

# **FINAL REPORT**

**ON**

## **AVAILABILITY & UTILIZATION OF WASTE PAPER**

### **Executive Summary**

**Submitted to**

**Indian Paper Manufacturers Association**



**CENTRAL PULP & PAPER RESEARCH INSTITUTE**

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**CONTENTS**

# Executive Summary

	<b>Page No.</b>
<b>1.0 Background &amp; Objective of the Project</b>	<b>2 -</b>
<b>4</b>	
<b>2.0 Methodology Adopted</b>	<b>4 - 5</b>
<b>3.0 Outputs of the Project</b>	<b>5 - 7</b>
<b>5.0 Contents of the Report</b>	<b>7- 10</b>
(i) Volume - I : Background & Status of the Industry	
(ii) Volume - II : Availability of Waste Paper	
(iii) Volume - III : Utilisation of Waste Paper	
(iv) Volume - IV : Data collected from Mills	
<b>6.0 Recommendations</b>	<b>10 - 22</b>
a) Availability of Waste Paper	
b) Utilisation of Waste Paper	
c) Fiscal Incentives and Government Policies	
d) Role of R&D	

# EXECUTIVE SUMMARY

## 1.0 BACKGROUND & OBJECTIVE OF THE PROJECT

The project on “Availability & Utilisation of Waste Paper” was sponsored by Indian Paper Manufacturers Association (IPMA). The project commenced in January 1999 and was completed in June 2001. Later on in one of the committee meetings the project was extended upto September 2001 to carry out the deinking studies exclusively for Nepa Mills Ltd. The project team comprised of following scientists:

<b>Dr. A. G. Kulkarni, Director</b>	-	<b>Advisor</b>
Dr. R. M. Mathur, Scientist E - II	-	Project Coordinator
Mrs. Rita Tandon, Scientist E - I	-	Project Leader
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The objective of the project is to suggest an indigenous gradation system based on the quality and characteristics of indigenously recovered paper which eventually will help in formulating a mechanism for an organised collection system and distribution system in the country and also to identify an appropriate processing system with proper selection of equipment so that different varieties of indigenous and imported waste paper can be effectively utilised by the mills.

The study involves preparation of status report on “Availability & Utilisation of Waste Paper” containing meaningful recommendations for implementation to improve the present collection and distribution system in the country and also the appropriate processing technology and system configuration for producing different types of product using

different varieties of waste paper. This would not only enhance the utilisation rate but also facilitate the production of quality papers from waste paper.

The outputs of the project will immensely benefit the Indian Paper Industry as it is facing an acute shortage of fibre resources. The new national Forest policy (NFP) in 1989 of GOI and the guidelines provided by NFP have clearly indicated that no forest wood supply would be forthcoming for paper industry in near future and therefore raw material requirement cannot be sustained from forest produce and paper industry shall have to generate their own woody raw material source or have to increase the use of agricultural residues or waste paper.

Though there is surplus availability of agricultural residues, however due to limitations in handling transportation, lack of adequate technology to process these raw materials and also in absence of a technology for recovery of chemicals, it is difficult to go for mills with larger capacities based on agro residues.

Under such conditions, there is a need to evolve long term strategies to ensure the supply of raw materials from sources other than forests, and waste paper occupies a pivotal position in bridging the widening gap between demand and supply of raw materials.

Increased use of waste paper can ensure the sustained supply of raw materials to a large extent provided an organised sector is evolved for supply of waste paper. Presently in India, in absence of grading system, there is no systematic/organised collection and distribution system existing, due to which large volume of waste paper remains unrecovered. The paper industry in India has long been utilising waste paper in its product -furnishes, but a major portion is being utilised for the

production of packaging grades or low quality writing/printing grades of paper due to poor quality of indigenously recovered paper.

