Plant Studies on Krima Hot Dispersion System on Various Waste Paper Compositions For Newsprint and Creamwove Production

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ABSTRACT:- *Plant trials were carried out at Servalakshmi paper Mills, using Krima Hot Dispersion system. The various combinations of waste paper from OINP, SRD (Sorted records) Text-Book, Composite-Records, Magazine-Trimmings, Magazine-Insertions, Note-Books, Waste-Office Records, Printed Waste Envelops, and Number-One Cuttings were experimented to produce Newsprint and Creamwove. The trial lead to a few interesting findings well supporting the established fact of superior treatment by hot dispersion in obtaining good properties of paper produced and reducing the specky appearance inspite of low brightness.*

The hot dispersion process does not significantly alter the scattering coefficient. Both the absorption coefficient and the ERIC value are reduced as the ink particles are separated from the furnish due to hot dispersion, improving visual appearance of the paper sheet as the ink particles are finely dispersed.

Average M.D. breaking length values for all the newsprint produced was about 3800 ± 200 m. which is certainly very good, meeting the strength requirements by the latest of the newsprint printing machines.

Hot dispersion could save the fiber length/ strength contributing to tear factor. The tear factor for newsprints produced is 54 ± 4.

The opacity of the creamwove papers produced was in the range of 87 to 97%.

The strength values of creamwove papers produced from two combinations were very good, breaking lenght in M.D. in the vicinity of 3800 m. tear factor was 65 ± 2, obviously due to better furnish and the role of hot dispersing unit in retaining strength. The third combination (SRD+N.Book) gave average 45 tear factor. For a machine made paper

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from recycled fiber, the tear factor of 45 and more is a clear indication of the selective treatment of hot dispersion system in saving fibers from any damage during the treatment. The ash content of the samples were not high but the worth mentioning aspect is fairly high opacity with good tensile, which certainly indicates the possibility of high ash papers from the same compositions for better economics and printability.

INTRODUCTION

With the increasing use of waste paper recycled fiber, selection of a proper waste paper treatment system has become inevitable to produce acceptable qualities of normal papers. The significance of cleaning, washing and floatation has been stressed since long and is widely implemented in almost all the Indian paper mills using substantial proportion of waste paper recycled fiber in their furnish, but the end product thus produced are found to have specky appearance. With increasing awareness of quality vs price relationship and stress of using least natural resources for the general commodity item - paper, the proper selection of treatment systems have taken priority over raw material resources for the future planners and technocrats of the country. The requirement of the future will not be always high brightness or strength for newsprint and the normal writing printing grades of papers but the least amount of eye disturbing elements like ink particle agglomerates and contaminants.

Since Dr. Herbert Ortner of Voith published the first technical paper on dispersion of deinked pulps in 1977, dispersion has become almost an unavoidable part of waste paper treatment systems where deinking is the requirement of the product. It helps in improving the appearance of the paper produced from deinked pulp.

Despersion can be defined as thermomechanical treatment of fibrous stock to breakup and separate various contaminants so that they will not be optically disturbing, and will also not interfere with the papermaking operation, or degrade the quality of final paper product.

Dispersion is intended to reduce ink speck size, free ink from fibers, disperse stickies and other contaminants, and homogenise the stock.

The variety and quantity of contaminants contained in waste papers has increased since last two decades. The reason is wider use of paper in aesthetic packaging and newer technologies of printing, ink qualities, reproduction, and conversions with synthetic polymers. As a result the cleaning systems are not able to cope up with these wider variations and end product from waste paper pulp is not acceptable with normal cleaning systems only. Conventional deinking systems of floatation and washing are no more effective for xerography inks.

The working concept of a dispersion system can be seen in the figure-5. Waste paper stock is dewatered from 4-5% consistency to approximately 30% consistency in two stages. Back water is recirculated back into system for dilution. At 30% consistency, stock web is first shredded then heated to about 100 °C. The steam softens the contaminants for easy dispersion. The stock is then fed to the rotor housing of the disperser. The disc assembly consist of hardened tooth-type disc.

While outer disc is stationary, the inner disc rotates at high speed. As the stock passes from the centre of the disc, it is evenly distributed on the either side of the teeth and while its travel to periphery, the stock undergoes acceleration and deceleration forces. The internal stock friction creates a brushing & flexing action intended to reduce the size of the ink/contaminant particles. Dispersion of ink agglomerates is different than detachment of ink from fibers. Dispersed particles can be easily removed by subsequent floatation, washing or centrifugal cleaning. By dispersion, the ink and contaminants are homogenised into the pulp so that those not removed do not affect the quality of the final product.

