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IMPROVING THE PRINTING QUALITY OF INDIGENOUS NEWSPRINTS

Kapoor S.K., Sood Y.V.; Pande P.C., Pant R. and Panda A.
Central Pulp & Paper Research Institute,
Dehra Dun 248011 (India)

Abstract

Indigenously manufactured newsprints contain a substantial proportion of short fibred pulps from Salai, eucalypt and bagasse. Their strength properties, i.e. tensile index, tear index and inplane tearing strength were found to be reasonably good and comparable to the newsprints produced in developed countries like Canada, USSR and G.D.R., which are mainly using pine and spruce. Among the various optical properties – brightness, specific absorption coefficient and yellowness were found to be comparable in few papers whereas others need improvement to be at par with foreign newsprints. Specific scattering coefficient of all the indigenous newsprints was on lower side.

The printing quality which is equally important for a newsprint was not all that good for the indigenous newspapers. The main defect observed was high print-through almost two times of the value found for imported ones. The other printing parameters like print set off and speckle tendency were comparable to those of foreign origin. The high print-through tendency of the indigenous newsprints was found to be due to excessive loss of fines as confirmed by analysis of the pulp samples taken from different process sections of three Indian newsprint mills. Fines content determined in the couch press pulps which was becoming paper was almost half the amount present in the head box pulps. Refining trials conducted on different pulps using different beating equipment, i.e. a PFI mill and a 12 inch Sprout Waldron disc refiner showed that print-through tendency is not dependent on the amount of fines only but it also depends upon the type of fines and extent of fibrillation which fibres undergo during refining. The refiner which produced more fibrillation gave pulp of low print-through tendency although the fines production was relatively lesser. Microphotographs of slushed plps of different newsprints showed that pulp fibres of foreign papers were having more fibrillation than those of indigenous newsprints. The print-through tendency of indigenous newsprints can be improved if the refining of pulp is carried out in such a way that more fibrillation occurs in the fibres which will improve fibre bonding and at the same time increase retention of fines in the paper.

Introduction

Newsprint mills in India which are only four at present make use of different types of raw materials like salai, bamboo, eucalypt, bagasse and imported CTMP etc. These raw materials are inferior to spruce and pine being used in Europe, Scandinavia, U.S.A. and Canada. The inferior quality of raw materials affects adversely not only the cost of production but the quality of paper as well.

In the earlier studies (1, 2) carried out on the evaluation of printing characteristics of few indigenous and foreign newsprints, it was observed that in spite of variation in the manufacturing process all indigenous newsprints had one common defect, i.e. the presence of excessive pinholes. These pinholes increase the ink demand and affect the print legibility due to the excessive ink penetration into the sheet resulting in print visibility on the unprinted side. In the preliminary studies (3) the probable cause of pinholes in the indigenous newsprints had been identified as the loss of excessive fines during papermaking. To verify this finding in the present studies detailed investigations were carried out on the pulp and paper samples collected from different process sections of the Indian newsprint mills and the factors responsible for high print-through tendency in indigenous newsprints have been indentified and possible remedies to improve their printing quality suggested.

RESULTS & DISCUSSION

Quality Comparison of Indigenous & Foreigin Newsprints :

Strength Characteristics : Tensile index, tear index and in-plane tearing strength of indigenous newsprint manufactured by different Indian mills were found to be comparable to the foreign papers tested. This indicated that indigenous newsprints will not pose runnability problem on the printing press. Sheet formation grading of newsprints of three mills were found to be better than foreign samples, however, it was poorer for one mill. Except in the case of one mill, the papers from remaining mills were having low shive content comparable to the foreign papers (Table-1).

