

# Manufacture of Packaging Grades Paper From Recovered Papers - An Experience

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## ABSTRACT

*Importance of recycling in the present scenario, highlighting manufacture of packaging grades paper has been mentioned. The paper deals with pulping of brown recovered papers like DSOCC, Singapore OCC, European OCC and Used Cement Sacks etc. The significance and operation of various cleaning and screening equipments have been described including handling of contraries like plastics, thermocools, pins, clips, specks and stickies etc., during processing recovered papers. Desired quality of packaging grades paper is achieved through selection of appropriate grades of recovered papers, effective operation of various stock preparation equipments and Quality Assurance System adopted at the Unit.*

*The properties like stretch and Tensile Energy Absorption (TEA) of Extensible Sack Kraft Paper (ESKP) could be increased significantly through refining at a High Consistency Refiner (HCR). The cleanliness of the pulp improves significantly because of high consistency refining. The paper also describes properties of various grades of papers manufactured at Unit using recovered papers.*

## INTRODUCTION

Pulp and paper industry is mainly based upon the use of virgin fibre as raw material. Technologies were evolved day by day to process various woods and other raw materials to extract virgin fibres.

The depletion in the source of virgin fibre i.e. forest cover, imbalance in the ecosystem, awareness of people towards environment, legislative restrictions etc. activated the paper technologists to find out alternative source of raw materials. Recycling the paper came to limelight in 1690 AD at Rittenhouse mills near Philadelphia. Various difficulties encountered in handling the waste paper were tackled time to time with the advent of new technologies. Manufacture of paper from waste paper has got the status of a full fledged technology by itself and

implemented successfully throughout the world. Several terminology developed like recycled fibre, reuse fibre, waste fibre, recovered paper etc. to replace the term waste paper as it not a real waste.

The recovered paper is being imported predominantly from USA (60-65%) and Middle East (25-30%). Some small quantities are also imported from Singapore and Europe.

In India, more than 250 mills manufacture various grades of paper using recovered paper as

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partially or fully in their furnish. This figure is increasing day by day. The papers manufactured using recovered paper has also increased significantly which clearly indicates the growth of the sector with time.

The World trend on the recycling of recovered paper is also quite encouraging. The growth pattern achieved, forecast a bright and challenging future for this segment of paper industry in 21st century.

Various factors which encourage the growth of this sector are:-

- a) Availability of recovered paper in plenty.
- b) Low cost of recovered paper compared to virgin fibres.
- c) Conversion of recovered paper to selective products which has good market potential.
- d) Less capital investment for the processing of recovered paper as compared to processing of woody raw materials.
- e) Environmental issues like fast depletion in forest area cover, compels industry to go for recycling of recovered paper.
- f) Advantage of marketing papers made fully or partially from recovered paper.
- g) Customer acceptance of recycled paper products.
- g) The advantage of waste paper based industries are high fibre yield as compared to woods.
- i) Lower water consumption and low BOD discharge in the effluent.
- j) Recycling of paper is an easy way to get eco-friendly products.

The main technical bottlenecks, which limit the use of recovered paper are, lower brightness, lower strength, higher prevalence of stickies etc. and environmental concerns caused by effluents of deinking plants. However, technologies have evolved in all the fields of recovered paper processing strating from collection, sorting, storage and stock preparation and papermaking. For example:

- a)- technology evolved in stock preparation, deinking, bleaching and fractionation etc. where waste papers are processed to get clean and homogeneous pulp with less detrimental

particles.

- b) development of multilayer technology has created a lot of option to use recovered fibre in different layers of products mainly in boards.
- c) improvements in the paper machine technology, cleaning and screening equipment with a lot of automated process controls has improved the runnability of paper machine maintaining desired quality in the end product.
- d) selective use of recovered paper grades for specific value added products.

This paper deals with processing of recovered papers mainly OCC, NDLC and Used Cement Sacks (UCS) for manufacture of different grades of kraft papers.