Hot dispersion at 80-90 °C for non pressurised units and upto 120 °C for pressurised units is common. The typical advantages identified for Indian systems with hot dispersion are:

Table-1

PLANT CONDITIONS FOR NEWSPRINT MANUFACTURING

Sample No.	1	2	3	4	5	6
Furnish	OINP SRD T.Book	OINP CRD T.Book	OINP CRD	OINP CRD Mag.trim	OINP CRD SRD	OINP CRD, SRD T.Book
Quality	Newsprint	Newsprint	Newsprint	Newsprint	Newsprint	Newsprint
Krima Hot Disperser conditions						
Disc Gap	0.19-0.21	0.21-0.25	0.18-0.25	0.19.024	0.18-0.20	0.18-0.20
Feed PulpCy.%	3.9-4.2	3.9-4.2	3.6-4.6	4.5-4.9	4.6-4.8	4.0-4.6
Feed PulpAsh%	6.9-7.5	7.0-8.2	8.2-12.2	10.0-10.5	9.3-9.7	9.5-10.0
Feed Pulp°SR	40-43	40-45	35-43	38-40	36-46	35-38
DewaterCy.%	12-15	13.3-14.3	14-16	17-18.2	16-16.8	14.8-16.2
Screw Press Cy.%	24.5-27	23-26	24-26.4	26.7-27.3	26.7-27.4	27.2-28
Krima Back Water.Cy.%	0.24-0.30	0.24-0.32	0.25-0.28	0.38-0.40	0.36-0.40	0.34-0.35
Ash in Filtrate%	22-23	15-17.3	27-33	27.5-28.5	22.-24.5	28-30
Preheater temp.°C	100-110	100-110	102-119	111-118	110-115	110-115
Cy.after disperser	3.5-4.0	2.7.3.4	3.4-4.0	4.0-4.2	4.0-4.1	3.8-4.1
°SR after disperser	48-52	50-55	45-52	55-58	51-54	48-52
Temp.after disperser	52-56	47-52	45-52	58-60	55-60	54-58
Ash after disperser %	6.0-7.0	6.0-7.0	7.0-7.6	8.5-9.0	7.6-7.9	7.5-7.8
Paper Machine conditions						
H/B Cy. %	0.97-1.02	0.90-0.92	0.92-1.0	1.07-1.1	1.06-1.1	1.0-1.05
H/B °SR	68-73	70-71	64-70	68-72	68-70	67-69
Tray water Cy.%	0.27-0.3	0.26-0.3	0.3-0.33	0.39-0.42	0.34-0.35	0.33-0.34

Table-2

PLANT CONDITIONS FOR NEWSPRINT AND CREAM WOVE MANUFACTURING

Sample No.	7	8	9	10	1	2	3
Furnish	SRD	SRD T.Book	SRD Magtrim	SRD Magtrim M.Ins.	SRD N.Book	WRD PWE	WRD NOICU PWE
Quality	Newsprint	Newsprint	Newsprint	Newsprint	Creamwove	Creamwove	Creamwove
Krima Hot Disperser conditions							
Disc Gap	0.22-0.25	0.35-0.37	0.15-0.19	0.21-0.25	0.17-0.20	0.16-0.18	0.18-0.22
Feed Pulp Cy.%	3.4-4.8	4.9-5.2	4.8-5.2	4.6-5.2	4.3-5.0	4.5-4.7	4.34.7
Feed Pulp Ash%	9.0-9.2	9.0-10.0	12.2-16.0	12.8-13.0	8.7-9.2	6.0-6.5	7.8-8.0
Feed Pulp °SR	40-45	38-43	40-45	40-48	38-42	44-50	49-50
Dewater Cy. %	15.1-19.2	17.4-18.6	17-18	17.5-18.6	16-17.8	15.3-16.0	16.5-17
Screw Pess Cy. %	25.8-28.6	25-28.6	25-28	26.7-27.3	27-28.5	26.2-27.5	20.2-26.7
Krima Back Water Cy. %	0.34-0.38	0.32-0.40	0.46-0.51	0.32-0.35	0.39-0.43	0.24-0.28	0.26-0.20
Ash in Filtrate %	28.29.5	26.32.5	28-39	32-39	22-27	32-36	29.5-30
Preheater temp. °C	110-120	90-115	90-110	105-110	110-115	110-120	116-120
Cy. after Disperser %	3.8-4.2	3.9-4.6	4.3-5.0	4.7-5.0	4.5-5.8	4.4-4.6	4.0-4.3
°SR after Disperser	50-55	55-61	55-60	55-60	47-55	44-50	49-50
Temp. after Disperser °C	48-55	45-50	52-62	55-60	52-62	49-53	50-55
Ash after Disperser %	7.2-7.5	8.5-9.0	10-13	10.5-13.5	8.5-9.2	5.2-5.5	6.9-7.2
Paper Machine conditions							
H/B Cy. %	0.92-0.96	0.94-1.2	1.16-1.17	1.08-1.14	0.92-1.02	0.97-0.99	0.78-0.83
H/B °SR	64-68	72-75	72-74	72-75	67-72	55-60	62-65
Tray water Cy %	0.25-0.32	0.32-0.33	0.45-0.48	0.43-0.50	0.32-0.39	0.30-0.32	0.22-0.25

