Neutral Flotation De-inking - A New Opportunity for Indian Paper Industries

Lakshmana Reddy B.H., R.G. Nayak.,
K.Vasanthakumar Pai

ABSTRACT

The Global debate on providing carbon credits for the process inventing conservation of carbon resources as well as the rapid forest depletion promoted us to explore the possibility of recycling news print paper by employing an efficient method of de-inking. For selective and easy ink removal better physical and surface property of the pulp formed, and to keep the method environmental friendly and cost effective. It was imperative to identify a de-inking aid running under near neutral condition. Casuruf-108 a biodegradable sulfonated derivative of card phenol was found to do the specific job in this regard. This paper deals with the utilization of casuruf-108 as de-inking aid in ONP (Old news paper) and the study of optical and physical strength properties of the de-inked news print pulp. Cost and environmental advantages of the neutral de-inking over conventional alkaline de-inking using casuruf-108 are also discussed.

INTRODUCTION

In India, paper and paperboard industries recycled only 35% of the fiber produced. Out of this only 10-15% fiber is recycled as de-inking pulp remaining is utilized for making corrugate boards, boxes, wrapping paper etc., Conserve resources are the order of the day. To meet the demand in the coming years Indian industry will be forced to use more and more waste paper by recycling as well as by imports. Recycling of waste and old newspaper (ONP) not only saves trees and minimize pollution, but also reduce the bio-mass waste and provide carbon credits to the nation. The de-inking process (DIP) saves 75% water 60-70% energy and reduces pollution by 75% per tonne by pulp production.

Recycling of old news paper has been a high profile with an increasing commitment towards the use of secondary fiber. Improved de-inking and fiber processing have aided their procedure. De-inking of waste paper is normally carried out at alkaline P^H value 10-11 in the presence of alkali metal hydroxides, alkali metal silicates, oxidative/reductive bleaches and surfactants at a temperature in the range of 30-50°C Anionic and/or non-ionic surfactants are also recommended.

During the exploration work at our R & D, we have stumbled upon a surfactant: casurf-108" a surfactant product of card phenol which functions as displector in the de-inking process of news print waste paper. The surfactant are used for de-inking will have two principal components viz. hydrophobic and hydrophilic. It has been observed that CASURF-108 effectively works in ink removal and separation of ink particles from the fiber surfaces. To quantify this de-inking efficiency by determine the brightness, dirt counts of the TAPPI de-inked sheets is compared with a reference. This paper deals with study of de-inking using casuruf-108.

EXPERIMENTAL

NEUTRAL FLOTATION DE-INKING

De-inking is the process of removing ink particles from waste paper fiber by a combination of mechanical and chemical action in a pulper. There are several types of chemicals used for de-inking, each one operating on a different chemical principles. The types and amounts of these chemicals depend on the type of waste paper and the intended end use of the recycled pulp, and the nature of the de-inking process.

Old newspaper of "DECCAN HERALD" version is stocked sufficiently for study. 250 g of news paper sheets were torn in to pieces by hand and disintegrated for 30 minutes with hot water. The above stock of 1.0-1.2% consistency and freeness of 300 CSF was subjected to de-inking in laboratory by froth flotation. Conventional alkaline de-inking as well as neutral floatation de-inking is done to compare the optical and physical properties of de-inked pulp.

Chemicals used for conventional alkaline de-inking are the following;

1.5 % by wt. of sodium hydroxide.
1.5 % by wt. of H_20_2.
1.0 % by wt. of ammonia.
1.5 %by wt, sodium silicate.
0.1% by wt.of CASURF-108

Table no. 1.

Comparison of optical properties of conventional alkaline de-inking with and without casurf-108.

EXPT	STOCK	BLANK	SAMPLE CAD_{WO}	SAMPLE CAD_W
Brightness ISO %	47	50	58.5	60
Dirt counts /M^2	700	600	500	325
P^H	6.5	7.0	10.5	10.8
Res.peroxide %	---	------	0.028	0.028

The above values are reproduced by taking average of 3 trials.

