Role of Paper in Laminate Industry

S. R. Gupta
S. M. Chatterjee
S. W. Patwardhan

Introduction

Plastics, a group of material to which laminates belong, introduced during the last century and a half have not only challenged the conventional materials for their well established uses, but also made possible new products which have already expanded the limit of activity of mankind without which the modern living today could not have been so colourful and comfortable. The major growth of plastics industry started after 1930 and within two decades a number of thermoplastic materials of variable properties were added to its range leading to the growth of plastics in the world market from 300,000 Tonnes in 1939 to 18 million tonnes in 1967, after which the growth has been phenomenal.

Decorative and Industrial Laminates

Laminates, an important member of the plastic family, used for Decorative and Industrial purposes, are a particular type of reinforced plastics consisting of super-imposed layers of reinforcing materials that have been impregnated with a resin binder and cured under heat and pressure.

Decorative Laminates are relatively thin, rigid, hard sheet materials faced with decorative colour patterns and bonded to structural cores. These decorative surfaces are highly resistant to damage, unaffected by boiling water and common house-hold chemicals, shows good resistance to stain and cigarette burns and can provide very flat dimensionally stable surface in varying finishes.

Industrial Laminates are produced to perform specific job functions requiring materials with pre-determined balances of mechanical, electric, electronic and chemical properties. These properties are produced in a laminate by altering the type and the properties of the reinforcements and binders.

Manufacturing Process

Before discussing the relation between the various properties of paper and the properties of the final laminate, it will be essential to describe very briefly the process of the manufacture of lamintes without which the role of the paper in the laminate industry may not be very clearly understood. Our discussion in this paper is mostly confined to the production of Decorative Laminates.

The theory of the prodution of Decorative Laminate is very simple and straightforward. First the reinforcement material paper is impregnated with a resin solution, generally phenolic or amino, and driven through an oven to drive off the solvent and partially cure the resin to a desired level. The three types of papers used are :

(a) *Kraft Paper* impregnated by phenolic resin and used for providing the core to the thickness of the laminate board.

(b) *White Background Paper* highly loaded with Titanium Dioxide for printing the Decorative pattern and impregnated with Melamine resin.

(c) *Overlay paper Alpha Cellulose* impregnated with Melamine resin to provide the top-most layer i. e. the resistant surface of the Decorative Laminate.

These are then assembled in the following order :

Overlay paper

White Background paper with pattern

Kraft paper (n. No.)

The above assembled pack is then pressed under high pressure and temperature between st iinless steel plates to produce the laminate.

S. R. Gupta, S. M. Chatterjee & S. W. Patwardhan
Formica India Limited, Akurdi, Poona-35

This paper was presented at Zonal Meeting of Ippta on 'Paper Conversion and uses' held at Bombay on Sept. 7 & 8, 1974.

4. Role of Paper :

Role of paper in the production of laminate both for Decorative and Industrial is most important as it forms more than 50% of the total weight of the finished laminate. The paper used in the laminate is either kraft, alpha, rag or blends of these. Kraft emphasises mechanical strength and to some extent di-electric strength. Alpha is used for its electrical and electronic properties, machinability and dimensional stability and uniform appearance.

The various properties of paper are discussed below :

(A) Kraft Paper (Unbleached)

This is used exclusively for cores in decorative grade and, therefore, its quantitative requirement outweigh that of the other two grades of paper.The following properties are of paramount importance for this grade of paper.

(a) **Absorbency**

This is the most vital characteristic as impregnation of paper with phenolic resin is a very critical operation. It is essential that resin solution must saturate and coat every bundle of fibre. If the absorbency is poor, resin does not penetrate but lies on the surface–thus inviting delamination, blister formation and similar failures after pressing.

However, if the absorbency is more than what is desired, it calls for the following complicated problems :

(i) The cost of production goes up substantially due to higher resin pick up.

(ii) In view of higher penetration, the operation of driving out the solvent becomes more difficult at the drying stage after impregnation which cuts down the machine speed by as much as 40%.