TABLE - I

STRENGTH CHARACTERISTICS OF INDIGENOUS AND FOREIGN NEWSPRINT SAMPLES

Property		Indigenous			Foreign		
	Mill-1	Mill-2	Mill-3	Mill-4	Canadian	Russian	G.D.R.
Grammage (g/m^2)	51.9	53.7	54.7	51.1	49.8	50.1	49.1
Moisture Content(%)	8.8	8.8	9.2	8.3	9.7	9.6	8.8
Thickness (micron)	98	84	90	78	76	79	71
Apparent density (g/cm^3)	0.53	0.64	0.61	0.66	0.66	0.63	0.69
Tensile index (N. m/g) CD	14.0	17.0	13.5	13.5	15.5	12.5	11.5
MD	29.0	45.5	32.5	39.0	35.0	31.0	32.0
Stretch (%) CD	2.1	1.8	1.7	1.8	2.1	1.6	1.6
MD	1.0	1.2	1.2	1.0	1.3	0.9	0.9
Tear index ($mN.m^2/g$) CD	4.90	4.05	4.75	4.05	4.25	3.90	4.00
MD	3.90	3.30	3.40	3.50	3.65	3.30	3.00
In plane tear (N)	1.7	1.5	2.0	1.6	2.1	1.5	1.7
	1.5	1.2	1.2	1.2	1.3	1.2	1.2
Ash content (%)	3.4	2.7	1.3	4.6	0.4	0.6	5.7
*Formation grading	7	1	3	2	4	6	5
*Shive content grading	7	1	3	6	2	4	5

*Grade No. 1 indicates best formation and least shive content, increasing nos. (2,3,4,5,6,7) indicate comparatively poor formation and more shive content.

Optical Properties : Brightness values for indigenous newsprints of two mills were slightly lower than foreign newsprints, whereas the remaining two samples had much low values. Sp. scattering co-efficient of all indigenous papers was lower than foreign samples (Table-II). This low value is due to different inherent nature of fibres and the process employed in pulp manufacture. This can also be attributed to the presence of relatively lower amount of fines and fibre debris in these papers as indicated by Bauer Mc Nett Classification tests (Table-III). Sp. absorption co-efficient were comparable to foreign papers, however, for one paper it was quite high. This high value is probably due to its low brightness. Yellowness of two indigenous papers was comparable to foreign newsprints studied whereas the remaining two papers had quite high values. Dominant wavelength observed in indigenous papers was in the range 574 nm to 578 nm whereas for foreign papers it varied from 576 nm to 586 nm. Excitation purity which indicaters the hue of colour indicated by dominant wavelength were found to be different for different samples.

TABLE - II

OPTICAL CHARACTERISTICS OF INDIGENOUS AND FOREIGN NEWSPRINT SAMPLES

Property	Indigenous Mill-1	Mill-2	Mill-3	Mill-4	Foreign Canadian	Russian	G.D.R.
Brightness (%) ISO	29.4	47.9	56.2	56.7	60.1	57.1	59.6
Opacity (%)	98.1	93.0	95.2	90.0	93.1	92.4	93.1
Sp.scat. co.eff.(m^2/kg)	37.2	40.6	42.8	40.7	48.0	48.1	48.0
sp. abs. co.eff. (m^2/kg)	14.6	6.5	6.3	3.7	4.8	4.2	4.8
Yellowness (%)	47.4	31.4	16.6	23.3	14.3	21.4	16.9
Luminance (%)	43.3	62.1	61.3	67.5	66.3	67.9	67.7
Dominant wave length (nm)	578	574	576	573	580	576	586
Excitation purity (%)	23.8	11.0	6.2	11.0	8.0	6.2	10.2

TABLE - III

BAUER Mc-NETT CLASSIFICATION OF DIFFERENT NEWSPRINT SAMPLES

	Fibre fraction, percent				
Newsprint	+30	+50	+100	+200	-200(fines)
Indigenous:					
Mill-1	33.9	19.7	16.0	7.8	22.6
Mill-2	26.9	19.0	16.9	10.4	26.8
Mill-3	26.3	19.9	17.1	11.1	25.6
Mill-4	33.4	20.2	12.2	9.9	24.3
Foreign:					
Canadian	34.4	9.2	11.5	9.7	35.2
Russian	33.8	10.6	13.6	7.7	34.3
G.D.R.	32.4	11.7	14.0	9.5	32.4

+ Indicates retained on the sieve

- Indicates passed through the sieve

Printing Characteristics : All indigenous newsprints had higher amount of pinholes as indicated by their very high pinhole intensity that foreign papers. The presence of excessive pinhole present in these papers caused high print-through. Out of the four indigenous newsprints, three showed print-through almost double that that observed in Canadian and Russian papers. The print set off tendency observed in three indigenous newsprints was found to be comparable to foreign samples whereas for one it was on higher side indicating slower rate of ink drying. Speckle tendency for indigenous newsprints was found to be little higher which is probably due to their slightly higher roughness. Ink requirement for two indigenous papers was marginally higher whereas for the remaining two, it was quite high which could also be due to their low brightness (Table-IV). All these printing tests indicated that only major defect in the indigenous newsprints of different mills is the presence of excessive pinholes resulting in high print-through tendency.

