

# RECYCLED FIBRE IN HIGH GRADE WRITING AND PRINTING PAPER MANUFACTURE



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## Abstract:

Secondary fibre use in paper manufacture attracts more attention owing to its environmental sustainability and supplementation to virgin pulp in high grade writing and printing sectors. Nature of waste paper and raw material mix pattern in two loop deinking process determines the RCF pulp quality with reference to brightness, strength and ERIC value besides yield. Optimization of raw material furnish in deinking process is a key requirement according to final product is concerned. Combined use of sorted office paper (SOP) and white records (WR) in recycled fibre processing provides stable and balanced furnish to paper machine with high bright, low ERIC and improved breaking length. Wood free long fibrous, high bright and low ash are the essential selection criteria for waste paper mix in deinking process to manufacture high grade writing and printing paper. Sustainable development is major challenge for industrialization and globalization; therefore "recycling" considered as a prime strategy throughout the sphere.

**Keywords:** RCF, SOP, WR, Brightness, ERIC.

## 1.0 Introduction

Recycling is a core and essential element for the Environmental sustainability. Replacing of virgin fibre in paper manufacture eliminates deforestation, reduces energy costs, minimizes greenhouse gas emissions and suppresses the related harmful environmental practices. Recycling is a prominent alternative for the crisis of climate change(1). Use of recycled fibre in paper making has a major benefit as millions of tons of agriculture residues and used paper recovered from the phenomenal decay resulting GHG emissions. RCF raw material mix for high grade writing and printing paper manufacture would be of primarily printed and unprinted

high grade white waste papers such as sorted office paper (SOP), Magazine (MG), Sorted white ledger (SWL), Flyleaf shavings (FLS), No. 1 cuttings from printing press (NC) and White record (WR) collected from conversion units, printing sectors and offices as versatile raw materials to keep the paper quality equal to virgin.

## Deinking of Recovered paper

The waste paper processing for deinking commence with pulping; where waste paper is fed with continuous drum pulper and hydrogen peroxide, sodium silicates, sodium hydroxide, EDTA and soap are dosed to facilitate disintegration and ink separation in the subsequent processes. Plastics, larger contraries are separated in drum pulper. High consistency cleaning and Coarse screening provide heavy contaminants removals such as staple pins, gem clips, glass pieces etc. Low consistency cleaning system has been operated on cascade principle to remove sand & specs and diverted into sludge tank. Pre flotation unit is a two stage system consisting primary and secondary cells in which ink is separated as floats and foam from the stock by flotation principle with the presence of pressurized air. Ink containing foam is rejected and collected in the sludge tank. Fine screening screens debris and stickies after three stages enabling to feed 1st loop disc filter. First stage thickening takes place in the disc filter after that thickened pulp is further dewatered in screw press and fed to disperser before brightening by oxidative bleaching by  $H_2O_2$ . High consistency brightened pulp is fed to post flotation followed by second stage thickening in disc filter. Reductive brightening takes place by sodium hydrosulphite addition in the stock for further brightening the pulp to reach 82% bright in 66% pulp yield. Stage wise deinking process on brightness gain (15%), reduction in ERIC (89%) and pulp yielded (66%) have been presented in table 1.

Rejects from screening, cleaning, DAF and flotation foam are mixed together for pre-dewatering in drum screen thickener to a consistency of 15% and further dewatered in the screw press to 52%.

Table 1 : Pulp quality at different stages of deinking process

Parameters	Pulper	Cleaner	Flotation 1	Fine Screen	Disperser	Flotation 2	Final Pulp
Brightness (% ISO)	67.0-68.5	67.0-69.0	69.5-70.5	70.0-71.5	72.0-74.0	75.5 -78.0	80.0-82.0
ERIC (ppm)	450 - 550	450 - 500	300 - 350	250 - 300	150 - 250	60 - 100	55 - 60
Yield (%)	97	94	76	74	74	66	66

