NEWSPRINT FROM SODA BAGASSE PULP IN ADMIXTURE WITH HARDWOOD CMP PULP

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Based on global research and experiences producing newsprint from bagasse, the possibility of using bagasse chemical pulp in the furnish of local mill-made mixed hardwood CMP pulp was studied at laboratory scale, for making newsprint. Bagasse soda chemical pulp at digester yield of about 47% was bleached to about 60% brightness by single stage hydrogen peroxide. The effects of using up to 30% bagasse chemical pulp in a blend with hardwood CMP pulp, with or without softwood kraft pulp, were studied. The results showed that superior hand sheet properties could be achieved by using bagasse chemical pulp; in comparison with main mill pulp furnish (83% hardwood CMP pulp and 17% imported long fiber pulp). In other words, by using bagasse chemical pulp in a blend with local mill made hardwood CMP pulp, acceptable newsprint could be made with considerable reduction in the consumptions of hardwood species and softwood reinforcing kraft pulp.

Keywords: Bagasse; Soda chemical pulp; BSKP; HW CMP; Newsprint

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INTRODUCTION

There are often insufficient softwood resources in many countries, including Iran, for making groundwood or thermomechanical pulps suitable for newsprint production. However, with development of chemimechanical processes such as CMP and CTMP, these countries have an opportunity to use local hardwoods to make chemimechanical pulps having quality attributes close to those of softwood groundwood. Such pulps, after being reinforced with semibleached or bleached softwood kraft pulp, may be used to make newsprint. For instance, at Mazandaran Wood and Paper Industries (MWPI) in Iran, newsprint is made from fiber furnish consisting of 83% mixed hardwood CMP and 17% imported bleached softwood kraft pulp (BSKP) from Sweden. However, current shortages of adequate hardwood species and lack of foreign currency to import enough BSKP pose challenges for MWPI. Huge amounts of bagasse are now available in sugarcane mills in southern Iran, and this can be used as a suitable raw material for newsprint. Based on global research and experiences in making newsprint from bagasse (Rangamanar et al. 1990; Wong 1996; Granfeldt and Sadawarte 1988; Zanuttini 1997; Ryrberg et al. 1998; Roberts 1999; Phillips et al. 2000; Hurter 2007), the possibility of using bagasse chemical pulp in a blend with local mill made mixed hardwood CMP and BSKP, was investigated with the aim to reduce the hardwood and BSKP consumptions.

EXPERIMENTAL

Raw bagasse, after disintegration and depithing, with a depithing yield of 70%, was used for soda pulping. Soda pulping was carried out in a batch 10 liter rotary digester under cooking conditions of 15-20 % AA, L:W =10:1, and 60-120 min at 160 ºC, with total pulp yields of 46.6 to 52.5% and kappa number of 17 to 26.7, respectively. Unbleached bagasse chemical pulp at kappa number of 12 was bleached by a single stage hydrogen peroxide under bleaching condition of 12% consistency, 1% hydrogen peroxide, 1.5% sodium hydroxide, 2% sodium silicate, 0.3% DTPA, and 2 hr treatment at 70 ºC to achieve a pulp brightness of 60%.

Bagasse bleached chemical pulp was refined by PFI mill to 300, 350, and 400 mL, CSF but in case of the hardwood CMP and BSKP the final refined freeness were selected to be 300 and 500 mL, CSF, respectively. Furnishes of different ratios of bagasse bleached chemical pulp, CMP, and BSKP used for handsheet making are shown Table 1. The handsheet properties were determined according to TAPPI standards except for tear strength, which was determined by the SCAN standard methods.