TABLE - IV

PRINTING CHARACTERISTICS OF INDIGENOUS AND FOREIGN NEWSPRINT SAMPLES

property		Indigenous Mill-1	Mill-2	Mill-3	Mill-4	Foreign Canadian	Russian	G.D.R.
Print through (Macbeth density)	Top	0.29	0.48	0.36	0.40	0.16	0.22	0.28
	Wire	0.34	0.58	0.48	0.53	0.24	0.28	0.40
	Avg.	0.32	0.53	0.42	0.47	0.20	0.25	0.34
Pinholes intensity (% Elrepho)	Top	4.5	6.9	2.4	2.0	0.5	0.8	1.4
	Wire	4.0	4.9	1.7	1.6	0.3	0.5	1.2
	Avg.	4.3	5.9	2.1	1.8	0.4	0.7	1.3
Print set off after (s)								
	0.1	0.19	0.16	0.27	0.31	0.19	0.16	0.16
	1.0	0.10	0.10	0.20	0.28	0.16	0.15	0.13
	5.0	0.07	0.06	0.13	0.24	1.11	0.14	0.11
	15.0	0.04	0.04	0.05	0.22	0.08	0.08	0.05
	60.0	0.02	0.03	0.03	0.12	0.03	0.04	0.03
Speckle at print density 0.90(IGT Std. Scale)		5-6	5-6	5-6	5-6	3-4	4-5	5 6
Roughness (micron)Parker Print surf, H-20	Top	5.40	5.00	4.40	4.50	3.05	3.80	4.05
	Wire	5.80	5.20	4.60	5.10	3.35	4.10	5.00
Porosity (ml/min) Bendtsen		2380	1450	1425	300	400	380	285
Ink reqirement to get print density of 0.90 (micron)		8.8	7.2	5.6	5.1	4.8	4.8	4.8

Investigation of pulp samples collected from different process sections of the Indian newsprint mills :

To ascertain the cause of pinholes formation in indigenous papers, pulps collected from stuffbox, head box and couch press sections of three mills were analysed for fibre classification, ash content ant tested for printing characteristics. Print through tests carried out on the handsheets prepared from these pulps indicated that head box pulp had low print through tendency than couch press. In case of Mill-1 and Mill-3 there was high loss of filler from head box to couch press as indicated by reduction in ash content values from 9.4% to 3.4% for Mill-1 and 11.2% to 4.2% for Mill-3 respectively. Mill-2 was not using any filler, therefore, ash content values were quite low (Table-V). Bauer Mc Nett Classification (Table-VI) indicated that couch press pulp samples for these mills were having almost half fines content (fraction passing 200 mesh) than those present in head box pulps.This indicated that high print-through tendency of couch press pulp samples which is finally becoming paper was due to excessive loss of fines. Also the classification experiments carried out on the pulps prepared by dispersing the newsprints showed that all indigenous papers had low amount of fines.

TABLE - V

PRINT THROUGH TENDENCY OF PULP SAMPLES COLLECTED FROM DIFFERENT INDIAN NEWSPRINT MILLS

Mill	Pulp from	Freeness (CSF)	Drainage time(s)	Print through (Macebth density)	Ash content (%)
1.	Stuff Box	210	6.0	0.27	2.1
	Head Box	125	24.3	0.13	9.4
	Couch Press	280	5.4	0.26	3.4
2.	Stuff Box	255	6.1	0.20	1.2
	Head Box	100	40.5	0.18	1.3
	Couch Press	260	6.0	0.27	0.8
3.	Head Box	100	22.4	0.20	11.2
	Couch Press	360	4.3	0.38	4.2