(iii) There are all the chances that the final boards will have brittleness, resin flashes and cannot be marketed.

The differential absorbency across the web leads to similar problems causing delamination, resin flashes etc. as the case may be.

(b) **Calipre Variation**

When a specific GSM of paper is asked for, it is extremely important to maintain the calipre variation within a tolerable limit, failing which the undernoted problems are bound to arise :

(i) If gsm is higher or lower, the final board will have different thickness. The ISI specification limiting the tolerance is very close and critical and, therefore, such boards will not find any use in the market, but have to be scrapped at the source itself.

(ii) If gsm is higher, it will require more resin for proper lamination, thus calling for high production cost.

(iii) If the gsm across the web varies, the resin treated paper will obviously give differential thickness across the width–laminated boards manufactured from such sheets will thus fail in thickness tolerance.

(iv) If gsm varies often, it would be essential to change the machine condition repeatedly to get the desired properties of the treated paper which, in turn, will lead to more scrap formation.

(c) **Formation**

For all practical purposes, the formation must be uniform. Otherwise, patchiness and similar defects are bound to result after resin impregnation. This invites brittleness, resin flashes, blister formation etc.

(d) **Wet Tensile Strength**

This property determines the ability of paper to withstand stress whilst under tension during impregnation in the wet state. If the wet strength is poor, the paper breaks immediately after dipping in the resin bath, thus causing frequent discontinuity of the run and aggravating scrap formation.

(e) **pH Value**

Acid or alkaline condition may alter the rate of cure of some resins giving rise to unpredictable impregnated paper properties. Hence the pH of the paper should be as close to neutral as possible.

B. White Background Paper

This paper is used as the background on which the various colour patterns are printed. It must therefore be receptive to the application of inks. It is

highly loaded with T_1O_2 to give it complete oapacity which prevents the possibility of the phenolic core showing through when placed in position as the surface sheet on top.

(i) Absorbency must be proper as the ink has to penetrate to some extent. Resin must penetrate in the fibres fully, otherwise improper lamination, blister formation etc. are unavoidable.

(ii) The cash content is very critical to impart the desired opacity, in the absence of which the core shadow appears on the surface of the print in the finished laminate.

(iii) Required extent of calendering is most desirable to yield the sharpness of prints.

(iv) **Appearance** : The paper must be free from dust, service and other foreign materials to avoid such appearance on the surface.

C. Overlay Paper

This is used as the topmost layer of decorative build up as overlay. Absorbency of the paper mus be sufficient to enable the resin to saturate the fibres and its wet strength should be sufficient to withstand the tension during the resin impregnation stage. It is also essential that it must be devoid of creases and foreign particles, otherwise, such defects will be clearly visible on the surface of the laminate.

The future of the laminate industry is very bright in India. It is interesting to note that within a short period from 1965 to 1971, the market for decorative laminate had expanded as much as 275%. Some of the uses are still to be fully exploited. For industrial laminates, the growth is directly related to the development of the Electronic Industry in the country, which is already expanding at a very fast rate.

From the above discussion, it is imperative to note that the quality of laminates is greatly dermined by the quality of paper which is used as reinforcement material. The role of paper Mills is, therefore, most important to produce the best quality of paper for this industry, which will greatly minimize scrap percentage which is a national wastage at the moment. For paper fault alone the scrap sometimes goes as high as 20% in the manufacturing process.

Formica India Limited has played a very important role in the development of suitable grades of papers for the laminate manufacture by co-operating with various indigenous paper Mills. The quality of the paper has improved, but still a great deal of work is necessary to bring it to a level of satisfactory standard. We are still importing some papers which are not being produced in the country. The quality of the imported papers is far superior to what is produced in the country, today.

It is high time that paper mills and laminate manufacturers go hand in hand and develop certain grades of papers which are still being imported into the country, thereby saving foreign exchange. Towards the attainment of this goal, Formica India Limited are willing to co-operate with the Paper Mills.