As the waste paper is recovered in mixed form, the out throws and prohibitive percentage is high due to presence of contaminants and contraries in the recovered stock. The inconsistent quality of indigenously recovered paper, presence of contaminants/contraries in imported waste and improper selection of equipment and technology prevailing in the mills, limit the effective utilisation of waste paper for producing good quality paper.

In view of the above problem, it was felt that there is an urgent need to evolve an indigenous gradation system, and formulate a mechanism for an effective system of waste paper collection and distribution in India, so that consistent quality of waste paper grades could be made available to the mills for subsequent utilisation in various end uses in an effective manner and to fulfill these objectives the above project was envisaged.

## **2.0 METHODOLOGY ADOPTED**

- (i) To fulfill the objectives, extensive literature have been reviewed to collect information on gradation system being adopted by developed nations as well as in other countries where the recovery rates have steadily increased over the years due to improved collection system.
- (ii) Information has been collected through questionnaires on utilisation pattern of different available varieties of imported and indigenous waste paper for the production of different end products in India.

- (iii) Mill visits have been undertaken to conduct on the spot study and collect information on raw material supply, collection & sorting system being adopted by mill.
- (iv) During mill visits waste paper samples were collected for subsequent evaluation at CPPRI for their quality characterisation and fibre furnish composition.
- (v) For effective utilisation of waste paper, extensive studies have been conducted on contaminant removal particularly wet strength resin which is commonly found in most of the imported varieties.

### **3.0 OUTPUTS OF THE PROJECT**

1. Extensive literature review was carried out on gradation systems, collection/recovery systems and technological trends prevailing in industrialized countries, considered to be major recyclers in the world for effective collection and utilisation of waste paper.
2. To assess the current status of the industry with respect to waste paper collection and its subsequent utilisation, technology inputs & state of equipments and the major issues, questionnaires were sent to nearly 150 mills to collect information. Information has been received from following mills.
  1. Servalakshmi Paper & Boards, Tamil Nadu
  2. Chandpur Enterprises Ltd., Chandpur
  3. Gambhir Paper Mills, Saharanpur
  4. Vijay Laxmi Paper Mills, Tamil Nadu
  5. Saurashtra Paper & Board Mills Ltd., Rajkot
  6. Daman Ganga Paper Ltd., Vapi
  7. Rama Newsprint & Papers Ltd., Surat
  8. Pudumjee Pulp & Paper Mills Ltd., Pune
  9. Ponmudi Paper Mills Ltd., Tiruvananthapuram.

10. B.G. Shirke Construction Technology Ltd., Pune
11. Laxmi Board & Paper Mills, Kalyan
12. Progressive Paper Mills Pvt. Ltd., Calcutta
13. Sri Venkatesa Paper & Boards Ltd., Coimbtore
14. Jaipur Paper & Board Mills Sanganer (Jaipur)
15. Orient Paper Mills, Orissa
16. Shri Swami Harigiri Paper Mills Ltd., Gujrat
17. Ashi Dipi Paper (P) Ltd., Ujjain
18. Surya Chandra Paper (P) Ltd., A.P.
19. Kasat Paper & Pulp Ltd., Pune
20. Danalaxmi Paper Mills Ltd., Tamil Nadu
21. Khatema Fibres, Khatema

3. Following mills were visited to conduct on the spot study and collect information on waste paper supply, collection & sorting system being adopted by mill and its subsequent utilisation for various products.

1. Khatema Fibres Ltd., Khatema, (U.P.)
2. Rollatainers Ltd., Sonapat, (Haryana.)
3. Madhya Desh Paper Ltd., Nagpur
4. Gambhir Paper Mills, Saharanpur
5. Shree Acids Ltd., Ahmedabad
6. Chandpur Eneterprises, Chandpur
7. Rama Paper Mills, Bijnor, (U.P.)
8. Shri Swami Harigiri Papers Mills, Gujarat
9. Rama Newsprint and Paper Ltd., Surat
10. Servalakshmi Paper & boards, Tamil Nadu
11. Vijayalakshmi Paper mills, Tamil Nadu

4. Despite of making efforts the response of most of the mills was very lukewarm and in many cases the mills were hesitant in giving the required information.

