Deinking Studies of OMG with Flotation Cell

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ABSTRACT

The use of recycled paper is increasing worldwide. The slushing and flotation cell operations are greatly affected by the operating conditions, chemicals used and type of raw material. In this study old uncoated magazines (OMG) have been used with different operating conditions and concentrations of NaOH, Na_2SiO_3 H_2O_2 and active chemical as surfactant. The effects on yield, deinkability factor, brightness and opacity are estimated for the changes in operating conditions and dosages of additives, to a reasonable extent. It is found that at 65°C, 6 % consistency and proper chemical compositions, good quality acceptable pulp can be obtained.

INTRODUCTION

The demand of paper has been continuously increasing at a pace much faster than the availability of fibres from the natural sources. Recycling of waste paper, after its intendment use, has been found to be more economical and eco -friendly. Without recycling, the fibre supply from the world's natural sources shall not be sufficient to keep up with the demand. Recycling efficiency can be increased further by choosing recovered paper by grade and reusing high value papers. The reuse of the paper fibres is essentially dependent on their deinking and cleaning. Deinking is a sophisticated process for the benefit of recycling the paper and for the proper future growth of the paper industry. Using new techniques for processing, post - consumer or pre - consumer recovered paper, can produce high quality papers. Deinking operations utilize chemical, mechanical and thermal energies produce a fibrous suspension from printed wastepaper, which is sufficiently clean and bright for use in various high quality grades of paper. For manufacturing writing and printing grades, efficient deinking of the waste paper is an essential operation of the paper making process. Flotation deinking operation is found to be the most efficient process now a days. The most important factor, which will decide the growth rate of paper industry in the coming years, is the availability of suitable raw materials economically on sustained basis.

Magazines grades

It is a generic term, which refers to coated and uncoated paper that is bound with staples or glue. Magazine is a highly variable raw material (1). The fibre components of the magazine can range from 100% Kraft to 100% ground-wood pulp. An individual magazine may have several grades of paper included in its production, thus resulting in a highly variable furnish component. A single magazine may include coated free sheet, coated groundwood, uncoated mechanical fibre, and card inserts made of hardwood groundwood. Fillers such as clay, alum and precipitated calcium carbonate (pcc) are added in the paper making process, to improve the sheet characteristics. In magazine stock, the inorganic portion of the furnish can range from 10 wt.% in the uncoated sheet to as high as 40 wt.% in a sheet that is coated on both sides. The addition of dye is also common in the production of magazine grade papers. Since some of these are sensitive to pH and colour, stripping of recycled fibre can be expensive, thus dye addition can interfere with the recycling process. Contaminants associated with magazine grades are introduced in the converting process. Adhesives associated with the bindings, thermal plastics and hot melts can all contribute to stickies. Ink, which is used on printed paper, can also present a removal challenge in the deinking stages. Ink can range from 1 to 7 % in magazine grades of waste paper, with again different types of inks used.

Ink removal methods

There are four basic methods for removal of ink particles and other contaminants from recycled fibres:

(a) Washing (b) Flotation (c) Cleaning (d) Screening

Washing efficiency is best at a range of 1-10 microns. Flotation efficiency is high through the next range of 10 -150 Microns. Cleaning equipment works best at 100 -1,000 microns and screening at 1,000 microns and above (2). In the present studies, only flotation deinking has been considered.

Experimental methodology

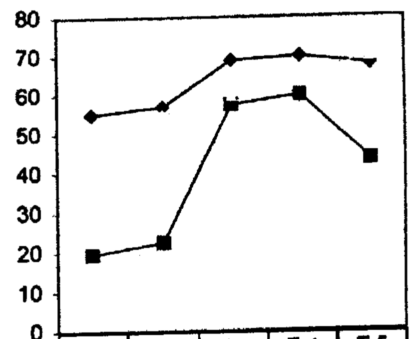
Old uncoated magazine (OMG) maplitho paper is used for this study. The paper is slushed in a hydropulper and subsequently flotation is carried out in a flotation cell, to remove the separated ink in the form of foam. The principle and equipments have been discussed in our earlier paper (3). The slushing of OMG is carried out in the laboratory 35 litre capacity Hydropulper, having provision for controlling rpm and temperature, at varying conditions. The pH value for all these experiments after pulping are in the ranges of 9.0 to 10.5 into the pulper and 8.0 to 9.5 into the flotation cell.