#### Recovered Paper Mix in deinking:

Sorted office paper (SOP) is the major raw material (60%) along with White records (WR) at 40% mix have been processed for deinking to reach the yield of 66%. Ink, additives and coating chemicals may cause variety of problems during recycling process and those are removed essentially by deinking process to restore the fibre characteristics to meet the required specifications. Conventional NaOH treatment facilitates the alkaline pH enabling for better detergency and ink dispersion with the presence of surfactant to promotes solubilization of ink particles into the aqueous medium. Elevated pH induces the fibre swelling for enhancing ink detachment and wettability change in cellulose layer promotes emulsification and ink segregation from fibre. Hydrogen peroxide and sodium silicate have been widely used to stabilize the detached ink and prevent redeposition whereas the former with sodium hydroxide together at disperser increase the pulp brightness to the extent of 82%. Deinking and recycling process changes the properties of the fibre to certain extent and hence recovered fibre characteristics may differ to virgin.

#### Furnish optimization:

Raw materials such as Sorted office paper (SOP), Magazine (MG), Sorted white ledger (SWL), Flyleaf shavings (FLS), No. 1 cuttings from printing press (NC) and White record (WR) had been used for deinking process since 2018-19. SOP has been considered as a major raw material mix at all times owing to its availability and quality. Overall usage of SOP for the past five years has been calculated from 60 to 80%. The final brightness (ISO) after deinking of SOP has been recorded from 81 to 83% with 65% yield and 85 to 100 ppm ERIC. Perennial availability and quality in terms high brightness, good yield, moderate Eric content, low ash and affordability suggest the mill to use maximum SOP in the raw material mix. White record (WR) has been incorporated in the raw material mix in 2019-20 at 5% and gradually increased to 40% in 2022-23. 77 to 80% brightness achieved after deinking process along with 68% yield and 95 to 120 ppm ERIC considered as a 2nd largest raw material mix (table 2). Combined SOP and WR grade recovered paper is capable of producing quality secondary fibre with high brightness (82%) and low ash (<5%), suitable to manufacture high grade writing and printing paper (table 3).

Table 2 : Year wise recovered paper usage (%) in deinking process with pulp quality & yield

Grades Recovered Paper & RCF pulp quality	Year				
	2018 - '19	2019 - '20	2020 - '21	2021 - '22	2022 - '23
(SOP) Sorted Office Paper (%)	80	80	80	75	60
(MG) Magazine (%)	10	5	5	0	0
(SWL) Sorted White Ledger (%)	5	5	5	5	0
(FLS) Fly Leaf Shavings (%)	5	0	0	0	0
(N1C) No.1 Cuttings (%)	0	5	0	0	0
(WR) White Record (%)	0	5	10	20	40
Initial Brightness (% ISO)	66 - 68	68 - 69	66 - 68	65-67	65 - 66
Final Brightness (% ISO)	79 -81	80 - 82	80 - 82	81 - 83	80 - 82
Final ERIC Value (ppm)	55 - 60	52- 55	50 - 55	50-55	52- 55
Yield (%)	63	65	65	66	66

Mill experienced with magazine (MG) addition in the raw material furnish from 5 to 10%; which gave the brightness from 75 to 78% along with 60% yield and ERIC 100 to 120 ppm, High ash content (>30%) of MG discourage the mill in the ground of sludge processing, handling and disposal. SWL usage as raw material provides much desirable results of brightness 85 – 90%, yield 75% and ERIC 25 to 40%. Whereas, the availability and cost discourage the mill to use a major mix option in the raw material furnish. Raw materials such as FLS and N1C have also been used with a fraction of 5% during 2018-19 and 2019-20 respectively, which provide brightness 84 to 87 / 80 to 82 %; yield 72 / 85% and ERIC 30 to 50 / 10 to 20 ppm respectively (Table3).

#### Impact of RCF furnish on High grade writing and printing paper

Mill manufacture variety of products under Non Surface Sized (NSS), Surface sized (SS) and Copier grades in white shades (Table 4). Several experimentations in the paper machine using combined RCF pulp mix (SOP 60% and WR 40%) in the paper furnish suggest 20 – 25% for NSS,

Table 3 : Quality of various RCF pulp prepared from recovered paper through lab trials.