Table-3

PAPER PROPERTIES OF THE NEWSPRINT AND CREAM WOVE PAPERS PRODUCED

Sample No.	1	2	3	4	5	6
Furnish	OINP SRD T.Book	OINP CRD T.Book	OINP CRD	OINP CRD Mag.trim	OINP CRD SRD	OINP CRD, SRD T.Book
Quality	Newsprint	Newsprint	Newsprint	Newsprint	Newsprint	Newsprint
Grammage	48-51	48-51	47.5-51.5	47.5-50.5	48-50.6	48-51
Br. Length M.D.	4000-4200	3600-3900	3600-4050	3575-3700	3700-3720	3530-3670
C.D.	2100-2350	1950-2300	2150-2450	2090-2220	2150-2300	1960-2030
Tear factor M.D.	47.5-56	45-49	43.5-49.5	46.5-51	44.5-47.5	46-48
C.D.	53-62	53-62	52-57	54-59	52.5-55.5	52-55
Ash %	6-7	6.5-6.8	6.5-6.6	8-9	7-7.5	7-7.3
Porosity (Gurley)	20-31	22-24	25-32	28-36	24-31	18-24

Sample No.	7	8	9	10	1	2	3
Furnish	SRD	SRD T.Book	SRD Magtrim	SRD Magtrim M.Ins.	SRD N.Book	WRD PWE	WRD NOICU PWE
Quality	Newsprint	Newsprint	Newsprint	Newsprint	Creamwove	Creamwove	Creamwove
Grammage	47-50	49-52	46.8-50	47-50	51.5-52.5	46-50.5	50-51.2
B.L. M.D.	3750-4050	3500-4000	3500-3710	3550-3700	3720-4040	3580-3900	3870-3970
C.D.	2000-2250	2000-2480	1900-2150	2050-2470	2200-2400	2100-2350	2020-2110
Tear F. M.D.	44-49	42.5-46.5	42.5-45	42.5-46	44-46.5	60-70	63.5-72
C.D.	52-58	48-55	48-52	48-54	50.5-54	76-83	72.5-80
Ash %	6.8-7.2	6.7-9.3	9.6-11.8	10.2-11	9.2-9.8	5-6	6.5-6.6
Porosity (Gurley)	21-34	20-27	20-27	28-36	23-29	6-8	8-10

LEGENDS USED

OINP	-	Over Issued News Print
SRD	-	Sorted Records
T. Book	-	Text Books
CRD	-	Composte Records
Mag. Trim	-	Magazine Trimmings
M. Ins	-	Magazine Insertions
N. Book	-	Note Books
WRD	-	Waste Office Records
PWE	-	Printed Waste Envelops
NOI CU	-	Number One Cuttings

WASTE PAPER COMPOSITIONS ARE NUMBERED IN THE TABLES AT THE TOP OF EACH COMPOSITION FOR EASE OF MENTIONING IN DISCUSSION.

- **Flexibility, in input can be tolerated thus more suitable for Indian conditions.**
- **Higher temperature at dispersion gives swollen fibers thus lesser damage to fiber, specially good for short fiber furnish.**
- **High temperature destroyes and bacterial and fungal growth developed during storage of waste paper.**
- **Improves dispersion of hydrophilic ink due to swollen fibers.**

The benefits of treating secondary fiber stock with hot dispersion are:

Increased strength properties
Reduced refining energy
Improved optical homogeneity
Reduced stickies

The advantage of dispersion is good separation of ink particles from fibers. In common writing printing grades of paper produced from newsprint & waste paper furnish, this helps in eliminating ink mottling. For papers requiring low ash content like Tissues- the ledger, coated paper and computer waste can be used with hot dispersion which will help in removing ink and coating from fiber thereby reducing ash.

The disperse can be conveniently used as an efficient bleach mixer for high consistency and high temperature bleaching.

Plant trials were carried out at Servalakshmi paper Mills, using Krima Hot Dispersion system. The various combinations of waste paper available were experimented to produce newsprint and creamwove. The trial lead to a few interesting findings well supporting the established fact of superior treatment by hot dispersion in obtaining good properties of paper produced and reducing the specky appearance inspite of low brightness.