Table 1. Combination of Different Ratios of Soda Bagasse Pulp, CMP Hardwood Pulp, and Imported Long Fiber Pulp for Newsprint Furnish

Furnish No.	Imported long fiber pulp (%)	CMP hardwood pulps (%)	Chemical bagasse pulp (%)	Explanations
1	17	83	0	Sample
2	5	65	30	Gradual reduction of CMP hard wood pulp and imported long fiber pulp
3	8	62	30	
4	12	58	30	
5	17	53	30	
6	0	90	10	Elimination of imported long fiber pulp
7	0	80	20	
8	0	70	30	

RESULTS AND DISCUSSION

Based on experiments, optimal chemical pulping of bagasse was achieved under conditions of AA 20%, 90 min at 160 ^{o}C. These conditions achieved the following yield, kappa number, and initial brightness of pulp: 46.64%, 11.9, and 40% ISO, respectively.

Semi-bleached chemical bagasse pulp and CMP hard wood pulp were refined to selected CSF levels. The results showed that in order to reach an optimum freeness level, chemical bagasse required lower energy consumption in comparison to the other tested conditions. It should be noted that chemical bagasse pulp had a higher content of long fibers that do not pass from 0.5-mm (50-mesh) screen compared with CMP hardwood pulp. Therefore chemical bagasse pulps appeared to be superior to CMP pulp with respect to the distribution of fibers in handsheet structures. Produced paper from pulp with freeness of 350 mL had better physical, mechanical, and optical properties than other value of freeness. So, a freeness of 350 mL was chosen for blending with CMP and imported long fiber pulp for newsprint production.

Table 2. Composition of Furnishes and Experimental Results for the Properties Determined in the Resulting Paper Sheets

Furnish	Bulk$_{(cm^3/gr)}$	Porosity$_{(sec)}$	FE$_{(N)}$	BL $_{(km)}$	TI $_{(mN.\ m^2/gr)}$	BI $_{(Kpa.\ m^2/gr)}$	TEI $_{(N.m/gr)}$	Opacity $_{(\%)}$
(17% ILF+83% CMP)	1.94	2.03	0.73	3.73	6.86	2.12	36.62	88.20
(5% ILF+65% CMP+30% CBP)	1.71	6.03	1.17	4.06	6.82	2.52	39.80	88.89
(8% ILF+62% CMP+30% CBP)	1.76	5.57	1.50	4.22	6.94	2.68	41.38	88.10
(12% ILF+58% CMP+30% CBP)	1.83	4.80	1.97	4.47	7.41	2.81	43.86	87.10
(17% ILF+53% CMP+30% CBP)	1.83	4.20	2.73	4.86	7.73	3.02	47.70	87.43

CBP: Chemical bagasse pulp; CMP: CMP hard wood pulps; ILF: Imported long fiber pulp; BL: Breaking Length; FE: Fold Endurance; TI: Tear Index; BI: Burst Index; TEI: Tensile Index.

The effects of different mixing levels of these pulps (Table 1) were investigated on the properties of handsheets as compared to commercial newsprint furnish (17% long fiber pulp and 83% CMP hard wood pulp), and the results are summarized in Table 2. On the basis of these results, it can be understood that:

The effects of chemical bagasse pulp on physical properties of newsprint furnish, porosity and density of produced hand sheets with different ratios (10%, 20%, and 30%) of chemical bagasse pulp were steadily positive in comparison to newsprint furnish in admixture with CMP pulp. Adding 30% by weight chemical bagasse pulp to the main newsprint furnish portion can make it possible to reduce consumption of imported long fiber from 17% to 5% without any changes in physical properties of handsheets. In this case, fiber flexibility and surface bonding area are probably important properties that characterize pulp quality. Normally, chemical bagasse pulp with higher flexibility and surface bonding area showed higher density and porosity plus lower bulk than mechanical pulp, especially in the case of newsprint furnish. Figures 1 and 2 show the

