Improvement In Optical And Print Properties Of Coated Recycled Board Used For Packaging

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ABSTRACT

In paper industry, filler is the second most commonly used raw material after cellulosic raw materials. Different types of fillers are being used in the papermaking process viz. GCC, PCC, Talc, Clay etc. These fillers are commonly used to improve the optical properties of paper while reducing the papermaking cost. These fillers attribute brightness, whiteness, opacity, smoothness, porosity and hydrophobicity to paper. Similarly in coating application, pigments also exhibit similar properties to coated paper. The coating of paper reduces the total cost and significantly improves the paper properties including printability. The other method to reduce the cost is through use of recycled fibre in papermaking and its use as base for coating application. Use of recycled fibre is of increasing interest not only because it is environmental friendly but also for many other reasons. The brightness of high quality recycled paperboard is very important and the coated paper manufacturers always have keen interest to search new ways to increase the optical properties of coated paper with reduced overall production cost. The present study presents the dosage optimization of different pigments used in coating recipe for improving the optical properties of coated recycled board. The results revealed that optimization of pigments is able to improve the optical properties and printability of coated recycled board and also help in reducing the production cost.

Key words: *Pigment, Coated recycled board, Brightness, Whiteness, Printability.*

INTRODUCTION

The competition in the global paper market has increased due to increasing demand of coated paper. The price and quality of paper in present scenario have been a major issue and cause of concern to the manufacturer. Like other technological development, coating formulation too has undergone a sea change; new ingredients and processes have been introduced. Periodical review of all the formulations is desired to get the benefit of advancement in quality of ingredients and associated cost to have improved quality of coated paper at a competitive price. The other method to reduce the cost is through use of recycled fibre in papermaking and its use as base for coating application. The demand for recycled raw material is increasing as available wood resources in natural forests are declining (1). A large number of other factors also contribute to the feasibility of incorporating recycled fibre into various packaging applications. These factors vary based on the quality & consistency of the recovered fiber and the treatment of the fiber during the conversion process desired for packaging.

Most of the coated paper produced globally is multicoated with two or three coating layers applied to each side of paper. The first layer provides physical coverage of the base

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sheet while the top layer provides surface finish and printability (2). In first layer i.e. precoat, coarse & less expensive ground calcium carbonate (GCC) is generally used as pigment, while in the top layer i.e. topcoat, combinations of finer GCC and clay are used. Whether the formulation is precoat or topcoat, all coating formulations contain different pigments, polymeric emulsion rheology modifier, insolubilizers, optical whitening agents etc. (3-8). As the trend of using recycled fibre is increasing in coating application, it is of vital importance to establish the most effective coating formulation for maintaining the desired coated recycled board properties (9).

The purpose of this study is to investigate the effect of various pigment systems in precoat and topcoat coating formulation on rheological properties of coating color. This study will also help us to understand the effect of different coating formulations on final coated recycled board properties.

EXPERIMENTAL

Preparation of coating formulation

The conventional method was used for the preparation of coating formulation in laboratory while maintaining the desired solids and low shear viscosity. All the ingredients were added on the basis of percent OD weight of pigment. The coating formulations prepared using GCC and clay in ratio 100:0 and 50:50 were selected as control for precoat and topcoat formulations, respectively. Coarser grade GCC & clay and finer grade GCC & clay were used in precoat and topcoat formulations, respectively. The parts of clay were increased in precoat formulation while same was reduced in topcoat formulations. *The attempts were made to adjust the viscosity of coating color for all the trials in the range of 1100±100 cP at 100 rpm by increasing the solids level or parts of rheology modifier in coating formulation. The other coating ingredients were kept constant for all the trials.*

Determination of properties of coating color

The low shear viscosity of coating color was measured at 100 rpm using BF viscometer. The pH of the color was measured using conventional pH meter. Solid content of the coating color was determined as per standard test method. Water retention value was measured on AAGWR water retention meter as per Tappi Test Method T 701.

Paper coating and evaluation

The coating color was applied on the recycled board sheets of 285 g/m^2 using an automatic laboratory bar coater (RK print coater). The sheets were preconditioned for 24 h at 27 ^{0}C and 65% relative humidity. The coating amount was adjusted using bars of different numbers and coat weight was maintained to 14-15 and 10-11 g/m^2, respectively for precoat and topcoat application. The coated board sheets were immediately placed for drying for 60 s in an oven maintained at 105 ^{0}C. The coated recycled board sheets were supercalendered through soft nip on plant scale supercalender to achieve the desired properties.

Basis weight of coated sheets was measured as per Tappi Test Method T 410 om-98. Thickness of coated sheets was measured on L&W thickness tester as per Tappi Test Method T 411 om-94. Gloss of the coated sheets was determined on Hunter lab gloss meter as per Tappi Test Method T 480 om-92. Optical properties of coated sheets were determined by using brightness tester as per Tappi Test Method T 452 om-92. The pick value was measured on IGT printability tester. Print gloss was measured on IGT printability tester as per instrument manual.

RESULTS AND DISCUSSION

The recycled board sheets of 285 g/m^2 (bulk: 1.30; brightness: 61 %ISO and whiteness: 78) were used for coating application. The present study was carried out using GCC:clay ratios as 100:0 and 50:50 for precoat and topcoat

Table 1: Coating Formulations

Ingredients in parts	Precoat Trials					
	A	B	C	D	E	F
GCC	100	85	75	65	55	50
Clay	Nil	15	25	35	45	50
	Topcoat Trials					
	G	H	I	J	K	L
GCC	50	55	65	75	85	100
Clay	50	45	35	25	15	Nil

coating formulation, respectively. The precoat and topcoat formulations were applied to recycled board to achieve the desired coat weight. All the lab coated sheets under trial were supercalendered under similar conditions for comparison purpose.

Effect of increased parts of GCC in topcoat coating formulations on coated recycled board properties with constant ratio of GCC and coating clay (100:0) in precoat formulation

In topcoat trials, GCC parts were increased from 50 to 100 in coating formulation and the impact on final coated board quality was observed. The final coated board properties in terms of brightness, whiteness, gloss and print gloss after same precoat application with different topcoat formulations are given in figure-1. The brightness of coated sheet was increased marginally while increasing the GCC parts in topcoat coating formulation. This may be attributed to increasing parts of GCC in topcoat formulations. The other reason may be attributed to the fact that same bulk was maintained for coated recycled board by applying less linear pressure during supercalendering as this property has direct impact on stiffness of coated board. Similarly, whiteness was increased by 5.0 points. It was observed that the gloss of coated recycled board reduced drastically from 57 to 43% while increasing GCC from 50 to 100 parts in topcoat formulations in different trials with same precoat. The initial value of gloss also had an impact on print gloss of coated recycled board. The results of the study revealed that increasing GCC parts in topcoat formulations had positive impact on the brightness, whiteness while negative impact on gloss, print gloss and smoothness of coated recycled board with same precoat formulation containing GCC:clay as 100:0 . The surface strength in terms of IGT pick value was improved because of low parts of finer grade coating clay in coating formulation.