TABLE - VI

BAUER Mc-NETT CLASSIFICATION OF PULP SAMPLES OF DIFFERENT NEWSPRINT MILLS

Mill	Pulp	Fibre Fraction Percent				
		+30	+50	+100	+200	-200 (fines)
1.	Stuff Box	21.2	21.4	16.8	9.0	31.6
	Head Box	13.6	15.9	14.3	8.2	48.0
	Couch Press	25.0	22.5	17.3	9.5	25.7
2.	Stuff Box	36.9	17.9	18.3	9.6	17.3
	Head Box	26.2	14.3	14.9	9.8	34.8
	Couch Press	32.2	21.2	20.8	10.2	15.5
3.	Head Box	8.5	14.5	16.8	10.0	50.2
	Couch Press	15.6	27.8	15.8	14.8	26.0

TABLE - VII

BAUER Mc-NETT CLASSIFICATION OF PULPS REFINED IN PFI MILL & SPROUT WALDRON REFINER

Pulp	Refined	Freeness CSF	Fibre Fraction Percent				
			+30	+50	+100	+200	-200 (fines)
Bamboo	PFI Mill	300	37.6	11.6	11.4	5.1	34.3
Chemical Pulp	Sprout Waldron	310	48.6	7.4	12.0	3.0	29.0
CTMP pulp	PFI Mill	150	29.6	15.1	12.2	3.6	39.5
Imported	Sprout Waldron	160	33.8	12.7	12.22	8.8	32.5
CMP	PFI Mill	150	12.8	17.7	14.8	6.6	48.1
Eucalypt	Sprout Waldron	140	20.8	16.5	11.0	7.0	44.7

Steps to improve the print through defect of indigenous newsprints :

As indicated above, the retention of fines in the web improves the print through tendency of the paper, therefore, one way to improve the print through tendency would be to improve fines retention. The nature of fines also may have different effect. In order to assess the effect of different types of fines produced in different refiners on the print through tendency, refining experiments were conducted using a PFI mill and a 12 inch Sprout Waldron disc refiner. Chemical bamboo pulp, CMP eucalypt pulp and imported CTMP pulps collected from newsprint mills were refined in these two refiners to the samee freeness level. The fines (passing 200 mesh) were separated from refined pulps. Handsheets of pulps, devoid of fines and containing fines in different proportions were prepared. Print through tests on these handsheets using IGT Printability Tester indicated that fines produced in Sprout Waldron refiner were more effective in reducing print through tendency than those produced in PFI mill (Fig-1). The order of print through observed in these pulps was as under :

Chemical bamboo pulp -- Maximum
CMP Eucalypt --- Intermediate
CTMP -- Minimum

EFFECT OF DIFFERENT TYPES OF FINES PRODUCED IN DIFFERENT REFINERS ON PRINT THROUGH TENDENCY.