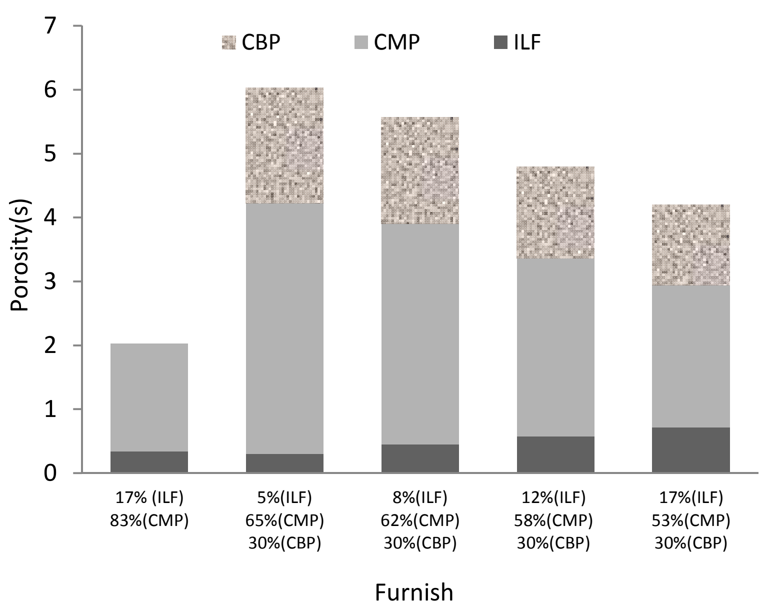

Fig. 1. Comparison of porosity factor in handsheets made from different ratios of imported long fiber (ILF), hard wood CMP, and chemical bagasse pulp (CBP)

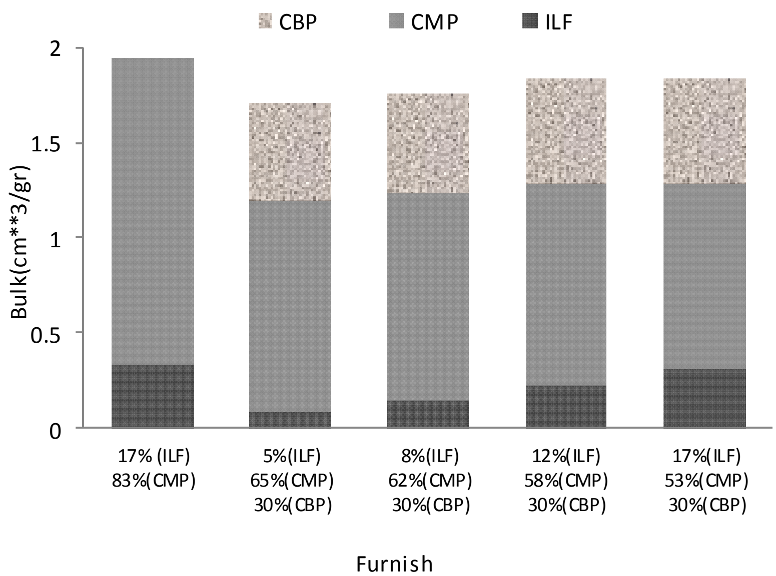

Fig. 2. Comparison of bulk factor in handsheets made from different ratios of imported long fiber (ILF), hard wood CMP, and chemical bagasse pulp (CBP)

variation of porosity and bulk properties of Furnish No: 1 to 5 respectively [(17% ILF + 83%CMP), (30%CBP + 65%CMP + 5%ILF), (30%CBP + 62%CMP + 8%ILF), (30%CBP + 58%CMP + 12%ILF), (30%CBP + 53%CMP + 17%ILF)]. As can be seen, the maximum porosity was obtained from Furnish number 2, which included 30% CBP, and vice versa the bulk of all Furnishes with 30% CBP were less than commercial newsprint furnish. So, it can be understood that in spite of decreasing of the bulk of handsheets, the porosity of handsheets was increased by using of CBP in the newsprint furnish.