### **MAJOR RECOVERED PAPER GRADES USED FOR PACKAGING**

The quality of the paper manufactured is monitored by the variety of recovered paper selected. Grades of recovered paper have different definitions in various countries mainly due to difference in the terminology and collection system. Since brown waste papers are the most important grades traded internationally, OCC (old corrugated containers) one of the major group of recovered paper family, definitions for approximately equivalent grade according to various recovered paper grading systems are.

Paper Stock Institute (PSI) of America: corrugated containers: consists of baled OCC having liners of either test liner, jute or kraft. The maximum limit of the prohibitive material and total outthrow in a consignment allowable is 1.0% and 5.0% respectively. The term "Outthrow" defined as all papers that are so manufactured or treated or are in such a form as to be unsuitable for consumption as the grade specified. The term "Prohibitive material" is defined as any materials which by their presence in the packing of paper stock, in excess of the amount allowed will make the packing unusable as the grade specified. In addition to this, any material that may be damaging to the equipment is also considered as prohibitive material.

The other important defining bodies of world are British Paper and Board Industry Federation (BP&BIF), European (CEPAC), German (BVP) and Japan Paper Recycling Promotion Centre.

In regards to the quality of fibre in corrugated containers, OCC of American origin are considered to be superior compared to OCC of other origin of world due to higher softwood fibre content.

NDLKC is defined as New Double Lined Kraft Cutting consists of baled corrugated cuttings having liners of either kraft, jute or test liner. Non soluble adhesives, but rolls, slabbed or hogged medium, and

treated medium or liners are not acceptable in this grade. The prohibitive materials are not permitted in these varieties. The total outthrow content is limited to 2.0% only in NDLKC.

UCS (Used Cement Sacks) are defined as paper sacks collected after consumption of packed cement at customer end. These sacks are preferably of BILT

**TABLE-1**

**NORMAL PHYSICAL STRENGTH PROPERTIES OF VARIOUS RECOVERED PAPERS**

SR NO	PARTICULARS	UNIT	DISOCC (US ORIGIN)	NDLK-II (US ORIGIN)	SINGAPORE OCC	EUROPEAN OCC	USED CEMENT SACKS
1.	Final Freeness	°SR	25	25	25	25	25
2.	Beating Time	Min.	30-35	27-30	15-18	15-18	5-8
3.	Breaking Length	m	5200-5400	5000-5300	4000-4400	4200-4400	3700-3900
4.	Stretch	%	2.2-2.5	2.1-2.3	1.8-1.95	2.3-2.35	2.1-2.3
5.	TEA	J/M <sup>2</sup>	45-50	45-50	36-42	38-40	37-39
6.	Tear Factor		98-102	90-96	78-82	90-94	85-88
7.	Burst Factor		30-33	30-32	23.5-24.5	24-26	27-29

\*\* : Pulps are beaten at valley beater.

**TABLE-2**

**NORMAL PROPERTIES OF EXTENSIBLE SACK KRAFT PAPER**

SN.	PARTICULARS	UNITS	80 GSM	90GSM	100 GSM
1.	SUBSTANCE	g/m <sup>2</sup>	78-81	88-91	98-101
2.	BREAKING LENGTH	MD	4200-5000	4200-5000	4200-5000
		CD	3200-4000	3200-4000	3200-4000
3.	STRETCH	MD	7.5-8.5	7.5-8.5	7.5-8.5
		CD	5.8-6.6	5.8-6.6	5.8-6.6
4.	T.E.A.	MD	175-200	180-245	210-260
		CD	110-145	125-155	130-140
5.	TEAR STRENGTH	MD	90-100	100-112	110-124
		CD	100-110	112-120	130-140
6.	POROSITY	s/100ml	12-18	12-18	12-18
7.	COBB (AVG.)	g/m <sup>2</sup>	25-28	25-28	25-28

