Speciality Papers in Paper Conversion

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The use of paper for writing and printing purposes is as old as its invention and throughout the history of paper making it remained unchallenged. This might be due to the reasons that no suitable material is available which can compete with paper for its characteristic cheapness or otherwise. But the ingenuity of man which brought rapid development in the engineering and technological field, increases its scope of use for variety of purposes.

Paper being a non-toxic, odourless, tasteless media, whose basic properties can be suitably modified according to the needs at the different stages of production to perform variety of functions. A large number of desirable properties such as wet strength, resistance to water, water vapour and gases, oils, greases, fire, insects, chemicals, drugs and foods etc., physical resistance to scuffing, abrasion and folding and also properties like chemical reactivity, heat sensitivity, photosensitivity, electrical conductivity and insulation etc., can be rendered to paper by various chemical and mechanical treatments involving many simple and complex operations.

Most of the papers, having functional as well as decorative values, fall within the scope of paper conversion insdustry. The paper converting techniques involve a series of manufacturing steps, such as coating, saturating, laminating and finishing operations, to obtain certain desired product.

In our country, during the last two decades, there has been considerable progress in the production of writing and printing papers and conventional type of paper boards, but the progress made in the field of speciality and converted papers and paper boards is very meagre and insignificant. The country imports every year different grades of speciality and converted paper and paper products incurring a huge expendiure and drainage of foreign exchange. In view of the present critical position of foreign exchange all out efforts have to be made for the rapid growth of converted paper industry. Paper converting industry has, therefore, an important role in the economy of the country. Speciality paper itself is a vast field. Only a few speciality papers, having bright prospects in the country are discussed below :

Grease proof paper :

Grease proof paper as the name implies, is a paper which possesses the property to resist the penetration or passage of grease, oil or fat. Grease proof paper finds extensive use for its outstanding advantages over others in protective packing. It resists not only grease and oil, but also prevents or retards the growth of mold, bacteria etc. In fact, grease proof paper is the most economical packaging material available except metals and glass. It is used as wrapper for innumberable products like beverages such as tea, coffee and cocoa, confectionary such as biscuit, cake, toffe, candy etc., snacks such as potato-chips, cashew and peanut, dairy products such as chease, ice-cream etc., dehydrated foods such as cornflakes, dried fruits and vegetables, toilets such as soapcakes, razor-blades, powder detergents, pharmaceuticals such as strip packaging of pills, powders, sterilised surgical instruments and dressings and all metal parts that are greased and oiled for rust prevention during prolonged storage. It is also used in the copy paper field as the base paper e.g, thermographic and electrostatic base papers and for certain types of coated papers.

Conventionally greaseproof paper is manufactured from highly hydrated long fibrous coniferous

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This Paper was presented at Zonal Meeting of IPPTA, held at Bomay on Sept. 7 & 8, 1974.

wood pulp, hydration being achieved by intensive beating or refining. The pulp is produced by–Mitscherlich or by NSSC process.

Grease proof paper can also be obtained by surface sizing or by coating the paper. By this means a barrier coating is formed which is resistant to oil or grease. Many chemicals such as polyvinyl alcohol, carboxymethyl cellulose, methyl cellulose, chromium perfluro mono carboxylic acid complex etc. are available for this purpose. Indigenous technology is now available for the production of grease proof paper by surface treatment[1].

Parchment Paper : Parchment Paper derives its name from the town "*Pargamum*" of Asia Minor, where high quality parchment was being made out of animal hide from very early times. The untanned skins of sheep, goats or donkeys were dipilated, cleaned and scoured with lime and polished and then used as writing material. Parchment paper of today, commonly known as "vegetable parchment" is made from conventional cellulosic raw materials for paper. Vegetable parchment was discovered accidently by an Englishman, while preparing a sheet made of cotton rag pulp for use in demonstrating a lecture. While he was examining the sheet, it accidently fell into a vessel containing sulphuric acid. Quickly washing it in water, he found that the hand made cotton rag paper had taken an entirely new form. Instead of porous, absorbent and opaque sheet, it became non–absorbent and translucent. No amount of soaking in water or even boiling had any effect on the product.

Because of its inherent characteristics of high wet strength, grease resistance and the fact that it is non toxic, odourless and tasteless, parchment paper is extensively used in food packaging, particularly for such products as butter, margarine, dairy products, fish, meat, poultry, ice–cream etc. It is also used for lining the walls of boxboard food containers. Translucent parchment is used in the copying field, while releasing parchments are useful for sticky and tacky materials. Parchment also finds application in the electrical industry as insulating material.