Grades of Recovered Paper	Brightness (% ISO)		ERIC value (ppm)		Break-ing Length (m)	Tear Factor	Ash (%)		Yield (%)
	Initial	Final	Initial	Final			Initial	Final	
Sorted Office Paper (SOP)	72 - 74	81 - 83	500 -600	85 - 100	2650 - 2950	32- 36	20 - 23	4 - 6	65
Magazine (MG)	65 - 66	75 - 78	550 -650	100 - 120	2000- 2300	28 - 30	30 - 35	10- 15	60
Sorted White Ledger (SWL)	75 - 76	85 - 90	400 -500	25 - 40	2800 - 3050	30 - 32	20- 22	5-6	75
Fly Leaf Shavings (FLS)	68 - 70	84 - 87	450 -550	120 - 140	2750 - 3000	32 - 34	20 - 22	5 -6	72
No.1 Cuttings (N1C)	79 - 81	80 - 82	100 -150	10 - 20	2900 - 3200	60 - 64	10 - 15	3 -4	85
White Record (WR)	64 - 66	77 - 80	550 -650	95 - 120	2850 - 3020	55 - 60	10 - 13	3 -4	68

15 – 20 % for SS and 28 - 32% for copier recycled grade. RCF mix in NSS has been optimized to obtain the brightness  $87\pm 1\%$  with MD/CD breaking length (BL) ratio of 1.9 – 1.95. In case of SS varieties, the brightness level  $90\pm 1\%$  and MD/CD ratio of BL 1.85 – 1.9 have been optimized at maximum 20% RCF mix. One of the valuable high bright export products under copier grade got an average of 30% RCF mix to obtain to 92 to 93% brightness and BL ratio for MD/CD at around two. ERIC ceiling has been fixed as 30, 12 and 35 ppm for NSS, SS and

Copier grades respectively. Paper properties are stable in all grades at suggested levels of RCF mix in the paper furnish. There is a marginal increase in breaking length of paper by 5%, while with RCF mix. High speed machine encounter with an occasional issue of stickies and fluff induced “calendar scabbing” in all the paper grades at the recommended RCF mix in the furnish. In spite of stickies control in place, issue becomes serious when the RCF mix level is above the stipulated limit; which affects machine runnability by large.

Table 4 : RCF content in different grades of paper with paper properties

Writing & Printing Paper Grades	RCF in furnish (%)	Brightness (% ISO)	ERIC Values (ppm)	Breaking Length ratio (MD/CD)	Fluff (mg/1000m)
Non Surface Sized (NSS)	20 - 25	86-88	25 - 30	1.95	50 - 60
Surface Sized (SS)	15 - 20	89-90	9 - 12	1.87	30 - 40
Copier (Virgin)	Nil	93 - 94	3 - 5	2.0	25 - 35
Copier (Recycled Grade)	28 - 32	92 - 93	30 - 35	2.0	30 - 40

#### Selection Criteria of recovered paper:

- Long fibrous, wood free (chemical), high bright and low ash waste paper
- Free from kraft, newsprint (mechanical) and Internal sized colour material
- Minimum plastic content (< 2%), moisture (<10%), and out throw (< 3%)
- Less fine fibre and lifeless materials
- RCF pulp manufactured shall facilitate higher end printing and writing paper quality

#### Conclusion:

Despite having a cost impact and fluctuation in availability, recovered fibre is a sustainable pulp supplementation for high grade writing and printing paper. RCF mix and optimization process suggests, sorted office waste paper (SOP) and white record (WR) are the two recovered paper grades capable of producing quality secondary fibre with high brightness (82%) and low ash (<5%), suitable to manufacture quality paper without compromising optical and strength properties. The suitability of magazine and coated papers in the raw material mix is considered as the least option by its high ash content. Long fibrous, wood free, high bright and low ash content waste papers are considered as a major criterion factor while selecting the recovered paper. Recycling of recovered paper is an environmentally friendly practice for waste management and efficient use of natural resources.

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