

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES SYNTHETIC PAPER A SUBSTITUTE OF CELLULOSE FIBER PAPER FOR PRINTING AND PACKAGING INDUSTRY: A REVIEW

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ABSTRACT

Synthetic paper is a type of calendared plastic sheet which is a unique mixture of Calcium-carbonate i.e. clay and polypropylene resin. This duo combination results in fabrication of paper with not only printing facility but also durability and tear resistance of plastic. In case of white opaque paper which is fine mat finish single-layered substrate has excellent bonding strength and facilitates superior ink adhesion characteristics. It is easily printable without any surface treatment. Another example in this category is Hop-Syn G2 synthetic paper. This paper is especially designed for printing of high quality and heavy gauge polypropylene. This offers excellent features required for packaging sector.

I. INTRODUCTION

Life span of this paper is long because of its synthetic nature and it can handle a lot of stress without tearing. This paper is water resistant and does not degrade in water because it lacks wood fiber. This paper can be folded without any cracking. Another specialty of this paper is dimensional stability. Some synthetic papers are heat resistant also. These all characteristics are ideal for publications that can be read in the bath, pool, spa or shower, and have been used in a number of such products. They can be safely used while boating, fishing, skiing, snowmobiling or scuba diving. They're ideal for instruction manuals for lifeguarding, first aid, emergency preparedness, mechanics or landscaping. Cookbooks and children's books are also good candidates, as they can be wiped clean. The stain resistant feature of this paper makes it ideal in food service industries. Because of its water resistant and tear resistant nature, it is used for specialty print and laminated materials, durable product labels and tag that stand up to punish environments. Synthetic paper is also used for laminated cards and key tags, secure credentials and ID cards, e-passports etc. Synthetic papers offer different functionalities for a variety of applications in various industries, such as food & beverages, cosmetics, and pharmaceuticals for packaging & labeling and printing. Synthetic papers are not only durable and water-proof but also possess chemical resistance, tear resistance, and oil resistance. These superior performance characteristics, coupled with their outstanding printability, have gained synthetic papers a wide acceptance as materials of choice across various end user industries.

According to early development, the primary material using for synthetic paper is synthetic resin which is derived from petroleum. This is the material which gives it characteristics similar to those of plastic film. However the appearance of this is remarkably similar to regular paper which has been made from wood pulp. In market many of the suppliers are available who provide this paper. There are many types of synthetic papers which are available in the market globally or in domestic market. Quality or characteristics of synthetic paper is depends on the materials has been used. During manufacturing of synthetic paper, we have to keep in the mind that what type of quality we need as per requirement and what type of inks we are using for that paper. For example if the printer are not using special inks then it may clay coated paper, but if printer is using special inks then we have to manufacture non porous paper with directional grain. Some synthetic paper is made from silica particles and these are more porous in nature than plastic sheets and can resist high temperature, due to this it is not required more additional time for ink drying mechanism. The main concern during manufacturing of synthetic paper is type of product for which it has been manufactured and type of ink which it has been used on the paper.

There are so many products which have been made using synthetic paper but the tag and label industry is the largest growth area for the synthetic market. These include outdoor applications, posters, store banners, POP display

materials, covers, medical cards, rough duty maps and manuals. Synthetic paper are superior to pulp paper but they are most costly as compare to other papers. So according to market trends, synthetic papers are used whenever paper cannot fulfill an application. It has basically become a problem solver. The main challenge with synthetic paper is drying issue. The compatibility of any printing process with synthetic paper is not so easy. The most common process used for synthetic paper is digital printing. As in this method, drying mechanism is much faster as compare to other process.

Manufacturing Process of Synthetic Paper

The term synthetic paper has not been universally defined because it is basically an opaque plastic film. It may be printable and writeable. Most synthetic papers are either biaxially oriented polypropylene (BOPP) or high-density polyethylene (HDPE), although there are sizable amounts made from polyesters and fewer so from polystyrene and PVC. The market space of this paper is increasing year by year. According to market study, the market share of this paper is increasing 6-8% yearly since 2014.

Extrusion technique plays an important role in the manufacturing of synthetic paper. There are many methods available to manufacture this paper but all are possible with extrusion. Main techniques to manufacturing synthetic paper are film making process, tubular film process, and water cooled-tubular film and co-extruded process. Polymer composition, resin percentage, fillers amount, pigments amount, different additives for different purpose all are depends on type of synthetic paper has been manufactured.