5. Quite a large number of waste paper samples including imported as well as indigenously recovered paper were collected during the mill visits which were evaluated at CPPRI for their quality characterisation. The following parameters were studied for fibre quality characterisation.

- Pulp yield
- Ash content
- Quantitative fibre furnish composition
- Bauer Mcnett classification
- Canadian standard freeness
- CED viscosity

- Brightness
  - Yellowness
  - Visible speck
  - Physical strength properties
6. Based on extensive literature review carried out on gradation system prevailing in industrialized countries and the studies conducted at CPPRI, an attempt was made to grade the indigenously recovered paper in different groups based on their fibre quality and fibre furnish.
  7. To disseminate the findings of the project, an Interaction Meet was organised on 12<sup>th</sup> April, 2001 at CPPRI on 'Use of Recycled Fibre in Paper and Newsprint' which was well attended by representatives from Industry Associations, Paper Mills, Chemical Manufacturers, Waste Paper Suppliers and Senior Officials from Ministry of Industry.
  8. As one of the case study, deinking studies were undertaken for Nepa mills Ltd to improve the brightness of deinked pulp through flotation deinking. A separate report has been prepared and is included in Volume - IV.

#### **4.0 CONTENTS OF THE REPORT**

The contents of the report are presented in four volumes which have been compiled based on the information collected from literature review, questionnaires, mill visits, studies undertaken at CPPRI and through discussions with mill personnels and experts in the field. The volumes broadly cover the following areas:

**Volume I: Background & Status of the Industry**

**Volume II: Availability of Waste Paper**

Chapter I - Availability of waste paper in India



Chapter II - Recovery & utilisation of waste paper - A global scenario

Chapter III - Gradation of indigenously recovered paper -  
Studies conducted by CPPRI

**Volume III: Utilisation of Waste Paper**

Chapter I - Waste paper processing and contaminant removal techniques

Chapter II - System Modules for processing of waste paper

Chapter III - Environmental Impact of waste paper recycling

**Volume IV: Analysis of Data Collected from Mills**

A brief account of each volume is given below.

**(i) Volume - I: Background & Status of the Industry**

It gives an overview of the Indian paper industry elaborating the major issues of the Indian paper industry. One such issue is the sustained availability of fibrous resources, which has been dealt in detail with specific reference to recycled fibre (RCF) use in the country.

The prime focus is on the status of paper recycling in India, technical constraints in increased utilisation and domestic collection of waste paper in the country and a detailed review of waste paper based mills in the country with respect to system configuration, process equipment and quality of products produced. Attempt has been made to discuss the major issues in detail. The review is based on the collected information through questionnaire and studies undertaken during the mill visits.

**(ii) Volume - II: Availability of Waste Paper**

This volume mainly focuses on 'Availability of waste paper in India'. A retrospect of waste paper recovery rate and utilisation rate over the

years is presented showing a very slow rising trend in recovery of waste paper in India during last one decade. The volume also highlights about the unorganized domestic collection of waste paper, which is mainly due to lack of grading/classification of waste paper varieties. An overview of global scenario with respect to waste paper grading and collection system adopted in industrialized countries, which are considered to be major recyclers in world, has been presented.

The volume also covers in detail the studies conducted at CPPRI on fibre furnish composition and quality characterisation to evaluate the type and quality of indigenous and imported varieties of waste paper being utilized by Indian Paper Industry. Based on these findings CPPRI has proposed a system for gradation of indigenously recovered paper, which needs to be discussed and appropriately modified to benefit the large number of pulp & paper mills based on recycled fibre, as well as provide guidelines for suppliers so that there is a higher value realization from this important source.

The volume also covers recommendation for effective collection system that can be implemented under Indian conditions.