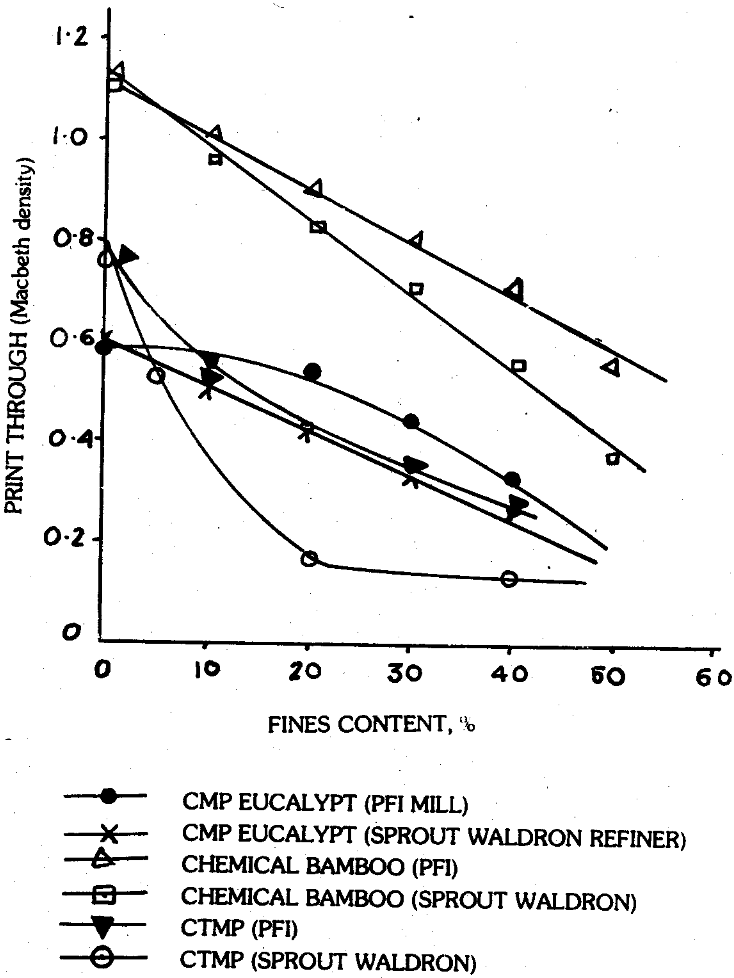
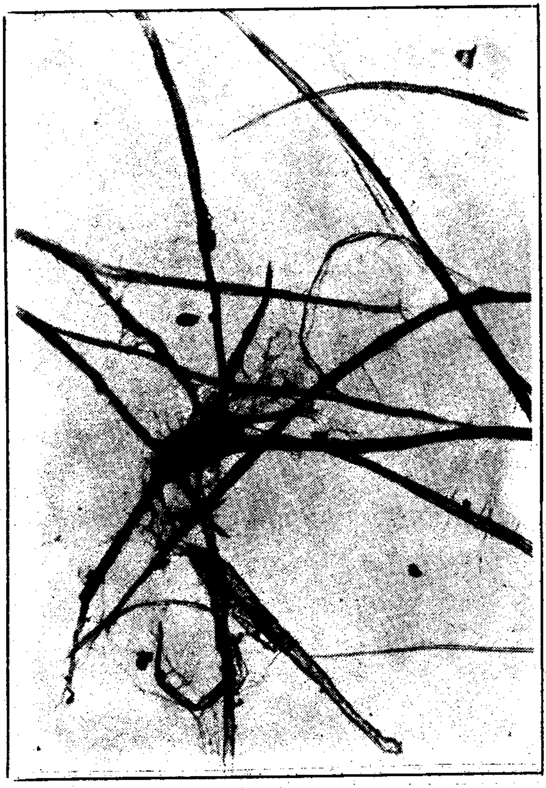


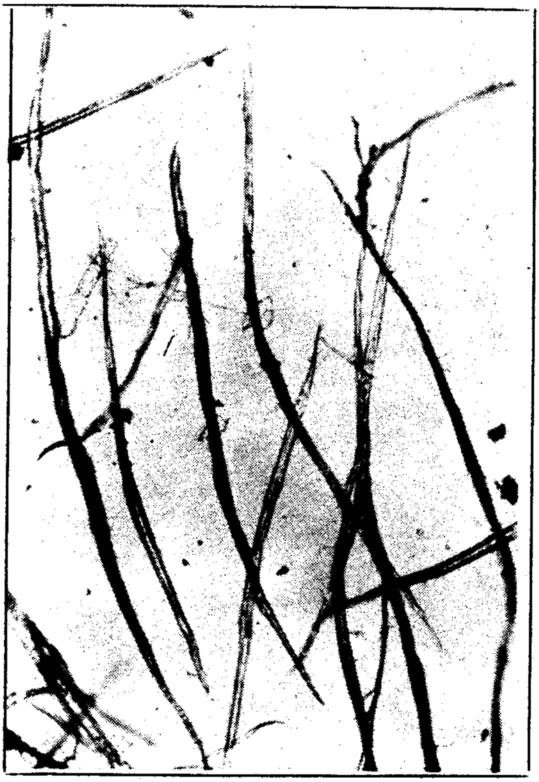
FIGURE NO. 1

Although Sprout Waldron refined pulps had lesser amount of fines than PFI mill procesed pulps as indicated by Bauer Mc Nett Classification (Table-VII), yet these showed low print through tendency. This indicated that print through tendency of pulps is not only dependent on the amount of fines but also on the refining treatment which fibres had undergone. Microphotographs of fines and fibres indicated that Sprout Waldron refined pulps were more fibrillated that PFI mill treated pulps (Fig-2a & 2b). The fines produced by Sprout Waldron refiner consisted of debris and fibre fragments (Fig-2c) whereas those by PFI mill had mainly debris (Fig-2d).