The Mysore Paper Mills Ltd.
P.O. Papertown, Bhadravati-577 302 (Karnataka)

Table no. 2.

Comparative optical properties of dip sheets obtained by neutral floatation de-inking with and without casurf-108

Properties	Stock	Blank	Sample NFD_{WO}	Sample NFD_W
Brightness ISO %	47	50	57.5	59.0
Dirt counts /M^2	700	600	575	325
P^H	6.5	7.0	7.8	8.0
Res. Peroxide %	----	-----	0.028	0.029

Table no. 3

Comparative strength properties of dip sheets and yield obtained by Conventional alkaline and neutral floatation de-inking by using casurf -108

Properties	Stock	Blank	CAD_W	NFD_W
Yield %	----	------	85	85
Fiber loss %	----	------	3.5	3.8
Ash %	4.5	4.0	2.2	2.3
Breaking length (m)	4300	4200	3490	4100
Burst factor	18	18	16.5	17
Tear factor	60	60	56	57
COD (ppm)	20	30	1650	230
P^H	6.5	7.0	10.0	8.0

The above all values are average of three experiments.

CHEMICALS USED IN NEUTRAL FLOTATION DEINKING.

0.1% by wt. of sodium hydroxide.
0.5% by wt. of H_20_2
0.5-% by wt, sodium silicate.
0.1%- by wt.of casurf-108

The above stock of 1-1.2 % Cy and freeness of 300 CSF was subjected to de-inking in laboratory by froth flotation at 60°C by using displector as de-inking aid and with small quantity of caustic soda.

The flotation cell consists of 2 liter capacity beaker with stirrer and an aerator, the whole unit is kept in a plastic tray for collection of froth along with ink particles. The above stock slushed in a vertical shaft stirrer with constant 4000 rpm at 60°C temperature and for 15 minutes flotation time. Through the aerator air bubbles rise through the floatation cell, the ink particles get attached to the bubbles and are carried out to the surface of the cell. After completion of the flotation, the stock was subjected to wash with water, and made into pulp sheets as per TAPPI standards with 220 CSF for measuring dirt count, brightness, and strength properties. In case of Dirt counts/M2 (specks) are measured by counting the dirt particles. The discharged effluent from DIP (De-inked Pulp) was subjected to analysis for the determination of colour, P^H, and COD. The results are shown in the following tables.

Blank Sample; Only slushed stock subjected to flotation.

CAD_{wo}; Conventional alkaline de-inking without casurf-108;
1.5% NaOH +1.5% H_2O_2+2.0% Sodium silicate

$CAD_{w.}$ Conventional alkaline de-inking with casurf 108.
1.5% NaOH +1.5%H_2O_2 +2.0% Sodium silicate +0.1% Casurf-108.

NFD_{wo} . Neutral floatation de-inking without casurf-108.
0.1% NaOH +0.5%H_2O_2+0.5% sodium silicate.

NFD w. Neutral floatation de-inking with casurf-108.
0.1% NaOH + 0.5% H_2O_2 +0.5% Sodium silicate +0.1% casurf-108

CAD 1; 0.5 % NaOH + 0.5 %H2O2 + 0.5 %sod silicate + 0.1 %Casur-108.

CAD 2; 1.0 % NaOH + 1.0 %H2O2 + 1.0 % sod.silicate + 0.1 % casurf-108.

CAD 3; 1.5 % NaOH + 1.5% H2O2 + 1.5 %sod silicate + 0.1 % Casurf-108.

NFD 1; 0.1 % NaOH + 0.5% H2O2 + 0.5 % sod silicate + 0.1 % casurf -108.

NFD 2; 0.1 % NaOH + 1.0 % H2O2 + 1.0 % sod silicate + 0.1 %casurf-108.