DISCUSSIONS ON RESULTS:

Newsprint (Optical Properties)

Ten different combinations of waste paper grades were used for the production of newsprint (Refer Tables). **The legends used for identifying the grade of waste paper are given separately, and the samples are numbered at the top of each table as referred in figures.** Eight of the ten combinations yielded brightness range of 40±2%

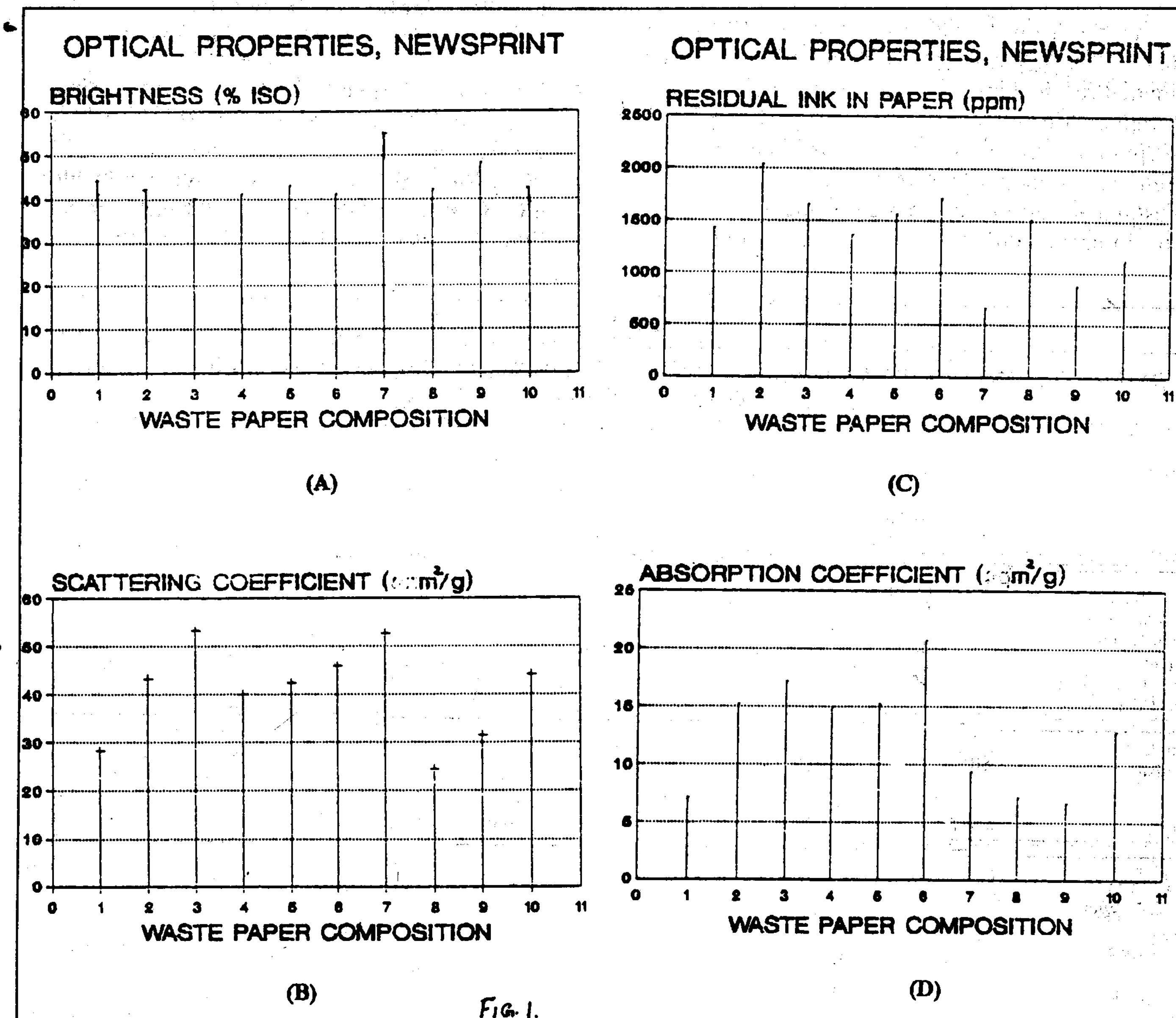

FIG. 1.

ISO. Higher brightness value of 50±2% ISO were obtained from 100%SRD (Sample 7) and 50% each of SRD+Mag.Trim.(Sample 9).

The estimated residual ink content (ERIC value) of final paper is obviously related to input waste paper furnish composition and various waste paper grades could be categorised in descending order for their relative ink content as OINP>CRD>T. Book>Mag.Trim/M.Ins.>SRD. Sorted records has minimum of ink content and subsequently the furnish compositions having higher quantities of SRD gave newsprint with minimum residual ink. [refer ink content of sample 7 produced from 100% SRD in Fig.1(C)].