**TABLE-3**

**NORMAL PROPERTIES OF MF KRAFT (24+BF)**

SL. NO.	PARTICULARS	UNIT	BROWN/GOLDEN SHADES				
			90	120	140	150	180
01	SUBSTANCE	g/m <sup>2</sup>	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%
02	BURST FACTOR		24-28	24-28	24-28	24-28	24-28
03	TEAR FACTOR, MD		85-95	90-95	95-100	100-105	105-110
	CD		90-100	95-105	100-110	110-115	115-120
04	COBB-60	g/m <sup>2</sup>	25-30	25-30	25-30	25-30	25-30

**TABLE-4**

**NORMAL PROPERTIES OF SUPER KRAFT (28+BF)**

SL. NO.	PARTICULARS	UNIT	BROWN/GOLDEN SHADES				
			90	120	140	150	180
01	SUBSTANCE	g/m <sup>2</sup>	±5.0%	±5.0%	±5.0%	±5.0%	±5.0%
02	BURST FACTOR		28-30	28-30	28-30	28-30	28-30
03	TEAR FACTOR, MD		95-100	95-100	100-105	105-110	105-115
	CD	kg/100mm	100-110	100-110	105-110	110-120	115-125
04	RING CRUSH CD	-	-	15-20	20-24	25-30	30-36
05	COBB-60	g/m <sup>2</sup>	25-30	25-30	25-30	25-30	25-30

make. It is cleaned before use in the process.

The normal physical strength properties of these recovered papers are tabulated in Table-1.

**PACKAGING PRODUCTS MADE FROM RECYCLED FIBRES**

There is a wide variety of packaging products, ranging from multi ply sacks through cigarette cartons to corrugated containers. The brown based packaging grades manufactured from recovered fibre is broadly classified in three major groups. They are

- a) components of corrugated containers
- b) solid boards
- c) packaging papers.

We manufacture Extensible Sack kraft Paper (ESKP) in various grammages ranging from 80-100 gsm for packing of cement and non-cements. The

ESKP is manufactured using long fraction unbleached bamboo pulp and recovered paper. The normal physical strength properties of ESLP are given in Table-2. The papers are manufactured in various colours as per the requirements of customers. These papers are converted to sacks mainly for cement and non-cements at the Unit.

The other major product is Kraft paper, manufacture in various grammages ranging from 80 to 180 gsr. The unit manufacture kraft in three major groups i.e MFK(24+BF), Super kraft (28+BF)and Super Kraft High Burst (32+BF).The normal properties of various grades of kraft papers are given in Table-3,Table-4 and Table5.These kraft papers are also manufactured at Ashti are mainly used for the conversion of corrugated containers.

**RECOVERED PAPER PROCESSING (BROWN GRADES)**

Brown grades recovered paper systems are

TABLE-5

## NORMAL PROPERTIES OF SUPER KRAFT (32+BF)

SL. NO.	PARTICULARS	UNIT	BROWN/GOLDEN SHADES		
			120	150	160
01	SUBSTANCE	g/m <sup>2</sup>	±5.0%	±5.0%	±5.0%
02	BURST FACTOR		32-35	32-35	32-35
03	TEAR FACTOR, MD		85-100	100-105	105-110
	CD		100-110	110-120	115-120
04	RING CRUSH, CD	kg/150mm	15-20	25-28	28-30
05	COBB-60	g/m <sup>2</sup>	25-30	25-30	25-30

very different from those used in the processing news and woodfree recovered paper grades. Different processing lines are used for different application of paper. Most of the recovered paper used by the Paper and Board Industry is not deinked.

Brown grades of recovered fibres are processed at Ashti to manufacture several types of kraft papers. A schematic flow diagram of the recovered paper processing street is shown in Fig. 1.

### PULPING SYSTEM

As recovered paper is generated from various sources it contains pins, clips, staples, coarse grit, coarse contaminant, lighter contaminants like plastic, plastic tapes and thermal sensitive chemicals like wax, bitumen etc. The equipment used to remove these contaminants must also be constantly upgraded and improve in the quality sheet using recovered paper is to be produced.

A wide variety of pulping options are available in the market including.

- a) Low consistency batch pulper.
- b) Low consistency continuous pulper.
- c) High consistency batch pulper.

The pulpers can be fitted with such auxiliaries as raggers tail cutter, junk towers, detrashers etc.

