

BEST MANUFACTURING PRACTICES FOR BARRIER COATINGS WITH ECO-FRIENDLY MATERIALS



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Abstract: Due to busy life and work schedules, working people habitually switched over from traditional food to packed food. Most of these packing conditions are dependent on type of food stuff like beverages, ice cream type pasty items, and burger/pizza type hot items.

Perfect packing is for aesthetic value, preserve the taste and smell with no harmful effects during storage and at the time of usage. Most of the suppliers go for tetra pack cartons for cold storage items and cardboard packing for hot packing edible items. Here mostly two important conditions prevail. These are temperature and the quality of packaging materials.

Major issues faced manufacturing of Barrier Coating packaging paper is its difficulty in re-pulpability, accumulation of plastic lining trash material in High Density cleaners, generation of stickies and deposits due to added material of synthetic nature aggregating in kneaders and hot dispersers. Cost reduction with plastic addition is not a solution for green environment and we Maxim want to implement eco-friendly bio-degradable coatings.

Barrier coating is nothing but impregnation of layer water proof, vapour proof, grease proof and oil proof with resistance to air and oxygen entry inside.

Packaging materials/boxes, whether odour problems inside box wall to food material or penetration of moisture, water vapour, volatile gases, Oil and Grease from food material to paper wall or from refrigerator surroundings to inside box, we have green solutions of manufacturing.

Key Words: Chitosan, CMC, Starch, Poly Lactic Acid, Glycerine, Paraffin wax, PE

Introduction: Barrier is technically a word used to express, "Wall between two Phases". Technically speaking, internal sizing, surface sizing, and barrier coating are similar with varied degree of prevention of penetration for various materials and water in particular. Barrier coated paper resembles a very, very hard sized paper with Cobb value less than 10.

Barrier coatings are products designed and used in order to provide a moisture barrier, grease barrier or other required barrier properties. Mostly used for food packing grades.

When a paper sack or carton is used for packing and storing of a food item for consumable food items, the paper quality should strictly adhere to porosity, hydrophobicity, migration resistance of vapour permeability, oil adsorption/absorption.

Certain qualities of baby products need to meet strict regulations of permeability and migration of harmful components from packing or printing material into food material inside. This is very much crucial in case of cold storage and tetrapack cartons.

In storage of tetrapack cartons for food and beverages, milk products in liquid form, barrier needs are essence as harmful substances likely to migrate from exterior to interior. This migration includes harmful components from print quality to unwanted stuff aroma from adjacent products. A strong interior barrier coating is must in this case to prevent migration from carton outer printing and adjacent through organic volatiles and vapour (mist) soluble aromatic compounds.

Second is the case with hot storage food packaging's like burgers, samosa, pizza etc. These food items either lose their original or gain added flavour from inside carton walls. Most

problematic is Volatile fatty acids and sulphur based (H₂S) emanating from Kraft paper quality due to repeated recycles of kraft waste paper material.

Reasons and remedies for both cold and hot storage Tainting and VFA migration, barrier coatings to prevent this; with principle of functioning and method of application are described here with.

Tainting, VFAs migration, vapour permeability, mineral oil permeability, harmful print ingredients contamination, migration to inner layers and food through tetrapack walls and kraft paper cartons either in cold refrigeration or in hot shipping conditions, spoil the taste and smell of goods along with harmful after effects. Reasons and remedies, resorting to firm barrier coating techniques to prevent this, principle and function, method of application of barrier coatings are well described with case studies.

Methodology of Barrier Coating with Eco-Friendly Materials and Reasons:

TAINTING & VFA MIGRATION:

Tainting and Volatile Fatty acid Migration to food stuff is major obstacle of using normal kraft paper. Hence Barrier coating is suitable remedy to overcome this problem.

Liner kraft of higher grammage and Extensible sack kraft bags are used for packing and shipping of hot burgers, pizzas, Samosa etc to deliver in online food marketing. Likewise sweets also are packed in boxes to send as gifts. In both the cases quality of packaging paper/board used in food packing play vital role in quality of produce. Packing is essence of marketing. If a original food product loses its odour or taste virtually due to

tainting effect(contamination due to migration of VFAs in packaging material), supplier had to face penalty and customer lose interest in buying next time.

