APMP: an alternative for Packaging Industry

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Abstract. APMP process has been conventionally used to produce writing and printing papers. Maragheh Paper Industries Company (MPIC) was first company in Iran which started producing alkaline peroxide mechanical pulp (APMP) on a new Andritz 50000 tones/year at its mill in Maragheh city followed by establishment of another 50000 tones/year in Kermanshah city, Iran. Due to lack of required chemicals for the process including H2O2, Sodium Silicates, DTPA and Magnesium Sulfate and the subsequent high production costs mill trials were performed to examine the suitability of APMP process for producing packaging paperboards for which only alkaline addition is adequate. Different ranges of Alkali dosage were experimented and the resulted pulps were both evaluated online using FiberScan System supplied by Andritz and the laboratory tests. The results from this investigation demonstrated that APMP can be utilized as an alternative to produce standard quality packaging pulp and paper other than the printing purposes using less production costs.

Keywords: Pulp and Paper Industry, APMP, Packaging Papers, Bleaching, Strength Properties.

1 Introduction

Pulp and Paper industry is changing rapidly; environmental concerns will be the big issue of the new developing industrial generation focusing on paper recycling and new pulping and bleaching technologies. NSSC pulp produced from a wide selection of raw material has been traditionally used to supply the fluting paperboard used in the packaging industry thanks to special strength properties in the end product RCT and CMT supported by extensive literatures published (1-9). Environmental issues towards sulfur-free processes (10- 11) have been the driving force for replacement of neutral sulfite semi-chemical pulps with recycled (12-14) and mechanical pulps (15-

In: M. Salampasis, A. Matopoulos (eds.): Proceedings of the International Conference on Information and Communication Technologies

for Sustainable Agri-production and Environment (HAICTA 2011), Skiathos, 8-11 September, 2011.

19) in the packaging industry and the recent fiber analysis have confirmed this altering trend (20-21). In Iran, the recycling fibers, however, do not meet the quality specifications required for the packaging industry and particularly the corrugating medium especially in the small papermaking mills because of the lack of certain wet end chemistry strategy and not economically compromising the use of different chemicals.

The APMP process was first introduced at the 1989 International Mechanical Pulping Conference (22). Since then, a number of studies have been reported from the Andritz Pilot Plant in Springfield, Ohio on the characteristics of the APMP process, on how it compares to CTMP and pre-bleached CTMP, and on its application to various wood species (23-26).

Generally, APMP is used most favorably for two special areas in high-yield pulping. One area involves high-brightness pulp grades when peroxide bleaching is necessary. The other involves a specific hardwood species for which caustic pretreatment is needed to reduce energy consumption and, more importantly, to obtain acceptable pulp strength. Alkaline Peroxide Pulping is conventionally used to produce writing and printing grades, but because of high Lignin content and the physical properties, the end product might have some applications in the packaging papers.

In the area of achieving high brightness with peroxide bleaching, a certain amount of sodium hydroxide has to be applied. In the APMP process, both sodium hydroxide (NaOH) and hydrogen peroxide (H2O2) are applied prior to refining. Not only does the sodium hydroxide function as a necessary component of bleaching reagents, but it also softens the fibers. As a result, the refining energy is reduced, and the pulp is improved by having greater strength and lower shive content. In this way, the chemical potential of sodium hydroxide is realized more fully, and the long fiber content is better preserved.

The APMP process, like conventional CMP or CTMP, consists of two primary components—impregnation and refining. During the impregnation stage, chips are steamed, pressed, chemically impregnated, and retained in the reaction bin to allow the chemical reactions to run to completion. Fiberization and fibrillation are completed with conventional atmospheric refining. The key to the success of any APMP process lies in chip impregnation. The goal at the impregnation stage is to achieve the best efficiency with the chemicals used. These chemicals include not only caustic and peroxide chemicals but stabilizers including DTPA, Sodium Silicate and Magnesium Sulfate (Epsom salt). The optimization of the conditions depends on the wood species and the requirements for pulp quality. Careful selection of species ensures the high brightness product unless reaching to the target brightness is not feasible.

Two APMP pulp mills were delivered to Iran by Andritz AG, Vienna, Austria to Gharb Paper Industries (GPIC), Bakhtaran Province and Maragheh Paper Industries (MPIC), Azarbayejan Province with the production capacity of 50000 ton/year from

which the latter was successfully started up in 2006. The mill has been designed to produce writing and printing grades. The mill process variables have been customized for two local selected species i.e. Populus alba and Populus nigra. Soon after the start-up and commissioning of the factory, use of other various Populus species and hardwoods other than the above mentioned ones became indispensible due to the lack of industrial plantation which high variation in the brightness level affected the market demand for the final product. Moreover, lack of an industrial production plant for any of the chemicals used (except Sodium Hydroxide) escalated the shipping and handling problems increasing the production costs. This paper reports the mill trials carried out in MPIC to modify the process for the production of corrugating medium.

2 Materials and Methods

Table 1. ISIRI number 3488- Corrugating Meduim Paper; Properties and Test Methods.

Basis Weight (gr/m^2)	Caliper (mm)	MD Breaking Length (Km) *	CD Ring Crush Test (N)	Concora Medium Test (N)	Air Resistance (S) *	Moisture Content (%)	Water Capillary Absorption (mm)
115	0.19 -0.23	4	125	177	35	8 ± 1.5	0
120	0.20 -0.24		129	184	40		
125	0.21 -0.25		135	190			
160	0.26 -0.31		204	240	45		
180	0.29 -0.34		229	269			
* Minimum values							

A mixture of Populus species including P. alba, P. nigra, P. euroamerican and P. deltoids chips was selected to supply the pulp mill. No certain selection for the Populus alba and Populus nigra applied as the pulp mill was designed for. PulpExpert PEX131 supplied by Andritz, recorded the results of the process modification on the strength properties excluding RCT and CMT which were determined separately according to Tappi standards. The target was to reach to minimum requirements for the corrugating medium as specified by the institute of standards and industrial research of Iran, ISRI number 3488 (table 1).