RESULTS AND DISCUSSION

The moisture content and ash content of the AD paper are shown in the Table - 1. Table 2 lists five sets of experiments (E - 1 to E - 5) showing the effect of change in temperature. The results of run No. E - 4 are the best from the view of deinkability factor. Next set of experiments E-4, E-6, & E-7 show the effect of change in consistency of pulp at constant temperature of 65°C. The results of run No. E - 6 are now better in term of deinkability factor. In the next set of experiments No. E-8, E-9, E-6, E-10, E-11show the effect of change in

Table 1

	ISO Brightness R_{457} %
Cuttings of unprinted portion of the waste paper taken for the study were pulped with same chemical composition used for deinking of printed paper, and after flotation the results are as shown.	75
Moisture content : in AD OMG = 8% Ash content : in OMG on OD basis = 15 %	



	E-1	E-2	E-3	E-4	E-5
—◆— ISO BRIGHTNESS%	54.98	56.95	69.08	70.11	67.76
—■— DEINKABILITY%	19.46	22.33	57.59	59.88	43.74
TEMPERATURE	50	55	60	65	70

Fig. 1 Temperature Vs. ISO Brightness and Deinkability

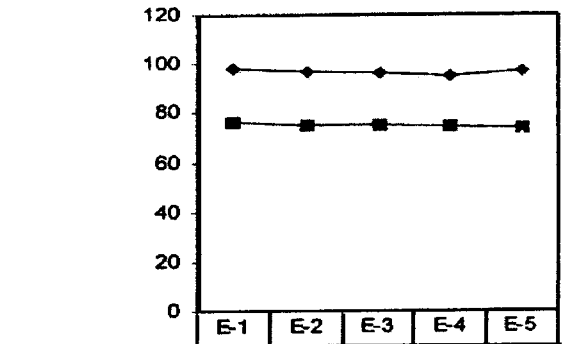
dosages of active chemical. The results show that the deinkability factor is hightest for run No.E - 9.

The efficiency of the process has been evaluated by means of brightness measurements, following 10 as TAPPI Standard T 452.(5) using an Elrepho 2000 from Datacolor International, Lawrenceville, N.J, USA. To quantify this efficiency, the brightness of the handsheets must be compared with a reference. The brightness of the unprinted paper subjected to the same disintegration

Table 1. Conditions & Pulp Properties after pulping and after flotation

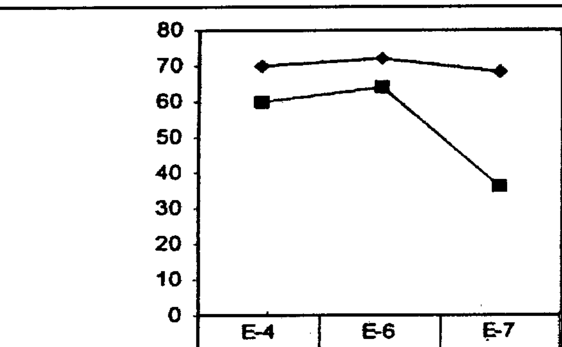
After Pulping						After Flotation					
Exp. No.	Consis-tency %	Temperature °C	Time Min	Active Chemical* %	ISO Brightness R_{457} %	Consistency %	Time min	ISO Brightness R_{457} %	Yield %	ISO Opacity %	Deinkability %
E-1	4	50	15	2.5	50.14	1	15	54.98	75.86	98.07	19.46
E-2	4	55	15	2.5	51.76	1	15	56.95	75.04	96.82	22.33
E-3	4	60	15	2.5	61.04	1	15	69.08	74.83	96.07	57.59
E-4	4	65	15	2.5	62.81	1	15	70.11	73.84	94.36	59.88
E-5	4	70	15	2.5	62.13	1	15	67.76	73.24	97.00	43.74
E-4	4	65	15	2.5	62.81	1	15	70.11	73.84	94.36	59.88
E-6	6	65	15	2.5	67.40	1	15	72.25	72.96	91.07	63.81
E-7	8	65	15	2.5	63.99	1	15	67.98	74.43	95.79	36.23
E-8	6	65	15	1.5	62.86	1	15	66.08	71.21	92.03	26.52
E-9	6	65	15	2.0	68.01	1	15	72.76	75.52	90.15	67.95
E-6	6	65	15	2.5	67.40	1	15	72.25	72.96	91.07	63.81
E-10	6	65	15	3.0	67.26	1	15	72.05	72.56	93.18	61.88
E-11	6	65	15	3.5	67.06	1	15	71.04	71.50	95.12	50.12

(* wt % on OD Raw material basis)
(Yield = On O.D Raw material basis with 15% ash content.)