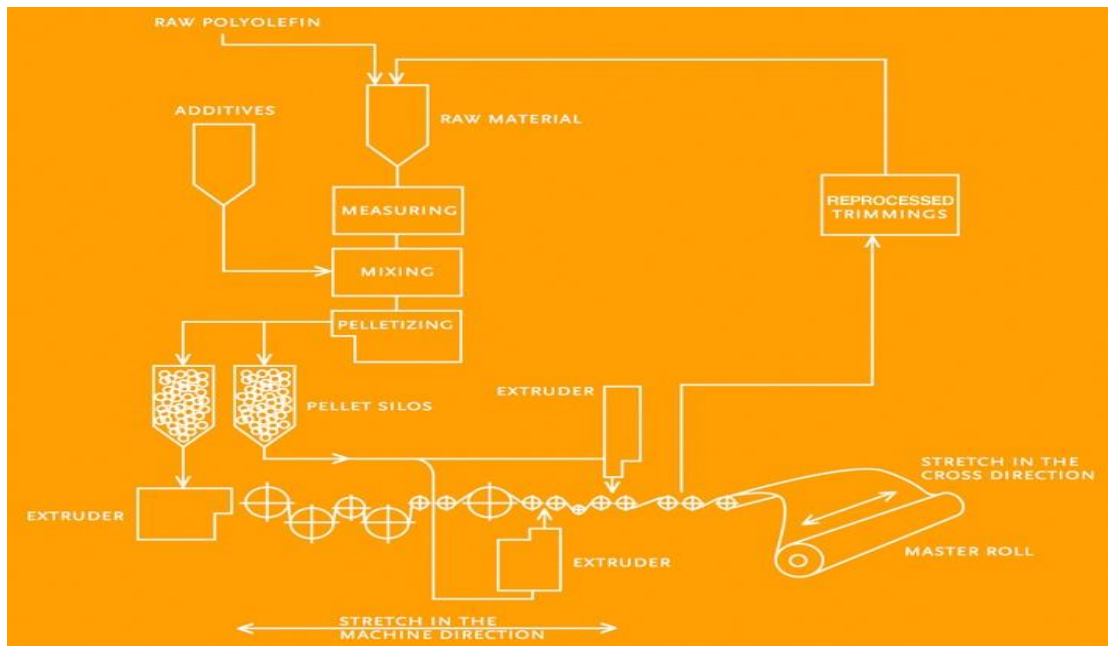


Fig.1. Manufacturing Process of Synthetic Paper

As shown in fig.1. First of all we loaded the mixture of high density polyolefin and inorganic filler as a raw material in respective container. After loaded the material then it get mixed in master mixing unit and enter into pelletizing unit to convert them into pellets. During mixing we add all additives in mixing unit as per paper quality requirement. These converted pellets fed into extrusion or heating unit. After extrusion, it produces a non-stretchable base or surface layers of comprising mixture of polyolefin and inorganic filler. After that these layers are stretched to create dimensionally stable or a uniaxial stretched film. These all steps are computer controlled and close monitoring is required to ensure precise quality.

Grain direction, micro-void, non-porous surface coated surface all are depends on manufacturing process. For example, if we are considering grain direction during manufacturing process, then it may cause problem in folding for heavier stocks. But if consider tear strength then again we have to consider grain direction, because without grain direction it get easily tears if the edge gets nicked. So in case of light stocks we can maintain gain direction to avoid tearing, but in case of heavy stocks we can avoid grain direction to avoid improper folding. The same case is with clay coating, if the paper is clay coated then it may printed with offset inks as coating helps with drying time but if it is not clay coated then the special inks are required for printing the paper. But in case of clay coated paper , there are more chances to get scratches on surface as compare to non-coated paper. If the paper is made from silica particles then it becomes more porous as compare to plastic sheet and it can resist damage from higher temperatures, as it absorb ink like normal paper and take less drying time. Some of the main additives use in synthetic paper is clays, titanium dioxide, calcium carbonate, talc and silica.

Synthetic Paper Properties

Synthetic paper is known for its unique and salient features offered during printing and packaging purposes. It is dedicated in order to facilitate:

- i. Dimensionally Stable and can withstand temperatures ranging from 601F to +2001F
- ii. Abrasion, Moisture and Tear Resistance
- iii. Scuff-resistance
- iv. It is resistant to cracking, shrinking or any other type of distortion in color or sheet size
- v. It is 100% water proof and not affected by moisture or humidity and offers superior tear resistance
- vi. No surface treatment required
- vii. Printability

Hop-Syn Synthetic Paper Properties

Hop-Syn synthetic paper is trademark of HIC Industries Corporation (formerly Tamerica) is formulated with antistatic agents. This synthetic paper offers following features:

- i. Porous printing surface. Its porous surface allows ink to be absorbed underneath its surface, preventing the printed image from being damaged by scuffing or scratching.
- ii. Very close gauge tolerance suitable for high-speed printing
- iii. Antistatic nature of surface eliminates double-fed sheets while printing and finishing operations
- iv. Ideally suitable for printing include flexography, rotary gravure, offset lithography, thermal transfer, rotary letterpress, and screen.

Environmental Aspects of Synthetic Paper

As aforesaid that Synthetic Paper is composition of Polypropylene resin and Calcium carbonate. These are nontoxic materials containing no chlorine or other halogens. It can be recycled as a plastic. During recycling when it is burned, emits no toxic fumes. Also during incineration it leaves a clean ash.

Types of Synthetic Paper

There are many types of synthetic paper are available in market. We differentiate synthetic paper according to their internal manufacturing, surface coating, surface treatment and film laminate etc. On the basis of resin, synthetic paper can be divided into two categories that is film synthetic paper or fiber synthetic paper. One can differentiate these paper on the basis of physical properties and optical properties also, but as per study, the following method are on the basis of raw material used for making of synthetic paper, because type of synthetic paper can be decided on the basis of raw material.