Effect of increased parts of GCC in topcoat coating formulations on coated recycled board properties with constant ratio of GCC and coating clay (85:15) in precoat formulation

In this study, the topcoat formulations were same as discussed earlier. The GCC:clay in precoat formulation was changed from 100:0 to 85:15 . The final coated board properties are given in figure-2. Again the brightness and whiteness of coated sheet was increased while increasing the GCC parts in topcoat coating formulation because of similar reasons. On comparing the gloss of coated recycled

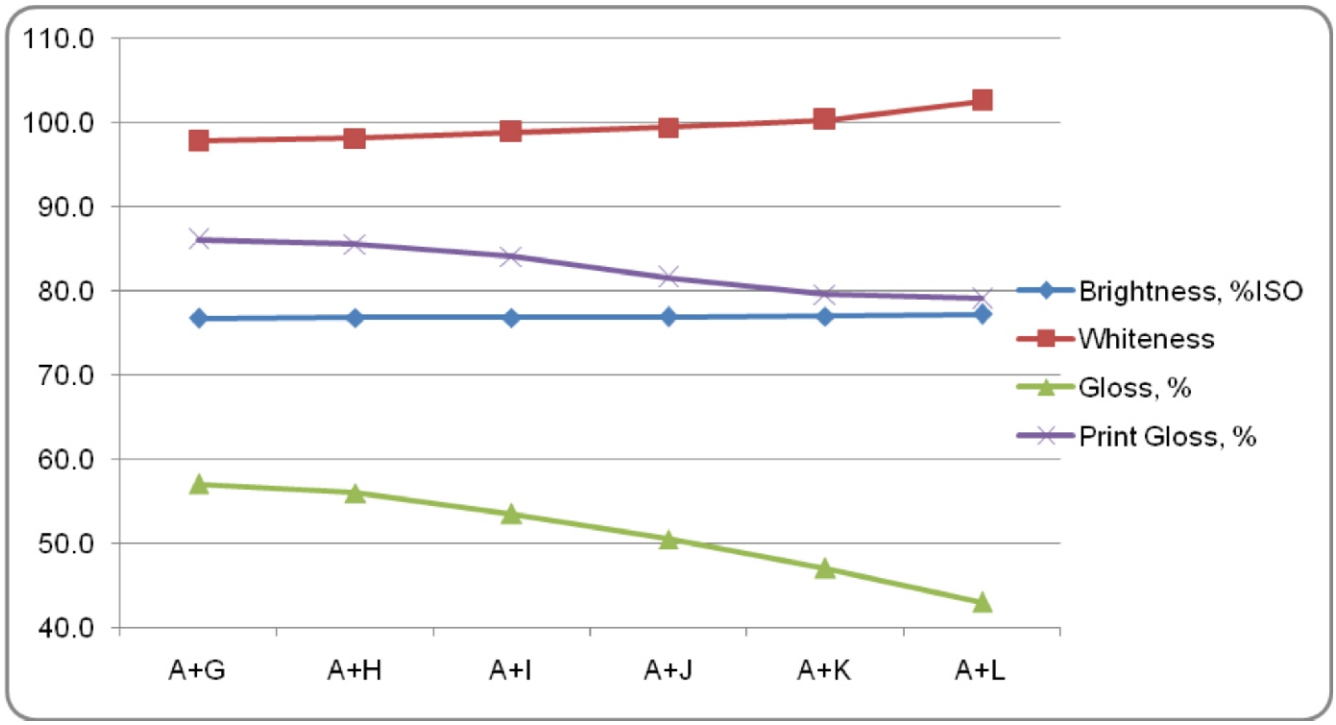

Figure-1: Coated recycled board properties with variations in GCC & clay in topcoat formulations having same precoat (100:0)