Low consistency pulpers are the most common with consistency usually in the range of 3-5%. In low consistency pulping, mechanical forces are very strong

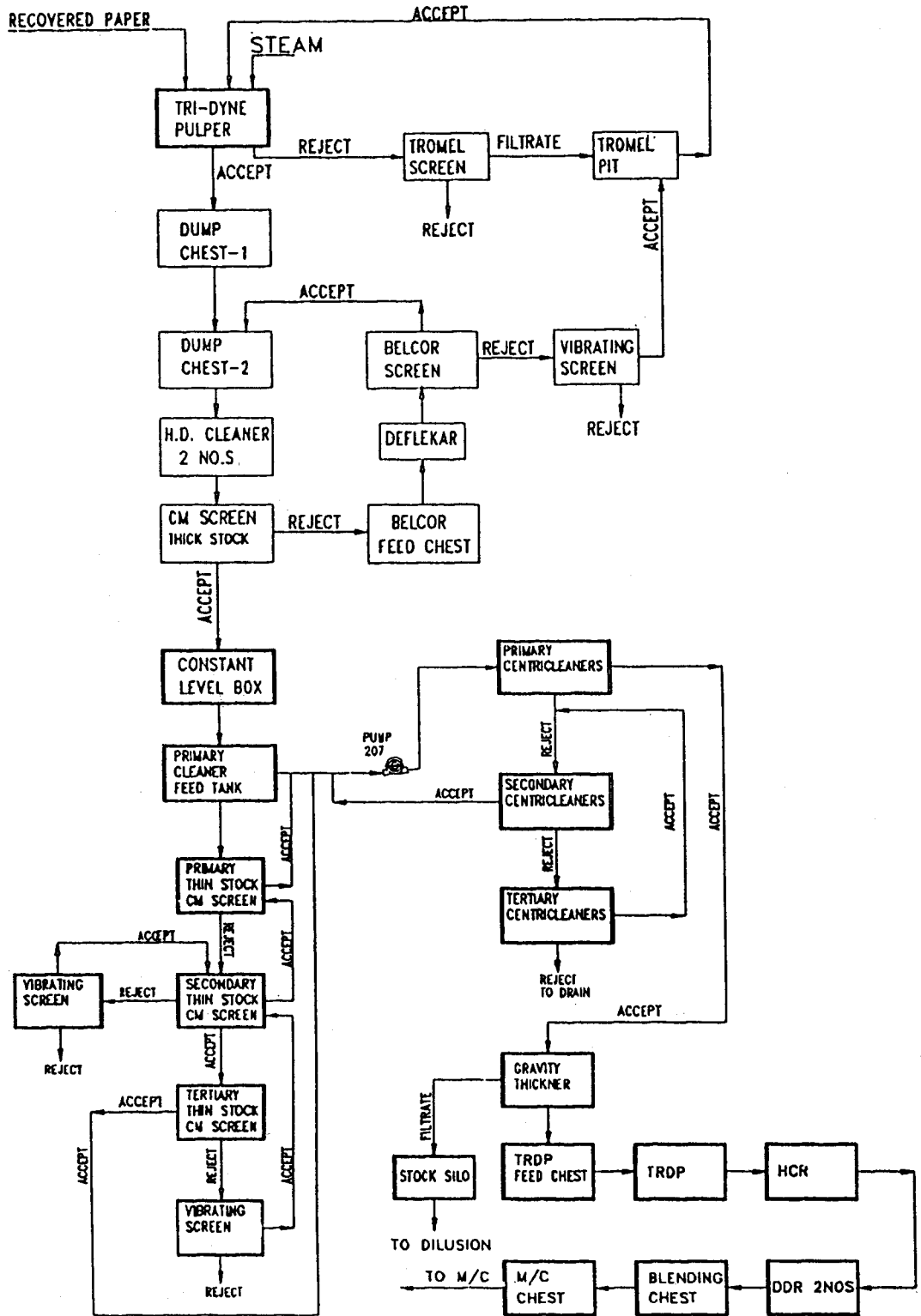
which results in the break downs of many of the contaminants present in the recovered paper.