Internal Manufacturing Method

In this method, synthetic resins are added with fillers and additives and then allow it for fusion and extrusion process. We convert this extruded material into film with the help of die slit. The output material can be considered in two ways.

Non Oriented Film or Biaxial Oriented Film

In non-oriented method, the hardness of fused resin can get by simply cooling it permanently for commercialization use. on the other hand in case of bi axial film, the hardness of fused resin maintain temporarily and it may soften again to stretch it into cross directions and the longitudinal and forming a film. Micro voids can be creating in case of bi axial oriented film depends on manufacturer. These tiny holes give it superior strength and finished surface.

Surface Coating Method

As the coating word is mentioned in this method, we can add addition layer of coating on the paper produced through internal manufacturing process. This addition layer is done to get additional properties like more opacity, whiteness or to get a suitable product for printing and writing both.

Surface Treatment Method

The same results we can get as in the surface coating method. The only difference is that synthetic film is treated chemically or physically.

Properties Of Synthetic Paper

All properties of synthetic paper fall under these four categories. Tensile strength is the main property under mechanical properties as it provides strength to the paper, In synthetic papers polyethylene paper (Tyvek) had the better mechanical property in comparison with the other papers.

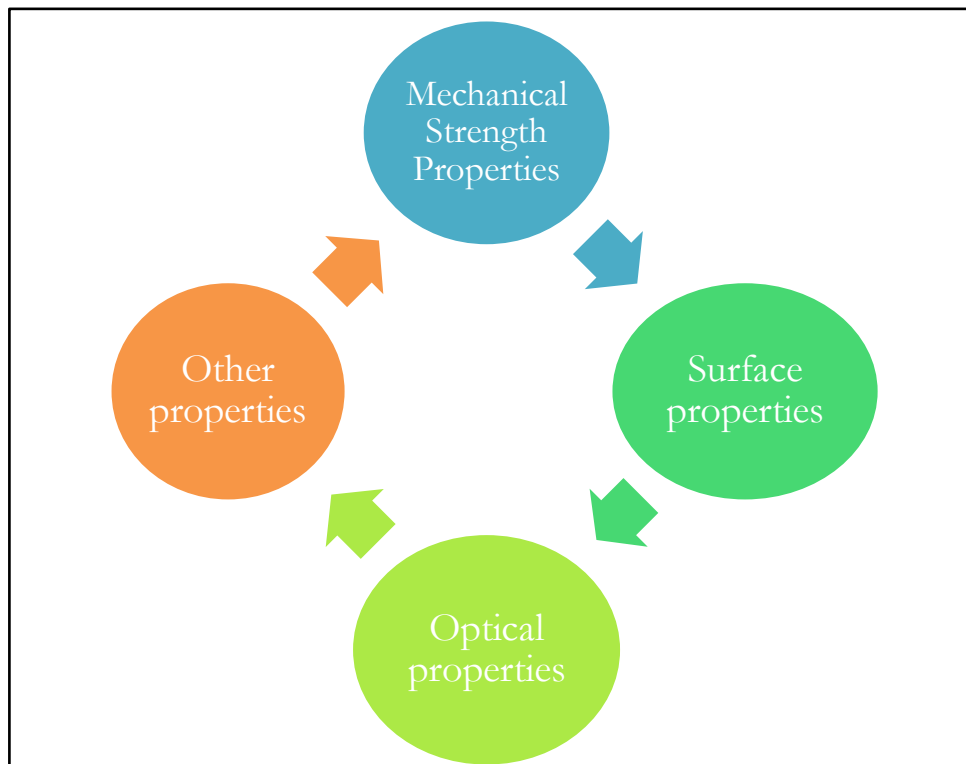


Fig.2. Properties of Synthetic Paper

It showed strong elongation as compare to polyethylene film elongation. The other main property is tear resistant. Tearing strength is the main property of synthetic paper. However some paper get tears easily it gets nicked. To avoid this, we have to maintain grain direction in case of synthetic paper. Surface chemistry of paper is responsible for many factors; it may be water-resistant, printability of paper. These all properties are come undersurface properties. Surface properties are very important for any paper as drying mechanism is depend on the nature of surface of paper. Optical properties cover the brightness, gloss, color, opacity etc.

II. CONCLUSIONS

- Synthetic paper provides the same characteristics and quality as laminated paper. Lamination gives us more durability and water resistance as we can get the same with synthetic paper with same characteristics and quality.
- Water resistant nature makes it prominent. In lamination, moisture leaked even through laminated material but in case of synthetic paper one can easily wiped off moisture from the surface and even can dip it in water.
- In case of synthetic paper, it reduces our production time as we can get laminated feature in our final product.
- Tear resistant is the best feature of synthetic paper. It increases the life span of final product.
- Weatherproof nature makes it more valuable. As in case of other paper, we have to maintain environment as per paper need. But in case of synthetic paper, it never effected with dust, dirt, sunlight etc.
- Erasable any written matter on the paper is another special feature of synthetic paper.

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