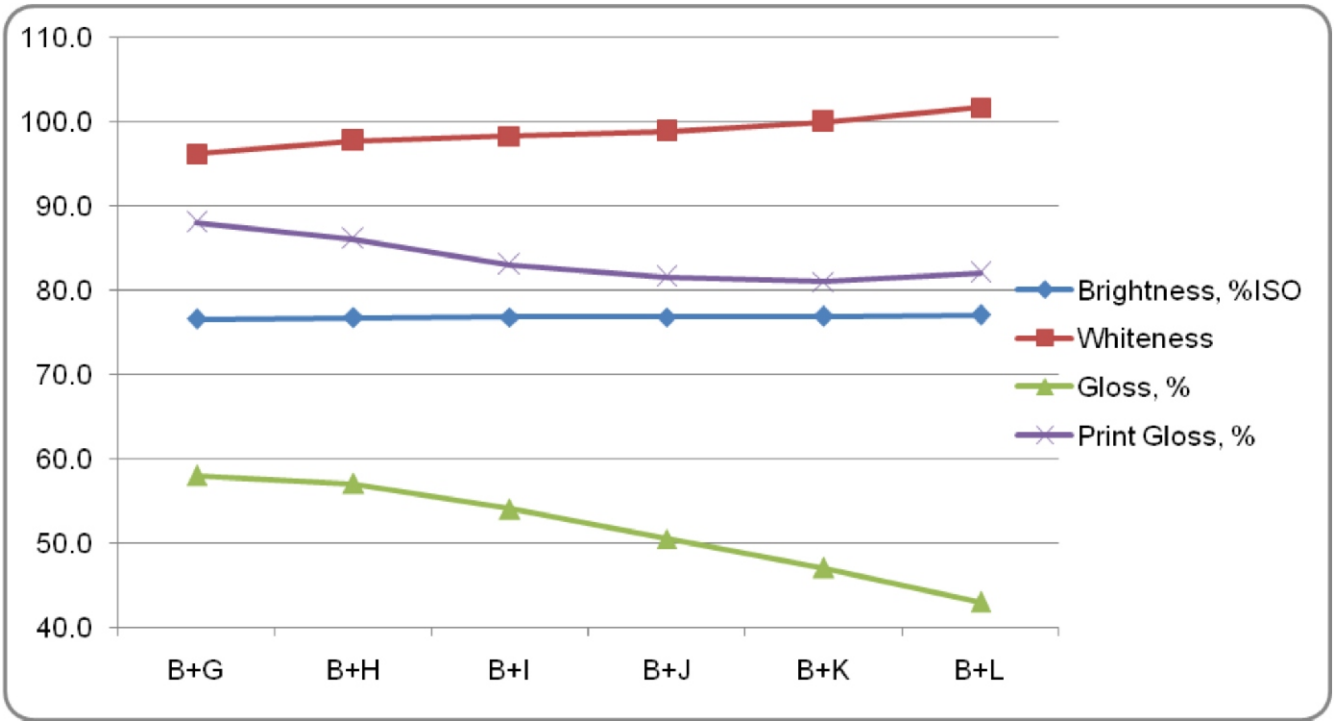

Figure-2: Coated recycled board properties with variations in GCC & clay in topcoat formulations having same precoat (85:15)

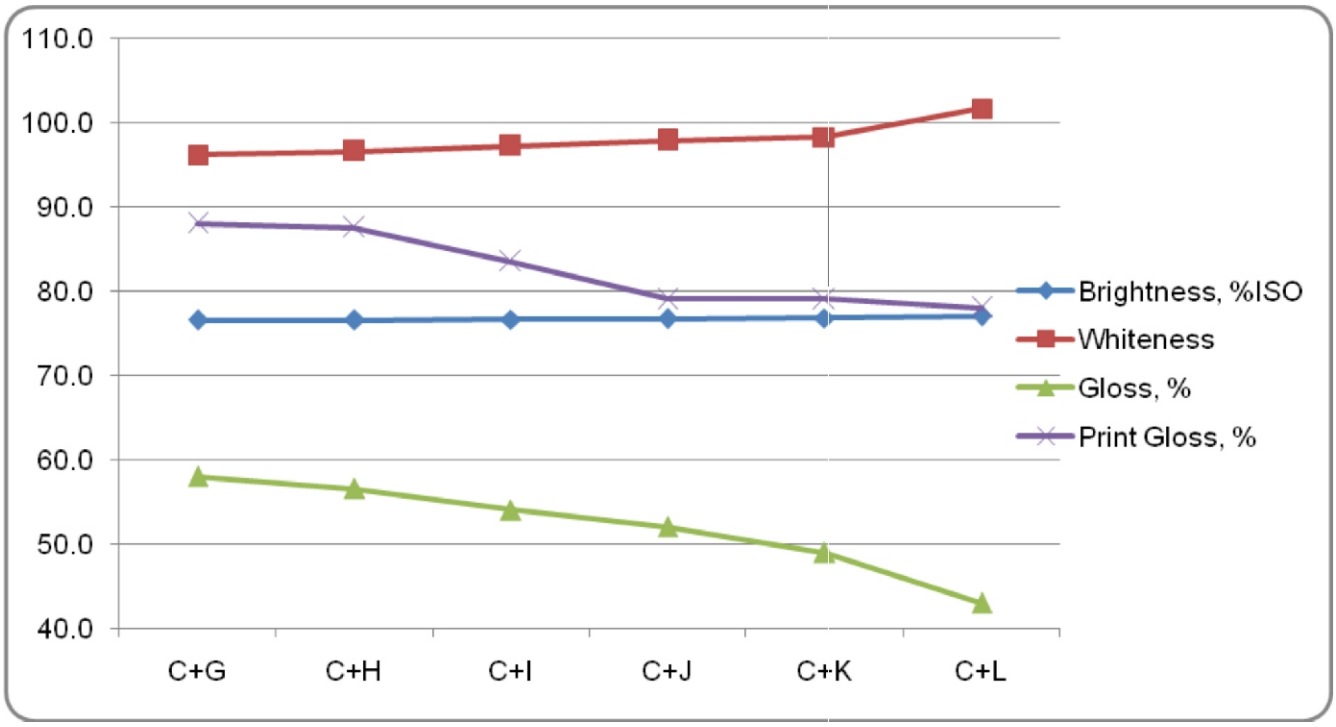

Figure-3: Coated recycled board properties with variations in GCC & clay in topcoat formulations having same precoat (75:25)

board, it was reduced from 58 to 43% while increasing the GCC from 50 to 100 parts in topcoat formulations in different trials with same precoat.

Effect of increased parts of GCC in topcoat coating formulations on coated recycled board properties with constant ratio of GCC and coating clay (75:25 to 50:50) in precoat formulation