### **(iii) Volume - III: Utilisation of Waste Paper**

This volume focuses on unit operations and equipment for contaminant removal, the integral process steps in the waste paper processing line. The volume also covers in detail the various type of contaminants present in waste paper and the role of process chemistry in performing various deinking mechanisms/functions which facilitate the removal of stickies and non-stickies contaminants like hot melts, waxes, adhesives, wet strength resin, ink, filler etc and decolorisation of pigments and dyes.

Removal of stickies, processing of wet strength papers, deinking aspects of mixed furnish of ONP/OMG for production of newsprint and mixed office waste (MOW) for the production of writing, printing grades of paper has been discussed in detail and appropriate system modules have been proposed based on extensive literature review on available technologies and mill visits.

Lastly, the environmental impact of RCF mill has been discussed in detail particularly in reference of biomethanation of liquid effluents and utilisation/disposal of deinked sludge and solid waste generated in these mills.

#### **(iv) Volume - IV: Data collected from Mills**

This volume comprises of case studies and the information collected through questionnaires, which have been presented in the form of Technical Data Sheets.

## **2.0 RECOMMENDATIONS**

### **a) Availability of Waste Paper**

1. Sustained availability of fibrous raw material for paper manufacturing is one of the key issues of Indian Paper Industry. Globally recycling of paper has been identified as one of the survival routes against dwindling forest resources and a great concern amongst the people for greener environment. In India also, large scale organised collection of indigenously recovered paper, supplemented by imports may be recommended as an immediate measure to partly bridge the winding gap between the demand and supply of raw materials.

2. The use of recycled fibre in paper and board production can be considered as the mainstay of raw material sourcing provided an efficient collection system is adopted to collect waste paper varieties in grade.
3. To establish an efficient collection system in India on par with countries like Germany, China, USA, Japan etc., it is imperative that the available waste paper is segregated at source before collection and which requires classification/grading of different varieties, based on their type and quality.
4. In view of this, CPPRI has made an attempt to classify/grade all the standard varieties of waste paper available indigenously by adopting a scientific approach, which have categorised the different varieties, based on its sources, quality and fibre furnish. In this system all the twenty (20) varieties of indigenous waste paper have been classified into nine (09) groups as summarized below.

#### CLASSIFICATION OF INDIAN STANDARD VARIETIES OF WASTE PAPER

<b>Statistical group</b>	<b>Grades</b>	<b>Contents</b>
Group - I <i>White woodfree Unprinted</i>	No. 1 cuttings	<i>Printers cuttings from high quality white printing paper uncoated or coated but without any printing. (Contains ruled or unruled cuttings)</i>

	Hard white shavings	Shavings or sheets of untreated high grade, high brightness bond ledger papers. Free from printing and ground wood.
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**Contd.**