NFD 3; 0.1 % NaOH + 1.5 % H2O2 + 1.5 %sod silicate + 0.1 %casurf -108

RESULTS AND DISCUSSIONS

1. Displector i.e Casurf -108 in neutral de-inking acts as a fiber retention and ink particle collector agent.
2. Neutral de-inking minimize the consumption of chemicals and lowers the pollution load.
3. Sodium silicate prevents the decomposition of H_2O_2 in ionic condition and also acts has anti-depositing agent (i.e Ink deposition on fiber)
4. Bio-degradable surfactant casurf-108 plays significant role as de-inking aid in neutral de-inking .
5. Optical properties and strength properties of the de-inked pulp allow us to admix the same with virgin mechanical pulp.
6. 1 % consistency of pulp in neutral floatation de-inking and washing removes almost all ink particles, fillers and ash effectively.
7. The results explains the de-inkability using both conventional alkaline de-inking and neutral floatation de-inking in the presence of casurf-108 as discussed in table no. 1 and 2.
8. Low pollution from neutral de-inking is seen when compared to alkaline de-inking.
9. A thumb Chemical cost analysis assures the healthy benefits for neutral flotation de-inking.

CONCLUSIONS

1. For the carbon credit, recycling of waste paper is important for India.
2. De-inking in the neutral condition and using biodegradable surfactant like casurf-108 it is possible to reprocess fiber from waste newsprint in newsprint manufacture.
3. Neutral de-inking process uses low energy, water and chemicals as compared with conventional alkaline de-inking process.
4. Flotation cell encourages the neutral de-inking with using displector as de-inking aid.
5. The COD is significantly low in neutral de-inking compared with

Table no. 4
Chemical cost estimation in conventional alkaline and neutral floatation de-inking with casurf-108.

Expt.	Dosage % W/W of fiber	Brightness % ISO	Dirt counts/M^2	End P^H	COD (PPM)	Cost. Rs. /ton. OD pulp.
CAD 1	0.5	56	450	10.0	800	408
CAD 2	1.0	58	400	10.5	1100	756
CAD 3	1.5	60	380	11.0	1600	1100
NFD 1	0.5	58	350	8.0	400	288
NFD 2	1.0	59	360	8.2	500	486
NFD 3	1.5	60	300	8.6	600	684

alkaline de-inking, surprisingly there is no significant pulp yield difference between the two types of de-inking. The reasons for the same need to be investigated.

ACKNOWLDEGEMENTS

The authors acknowledge their sincere thanks to the management of MPM LTD.,for giving us permission to publish the above article in IPPTA AGM seminar. We thank the management of Cashitron resins (p) ltd our sincere thanks also to Mr. N.C.Agasibagil GM (P), Mr. M.S.Hadli. AGM R&D /QC for providing research studies in the laboratory. Our thanks to the Chairman dept of Industrial chemistry Kuvempu university for his continued support and guidance to pursue innovations.

ABOUT AUTHORS

1. Chemist, MPM LTD.,/ Research Associate Kuvempu University, Shimoga ,Karnataka.
2. Dr. R.G. Nayak, Managing Director, Cashitron resins (p) ltd, Ankola, Karnataka.
3. Dr. Vasanthakumar Pai, Professor, Dept of Industrial Chemistry, KU, Shimoga

REFERENCES

1. Kyssel Ismantha -Challenges before the Indian paper industry IPPTA conv .1998.
2. Dr. A.R.K. Rao Key note address IPPTA conv. 1999.
3. Dr. M.C. Bansal, De-inking studies with floatation cell of ONP - IPPTA conv.2002
4. Rangan S,.G. Cost effective de-inking - IPPTA (12) 1998.
5. Herman Morrow. True neutral de-Inking - paper age 2005.
6. Jain. R.K. Enzymatic de-inking of recycled fiber. IPPTA sept. 2001.
7. Chemistry of de-inking by. Fergueson.L.D.
8. Surfactants. A global perspective - Chemical weekly- July , 1998.
9. An overview of the paper chemicals industry - de-inking and bleaching agent - Che. Weekly - dec-2002
10. M.K. Tiwari, R.G.Nayak. -Studies on caustic free de-inking - Dissertation work - Karnataka University.