As seen from the table-4, the absorption coefficient of the papers determined at 557 nm and the estimated residual ink content determined at 950 nm (IR range) are not directly related. The specific absorption coefficient of the sheet is likely to lessen by removal of ink particles from the furnish, whereas the estimated residual ink content value gets reduced with improvement in the fragmentation and dispersion of ink particles even though they are not removed from the furnish. However, the visual appeal for the sheet of the paper is well correlated with the ERIC value.

The results can be summarised with reasons as:

(1) The hot dispersion process does not significantly alter the scattering coefficient.

(2) Both the absorption coefficient and the ERIC value are reduced as the ink particles are separated from the furnish.

(3) The reduction in ERIC value is enhanced by the better dispersion of ink particles by hot dispersion process.

(4) The visual appearance of the paper sheet is related to the reduction in the ERIC value. Since the ink particles are finely dispersed, the human eye is generally not able to take note of the individual particles and the sheet appears free from specks.

Table-4

RESIDUAL INK CONTANT AND OPTICAL PROPERTIES OF THE NEWSPRINT AND CREAM WOVE PAPERS PRODUCED

Sample No.	1	2	3	4	5	6
Furnish	OINP SRD T.Book	OINP CRD T.Book	OINP CRD	OINP CRD Mag.trim	OINP CRD SRD	OINP CRD. SRD T.Book
Quality	Newsprint	Newsprint	Newsprint	Newsprint	Newsprint	Newsprint
Brightness	43.93	42.02	40.01	40.65	42.62	41.0
Residual Ink Quantity ppm	1416	2031	1652	1359	1551	1707
Opacity %	90.23	98.39	99.12	97.92	98.18	99.25
Scatt. Coeff m^2/g	28.3	43.27	53.3	40.07	42.27	46.04
Abs. Coeff. m^2/g	7.0	15.7	17.1	14.8	15.1	20.6

Sample No.	7	8	9	10	1	2	3
Furnish	SRD	SRD T.Book	SRD Magtrim	SRD Magtrim M.Ins.	SRD N.Book	WRD PWE	WRD NOICU PWE
Quality	Newsprint	Newsprint	Newsprint	Newsprint	Creamwove	Creamwove	Creamwove
Brightness	53.64	41.74	48.19	41.7	54.10	64.08	64.8
Residual Ink Quantity ppm	651.82	1500	856.54	1114	541.74	401.32	409.32
Opacity %	97.12	88.66	90.81	97.69	97.15	87.67	90.21
Scat. Coeff. m^2/g	52.6	24.52	31.73	44.33	48.48	38.16	44.03
Abs. Coeff m^2/g	9.26	7.07	6.5	12.7	10.22	3.41	3.7

Newsprint (Strength Properties)

The discussions are based on the breaking length in M.D. and tear factor in C.D., which are important for the printing applications of the newsprint. Referring to the Fig.2(A) and the values from table-3, it can be mentioned that the Average M.D. breaking length values for all the newsprint produced was in the range of 3800±200 m. The machine made newsprint with the strength of 3800 m can certainly be considered very good for the printers. The paper will obviously meet the strength requirements by the latest of the newsprint printing machines. The newsprint made from the similar waste paper inputs but without hot dispersion treatment will give much lesser tensile strength.