<b>Group -II White woodfree printed</b>	Note books	School notebooks, bleached variety with less ink. Sometimes slight yellowing observed.
	White records/office records	Mixed waste paper as collected from office refuse. Contains mixed office records including various grades of writing, printing, xerox, typing paper, CPO, envelopes with some staple/pins/cellophane and carbon paper (contains both heavily printed and unprinted matter).
<b>Group -III White &amp; lightly printed mechanical</b>	No-II cutting	Printer cuttings from average quality printing papers made of recycled or high yield pulps, unwanted or coated but without printing.
	White duplex cuttings	New cuttings of uncoated/coated duplex boards with very little printing/lamination received from folding box board cartons converters
<b>Group-IV Colored woodfree</b>	Colored cuttings /colored records	Colored cuttings received from printers of books, magazines, posters or advertisements. Contains newspapers, lottery tickets, text books, brown boards etc.
<b>Group-V Heavily printed mechanical</b>	Text book	Old text books without plastic laminated or straw board covers, contains bleached printed sheets, yellowness observed due to ageing.
	Old directory	Clean telephone directories bleached & heavily printed. Severe yellowness observed due to ageing. Includes both old as well as over issues from publisher house.
	Old newspaper/ over issues	Old newspapers collected from consumer or from newspaper vendors. Newspaper, printed but unused as available from newsprint presses or agencies.
	Old magazines/ over issues	Old or over issue magazines printed on good quality printing paper from chemical or recycled pulp, uncoated or coated paper.
<b>Group-VI Brown Kraft</b>	Kraft multiwall bag waste	New kraft multiwall bag waste and sheets with little printing but without staples or stitching.
	Mixed kraft cuttings	Cuttings of kraft paper received from converters with very little printing and no staples/pins or cellophane.
	New double lined kraft corrugated	Corrugated cuttings received from industrial packaging, corrugated box manufacturers with very little printing & staples/paste/cellophane.
<b>Group-VII Old corrugated containers</b>	Old corrugated boxes	Mixture of corrugated box with kraft/white top liner /printed/ unprinted. Stapled/pasted/spliced with cellophane, having one or few piles of corrugation.
<b>Group-VIII Mixed papers</b>	Mixed waste paper	Mixture of all varieties of paper including white or colored paper, bleached & unbleached, coated & uncoated, printed & unprinted, with & without mechanical pulp papers not limited to fibre content/quality and contaminants from converting units.
	Road sweepings	Mixture of various grades of waste paper as received from municipal dust bin not limited to fibre content or quality.
	Lottery tickets	Printed lottery tickets, unused over used received from agencies/vendors.
<b>Group-IX Contaminated grades</b>	Sack Kraft waste/ cuttings	Cuttings from the converters making industrial sack Kraft, having high stretch, wet strength and burst made from chemical

		<i>Kraft pulp.</i>
	Currency cuttings	<i>Printers trimmings of currency paper</i>

5. This proposed classification/grading system is a preliminary attempt, which needs to be discussed and appropriately modified to benefit the large number of pulp and paper mills based on recycled fibers as well as provide guidelines for suppliers so that there is a high value realization from this important source.
6. To improve the efficiency of existing collection there is an urgent need that the proposed grading system (duly amended, if required) may be implemented immediately and mill owners should demand the suppliers to supply waste paper “in grades”.
7. Waste paper collection of office refuse has not been to its fullest extent due to lack of any viable collection systems at these sources. There lies a huge potential of recovery from this source provided a scientific method of collection is introduced in offices and other business establishments.
8. In a market, which is moving towards the production of higher quality paper products, specific grades such as mixed office waste (MOW) must be pre sorted and collected at source.
9. To increase the over all recovery rate, there is a need to induct legislation like in USA, UK, Germany etc. In USA the legislation is grouped into following five categories.
  - ❖ Collection and separation legislation
  - ❖ Minimum secondary fibre content legislation

- ❖ Legislation prohibiting government agencies from purchasing products with no recyclable content.
- ❖ Incentives for recycled products
- ❖ Surcharges for virgin paper products

In India, such legislation can be enforced based on these guidelines in phase wise manner, which will eventually force the paper merchants and municipal government to set up schemes to collect and sort reusable waste.

10. There is an urgent need to make the use of recycled fibre mandatory for some of the paper grades like newsprint, few packaging varieties, tissue papers and speciality papers.
11. Some of the recommended measures to improve existing collection system in India are.
  - ❖ Enforcement of collection & recycling legislation by Government, as enacted in Germany
  - ❖ Adopting “pick up” collection system network involving Paper Industry Association, and other associations related to publishing, packaging, printing, traders & wholesalers
12. To establish such a system in India, there is a need to make a visit to some of these countries and study the implementation mechanism for inducting such programmes for countrywide collection of wastepaper in India.

In view of this it is recommended that a visit should be made by a team of executive to **Japan, USA, United Kingdom** and **Germany** to study collection sorting and distribution system prevailing in these countries and mechanism of implementing various collection programmes

at state levels and National levels for increased recovery, so that an indigenous system could be formulated and implemented for wider collection of domestic waste paper in the country.