In this study also the topcoat formulations were same as

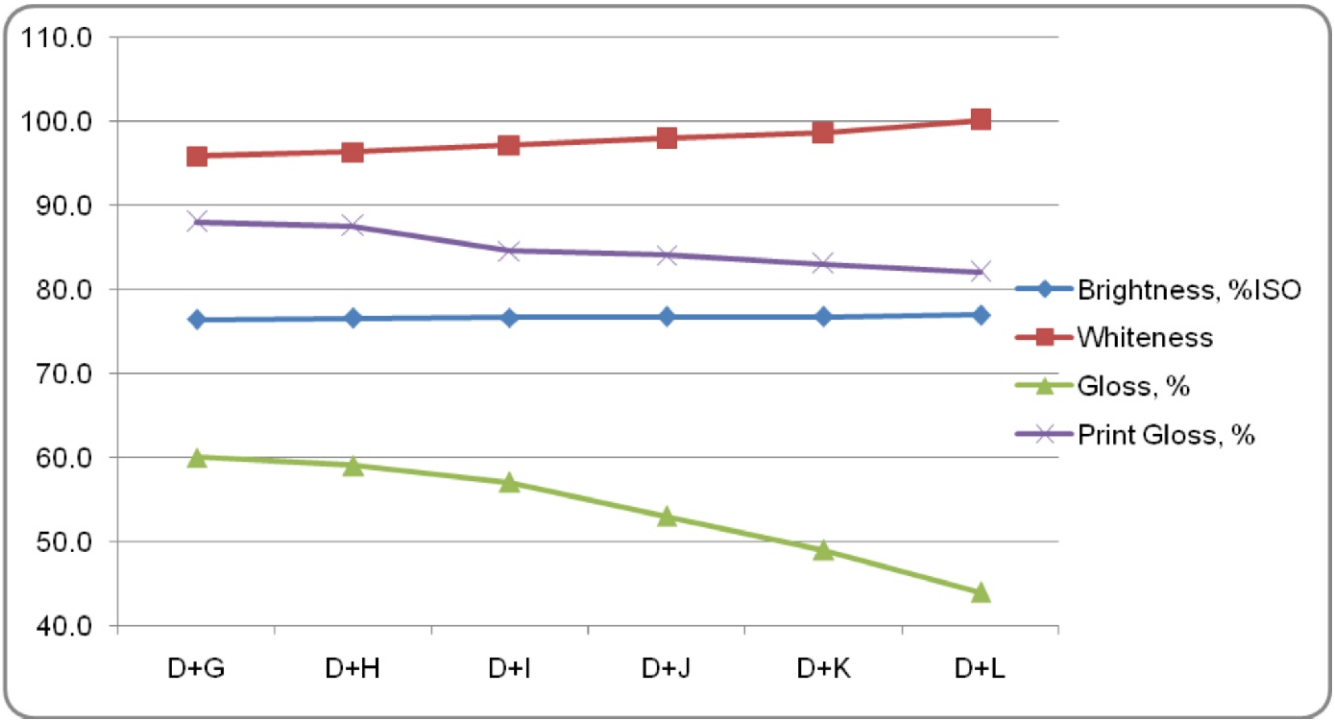

Figure-4: Coated recycled board properties with variations in GCC & clay in topcoat formulations having same precoat (65:35)

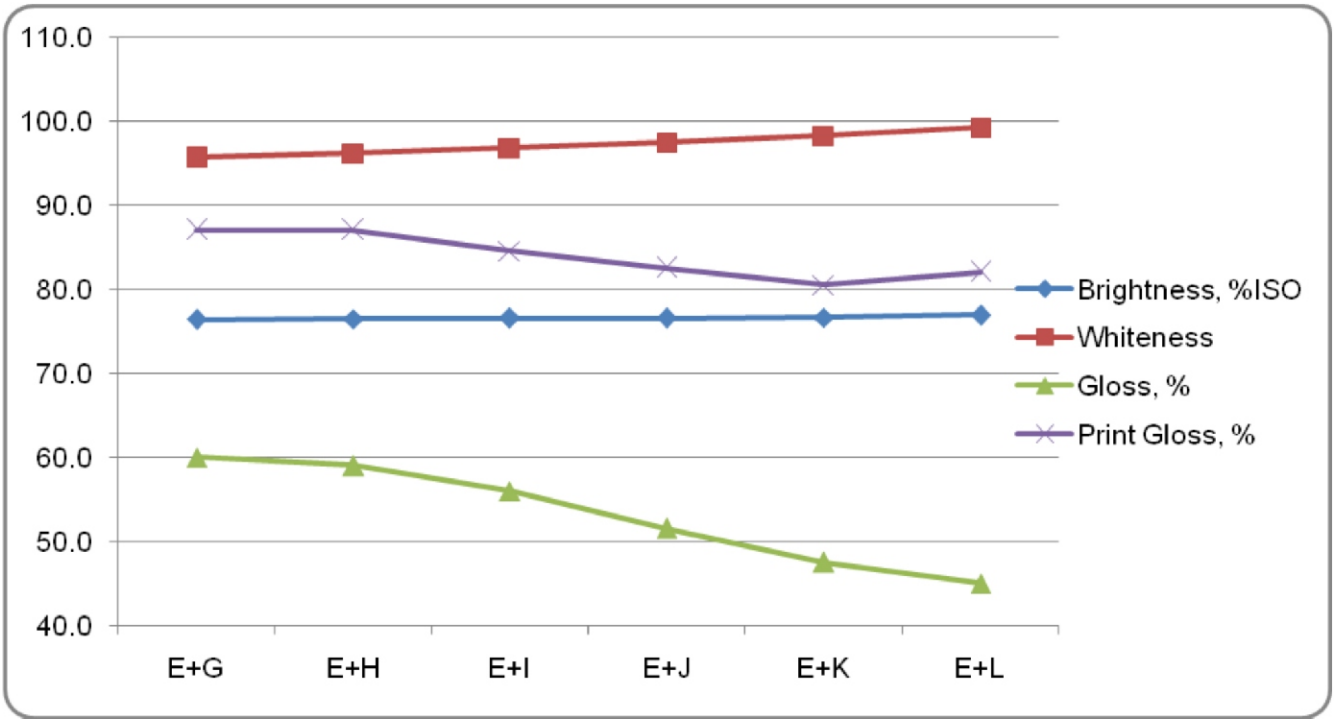

Figure-5: Coated recycled board properties with variations in GCC & clay in topcoat formulations having same precoat (55:45)

discussed earlier while in the precoat formulations, clay was increased to 50 parts as compared to nil in control. The final coated board properties are given in figure-3-6. Again the brightness and whiteness of coated sheet was increased while increasing the GCC parts in both precoat and topcoat coating formulations. The gloss of coated recycled board was also found reduced with same topcoat while the gloss was higher with 50:50 ratio of GCC:clay as compared to 100:0 in precoat formulation. The results revealed that clay in precoat formulation also has slight impact on optical