	E-1	E-2	E-3	E-4	E-5
ISO OPACITY %	98.07	96.82	96.07	94.36	97
YIELD %	75.86	75.04	74.83	73.84	73.24
TEMPERATURE	50	55	60	65	70

Fig. 2 Temperature Vs. ISO Opacity and yield



	E-4	E-6	E-7
ISO BRIGHTNESS%	70.11	72.25	67.98
DEINKABILITY%	59.88	63.81	36.23
CONSISTENCY%	4	6	8

Fig. 3 Consistency Vs. ISO Brightness and Deinkability

and flotation condition is considered as a reference value. Therefore, global efficiency of the deinking process would be defined by the following deinkability factor:

$$E_F = \frac{B_F - B_D}{B_{BF} - B_D} . 100$$

Where -

E_F = Deinkability Factor (%)

B_D = brightness after pulping (%ISO)

B_F = brightness after Flotation (%ISO)

B_{BF} = brightness of unprinted paper subjected to the pulping and flotation stages carried out in the same conditions (%ISO).

Traditionally, the simplest and fastest way to evaluate deinkability is to characterize the difference between the brightness of the deinked pulp and the brightness of the pulp before deinking. This is the brightness gain.

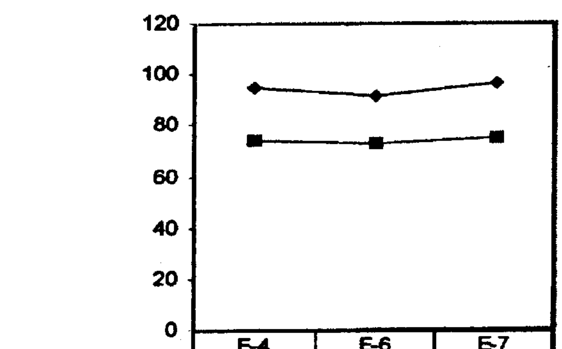
When waste paper is reprocessed, most non -fibrous materials, as well as some fibres, are discarded or lost during reprocessing. The fibre yield from waste paper is calculated as shown below:

$$\text{Yield (\%)} = \frac{\text{B.D. weight of product material after processing (slushing and flotation)}}{\text{B. D. weight of recycled paper input}} * 100$$

Actual yield is dependent on the recycled paper type and the product being manufactured.

Opacity refers to the "opaque" nature of paper and is inverse of the passage of light through paper. Thus a normal glass piece appears transparent (Zero opacity) as all the light falling on it passes through it, while a steel plate or plastic appears opaque as passage of light through them is nil (100% opaque).(4) Paper can have varying degree of opacity depending upon the process conditions and filler content. Paper meant for printing should have high degree of opacity (>90%).

Of all the pulps available for paper making, groundwood has maximum opacity. By raising the groundwood content of the sheet, it is possible to produce more opaque paper. But if this measure is impractical, then opacity is increased by adding pigments to the furnish or by coating the paper. Show through is the appearance of print viewed from the back of printed