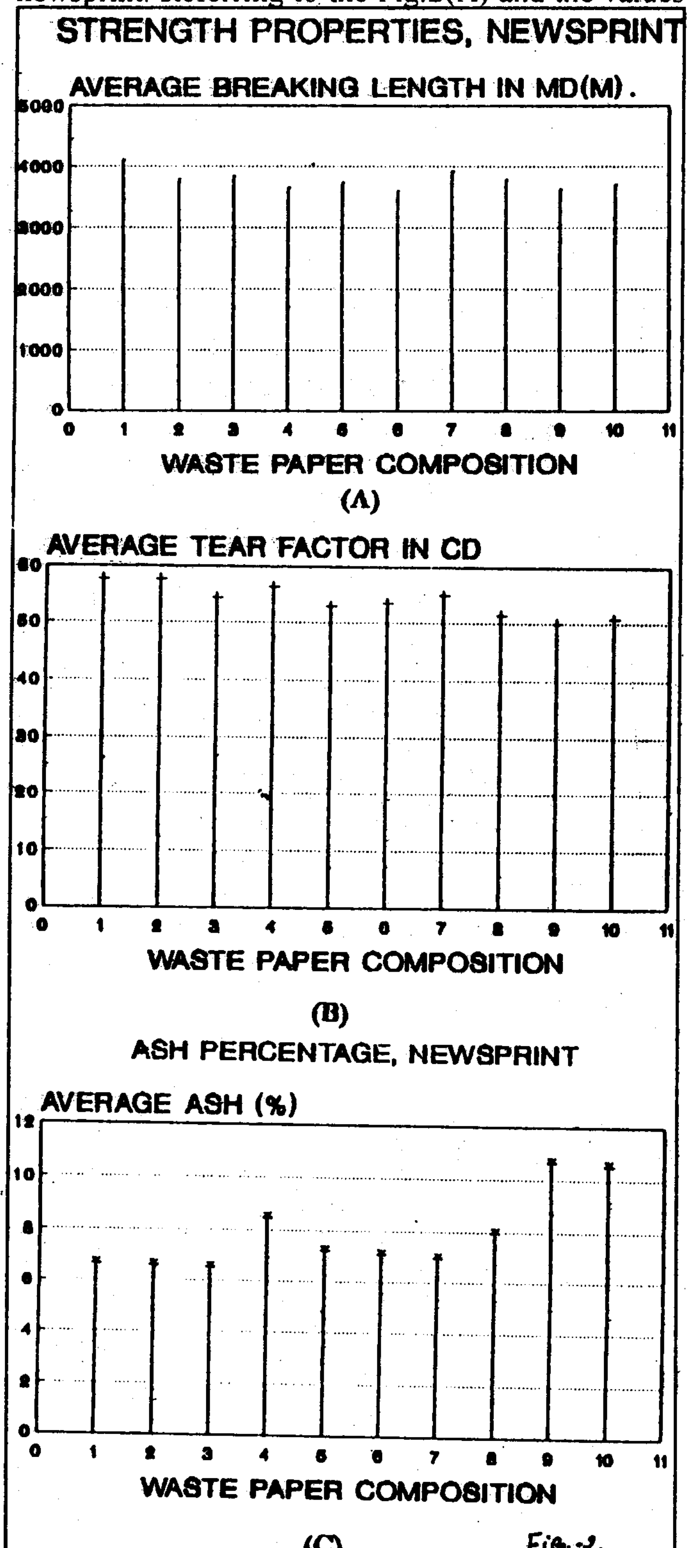

Fig.-2.

The average tear factor in C.D. for these samples is higher than could have been without hot dispersion system. Hot dispersion could save the fiber length/strength contributing to tear factor. The tear factor for newsprints produced is 54+4. [Fig.2(B)].

The ash content of the newsprint produced, [Fig.2(C)], is related to the composition of the input waste paper. However worth noting is the value of strength for newsprint with 7+% of ash, and confirms that there is margin to increase ash content of

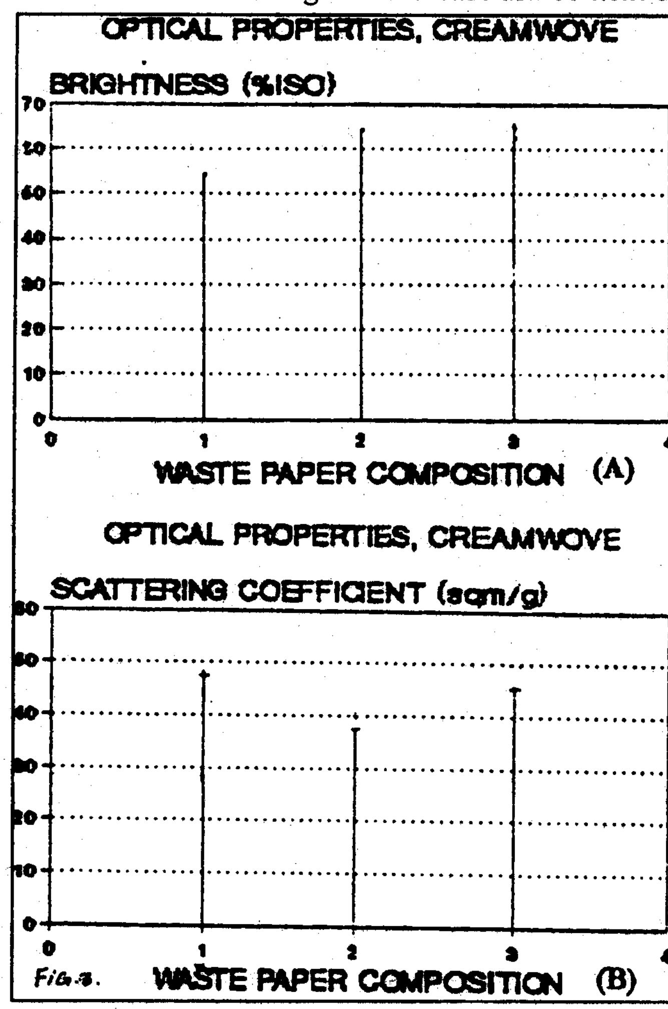

Fig.3.