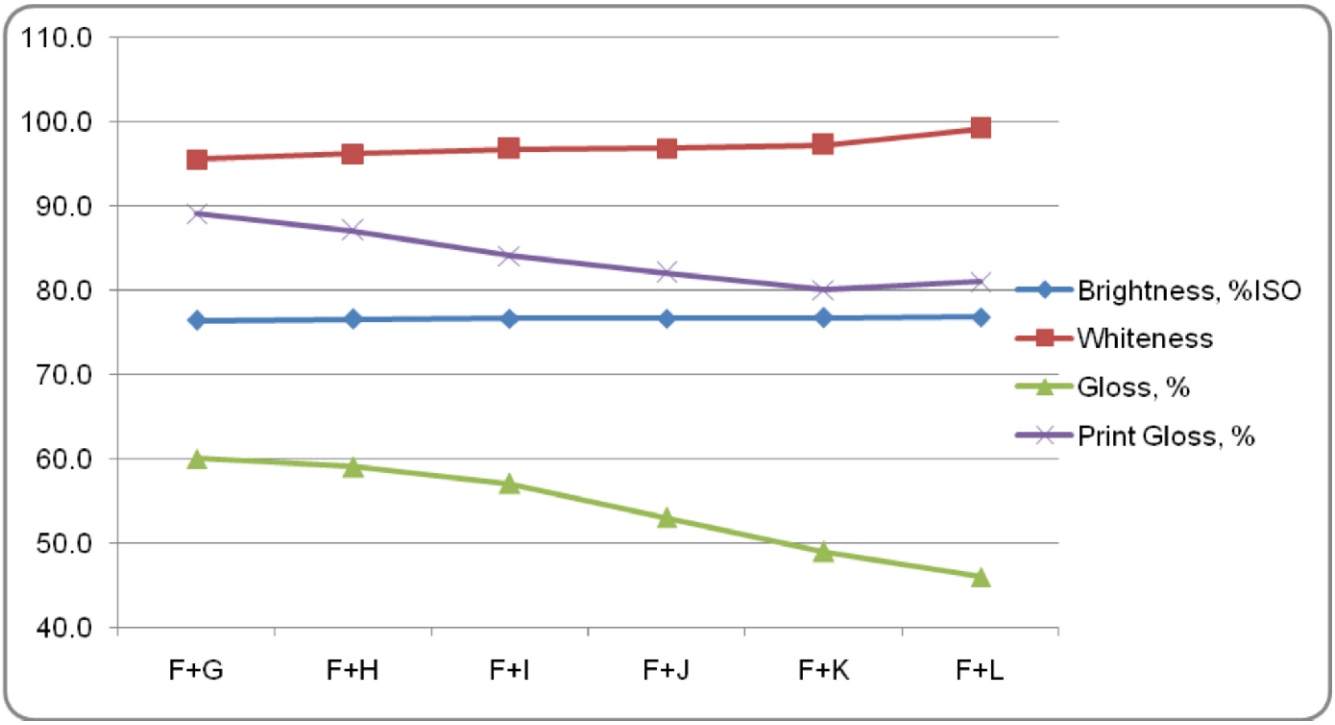

Figure-6: Coated recycled board properties with variations in GCC & clay in topcoat formulations having same precoat (50:50)

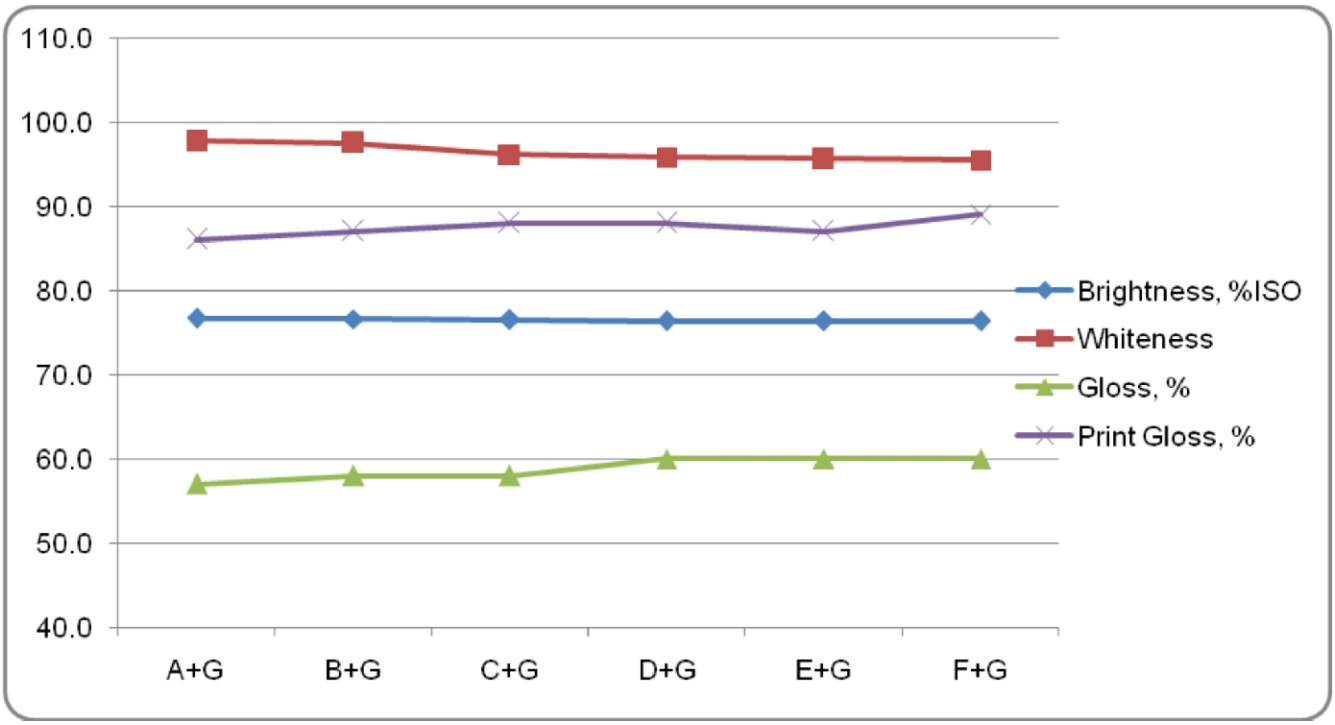

Figure-7: Coated recycled board properties with variations in GCC & clay in precoat formulations having same topcoat (50:50)

properties of final coated board quality as well on coverage.

Effect of reduced parts of GCC in precoat coating formulations on coated recycled board properties with constant ratio of GCC and coating clay (50:50) in topcoat formulation