2 Results and Discussion

The standard consumption of chemicals in MPIC formulated by Andritz AG is presented in table 2.

Table 2. Standard Consumption of Chemicals in Maragheh Paper Industries Company (MPIC), Azarbayejan, Iran.

Chemicals → / Process ↓	H2O2 (Kg/AD MT) *	NaoH (Kg/AD MT)	Na2Sio 3 (Kg/AD MT)	DTPA (Kg/AD MT)	Epsom Salt (Kg/AD MT) ×
Impregnation No. 1	20	45	18	3	1.5
Impregnation No. 2	25	30	17	2	1

*Air Dried Metric Ton APMP Pulp;
× Magnesium Sulfate, the application ceased after start up according to Andritz's process modification.

Table 3. Results Obtained with and without the Presence of Bleaching-enhancing Chemicals in the Standard Consumption of Chemicals.

	Freeness (CSF)	Brightness (%)	Tensile index (Nm/g)	Breaking Length (Km)	Ring Crush Test (N)	Concora Medium Test (N)	Air Resistance (S)
With bleaching enhancing chemicals	215	70.5	49.6	5.10	122	195	43
no bleaching enhancing chemicals	236	37.8	48.5	4.95	119	180	38

The main objective was the production of a modified refiner mechanical pulp with solely NaOH usage. According to the standard consumption of chemicals, two pulp mill trials with the presence of bleaching-enhancing chemicals and without the bleaching-enhancing chemicals keeping constant the other production variables were studied. The results determined by PulpExpert PEX131 and laboratory measurements are demonstrated in table 3.

Table 4. Response of Pulp Physical and Mechanical Properties to Different Alkaline Dosages.

Analysis ↓	Treatment →	56 (Kg/ADMT)	75 (Standard)	86 (Kg/ADMT)
Freeness	ml, cs	236	236	202
Air Resistance	Gurley, s	50	38	35
Burst Index	Kpa.m2/g	1.08	2.06	2.87
Tear Index	mN.m2/g	3.22	4.49	5.06
Tensile Index	N.m/g	28.2	48.5	64.3
stretch	%	1.13	1.45	2.12
TEA	J/m2	13	27	53
Ring Crush Test	(N)	116	119	145
Concora Medium Test	(N)	170	180	210
Scattering Coefficient	Cm2/g	613	533	407
Brightness	T 525, %	39	37.8	35
Specific Energy	(KWh/ADMT)	1200	1100	950

As indicated in table 3, presence of bleaching-enhancing chemicals affected slight improvement in the physical and mechanical properties of the pulp. The authors failed to find evidence explaining this effect, however, coagulation effect of chelating agents for extractives, metal ions and other contaminants should increase the effectiveness of sodium hydroxide functionality to soften the fibers and subsequently preserve the long fiber content. Also, table 3 suggests that removing the bleaching-enhancing chemicals diminishes some physical and mechanical properties below the

required range outlined in the Iranian corrugating standard (table 1). In order to compensate the inferior physical properties and to clarify the alkali charge effect, two alkaline dosage ranges, 56 and 86 Kg/ADMT were corresponded to standard alkaline dosage of 75 Kg/ADMT (table 4).

Reduction of alkaline charge in no-bleaching-enhancing chemical treatment to 56 Kg/ADMT deteriorated the pulp properties far below the standard specifications with the increase in specific energy consumption corresponding to 1200 KWh/ADMT. Charge of 86 Kg/ADMT alkaline improved the physical properties and reduced specific energy consumption to 950 (KWh/ADMT).

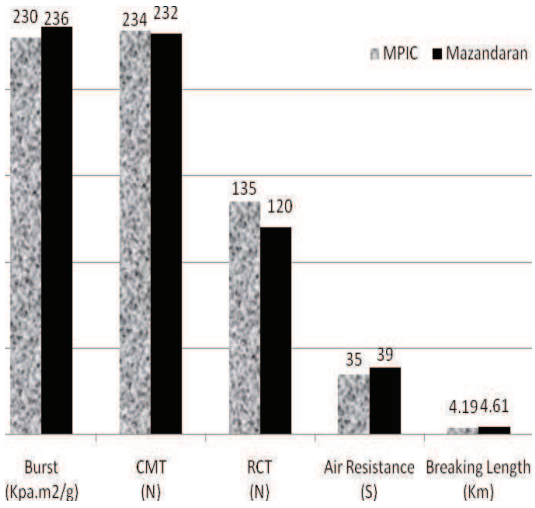

Fig. 1. Comparison of paper properties between the two packaging papers produced in MPIC and Mazandaran.

A comparison of paper properties between the two packaging papers produced in MPIC and Mazandaran Wood and Paper Company is shown in fig 1. As evident from the figure, the properties of paperboard produced in MPIC are almost identical or superior to the properties of the corrugating medium produced in Mazandaran Wood and Paper Company.

Conclusion

The results from this investigation demonstrated that APMP can be utilized as an alternative to produce standard quality packaging pulp and paper other than the printing purposes using less production costs and with properties comparable to the packaging paperboard of Mazandaran Wood and Paper Company.

Acknowledgments. The authors would like to thank Maragheh Paper Industries Company for the kind support in the production trials.

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