**b) Utilisation of Waste Paper**

1. There is a need to have a system configuration of appropriate technology/ technologies for processing different varieties of waste paper to produce good quality kraft paper, writing/printing paper, newsprint and boards etc.
2. The use of RCF in packaging varieties is well established in Indian industry. Looking into the future prospects of RCF utilisation more & more RCF should be used in newsprint & tissue production.
3. The use of recycled waste paper is bound to grow because of environmental awareness but high quality writing & printing paper cannot be made out of waste paper, which has its own limitation.
4. Based on the studies conducted by CPPRI on quality characterisation of different varieties of imported and indigenous waste paper, these varieties should be utilized for specific end uses as summarized below.

**UTILISATION OF WASTE PAPER GRADES FOR VARIOUS END USES**

WASTE PAPER GRADES	UTILISATION
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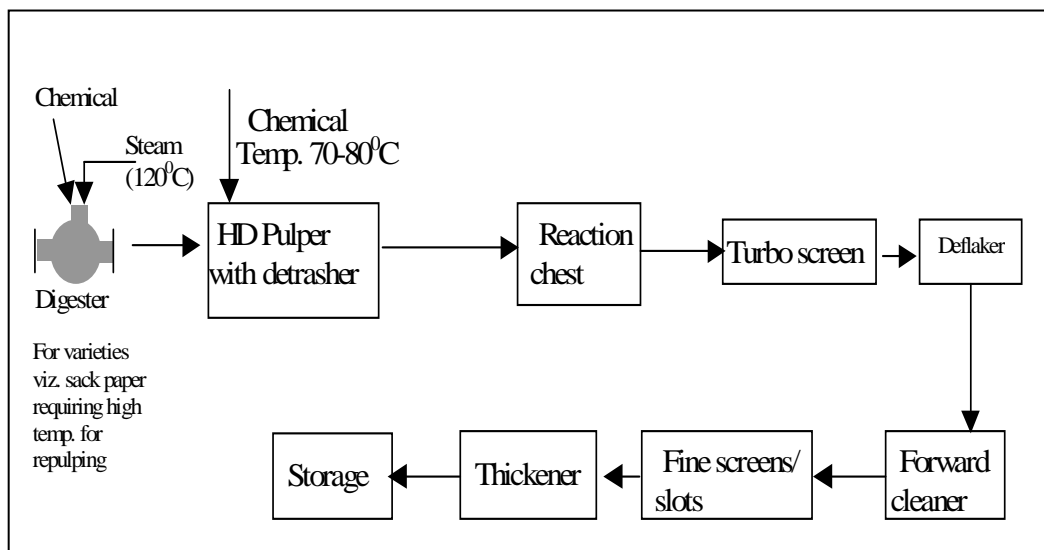


No. I cuttings, Hard white shavings	Writing/ printing paper along with pulp substitutes  For standard newsprint (high brightness)  Top layer for liner boards
Note books, white records/office records	do-
No.II cutting, white duplex cuttings	Ordinary newsprint for improved brightness
Colored cuttings/ records	As fillers in Liner boards
ONP/ over issues, OMG/ over issues,  Text Books, Old Directory	Ordinary Newsprint  Low quality printing and as filler for Liner board
Kraft multiwall bag waste, mixed kraft cuttings, new double lined kraft corrugated	All varieties of packaging
Old corrugated boxes,	Superior kraft
Mixed waste paper, Road sweepings, Lottery tickets	As fillers in Liner boards
Sack Kraft waste/ cuttings, Currency cuttings	Superior kraft  For writing / printing papers