Chemical soda pulp affected mechanical properties of paper produced from newsprint furnish. Moreover, properties of handsheets in comparison with control sample were significantly improved with addition of chemical bagasse pulp in different ratios up to 30% in the combination of CMP pulp and imported BSKP. For instance, tear strength of the newsprint with furnish of 70% CMP pulp and 30% chemical bagasse pulp was placed in the range of the control samples. Because of critical effect of tear strength on runnability of newsprint, the Furnish with 30% chemical bagasse pulp plus to 17% long fiber pulp and 53% CMP pulp had superior physical, mechanical, and optical properties in comparison to the control sample in the final Furnish (Fig 3). As can be seen from Figs. 4 through 7, other mechanical properties of handsheets indicated that by using Furnish number 2, which has only 5% imported BSKP, it was possible to reach a sufficient level of mechanical properties.

Opacity is as another printability characteristic of paper that is directly related to the bulk of newsprint. Increasing surface bonding between fibers is known to have an adverse effect on opacity (Wood and Karais 1991). Compared with the control sample, in spite of using chemical bagasse pulp up to a level of 30% in the main newsprint furnish and also reducing consumption of imported long fiber from 17% to 5%, opacity of handsheets was still very similar or slightly better than the control sample of newsprint furnish. In the other words, it is possible by using 30% chemical bagasse pulp in the admixture of CMP pulp to produce newsprint furnish with acceptable opacity. This approach probably provides reduction of CMP pulp from 83% to 65% and imported long fiber from 17% to 5% in the main newsprint furnish (Figs. 8).

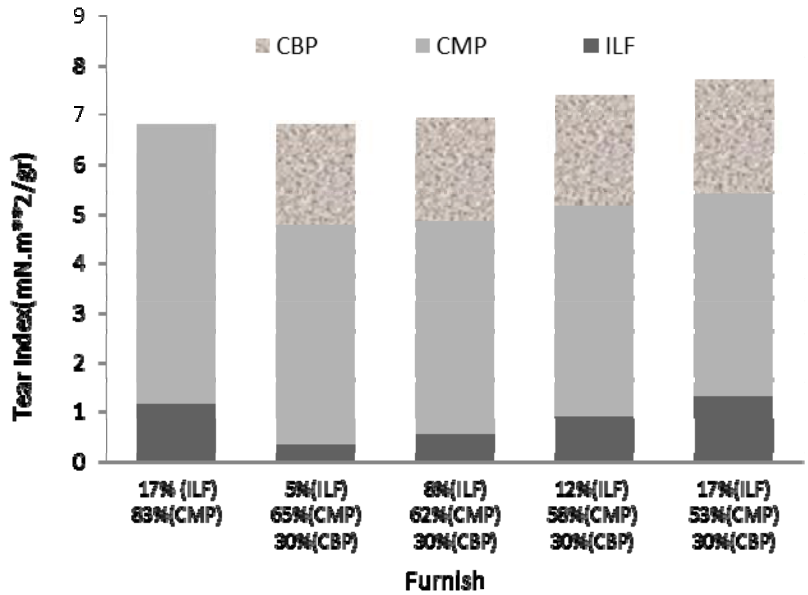

Fig 3. Comparison of tear factor in handsheets made from different ratios of imported long fiber (ILF), hard wood CMP and chemical bagasse pulp (CBP)

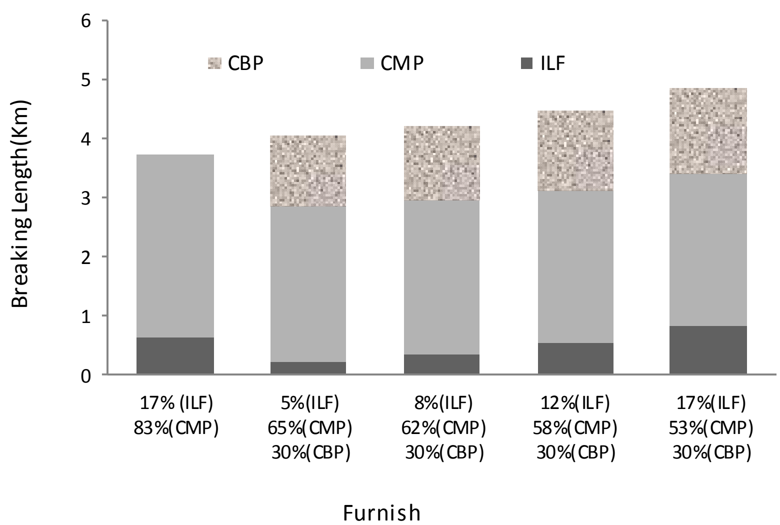

Fig. 4. Comparison of breaking length factor in handsheets made from different ratios of imported long fiber (ILF), hardwoods CMP and chemical bagasse pulp (CBP)