We have a high consistency pulper operates at approx. 12% consistency, it is supplied by M/s Beloit UK. It is a rugged heavy duty machine designed for pulping baled or loosed furnish like DSOCC, NDLC etc. High consistency pulping of recovered paper is done to pulp/ deflake the paper without cutting plastic and other contraries for their easy removal. This is because the deferring forces in high consistency pulping are less severe than in low consistency pulping. Rotor speed is relatively low and the fibering forces are provided by fibre to fibre shear, rather than mechanical forces.

The slushed pulp material is passed through perforated plate to dump chest. The foreign materials like string, wire, glass, plastics, metal, unslushed materials, etc. passed through automatic dump valve and go to trommel screen for further recovery of fibre from these contraries and unflaked material and removal of medium size and coarse contaminants from the stock along with pastic caps strings etc.

Trommel screen is a screen drum, the internal components of the rotating screen drum results in intensive blending of the stock which keeps the screen drum free and convey the contaminants to the end of the drum. the screen drum is run for reversible operation. Initially the screen drum rotates such that the rejects go to the closed end so that, no rejects are thrown out without being screened. Then it rotates in the opposite direction and the rejects are thrown out onto a conveyer for disposal. The accepted stock is collected in a pit and pumped to the pulper.

Fig. 1 Flow Diagram for Recovered Paper Street



## HIGH DENSITY (H.D.) CLEANERS

The slushed pulp from dump chest is passed through 2 nos. of High Density cleaner. H.D. cleaner is a high efficiency unit designed for removal of heavy contaminant working based on the centrifugal cleaning principle. It operates at 2.5-3.5 consistency. The inlet pressure is 4.5-5.5 kg/sq. cm with pressure drop of 0.8 - 1.5 kg/sq. cm. It is mounted with automatic reject system. The reject is collected in the reject sump which is periodically removed by intermittent operation of the reject sump valves. Rejects rates can be controlled depending upon the reject percentage in the inlet pulp. The accepted pulp of HD cleaner is passing from top of the equipments.

## COARSE SCREENS

The exit of H.D. Cleaner go to thick stock CM Screen (Model - 100). This equipment is the most upto date and works on the principle of pressurised screening of pulp. It operates ideally at a consistency of around 2%. The equipment is installed horizontally. The stock enters tangentially where centrifugal forces separates any trapped material in to the trap. The stock flows over and inlet baffle and into a screening compartment between a rotating rotor and a stationary screen plate. The acceptable stock passes through a screen and goes to a constant level box. The screen plate is kept clean by high frequency pulses generated by the rotor. Rejectable material continues to travel along the screen plate until it enters the reject gutter from where it is discharged. This screen is equipped with completely automatic reject valve system. This automatic system consists of following parts.

- a) Magnetic flow meter to sense the reject flow.
- b) A controller to regulate the reject valve opening.
- c) A valve cylinder operated with positioner to throttle the reject flow.

The rejects of screen go to the belcor feed chest for further cleaning and defiberating of stock in belcor. Belcor is an equipment meant for cleaning and defiberating of recovered paper stock. It continuously extracts through relatively

small perforation and installed in a horizontal tank. The stock is fed tangentially and accepted stock is discharged horizontally. Heavy rejects are collected in metal trap at the bottom of the tank and discharged intermittently Belcor screen out intermediate size pieces of plastic contaminants and undefibered pieces of wet strength paper. It serves as a second stage pulping unit after removal of all large pieces of plastics and heavy junks. It also removes any heavy junk like paper clips, staples etc. that have not been separated in either the pulper or high density cleaner.

The light rejects of belcor screen are discharged continuously at the central out let opposite to the rotor. The ideal flow rate maintained is 10% by volume, however, the flow rate is increased during handling of very dirty stock to prevent excessive build up of rejects in the tank and ensure good cleaning efficiency.