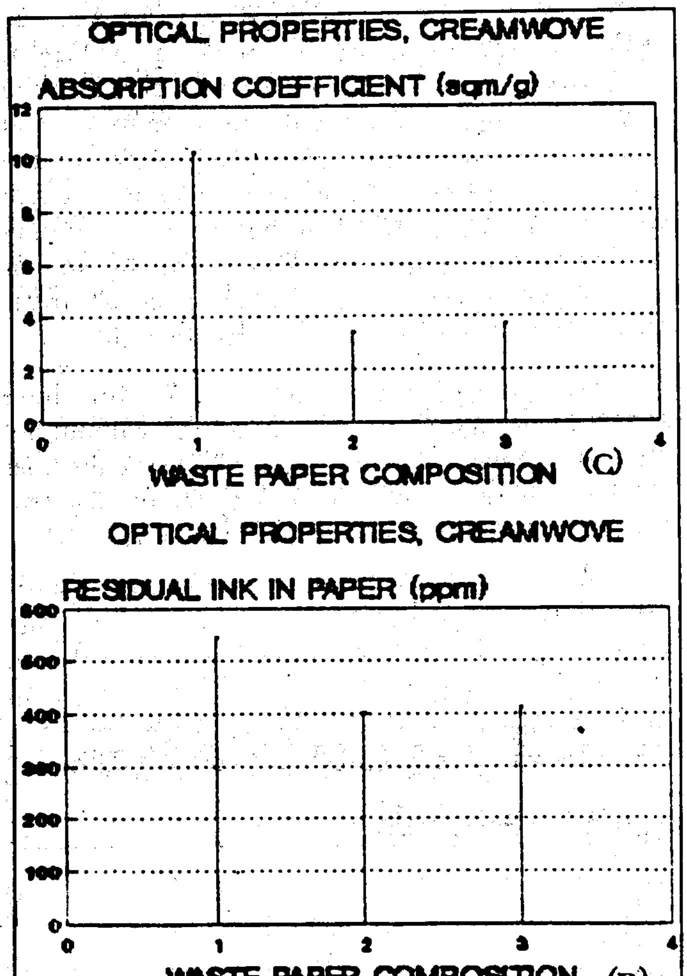

Fig. 3.

newsprint for better printability/smoothness and still maintain the strength requirements of printer for high speed printing.

Creamwove (Optical Properties)