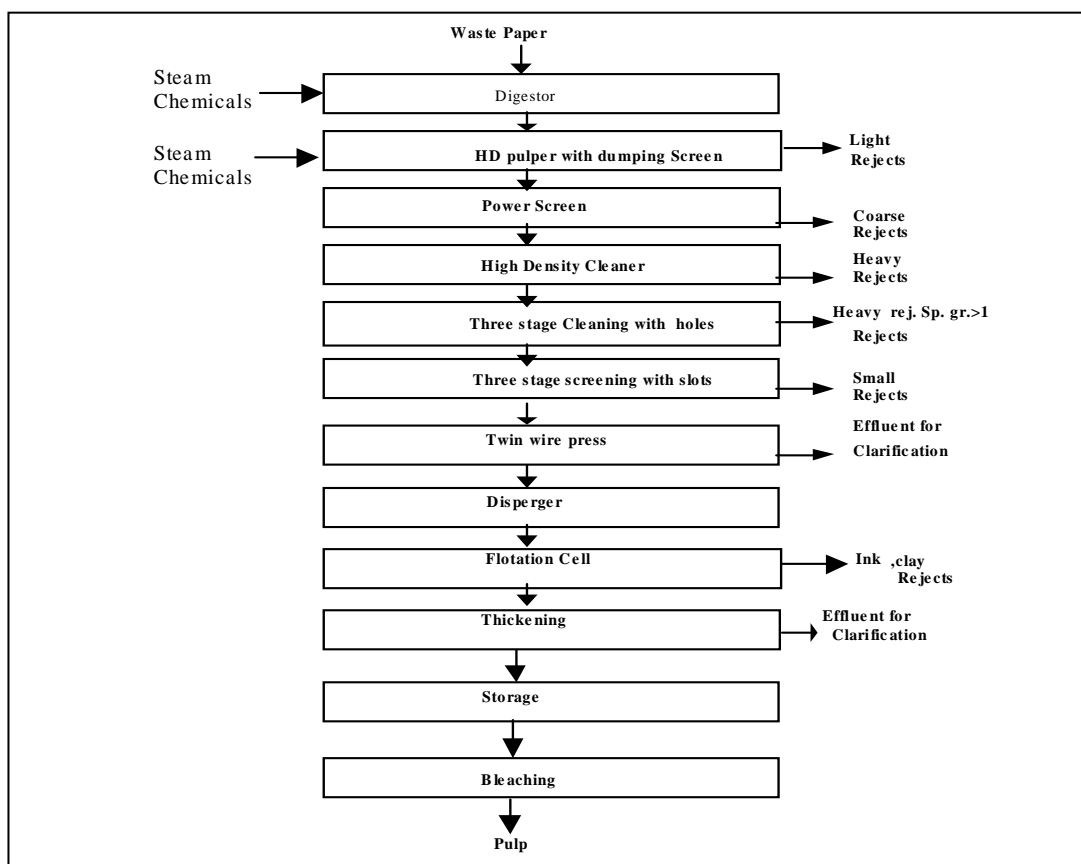
5. The unbleached imported varieties of waste paper viz. NDLKC, OCC, KCB, and similar grades which has fiber quality comparable to virgin fiber (Non-woods) should be utilized for the production of bleachable grades employing conventional pulping and bleaching process
  
6. The studies conducted on quality characterisation have revealed that the fibre length of RCF ranges from 0.7 - 1.2 mm which is considered to be short fibre. In view of this it is suggested that long fibre based waste paper and long fibre pulp should be imported and short fibre demand should be met through domestic collection of waste paper which means the recovery rate has to improve to at least 40% or otherwise the country would be a net importer of short fibre based waste paper as well.

7. Among the imported varieties a lot of contaminated grades are received. Removal of contaminants is essentially required to overcome the runnability problems on the paper machine. Identification and characterisation of contaminants is essential for selection of appropriate processing system.
8. Adoption of the appropriate technology/combination of technologies (chemical & mechanical treatments) must be coordinated into a comprehensive stickies control treatment programme specifically designed to solve each individual mills waste paper stickies problem and which requires a strong R & D back up.
9. Based on the studies conducted by CPPRI, mills using wide range of wet strength paper should have following system configuration. The inclusion of digester in system design is essential to keep optimum thermal condition for breaking of covalent bond of wet strength resin (PAE type) in paper.