Micrographs (x40) (a) Sprout Waldron beaten CMP eucalypt fibres



a



b

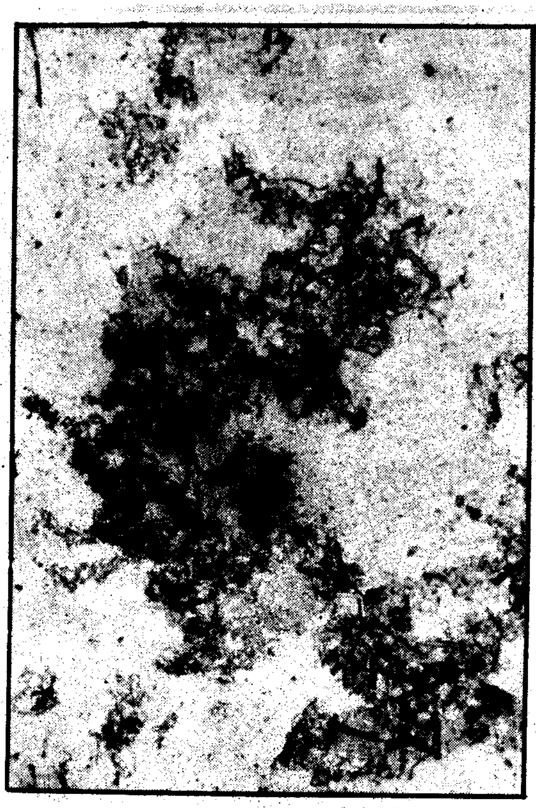
FIG-2

(b) PFI Mill beaten CMP eucalypt fibres

Micrographs (x40) (c) Sprout Waldron beaten CMP *eucalypt* fines

c

(d) PFI Mill beaten CMP eucalypt fines



d

FIG-2

This is an agreement with the studies carried out by Kibble White on the beating effect of a PFI mill and a 12 inch Sprout Waldron disc refiner in which he had shown that the Sprout Waldron refiner removed more intact outer layer of the fibres than the PFI mill which generally produced more fines(4). More fibrillation in fibres caused more retention of fines which in turn resulted in reduction in print through tendency. Microphotographs of the pulps prepared from different newsprints indicated that the foreign newsprint pulps (Fig–3a) are more fibrillated than indigenous papers (Fig–3b). More fibrillation in foreign papers must have resulted in more retention of fines thus giving newsprints of low print through tendency.

Micrographs (x40) of slushed pulps from - (a) Canadian Newsprint and

a

FIG. 3

(b) Indigenous newsprint mill— 1.

b

FIG-3

The above findings suggest that to improve the print through tendency of the indigenous newsprints the retention of fines should be improved. To retain more fines in these papers, which in turn will result in reduction of pinholes and print through, the fibres to be used for their manufacture should be refined in such a way that more fibrillation occurs. Effective fibrillation in fibres will enable them to retain more fines produced during refining which will substantially improve the printing quality of the paper produced.

EXPERIMENTAL

Newsprints of four Indian newsprint mills and from Canada, U.S.S.R. and G.D.R. were evaluated. Before testing all the samples were contitioned at 27 + 1°C and 65 + 5% relative humidity. All printing tests were carried out using IGT Printability Tester according to the standard procedures (5,6,7).

Print density & Ink Requirement :

Paper strips of 35 mm width and 250 mm length in the machine direction wer taken. Prints were made on the wire side of paper using different ink layer thicknesses of IGT striking-in ink on the printing forme. The printing conditions used were :-

Speed - Constant, 350 cm/s
Printing pressure - 196 N
Printing disc - 2 cm wide (aluminium)
Blanket - IGT Paper blanket.