	E-4	E-6	E-7
ISO OPACITY %	94.36	91.07	95.79
YIELD%	73.84	72.96	74.43
CONSISTENCY%	4	6	8

Fig. 4 Consistency Vs. ISO Opacity and yield

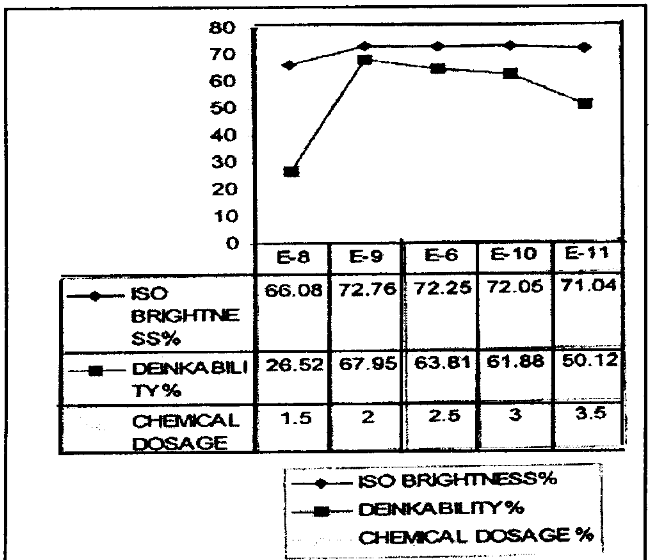


Fig. 5 Chemical dosage Vs. ISO Brightness and Deinkability

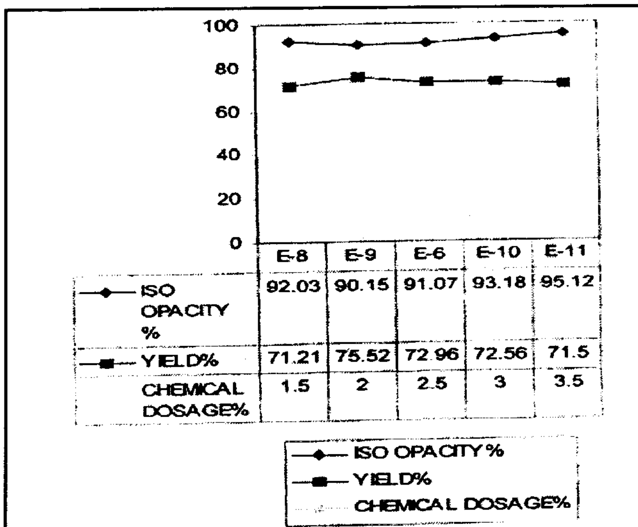


Fig. 6 Chemical dosage Vs. ISO Opacity and yield

sheet, if ink resides only on surface of paper e.g. on coated paper. This effect could be due to low opacity of paper. The opacity has been measured by using TECHNOBRITE following TAPPI method No. T 425.

The results have been shown in the Table - 2 for slushed pulp before flotation and after flotation in the flotation cell which also included yield, opacity and deinkability factor.Runs No. E - 1 to E - 5 indicate that the temperature of 65°C is better with other variables remaining same as shown in the results of Experiment No. E - 4. Experiment No. E - 4 to E - 7 indicate that the results are better with 6 % consistency, keeping all other variables constant as shown in the results of run No. E - 6. In Experiment No. E - 8 to E - 11, the chemical dosages have been varied and the results for run No. E - 9 are the best results. From the results of Exp. No. E-8 to E-11 it is evident that as the quantity of surfactant / active chemical is increased; during pulping operations the brightness decreases beyond the optimum dosage. This leads to net decrease in deinkability factor with the increase of active chemicals beyond the optimum dosage of 2%. During flotation, the hydrophobic component of the active chemical is responsible for removing the above materials from the system, as it acts as a wetting agent in the operation.

From the experiments, it is concluded that the ISO brightness will increase with the rise in temperature and consistency up to the optimum conditions and then it decreases as we exceed the higher limits, as further shown in the graphical presentation in Figs. 1 to 4 for runs number E - 4 and E - 6. The results at 65°C temperature, 6% consistency and at optimum deinking chemical doses as shown in Table 2 facilitate higher ISO brightness and comparable standard ISO opacity as shown in Figs. 5 and 6. The yield is also comparable to the normal range from paper industry with this type of paper. In all the results pH value for experimental runs is around 9-10.5 after slushing and 8 - 9.5 after flotation.

CONCLUSION

Acceptable quality paper can be produced using flotation cell at temperature of 65°C and 6% consistency on addition of chemicals suitably. With the optimum dosage of active chemical; the yield, ISO brightness, deinkability factor shall also be optimum due to more stabilized frothing action during foam removal.

ACKNOWLEDGEMENT

The Authors wish to convey their sincere thanks to the authorities of IIT, Roorkee for providing facilities for continuing this work under the UGC supported project on " Waste Paper Recycling and Deinking "under the Special Assistance Programme, at the Department of Paper Technology, Saharanpur.

REFERENCES

1. Ed. McKinney R.J.W., "Technology of Paper Recycling ", Alackie Academic & Professional, Glasgow G 642 NZ, UK (1995).
2. Ed. Kockurek M.J., Joint Text Book Committee of Paper Technology "Pulp & Paper Manufacture ", Vol-3, " Secondary Fibre and Nonwood Pulping ",Tappi Press, USA & Canada (1993) p. 214.
3. Bansal M. C. and Agnihotri P.K. " Deinking Studies with Flotation Cell of ONP" IPPTA Conv. Issue, 77(2002).
4. Pulp and Paper Testing, Book 17, Papermaking Sci. and Tech., TAPPI, 163 (1999)
5. Pelach M.A., Puig J., Vilaseca F. and Mutje P., "Influence of chemicals on Deinkability of wood free coated fine paper" J. Pulp and Paper Sci., Vol. 27, 353 (2001).