### PROPOSED SYSTEM FOR PRODUCING UN-BLEACHED PULP FROM WET STRENGTH PAPER



10. The state of art technology for production of newsprint and writing/printing paper from ONP/OMG furnish and MOW is either two loop or three loop system to achieve the required brightness specification and dirt count. In such system, the contaminant removal stages are being repeated to achieve the required cleanliness and are capital intensive. Under Indian conditions a universal system is proposed which can handle various grades of waste paper available. The schematic of the system is shown below.



## **FIG.1 UNIVERSAL SYSTEM FOR PROCESSING OF WASTE PAPER**

11. The waste paper based mills produce large amount of waste sludge (Clarifier and Deinked sludge) due to number of cleaning step during processing. As a part of waste management, incineration of sludge (clarifier sludge) in FBC boiler along with coal/ rice husk (HHV fuels) is proposed for implementation as a disposal alternative. Since the calorific value of sludge is close to black liquor, it can partially substitute the conventional fuels.
12. The sludge generated during deinking operation has high ash content and low calorific value, and when burned with conventional fuels will reduce the thermal efficiency of the boiler and auxiliary fuels requirement will be high. Other option of deinked sludge disposal is land spreading for loamy soil, which may be considered as an alternative.
13. Sludge dewatering is a necessary step to increase the dryness content of waste sludge to 40-45%. Belt press can be employed for sludge dewatering.
14. Other options for waste sludge utilisation can be adopting biological routes for energy generation such as biomethanation, ethanol production by fermentation etc. however feasibility studies need to be undertaken.

15. Closing of water loop with efficient water clarification system (Dissolved Air Flotation) is essentially required since recycling of back water without removal of contaminants (inks, stickies, fillers etc.) will create problem in maintaining the quality of product with respect to brightness and will also enhance the accumulation of stickies causing runnability problems on paper machines.

16. The installation of biomethanation plant in an individual RCF mill (even in 100 tpd mill) may not be technoeconomically viable, however, the concept of cooperative biomethanation plants where the effluent from three or four recycled fibre based mills located in a close vicinity is collectively treated together will not only help in meeting the discharge norms but also reduce the mills dependence on purchased power to a certain extent.

17. The data collected through questionnaire clearly reveals that there is a need for modernization in these mills and mills producing white grades should essentially have deinking system for more flexibility in utilising different varieties of waste paper.

**c) Fiscal Incentives and Government Policies**

1. In order to reduce investment burden and upgrade machinery and technology, import duty should be reduced from capital goods not manufactured in country like waste paper processing/ treatment plants and related equipments and technology.

2. All such technologies and equipments, which will help in improving the quality of domestic waste paper, should be allowed to import without duty.
3. 100% depreciation should be allowed on such capital goods since these equipments will facilitate reduced pollution and energy saving.
4. Waste paper recycling right from its Collections to its processing stage should be seen as a separate industry so that a centralised system may be developed to maintain the quality and supply on sustained basis.
5. A high level committee with representatives from Industry, policy making authorities and R&D sectors should formulate action plan for creating such centralised waste collection units (waste salvage stations) in different regions of the country.
6. Financial institutions should give priority to waste paper recycling projects with the favorable debt equity ratio.
7. The international cooperation like USAID/SIDA/JIACA may also be sought in promoting the deinking technology.

**d) Role of R&D**

There is an urgent need for concerted efforts in research and development activities aimed at improving the processes without additional machinery or higher processing cost. The R&D activities should be aimed at

- ❖ Economic means of contaminant removal
- ❖ Screening and cleaning methods
- ❖ Post treatment of pulps stock like refining beating, bleaching etc.

A premier institution like Central Pulp & Paper Research Institute is already working on projects on upgradation of waste paper for higher quality grades utilizing simple and economic technologies and equipments.