Can big level players in food processing and online supplies like Dominos, Swiggy should lose their business for defect in making of packaging material?

There can be two fundamental ways to prevent this problem. First remedy is "Prevention is Cure". During the process of liner kraft paper manufacture essential steps shall be taken to eradicate this VFA and tinting problems associated for further use of this paper for food packing. This methodology was already discussed in our previous paper "Paper Odour Problem – Maxim's Innovative Solutions" ISSN: 0379-5462. Now stress is given only on replacing traditional packing with barrier coated paper to overcome food packing related problems to take remedial actions in mill site like Odour problems.

Barrier Coating give blanketing effect on packaging paper by preventing permeability of water, water vapour, grease, Volatile gases, Organic solvent vapours bad smells, tainting everything as a solution for everything and anything. Recently I have seen a food packing container in a Chinese restaurant outlet and surprised, how they replaced plastic boxes with suitable barrier coated containers with not even polythene film inside. It has tolerance for temperature, oil penetration; water resistance, stiffness and every required character for food packing with recycle capability.

Methods of Identifying and Evaluating Barrier needs and Properties:

1. Milk, buttermilk, Lassi, Beverages, Cool drinks, Fruit Juices are sold in Tetra pack Cartons.
2. Some Products for children also stored in Paper packaging like dry form like Health drink powders(Horliks, Complan, Proteinex, Bournvita like products)
3. When these products are stored in Refrigerator, due to humid and mist conditions, migration can occur from out to in.
4. If migration is happening in carton from outer side to inner side, it can be print ink or label gum ingredients.
5. This is the reason some harmful components used in Print ink like Pthalic Anhydrides are tested in waste paper and finished products with stringent norms.
6. Export quality tetrapack paper shall meet these standards for food grades.
7. In addition to hydrophobic (Hard Sizing), packaging paper needs resistance for oils, mineral oils, volatile vapours (Vapour permeability) from outer to inner and vice versa.

Test Methods for Barrier effect of Packaging Paper:

1. Standard Cobb testing for water permeability also known as Cobb 60 normal and routine check for all sized papers. Ink penetration test/Hercules size test also similar purpose.
2. Air permeability test like Gurly porosity and smoothness tester or Bendsten Air permeability and smoothness tester.
3. Water Vapor permeability test as per ASTM E96 CUP METHOD. (LABTHINK INSTRUMENT)
4. Oxygen-Gas Permeability test for low, medium and high barrier coated papers as per ASTM D 1434 test method. Labthink VAC Series gas permeability testers are used for it.
5. Test methods and Standards are available in literature books and references.

Methods and Green Materials Preferred for Barrier Coating Applications:

Most of the barrier coatings can be applied using typical paper machine coaters, off-machine coaters and printing presses except for PE and Biopolymers, which require extrusion process for lamination Wax compositions can be hot melt addition and surface coating. Coating formulations can be modified as required for use on a wide variety of coating applicators, including:

- Puddle size presses
- Metered size presses
- Air knife coaters
- Curtain coaters
- Rod coaters
- Blade coaters (bent blade)
- Flexographic, gravure and digital printers

Grading of Paper according to water absorption and permeability:

Absorbent Kraft - Semi-Absorbent Kraft - News

Print -- Hard Sized Bond Paper - Surface Sized Maplitho Paper - Very Hard sized barrier coated paper for water and vapour permeability (Less than 10 cobb), Glossy thick films for oil and grease proofing, Parchment papers, Tetra pack inner/ Paper cups with inner barrier and out barrier or both.