The production of parchment paper consists of first preparing the basic paper called 'water–leaf' from an unsized and unfilled stock. For many years, rags constituted the principal raw material for the manufacture of parchment paper. This has largely been replaced by high alpha–pulps. Parchment paper is obtained from the unsized and unfilled sheet, having the requisite moisture content, by treatment with concentrated sulphuric acid and then removing the excess acid by washing it with water and finally with dilute ammonia. The sheet is further treated with plasticizer and then dried and calendered. The water leaf is kept in contact with sulphuric acid only for a few seconds, but during that time, it is believed that fibres of the paper are attacked by the acid, which forms a coating or film of gelatinous cellulose, covering the fibres and fiilling the pores of the sheet. This interlocks the fibres together and produces a paper with permanent high wet strength and grease–resisting qualities.

Parchment paper is not manufactured in the country and the import figure for 1972 is 207,067 Kg. for Rs. 987,508 and as such there is a vast scope of producing parchment paper in the country[2].

Release Paper :

A release paper is a type of speciality converted paper that shows adhesion sufficiently low, uncommon in ordinary paper, to some materials or articles of commerce, which are tacky or have some tendency to stick. An ordinary paper does not possess the property to resist the penetration of most of the liquids and hence penetration takes place very quickly when it comes into contact with liquids. If the liquid subsequently solidifies, it makes much more difficulty in removing it from the paper. As for example, asphalts, paints, plastics, rubbers and many vegetables possess sticking property. Therefore, during storage or transit, it becomes necessary to use a protective wrapper which will not only encounter this property but also help the material in storage and transit.

A release paper, according to its behaviour may be classified into three categories. The first one releases the material by virtue of its impenetrable smooth surface.

Papers like parchment, glassine or grease proof belong to this category. These papers are used as such or after coating with wax or polyethylene or laminating with aluminium foil etc. The second category of release paper produces a semi impervious surface by forming a layer of coat to the tacky surface and is made by coating a standard kraft paper with chemicals like sodium silicate or clay and is used for packing various types of synthetic rubbers. The last one reduces adhesion without contaminating the product by virtue of the chemicals present in the paper and is widely used. In this type, the paper is coated with silicone compounds like dimethylpolysiloxanes and methyl hydrogen polysiloxanes etc.[2] in presence of a catalyst or promoter in emulsified form in solvents like xylene, toluene and hexane. Silicone fluids of higher viscosity are more desirable for releasing purposes, both from the standpoint of efficiency and lack of contamination. Chromium complexes like stearato chromic chloride, polyvinyl esters of higher fatty acids containing sixteen carbon atoms or more, can be used for rendering release property to paper.

Packaging industry uses release paper as wrapper or interliner for frozen food products. Its other uses are as bakery tray-liners, candy table and pan-liners, postage stamps, forms, plastic shelf, ice-bag, plastic laminates, plywood laminates, asphalt container, surgical instrument container, synthetic rubber chemicals container and as shoe inter lever and many others.

Base paper for release paper is generally made from special grade of kraft paper, wet-strength paper, super calendered kraft paper, parchment paper, grease proof and glassine paper either alone or coated. The paper must be free from impurities, fibre fines and should possess strength and flexibility, good dimensional stability and uniform surface.

Mold, Bacteria, Insect and Rodent resistance and preventive paper :

Wrapping paper used for packaging though performs its functional properties, yet it is not free from certain disadvantages. Ordinary food packaging paper cannot prevent the attack of mold, bacteria, insect and rodent on materials of the package, if materials inside are suitable and attractive to them. Mold growth causes objectionable discolouration and smell and fungi produces organic acids that react with material inside, thereby causing it unfit for use and consumption.

To keep the inside materials intact, certain odourless, tasteless and non-toxic chemicals are incorporated in the paper. These chemicals by their presence in paper, prevent or restrict the growth of mold and bacteria by offering a chemically protective barrier. Chemicals like cellulose acetate, cellulose acetate-butyrate, ethyl cellulose, poly elethylene, saran, polyvinyl chloride, polyvinyl chloride acetate, calcium propionate, sodium propionate, propionic acid, biphenyl and ophenyl phenol and various mercurial base compounds such as mercury oxide, mercury chloride, mercury bichloride, mercury napahthenate, pyridyl mercury stearate, phenyl mercury oleate and phenyl mercury napthenate etc. are used for this purpose. Mercuric based compounds are toxic in nature and hence they are used only for outer protection of package[3].

Insect and rodent attack the covering wrapper thereby damaging the inside materials meant for human and animal consumption, and also contaminate it by laying eggs, which mature within very short period. Even though, their life period is short i.e. 30—45 days yet they multiply very rapidly and can withstand a wide range of temperature.

Chemicals like dinitrophenol derivatives and DDT are used for insect resistance. They are applied on paper along with adhesive materials or with waxes. For rodent resistance, no effective chemical is yet available. Chemicals like alpha naphthyl thiourea, which possess rodenticide property are generally used.