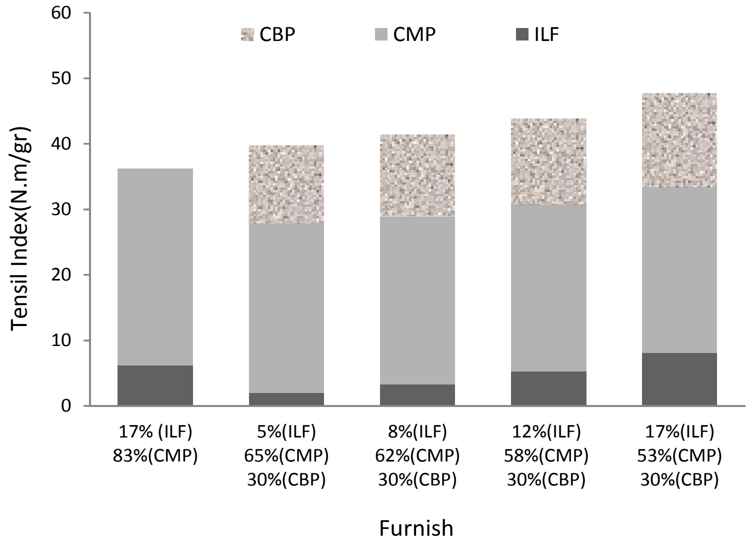

Fig. 5. Comparison of tensile strength factor in handsheets made from different ratios of imported long fiber (ILF), hardwoods CMP, and chemical bagasse pulp (CBP)

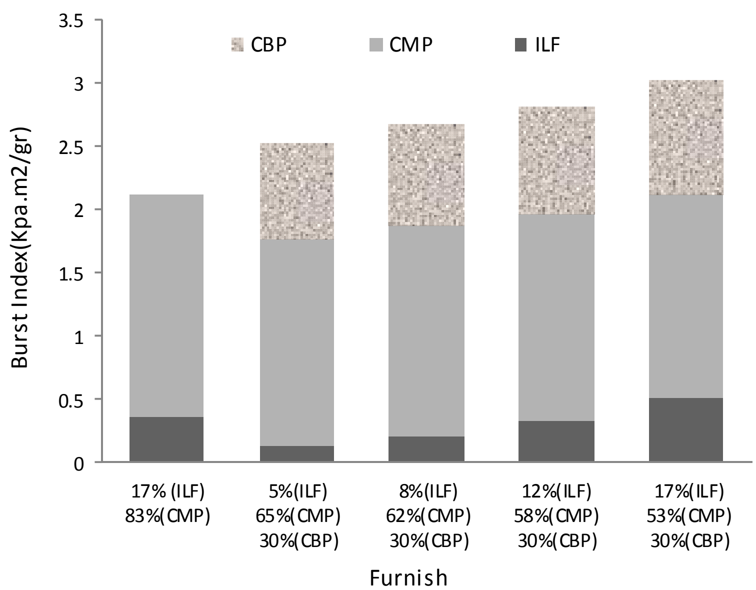

Fig 6. Comparison of burst factor in hand sheets made from different ratios of imported long fiber (ILF), hardwoods CMP, and chemical bagasse pulp (CBP)

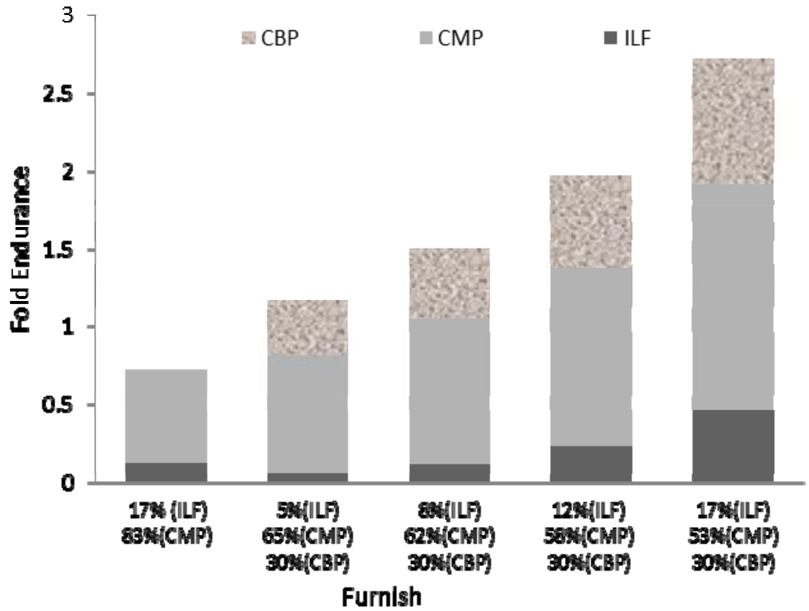

Fig 7. Comparison of fold factor in handsheets made from different ratios of imported long fiber (ILF), hard wood CMP, and chemical bagasse pulp (CBP)

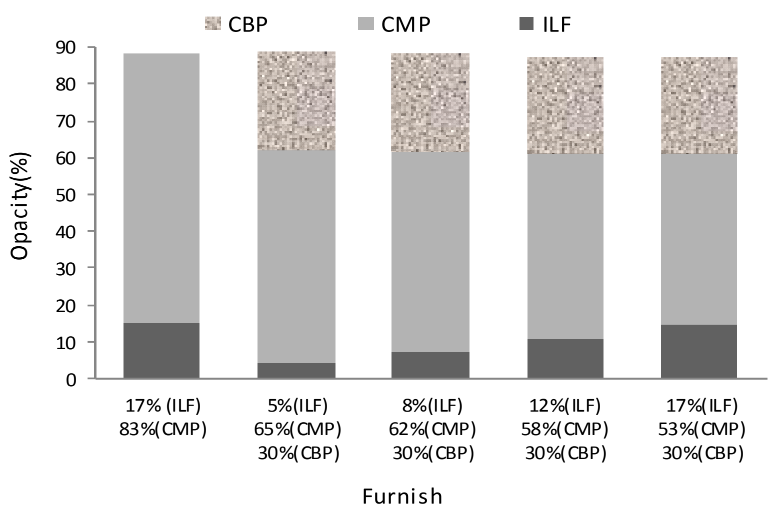

Fig. 8. Comparison of opacity in handsheets made from different ratios of imported long fiber (ILF), hard wood CMP, and chemical bagasse pulp (CBP)

CONCLUSIONS

The required refining energy to achieve certain freeness was higher in hardwood CMP than chemical bagasse pulp. In addition, at optimum refined freeness, bagasse chemical pulp had lower fines, 8.7 versus 32.9%, and higher long fiber fraction (+50) than hardwood CMP, 55.7 versus 46.8%, respectively. The results of handsheet evaluation at different freeness showed that refined freeness values of 300, 350, and 500 mL were the optimum freeness in terms of overall paper properties in hardwood CMP, chemical bagasse, and BSKP, respectively.

Handsheet properties such as porosity, density, burst, folding endurance, tensile strength, and tear strength in chemical bagasse pulp were much higher than in hardwood CMP, but at lower bulk and opacity. Similar results were obtained when properties of BSKP were compared with hardwood CMP.

On the basis of the above mentioned findings, by using up to 30% bagasse chemical pulp to reinforce hardwood CMP it is possible to either reduce or eliminate the imported BSKP consumption as a reinforcement pulp.

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