In this study the GCC parts were reduced from 100 to nil in

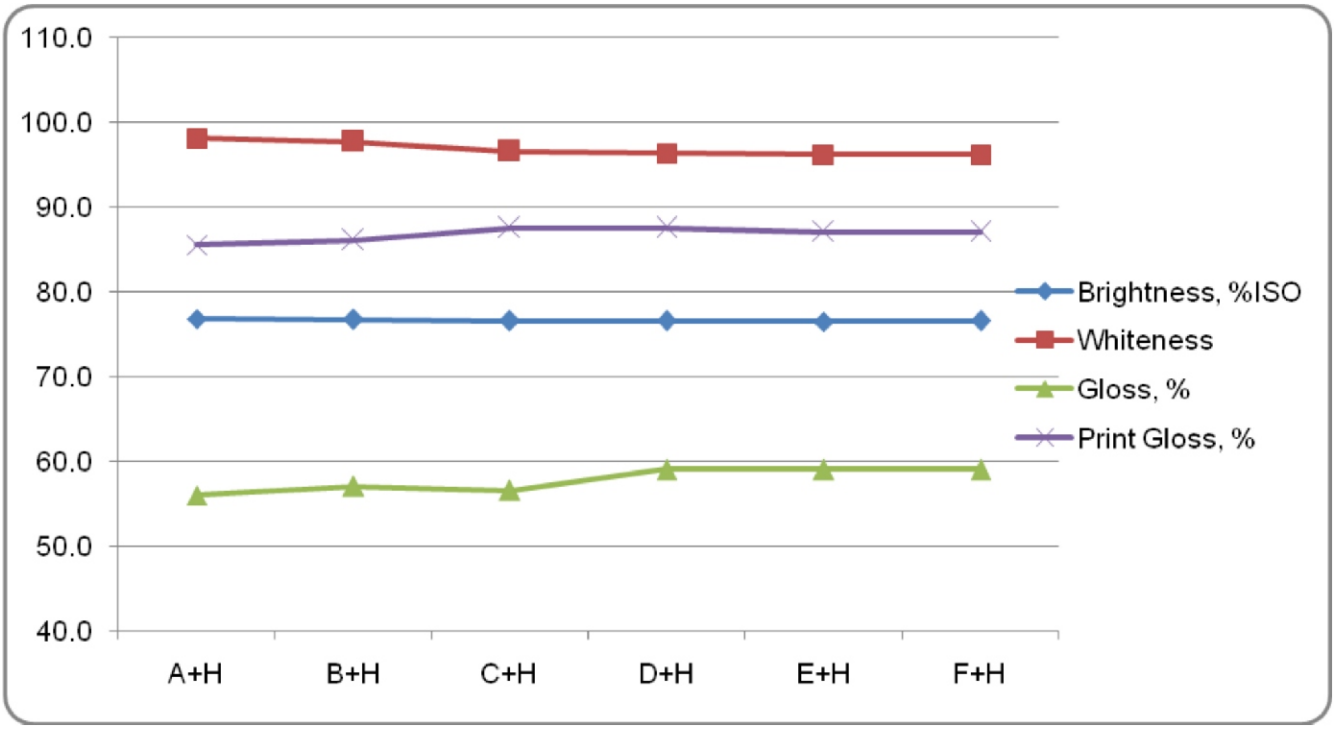

Figure-8: Coated recycled board properties with variations in GCC & clay in precoat formulations having same topcoat (55:45)

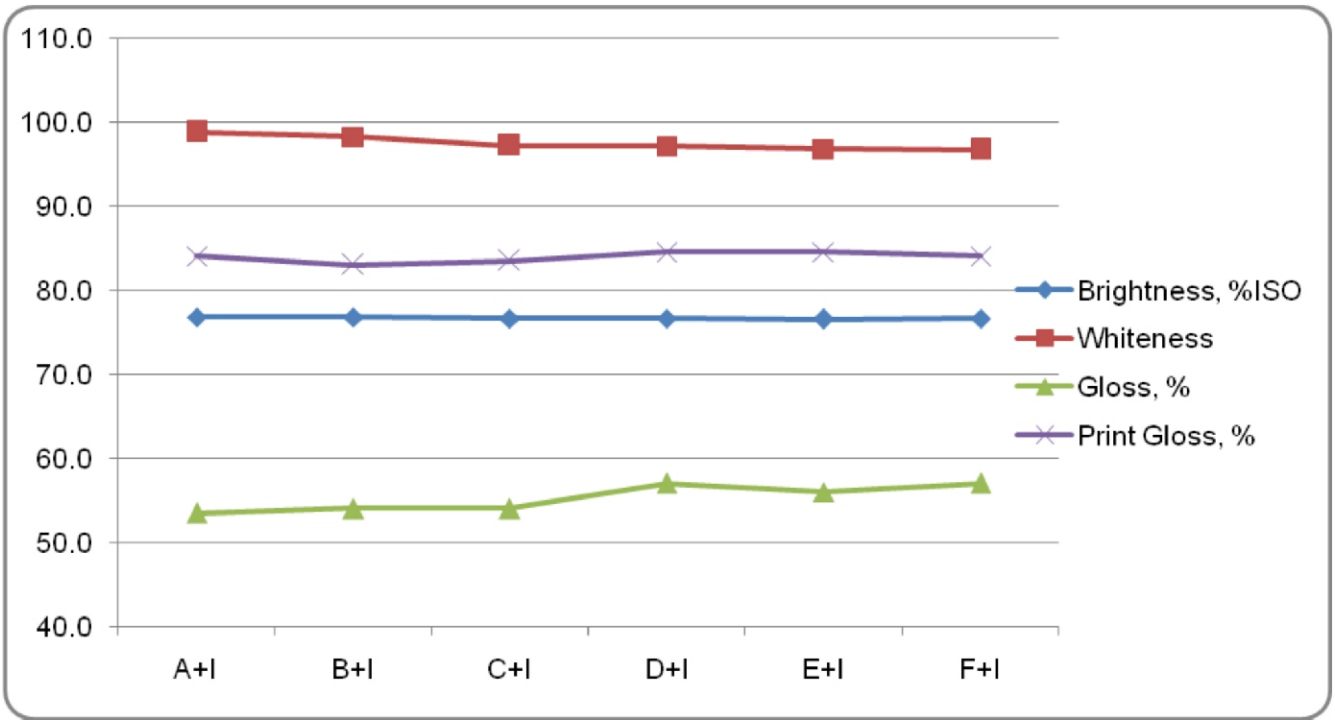

Figure-9: Coated recycled board properties with variations in GCC & clay in precoat formulations having same topcoat (65:35)

precoat coating formulations while the topcoat formulation was same i.e. 50:50 ratio of GCC:clay and the impact on final coated board quality was observed. The final coated board properties in terms of brightness, whiteness, gloss and print gloss after same topcoat application with different precoat formulations are given in figure-7. The brightness of coated sheet was reduced slightly while reducing GCC parts in precoat coating formulation. This reduction in