The base paper used for all these cases are almost similar to other coated packaging papers.

Copying Paper :

In recent years, considerable importance has been given to the science and technology of copying and duplicating processes and papers. A large quantity of paper is consumed every year by business and

industrial organisations, government and other offices, educational institution, etc., involving one or more copying and duplicating processess. In most of the copying processes, the base paper characteristics are altered either by coating or by other chemical means. The earliest known copying paper is the carbon paper, where the base paper is coated with an ink formulation containing mainly carbon black. Though many new methods of producing multiple copies have been developed, carbon paper remains unmatched for its ability to provide inexpensive multiple copies under a wide range of operating conditions. Carbon paper provides extreme versatility, and literally, hundred of different types of carbon papers are marketed. Carbon paper may be broadly grouped into two general classes viz. single use carbon and multiple use carbon. The most important of the carbon paper family is the typewriter carbon paper.

The base paper used for typewriter carbon paper is the light weight all rag paper. The tissues are available in varying weights; sometimes, all rag tissues are replaced partly by rag or all sulphite papers. An ideal carbon tissue must have a smooth surface, uniformly high density, good formation and above all free from pinholes. Further requirements are high strength, low basis weight and freedom from slime spots and dirt specks etc.

Though carbon paper is ideally suited for economic production of multiple copies and is universally accepted, yet the demand for improved copying methods lead to the development of pressure sensitive manifold copy papers which can be used in duplicating and manifolding operations such as business forms and sale contracts etc. The most important among the duplicating and manifold papers is the one developed by National Cash Register Company, U.S.A., known as the No Carbon Required (NCR) paper.

The NCR paper provides multiple copies of business forms etc. without the use of carbon inserts. The advantage of this new paper is that it eliminates the inconvenience and sumdging of carbon inserts.

The system depends on two coated surfaces, one that acts as a donor or transfer surface and the another acts as a receiver or acceptor surface of the printing fluid. The transfer coating consists of a hydro–phillic colloid material throughout which a profuse number of microscopic droplets of an oil marking fluid are dispersed. Each droplet of oil is encased in its own capsule of the colloid material and is actually produced not from an emulsion, but from a process of coacervation. "Coacervation" is the term applied to the ability of a number of aqueous solutions of colloids, to separate into two liquid layers, one rich in colloid solute and other poor in colloid solute. Coacervation can be accomplished in two ways–"simple or salt" coacervation and "complex" coacervation.

In general, the method of encapsulation of dye particles in oil by the phenomenon of 'coacervation, takes place in three distinctive steps.[4] In the first step, the liquid or solid to be encapsulated is dispersed in a solution of wall material, while in the second step the phase separation of the wall material takes place. In the third step, the liquid wall material phase deposits itself as a continuous coating around the dispersed droplets or particles of the internal phase and then the continuous wall of the capsules are hardened by suitable means.

The capsules of the colourless dye intermediates thus obtained are coated on the paper substrate and then dried. This transfer film of colourless dye–intermediate is rupturable by pressure of a marking system. When localized pressure is applied either by a ball point pen, pencil or by striking with the keys of a type writer, the wall of the hydrophillic capsule is ruptured at the points of pressure and the fluid containing leuco–dye intermediates is transferred to the under sheet, which when reacts with the material coated on the undersheet to produce a distinctive colour of the dye intermediate. The liquid nuclei of capsules contain an organic substance, most commonly leucodye intermediate, which is an electron donor automatic compound, which takes part in an electron donor acceptor

solid surface chemical reaction, giving it a distinctive colour and the solid particles are of an inorganic substance, which is an acid relative to the organic substance, so as to be an electron acceptor when in adsorption contact.[5] The solid inorganic material, in fine particle form, is adhered to the surface of the record material with the help of an adhesive material, may be a naturally occuring clay like kaolinite, bentonite or attapulgite type, having definite chemical composition.

The colourless dyes used in the NCR paper are selected from the number of available leuco-derivatives of triphenyl methane dyes or from other classes. These oil soluble dye–intermediates are generally dissolved in chlorinated diphenyl, cotton seed oil, soyabean oil, castor oil, cocoanut oil etc. The resulting colourless oil solution is stable in light and air. Most of the lactones are fugitive to light and therefore, a small amount of an inhibitor is preferably added to lactones, for permanancy of coloured prints.

The two coating systems employed in NCR paper may be incorporated on the same surface by the modern available techniques. The duplicating paper produced this way is termed as "self contained Record paper," in which both the capsule and the clay are coated on the same side of the sheet[6]. The problem of premature development of colour in such a manifold system are prevented by applying an intermediate coating or by incorporating the clay like material during capsule formation. This type of papers are used as chart recorder paper or data processing paper for high speed computers.