The prints were allowed to dry overnight and the optical density of printed area in reference to optical density of the blank paper was measured using Macbeth densitometer RD 514. Graphs between print density and ink layer for various papers were plotted and ink layer thickness required to get print density of 0.90 was determined for individual paper sample.

Print through and Pinholes Intensity :

The strips were printed using 16 micron thick layer of IGT striking in-ink. The printing conditions used were--

Type of ink - IGT striking-in-ink :
Amount of ink - 2 cm^3 on the inking rollers
Blanket - IGT Paper Blanket
Speed - Constant, 20 cm/s
Pressure- 686 N
Disc - 2 cm wide (aluminium).

For print through values, the density of the print visible on the reverse unprinted side was measured after alloing the printed sheets to dry overnight. For pinholes intensity determination during printing, another strip of smooth blank paper was kept beenath the printing strip to get the ink impression caused by its seepage through pinholes present in the paper. The brightness values of the pinholes impression and blank paper were measured. The difference between the two values was reported as a number directly proportional to the amount of the pinholes present in the test specimen,

Speckle :

The prints were made on the wire side of the paper using the amount of ink sufficient to get print density equivalent to 0.90. The extent of unprinted area in solid print was compared with IGT speckle scale for newsprint printing. This scale has been numbered from 1 to 7 and te higher values indicate more unprinted spots in solid print thus poor print quality. The printing conditions used were same as those for print density tests.

Set-off :

The prints were made on the top side of the paper strip using the ink quantity required to get print density of 0.90. The printed strip was run through the second nip after time interval of 0.1 s, 1 s, 5 s, 15 s, and 60 s, so that a part of ink gets transferred to a clean strip. The set off print density on the latter strip was measured using Macbeth denistometer. The printing conditions used for set-off tests were :

Speed - Constant, 70 cm/s
Pressure - 686 N
Disc - 2 cm wide (aluminium)
Blanket - IGT Paper Blanket.

Other Tests :

Grammage - ISO 536
Moisture content - ISO 287
Thickeness - ISO R 534
Tensile strength - ISO 1924
Tearing strength - ISO 1974
In-plane tear strength - Tested using MBR in-plane tear tester
Ash content - ISO 2144
Brightness - ISO 2470
Opacity - ISO 2471
Sp. scatt. co-eff. - SCAN C:27:69
Sp.abs.co-eff - Measured using Elrepho data colour 2000
Yellowness - -do-
Luminance - -do-
Dominant wavelength - -do-
Excitation purity — -d0-

Roughness - Measured using Parker Print surf roughness tester under letter press printing conditions.
Porosity - Measure using Bendtsen porosity tester.

Estimation of Fines Content in Paper :

10 g of paper sample was taken and torn into small pieces. These were soaked in water overnight alongwith small amount of alum. The soaked paper samples were disintegrated using standard British Pulp Disintegrator till the dispersion was complete. Normally 40000 revolutions were found sufficient for the complete disntegration. The fines content (passing 200 mesh sieve) ere estimated using Bauer Mc-Nett Classifier as per standard Tappi method 233-OS-75.

Conclusions

1. Strength characteristics - tensile index, tear and in-plane tearing strength of indigenous newsprints manufactured by different mills are comparable to foreign papers. Sheet formation grading for most of the indigenous papers is better than foreing newsprints.
2. Optical properties - brightness, sp. absorption co-efficient and yellowness of some indigenous newsprints are comparable to foreign papers, whereas other need improvement. Sp. scatt. co-eff. of all indignous papers is lower than foreign newsprints.
3. All the indigenous newspapers show high print through tendency than foreign smaples which is due to the loss of excessive fines during papermaking. This has been confirmed by studying the pulp samples collected from different process sections of three Indian newsprint mills. The other printing properties - print set off and speckle tendency for most of the indigenous papers are comparable to foreign newsprints.
4. Microphotographs of the pulp prepared from different newsprints indicated that fibrillation in fibres in case of indigenous papers is lower than foreign newsprints.
5. To improve the print-through tendency of indigenous newsprints, the refining of pulps should be carried out in such a way that more fibrillation in fibres occurs. More fibrillation will in turn result in the retention of more fines during papermaking.

Acknowledgement

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