanks, which are non-condensable and create nuisanc low concentrations.

As the waste paper recycling does not involve some of the processes used conventional pulping, the beneficiary of waste paper processing is 'ENVIRONMENT'. Apart from less water and energy consumption and saving of forest resources, waste water teatment is also less expensive.

In recycling there is need to seperate fibres from non-fibrous materials like ink, gluc, grits, debris etc. When seperated these can create an effluent load if not treated properly. If fresh water is used for single pass in the mill it would result in high water consumption. To avoid this mill has to adopt maximum basic water recycling without affecting the product quality.

Current best practice for specific water consumption in recycling plants of European mills are : (4)

Packaging Board - 6-8 $m^3$/mt

Newsprint & Tissue - 12-15 $m^3$/mt

Printing and Writing - 20 $m^3$/mt

## EFFLUENT LOADS IN RECYCLED MILLS

The recycled mill effluent contains fibre, fines, mineral fillers, ink particles, colloidal organic and inorganic materials etc. depending upon the furnish and process. Organic constituents like proteins, carbohydrates adhesives, coating binders influence the effluent loads. The organic loads generated during pulping, bleaching processes vary from mill to mill depending upon the process used. Bleaching with hydrogen peroxide dissolves the natural resins and fatty acids. The residual resin and fatty acids or active chlorine contribute to the toxicity of the mill effluents. The later can easily removed by treating with reducing agents and the former by bio-logical effluent treatment and pose no environmental hazard lignin derivatives can give rise to a strong colour in case of conventional pulping and bleaching processes, where as in recycled process effluents colour impact is minimal. Most extensive research results show that in recycling mill effluent, heavy metal are present in small quantities and concentration are lower than that in municipal sewage sludge (5)

The recycling mills have various rejects such as polythene fragments which can be removed by continuous screens. Foam generation can be problem

**ANNEXURE-11**

**WATER BALANCE - RNPL (350 TPD)**

| SR. NO. | SECTION | MILL WATER CONSUMPTION $m^3$/hr | DISCHARGE $m^3$/hr |
|---|---|---|---|
| 1. | CPP & CAPP | 12 | 5 |
| 2. | WDP & FDP | 164 | 254 |
| 3. | Paper Machines | 344 | 196 |
| 4. | Utility | 17 | 6 |
| 5. | Compressors | 40 | - |
| 6. | Mill & Colony | 20 | 10 |
| 7. | Evaporation Losses in Machines | | 18 |
| 8. | Gardening Civil Work etc. | - | 30 |
| 9. | Miscs | | 18 |
| 10. | Belt Filter Filterate | - | 60 |
| | Total $m^3$/hr | 507 | 597 |

Mill Water Consumption : 41 $m^3$/mt

Effluent Generation : 37 $m^3$/mt

especially in clarification and sedimentation. Droplet spray systems are prefered to chemical system. The performance of DAF, flotation and activated sludge systems can be adversely affected by the use of defoamers. With all these advantages over conventional mills recycled mills are gaining move mentum all over the world.

Rama Newsprint and Paper Ltd. Is a pioneer in manufacturing newsprint and writing printing papers using recycled fiber. The installed capacity of the mill is 1,44,000 mt/year. It is located at village Barbodhan, Surat dist. Gujarat State. Eco-friendly technologies have been adopted in the processing of waste paper. It is one of the total chlorine free bleaching mill of its kind to avoid ill effects of adsorbable organic halides (AOX). Presently the mill is producing about 350 TPD of newsprint from both the machines. Waste water generated is around 37$m^3$ per mt. Mill is running with semi closed back water recycling system. It is around 50% of effluent generated is reused by plant after treatment.

## DESCRIPTION OF THE EFFLUENT TREATMENT

The effluent water treatment plant is based on activated sludge process to treat the effluents generated from various sections of the mill. The daily requirement of fresh water is pumped from the river tapi flowing near by and treated in water treatment plant having capacity of 1670 $m^3$/hr. The effluent treatment plant designed to meet the following requirement. :

| | High solids | Low solids |
|---|---|---|
| Flow $m^3$/day | 16500 | 9900 |
| Suspended solids mg/l | 2300 | 250 |
| COD mg/l | 2000 | 1300 |
| BOD (5 Days at 20°C) mg/l | 800 | 500 |
| Colour Pt. CO units | 800 | 200 |

The total power required 13690 kWh/day.

## INPLANT CONTROL MEASURES

In order to reduce the pollution load various inplant measures are taken which are described briefly

## DEINKING PLANT

During waste paper pulping large quantity of process back water generated is taken to krofta dissolved air flotation system and with dual polymer dosage most of the total solids are removed as sludge and clarified water used for dilution in pulper, cleaning system, and in washing system. By this helps in saving of fresh water and residual pulping chemicals including surfactants. Residual surfactants may create foaming problem in ETP system. The krofta recovered sludge is taken to sludge pit in ETP for further processing. All the compressor water about 40$m^3$/hr., is being reused in deinking plants, from utility section 10$m^3$/hr. Water is sent to deinking plant, about 100$m^3$ of white water generated in paper machines is used for pulp dilution in deinking plant. This results in saving of fibres and fines and reduced from effluent load on ETP.

Secondary clarifier overflow discharge water is passed through pressure sand bed filters of 150$m^3$/hr. (2 Nos.) Each was installed clarified water for reuse in various sections of the plants is under progress. Flow diagram of effluents generation and reuse of total plant is given in annexure I and water balance figures are given in annexure II.

In order to reduce further water consumption it is proposed that paper machine No.1 excess back water which is going to drain may be diverted to paper machine # 2 save all system. Recovered fibres can be used in paper machine and clarified water can be used for dilution, vaccum pulp sealing and wire roll showers etc. By this saving of 60$m^3$/hr. of fresh water is expected.

## EXTERNAL EFFLUENT TREATMENT

Suspended solids is one of the major pollutant in the recycled mill. The entire mill effluents are segregated into high solids and low solids. The effluents from both the streams are treated seperately.

## HIGH SOLIDS

The combined high solids from various sections of the mill is taken in high solid sump of 180$m^3$ capacity. The effluents from high solid sump pit is transferred by pumping mechanism into inlet channel to primary clarifier. Bar screens are provided to screen the course material such as plastic etc. Before entering the primary clarifier. The primary clarifier is of 27m

dia and side wall depth of 4.0 meters. Alum/Lime and Polymer are added in the stream and mixed thoroughly with the help of flash mixer before entering into primary clarifier. The designed flow is 690 $m^3$/ hr and the detention time around 3 HRS. The main function of primary clarifier is efficient removal of suspended and colloidal solids by floculation and sedimentation with the aid of chemicals. The settled sludge is taken to belt filters for thicknening, and sent to the sludge drying beds having area of 600$m^2$. A portion of sludge is utilised for manufacturing of sun dry board. The capacity of the board machine is 1.5 mt/day each of 2 nos. The sundry board is used as side discs in reel packaging. The sludge from drying beds used as fuel in our FBC boiler and excess quantity is old to outside parties for board manufacturing. The clarified over flow water contain around 120 -150 mg/l suspended solids.

## FIRST AERATION TANK

The effluents from low solids after bar screening alongwith primary clarifier oveflow is taken to first aeration tank. The dimension are 80x48x4.5 meters having holding capacity of 15120$m^3$. 10 nos. of surface aerators of 37 kW capacity are provided. The essential function of this treatment process is waste conversion. oxygen supplied by means of surface aerators. The turbulence created by the aerators to maintain the contents of the basin in suspension. Cowdung is added to maintain the biomass. Recycled fibre mill effluents are nutrient deficient primarily nitrogen and

**ANNEXURE-III**

**EFFLUENT ANALYSIS REPORT AT EACH STAGE OF EFFLUENT TREATMENT**

| Sr. No. | Parameter | Unit | Before Treatment | Primary Clarifier Outlet | After Second Stage Aeration Treatment | After Treatment | GPCB Norms |
|---|---|---|---|---|---|---|---|
| 01. | pH | | 7.1 | 7.2 | 7.2 | 7.3 | 6.5-8.5 |
| 02 | Temperature | °C | 32 | 30 | 30 | 30 | 40 |
| 03 | Colour | Pt. Co. Units | 225 | 140 | 60 | 45 | 100 |
| 04. | Total Dissolved Solids | mg/l | 1350 | 1182 | 1260 | 930 | 2100 |
| 05 | Total Suspended Solids | mg/l | 780 | 120 | 540 | 85 | 100 |
| 06. | COD | mg/l | 1120 | 564 | 350 | 67 | 250 |
| 07. | BOD (5 days at 20°C) | mg/l | 395 | 226 | 125 | 22 | 30 |
| 08. | Chlirides as Cl | mg/l | 403 | 377 | 350 | 145 | - |
| 09. | Oil & Grease | mg/l | 4.2 | 2.4 | 0.8 | 0.4 | 10 |
| 10. | Phenolic Compound | mg/l | BDL | BDL | BDL | BDL | 1 |
| 11. | Sulphides as S | mg/ | 10.92 | 0.85 | 0.67 | 0.6 | 2 |
| 12. | Residual Surfactant | mg/l | - | - | - | <1 | - |
| 13. | Sulphates as $SO_4$ | mg/l | - | - | - | 20 | - |
| 14. | Total Organic Chlorine | kg/mt product | - | - | - | BDL | 2 |

**BDL - BELOW DETECTABLE LIMIT**

phosphorous. Urea and Diammonium phosphate are added at the ratio of 100:5:1 of BOD:N:P the dissolved oxygen is maintained around 2-3 mg/l and the MLSS are around 3500 mg/l. The detention is around 12hrs. The bio sludge is sent to intermediate settling tank of 14x48x3.5 meters having scrapper mechanism. The overflow enters the secondary areation tank, the dimensions are 46x48x4.8m and holding capacity is 9936m³. 4 Nos. Surface aerators of 37 kW capacity are provided to maintain the dissolved oxygen level in the effluent. The detention time is around 6-7 hrs. The reduction in BOD is around 80% and 55-60% reduction in COD levels. The efluent flows into the secondary clarifier where alum is added to enhance the settlement. The bio-sludge from secondary clarifier under flow is recirculated in the aerator zone or taken to the belt filter press depending upon the necessity. The secondary clarifier dia is 38 meters and side wall depth of 3 meters with detention time is around 3hrs. In primary clarifier the high solid effluent load reduction in suspended solids is around 80-85%, BOD is 35-40% and COD is 40-50% after secondary clarification further load reduction of suspended solids 80-85%. BOD 85-90%, colour around 80% takes place in final treated water. TOCL, phenolic compounds are below detectable levels. Residual surfactant is <1 ppm as the surfactant addition is controlled by routine checks of residual surfactants after pulping and in paper. Lesser the residual surfactant in effluent, lesser the foam geneation in aeration zone. Apart from this bio-degradable surfactant, slimicides, biocides are used in the process.

## REUSE OF SECONDARY CLARIFIER OVERFLOW

Around 300m³/hr. of final treated effluent from secondary clarifier overflow is passed through 2 nos. of pressure sand bed filters to remove further turbidity. The filter bed outlet water is used in various sections of the mill as a substitute to fresh water. Some portion of sec. clarifier overflow water is used in board making and gardening. Remaining excess water discharged to the creek at 600 meters away and finally flows in to the estuary of Arabian Sea at 5 km distance. The effluent water, treated water and Gujarat pollution control board norms were given in annexure - III.

## CONCLUSION

Government and public has to play a major roll in encouraging recycling of waste paper in order to save precious natural resources. Government should set the targets for recycling fibre levels in paper or newsprint manufacture. The waste paper recycled mills generate less pollution load and can be treated more efficiently. RNPL short term goal is to achieve fresh water consumption at par with Europian mills and longterm goal is to be the best eco-friendly mill.

## ACKNOWLEDGEMENT

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## REFERENCES

1) Alan. M. Springer - over view of water pollutants and their impact on pulp and paper industry. Tappi press 1993 page 7.

2&3) Christopher J. Bierman - essentials of pulping and paper making p-285.

4) R.W.J. Mckinny - water and waste water treatment in recycling mills, p-206

5) Hamm I. and Gottsching L. Eucepa symposium -1989 recycling of fibres and fillers in pulp and paper industry ljubljana pp 83-103.

6) Anon Usepa, Development document for effluent limitation, guidelines and standards for the pulp and paper Oct. 1982.