The base paper stock to be used for this type of pressure sensitive transfer copy system should have uniform density and dimensional stability. The web must be free from slime holes, stock slugs and pinholes. Formation of the paper is of paramount importance since it regulates transfer coating show through in conjunction with chemical resistance. The production of base paper for this type of paper is much like the production of grease proof paper, which must meet a specified turpentine resistance. Since the paper has to manifold, it must be relatively soft compared to grease proof. Due to the low basis weight and high opacity, this type of paper is generally made by using 70—80% bleached soft wood kraft pulp. The fibre must be well fibrilated to obtain adequate formation and whatever tear strength is possible. The remaining fibre may be bleached hardwood kraft and possibly some bleached soft wood sulphite[7].

Thermographic Paper :

Thermographic paper is another important converted paper, which is known for its role in spearheading the office copying explosion. Thermographic paper means paper which is sensitive to heat.

The thermographic process may be broadly divided into two classes-physical process and chemical process.

In the physical process, a coloured base paper is coated on one side with non-transparent fusible materials. When it is exposed to heat, the coating melts and becomes transparent. Thus the coloured base paper becomes visible.

This type of thermographic paper, finds extensive use in recording systems. In a recording system, when the hot stylus passes over such a paper, the portion melts and the base sheet becomes visible at those points. Economy is the main factor in favour of this type of paper.

In the chemical system, the colour formation takes place due to thermo-chemical reaction. In its simplest form, it comprises of a base paper carrying two superimosed coatings-one of the coatings melts at low temperature. Each layer contains one component of a two components colour forming system. Thermographic paper is mainly used for making copies. To make a copy, the thermographic paper together with the original is exposed to an intense radiant source. The coating corresponding to the printed areas of the original is heated up, causing a thermal reaction and thus colour formation.

The base papers used for thermographic system are generally, grease proofrand glassine type of papers as their infrared transmission is high enough to achieve adaquate thermal conductivity.

Direct Electrostatic paper

The application of electrostatic methods has revolutionised the office copying system. The electrostatic methods have very rapidly gained favour and at presnt are the most widely used sophisticated systems.

The Electrostatic methods may be broadly divided into two categories–transfer electrostatics and direct electrostatics. Direct electrostatic system differs primarily from transfer electrostatic or xerography in employing electrostatic sensitized papers instead of using a reusable selenium drum and the paper itself is corona charged, exposed and developed directly to produce the copy.

Electrostatic sensitized paper consists of a base paper on one side of which there is a coating, the electrical conductivity of which can be changed by exposure to light. It has been found that coatings containing zinc oxide respond to change in light values in this manner. If, therefore, zinc oxide coated paper is given an electrostatic charge and then certain areas are exposed to light, the charge will disappear in those areas so exposed, the dark areas retaining their electrostatic charge. If then, this paper is treated with a pigment either in the dry state or dispersed in a suitable solvent, the pigment particles will be attracted to the areas still holding the charge and if subsequently the pigment is fixed by some suitable means then a permanent record will be obtained with the pigment particles adhering to those areas which had retained their charges.

Although the basic technique is relatively simple many problems arise in the correct formulation of the zinc oxide coating. There is considerable scope in the imporvement of its weight, feel, metal marking tendency and increased image density.

The primary requirements for the base paper is adequate solvent hold–out to minimise penetration since electrophotographic coating is applied in a solvent system. Of course, some recent developments have been made in the production of aqueous electrophotographic coatings. These developments indicate that the adoptation of an aqueous system could lead to cheaper binders, lighter weight coatings, lower application costs and the elimination of solvent.[8] Print density of aqueous system is now equal to that of solvent system. Recent developments also indicate that there is some merit in a two coat aqueous and solvent coating of very light weight.

The copy paper must be able to resist absorption of the toner diluents used in liquid process Eletrofax machines. Hence, the uncoated side of these papers must also be treated to resist penetration by mineral spirits.

The base paper for the Electrofax system must have low electrical resistivities[9]. In order to avoid building up of a high charge across the base paper which is not effective in minimising the quality of the image, the paper must be relatively conductive. This requirement is satisfied by treating the papers with conductive materials in the form of inorganic salts or in the form of certain water soluble polymers which also form films on the papers.

The acceptance of the Electrofax system is mainly due to low copy cost, high rate of copy output, ease of machine operation and high level of copy quality and is one of the most promising copying processes.

Acknowledgement

The authors are highly grateful to Shri B. P. Chaliha, Project Co-ordinator, Pulp, Paper and Board group, for kind encouragement and advice and to Dr. D. Ganguly, Scientist-in-charge, Regional Research Laboratory, Jorhat, for permission to publish this paper.

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