Types of Eco-Friendly Chemicals used for Barrier coating composites and

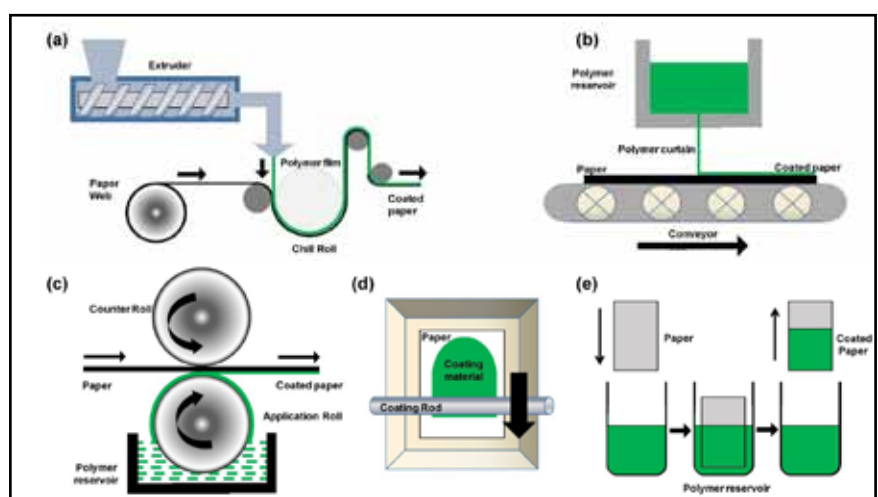
Green Chemistry for Barrier Coatings: Choice of Maxim.

- Starch – Citric acid – Glycerine biopolymer film : Give Barrier coating for water vapour resistance.
- Starch – Paraffin/Bee wax emulsions: Give function of water vapour barrier.
- Chitosan: It dissolves in 1-2%acetic acid giving viscous solution. Can be blended with starch recipes. It gives firm barrier for grease, air, Oxygen, water vapour and altogether.
- Chitosan - Palmitic acid: It gives firm barrier coat for water vapour.
- Chitosan – Sodium Alginate: It give oil and fat barrier application.
- Chitosan – Bee wax: Give firm coating as barrier for water vapour and grease.
- Rosin, Sodium Caseinate: It give firm water and fat barrier coating.
- Sodium Alginate : Fat barrier application.
- Sodium Caseinate – Chitosan: Water vapour barrier.

Coat weight generally ranges from 3-6 gm/square meter of paper. However for some special reasons and special applications, thick coating also given.

Further eco-friendly products under study by us are: Incorporation of vegetable gums, galactomannans, Palm wax etc as easily available and good opportunities.

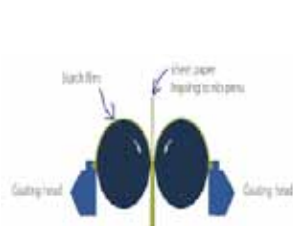
Barrier coatings can be applied during converting using various types of applicators:



Types of Size presses and Applicators for Barrier Coatings (online or offline):



Puddled size press



Metered Size Press



Air Knife Coaters



TYPES OF BARRIER COATINGS AND APPLICATIONS FOR FOOD GRADE



(Oil, Grease and Heat resistant)



(Oil resistant, Moisture resistant, clay coated)



(Paper cups, Heat and moisture resistant)



(Poly coated – Multi use)



(Oil and Fat Resistant Food grade)



(Moisture/Corrosion resistant)

Current and Future Demand for Barrier Coatings:

Demand for flexible packaging is gaining sustainable market and annual growth of market is about 4.5% every year. Current Global market for Barrier Coated Paper is around 4.8 Billion US Dollars and likely to touch 6.6 Billion US Dollars by the end of this decade according to one estimate.

Reasons attributed for Global increase in market demand of Barrier Coated Paper is due to the reason that, immense and uncontrollable waste generation from single use plastics resulting in impossible way of collection and degradability. We need not surprise if the same trend continues, every farmer find it difficult to plough for their crops. Cattle in the populated countries like India will have half their stomach filled with plastics.

Biodegradable Packaging Solutions is “Essence and Sense” of Future India.

Lucrative Opportunities before us:

Barrier Coated Paper marketers putting relentless efforts to induce bio-degradable and environment friendly products in to market to replace conventionally used single use plastics and Polythene film linings, Alumina foil paper lined packaging materials.

At the outset, future is for sustainable, recyclable, biodegradable, cost effective barrier coated packaging formats to meet food grade packing.

Since inception to till now food packing like Britannia Biscuits, use of wax coated TDL Poster has been regular practice. Days have come to replace even paraffin wax coating from barrier coating ingredients.

Suitable replacement for Paraffin waxes, Fluorochemicals, Polythene film is the need of the hour.

Role of bio-polymers like chitin, starch, Cellulose derivatives (Polysaccharides category), Collagen, Gluten, Soya, