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NOTE

Effect of Glycols and Glymes on Shredding Efficiency of Sodium Cellulose Crumbs and Viscose Rayon Fibre Properties

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For uniform and better pulp quality, surface active agents are used in the manufacturing process of viscose rayon. In the present work it has been observed that high molecular weight glycols and glymes improve the shredding efficiency of sodium cellulose, decreases the bulk density and reduces the quantity of knots, thereby improving the quality of viscose and fibre properties of viscose rayon.

The conversion of pulp to soluble xanthate is a process of great technical and economical importance and shredding of alkali cellulose (alk-cell) is the basic requirement of the process. Uniform and better shredding of alk-cell is a favourable factor during further steps of rayon process. The use of suitable additives in the early stage of viscose process improves the processibility of alkali cellulose. Some suitable additives are claimed for easier shredding and increased fluffiness of alk-cell[1, 2]. Majority of such additives are surface active agents of non-ionic nature[3]. The benefit of using additives is the easier penetration of alkali solution into cellulose matrix and better shredding which results in more fluffiness and uniform particle distribution of alk-cell crumbs which in turn provide a viscose of good filtration and spinning properties. Much of the literature shows the use of complicated condensate products as surface active agents in viscose process[4, 5]. In view of the above we have used some of the simple glycols, *viz.*, diethylene glycol (DEG), tetraethylene glycol (TEG) and polyethylene glycol (PEG-4000) and glymes, *viz.*, diethylene glycol dimethyl ether (DGDME), tetraethylene glycol dimethyl ether (TGDME) and polyalkylethylene glycol (PAGE) to study their effect on shreddng efficiency of alk-cell.

The industrial dissolving grade kraft pulp was used in the present study. The pulp has 730 degree of polymerisation (DP) and 94.5% α-cellulose. Commercial sodium hydroxide was used to prepare steep lye. The glycols and glymes used were of LR grade from S.D. Fine Chemicals and Hico Products Ltd., Mumbai.

Chemically purified pulp samples in sheet form (12″ × 10″) were taken to prepare alk-cell. The sheets were dipped in 18.3% sodium hydroxide solution for 1 h. Excess of sodium hydroxide solution was removed by pressing the sheets in a press. Aqueous solutions of glycols and glymes were sprayed at a rate of 0.2% on α-cellulose basis on the alkalised sheets. The shredding operation was carried out in a sigma blade shredder at 40°C. After a fixed interval of time the bulk density of the shredded mass was determined. The bulk density at different

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shredding time is given in Table-1. The unshredded material (knots) was determined by screening the alk-cell crumbs and segregating the knots from a known weight of alk-cell and is reported as knot per cent in Table-2.

TABLE-1
EFFECT OF GLYCOLS AND GLYMES ON BULK DENSITY OF ALKALI (CELLULOSE CRUMBS BULK DENSITY OF ALK-CELL IN g/l)

Shredding time (h)	Control	DEG	TEG	PEG-4000	DGDME	TGDME	PAGE
0.5	275	275	265	265	270	270	262
1.0	227	225	220	210	222	215	208
1.5	200	195	190	185	190	187	178
2.0	175	176	172	163	175	170	155
2.5	155	158	155	150	154	153	141
3.0	150	155	150	140	150	148	135
3.5	148	150	150	135	148	145	130
4.0	145	148	145	130	148	145	130
5.0	142	146	142	126	140	140	121
6.0	140	142	138	122	140	135	118

TABLE-2
EFFECT OF GLYCOLS AND GLYMES ON THE KNOTS PRESENT IN ALKALI CELLULOSE CRUMBS DURING SHREDDING

Shredding time (h.)	Control	DEG	TEG	PEG-4000	DGDME	TGDME	PAGE
0.5	25.0	24.8	24.6	24.0	24.5	24.2	24.0
1.0	18.0	17.3	17.0	16.0	17.2	16.8	15.0
1.5	16.0	15.0	13.6	11.2	14.5	12.5	10.5
2.0	12.0	11.0	10.7	8.6	10.8	10.0	7.8
2.5	10.0	9.3	9.0	6.3	9.0	8.0	6.1
3.0	8.2	7.9	7.5	5.1	6.8	6.3	4.7
3.5	7.0	6.5	6.2	4.3	5.8	5.2	3.8
4.0	6.1	5.7	4.9	3.6	5.3	4.6	3.3
5.0	5.2	4.9	4.3	2.8	4.8	4.0	2.6
6.0	5.0	4.5	4.1	2.5	4.3	3.7	2.2

The data in Table-1 indicate that the shredding efficiency increases with the addition of these compounds as shown by the lower bulk density of alk-cell crumbs than the control sample. The bulk density of control alk-cell was 140 g/L in 6 h of shredding; the TEG, DGDME and TGDME required 5 h to get the same bulk density. However, PEG-4000 and PAGE have shown a definite improvement in the shredding efficiency. The bulk density of 140 g/L was obtained in just 3 h with PEG-4000 and in 2½ h with PAGE. Glycols and glymes not only reduce the shredding time and increase the fluffiness but also reduce the quantity of knots

present in the alk-cell. It has been observed that after 3 h of shredding, the percentage of knots present in alk-cell was found to be 5.1% and 4.7% with PEG-4000 and PEGA respectively as compared to the control which shows a value of 8.2%. The data in the tables indicate that the quantity of knots in alkali cellulose reduces proportionately with the bulk density. Also the bulk density and the percentage of knots decreases as the molecular weight of the additive increases.

Incorporation of higher molecular weight glycol and glyme showed enhanced fibre tenacity, wet modulus and loop and knot tenacities. A synergistic effect was obtained when PAGE was added in alk-cell during shredding and PEG-4000 in viscose during dissolution. The fibra tenacity was 2.57 g/denier for control sample and 2.80 and 2.81 g/denier when PEG-4000 and PAGE, respectively, were added in alk-cell. Still higher tenacity (2.97 g/denier) was obtained when PAGE, in alk-cell, and PEG-4000, at dissolving stage, were added (Table 3).

TABLE-3
EFFECT OF PEG-4000 AND PAGE ON FIBRE PROPERTIES

Parameters	Unit	Control	0.2% PEG-4000 in alk-cell	0.2% PAGE in alk-cell	0.2% PAGE in alk-cell + 0.5% PEG-4000 in viscose
Denier	–	1.51	1.50	1.49	1.51
Conc. tenacity	g/den	2.57	2.80	2.81	2.97
Wet tenacity	g/den	1.28	1.41	1.43	1.49
Cond. elongation	%	18.80	18.80	18.60	18.50
Wet elongation	%	21.50	21.50	21.30	21.50
Loop tenacity	g/den	0.82	0.82	0.85	0.88
Knot tenacity	g/den	1.79	1.87	1.89	1.98

Thus the use of suitable glycols or glymes may be beneficial in preparing the alk-cell with improved uniformity, increased fluffiness and also modify the fibre properties. These compounds may be added either in the steep lye or sprayed on alk-cell or even on pulp sheet.

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