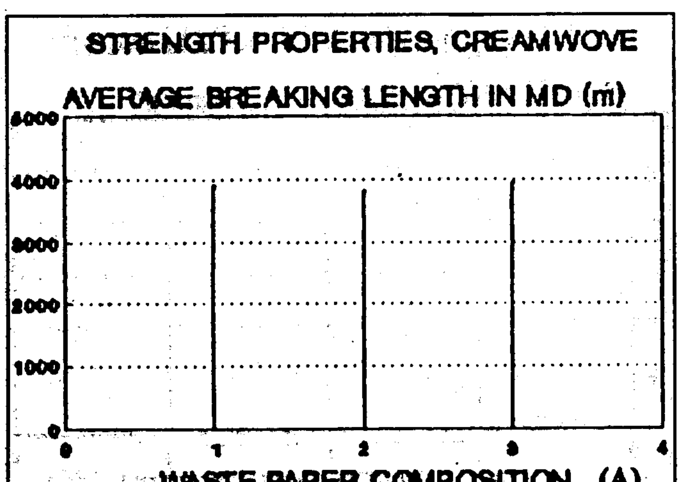

Fig-4

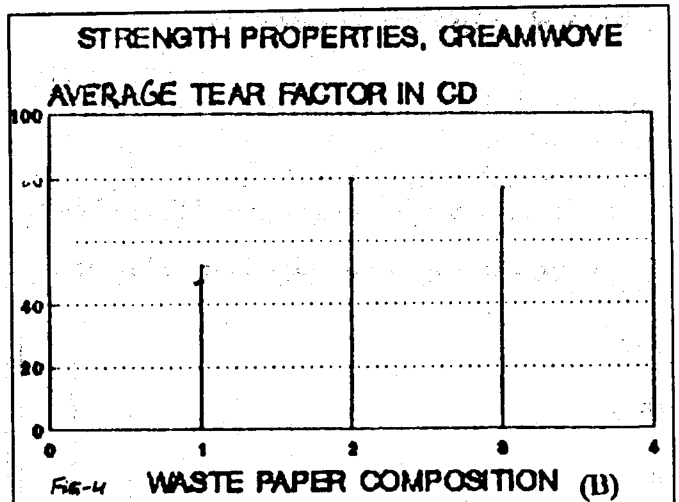

Fig-4

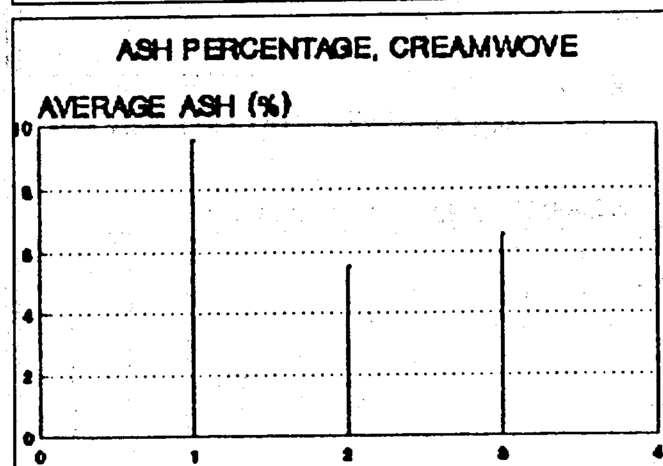

Fig-4.

Fig.3 (A,B,C,D) gives the optical properties of the three trial samples produced from the waste paper compositions. The choice of waste paper compositions was made to get paper of better brightness. The trial runs on creamwove gave a direct relationship between residual ink content and the brightness, and the absorption coefficient. The opacity of the papers produced was in the range of 87 to 97%, sufficiently good as compared to papers of the similar grammage produced from chemical pulps.

Creamwove (Strength Properties)

The strength values of creamwove papers produced were very good, obviously due to better furnish and the role of hot dispersing unit in retaining strength [Fig.4(A,B,C)]. The average breaking length in M.D. were in the vicinity of 3800 m, tear factor was 65±2 for two compositions having WRD +PWE and WRD+PWE+NOICU. The other sample from

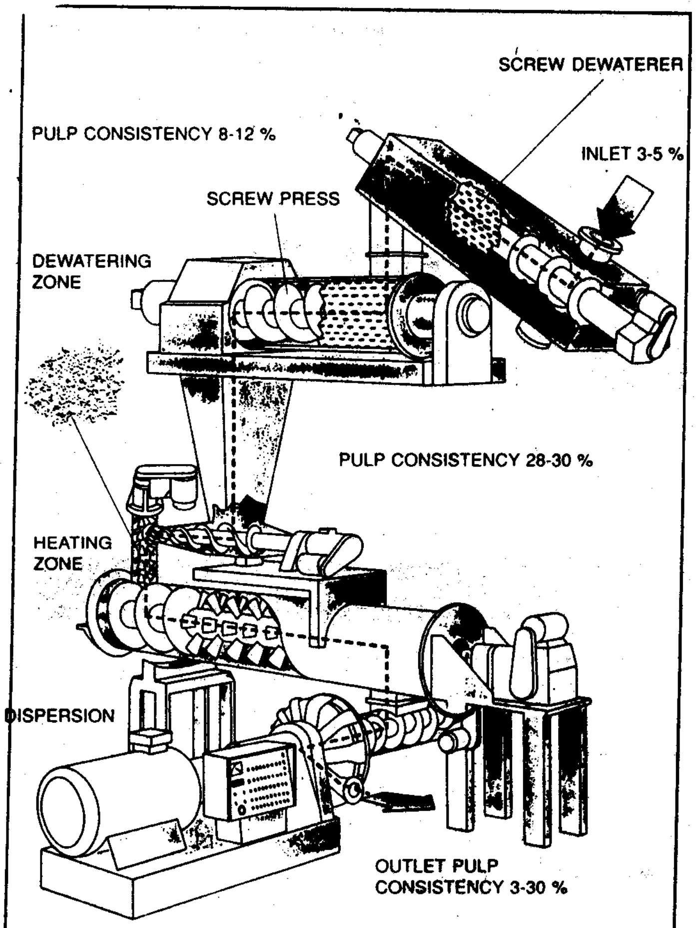

FIGURE-5

SRD+N. Book gave average 45 tear factor. For a machine made paper from recycled fiber, the tear factor of 45 and more is a clear indication of the selective treatment of hot dispersion system in saving fibers from any damage during the treatment. The ash content of the samples were not high but the worth mentioning aspect is fairly high opacity with good tensile, which certainly indicates the possibility of high ash papers from the same compositions for better economics and printability.

The analysis presented is brief but the role of hot dispersion in reducing specks and retaining strength in papers made from indigenous waste papers could be well established.