The accepted stock discharged through perforated extractor grate. The stock consistency is maintained in the range of 2 to 3%. The dimension of extraction hole is 1/8". The consistency of rejects, accepts would be same as the feed. The accepted stock is taken in the system.

## FINE SCREENS

The accepted stock from CM Screen (thick stock) is diluted to approx. 1.2% cy at primary cleaner tank and goes to three stage fine screening system consisting of primary, secondary and tertiary CM screen (model 400). These screens are specially designed (provided with bump rotor), suited for thin stock for effective cleaning. The accept of primary screen goes for three stage centricleaning at a cy of about 0.8%. The rejects of fine screening goes to vibrating screens from where, the rejects are disposed off. The accept of vibrating screen is taken back into the fine screening system.

## THICKNER

The cleaned pulp at a cy of about 0.8% goes to gravity thickener for thickening of the pulp to 4.5%-4.8% cy. The dewatering takes place in the vat while the pulp at about 4.5% cy is transferred to twin roll dewatering press feed chest. It is then pumped to Twin Roll Dewatering Press (TRDP) for further thickening of the pulp to 30-35% cy. for feeding to high consistency refiner.

## HIGH CONSISTENCY REFINER (HCR)

High Consistency Refiner is designed with horizontally divided disc housing with large outlet for non-pressurised refining. After removal of light and heavy contraries, thermal sensitive impurities like plastics, tapes, wax, bitumen etc remain the pulp and are not removed/dispersed, will stick to the wire and felts on the paper machine resulting in poor

efficiency and necessitating shut down for cleaning. This equipment disperses thermo sensitive impurities like bitumen and stickies.

The pulp is then subjected to a series of disc refiners depending upon the quality of paper manufactured.

### **EFFECT TO HIGH CONSISTENCY REFINING ON PAPER PROPERTIES**

This equipment mainly improves the stretch and tensile energy absorption (TEA) of paper. The fibres curl, twist, bend and fold during high consistency refining with minimum generation of fines. These effects on fibres remain in the paper and contribute significantly to the cross direction stretch and TEA. As the unit manufacture Extensible Sack Kraft Papers as the major products which are used for packing of cements and non-cements, these properties are critically controlled and maintained. Whenever a filled sack is dropped from a height, the impact is transferred in both machine direction and cross direction. Thus, the paper used for packing should have sufficient strength in MD and CD to absorb the energy. The MD stretch mainly imparted to paper through Clupack technology and CD stretch imparted through high consistency refining to take care of the impacts of drop. Generally ESKP possesses marginally lower tensile strength than normal krafts, however, stretch in MD as well as CD is much higher in ESKP. Due to the higher stretch property, resultant TEA is much higher in ESKP than MFK. Therefore, ESKP is preferred for sack manufacturing.

The effect of high consistency refining on the cleanliness of pulp is unquestionable. It cleans the pulp with minimum generation of fines. The equipment result in a much cleaner paper from recovered paper furnish.

### **QUALITY ASSURANCE**

Ballarpur Industries Ltd., Unit-Ashti is an ISO-9002 registered company since 1995 has established method of evaluation of recovered papers. The unit has established well documented procedures for the procurement, handling, storage, processing of recovered papers, intermediate controls at various stages of stock preparation etc. Highly effective cleaning equipments supported by automated control system at stock preparation and paper machine ensure smooth processing and manufacture of various superior

quality packaging grades paper.

The unit is supported by a dynamic team of technocrats, research and development personnels, strong Information and Technology department and a well trained work force which ensure the product quality. BILT-Unit Ashti is committed to provide its customers reliable and consistent quality product on agreed specification and delivery schedule.

### **CONCLUSIONS**

Recovered paper should no more be called a waste paper as it has already occupied a potential segment in the raw materials of packaging papers. BILT, Unit-Ashti has equipped itself with latest technologies of processing brown recovered papers and manufacture high strength krafts like ESKP and MF krafts. High consistency refining imparts cleanliness to the pulp through dispersion of thermo sensitive materials like bitumen and stickies. This has resulted in much cleaner paper and well accepted by various customers.

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