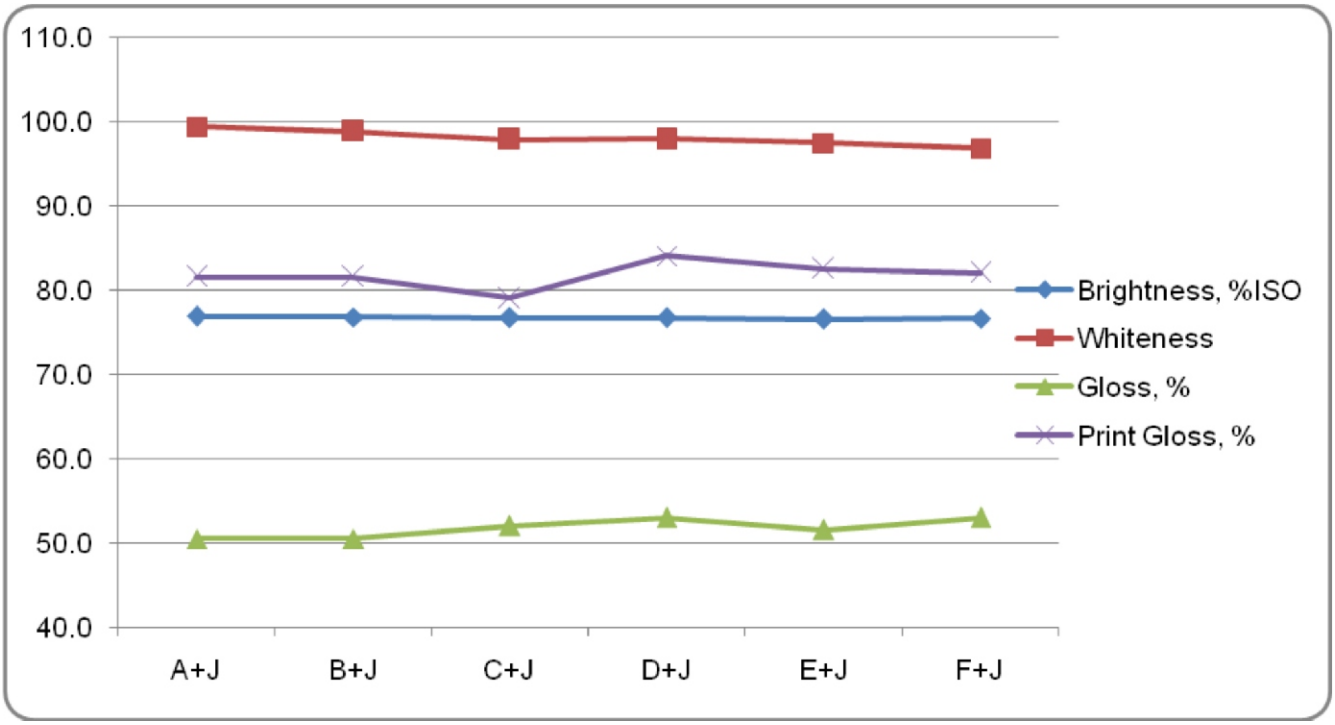

Figure-10: Coated recycled board properties with variations in GCC & clay in precoat formulations having same topcoat (75:25)

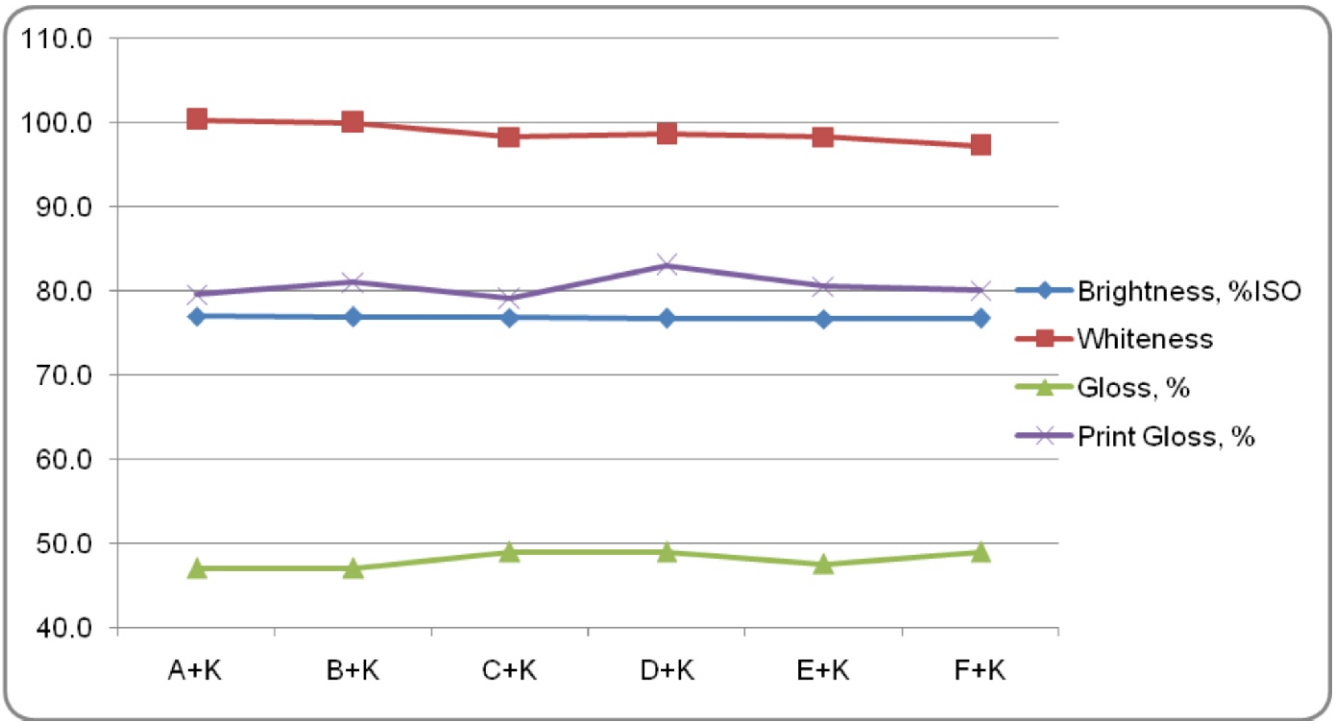

Figure-11: Coated recycled board properties with variations in GCC & clay in precoat formulations having same topcoat (85:15)

brightness may be attributed to the increasing parts of clay in precoat formulations. Similar impact was observed in whiteness of coated recycled board. As the topcoat was same and precoat formulations were having higher parts of clay, the gloss was improved from 57 to 60%. The increment in gloss was lower (only 3%) while the same was very high if the same amount of the clay was added in topcoat formulations (figure: 1-6). The initial value of gloss also had

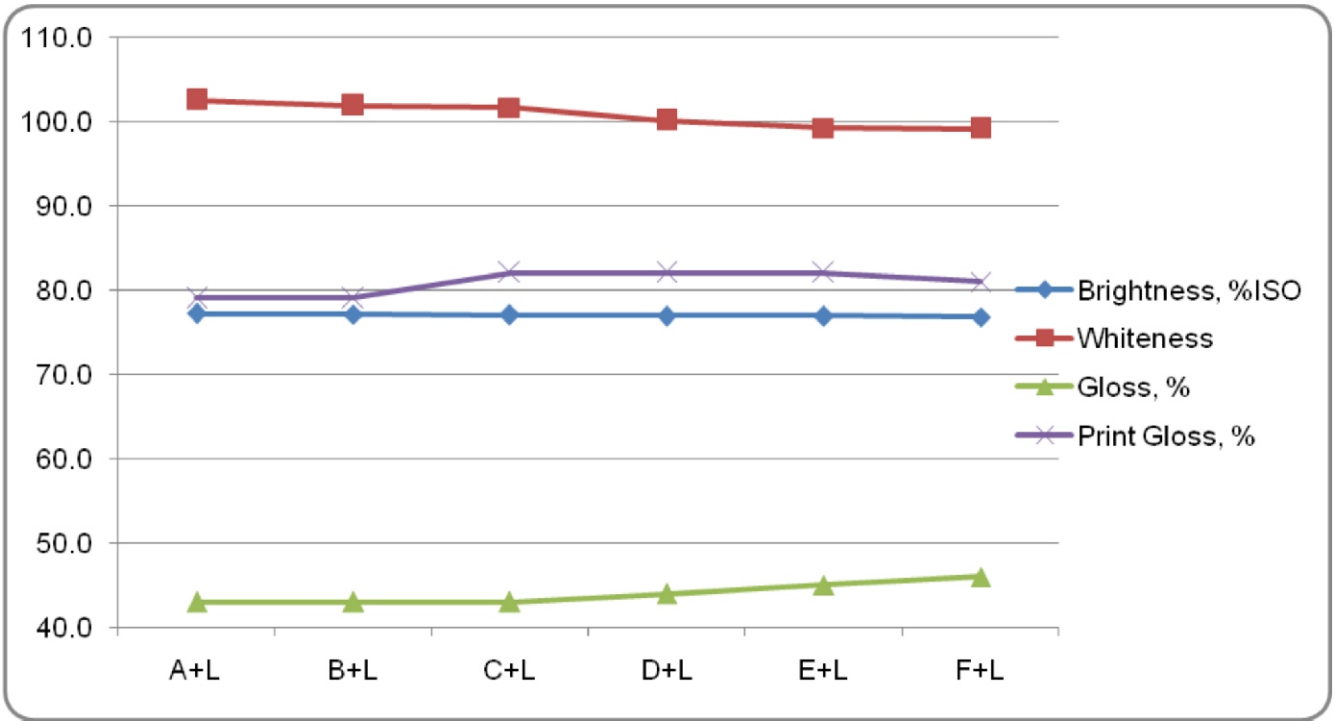

Figure-12: Coated recycled board properties with variations in GCC & clay in precoat formulations having same topcoat (100:0)

an impact on print gloss of coated recycled board. The results of the study revealed that reduction in GCC parts in precoat formulations has negative impact on the brightness, whiteness while positive impact on gloss and print gloss of coated recycled coated board with same topcoat formulation containing 50:50 ratio of GCC:clay. No much variation was observed in the surface strength as observed in terms of IGT pick value.

Similar trends were observed when the GCC parts were increased in precoat formulations at constant parts of GCC & clay in topcoat formulation. All the results in terms of brightness, whiteness, gloss and print gloss are shown in figure 7-12.

Potential aspects for mill scale application

The production of paper and board packaging using recycled fibre requires significantly less energy and other chemicals as compared to conventional woody material. Paper packaging is versatile, relatively inexpensive and easily biodegradable as compared to other poly-packaging. With the coating application, making paperboard more aesthetic, better printability and other barrier properties could be obtained. For this the selection of different ingredients and their dosages in coating color are of prime importance. Even change in one ingredient will cause impact on coating color rheology, machine runnability and final coated board quality. Papermakers have been using same coating color formulation for so many years for manufacturing coated paper or paperboard quality. The formulation needs to be optimized based upon the coated paper quality and cost competitiveness. The present laboratory study will help the mill to address issues related to rheology and machine runnability and manufacture coated recycled board of desired quality.

CONCLUSIONS

The parts of different pigments in topcoat coating formulation have great impact on optical and print properties of coated recycled board. On increasing the GCC parts in topcoat formulation, there is improvement in surface strength indicating possibility of reducing polymer emulsion and thus the overall cost. The pigment ratio i.e. GCC:clay can be changed depending upon the customer requirements/ final coated recycled board quality. The attempts should be made to increase the solids level of the coating formulation for better properties of coated board and cost reduction. Depending upon the requirement and end use, such coated recycled board can be used for packaging applications.

REFERENCES

1. S. Y. Wang, T. H. Yang, L. T. Lin, C. J. Lin and M. J. Tsai (2008). Fire retardant treated low formaldehyde emission particleboard made from recycled wood-waste, Biores. Tech., 99, 2072-2077.

2. J. Li, P. A Tanguy, P. J. Carreau and M. Moan (2001). Effect of thickener structure on paper coating color properties, Colloid. Polym. Sci., 279, 865-871.

3. G. M. Laudone, G. P. Matthews and P. A. C. Gane (2006). Modelling the shrinkage in pigmented coatings during drying: a stick−slip mechanism, J. Colloid. Interface Sci. 304, 180-190.

4. H. Nisogi, D. W. Bousfield and P. F. Lepoutre (2000). Influence of coating rheology on final coating properties, TAPPI J. 83(2), 100-106.

5. K. Rissa, T. Lepisto, and K. Yrjola (2006). Effect of kaolin content on structure and functional properties of water-based coating, Prog. Org. Coat. 55, 137-141.

6. A. K. Singhal, S. Kumar, S. Gupta, N. K. Bhardwaj and R. Varadhan (2015). Calcium sulphate as pigment for improved functional properties of coated paper, Prog. Org. Coat., 79, 31-36.

7. N. Kumar, S. Kumar, N. K. Bhardwaj and R. Varadhan (2014). An approach to achieve high solids coating, IPPTA, 26(2), 96-99.

8. S. Kumar, N. Kumar, N. K. Bhardwaj and R. Varadhan (2013). Better coated paper quality at low cost with a new additive in coating recipe, Paper India, 16(5), 10-14.

9. A. B. James and J. W. Ramp (1991). Recycled coated paperboard formulations, coating equipments and their relationship to printing properties, Proc. Tappi Coating Conference, 39-49.

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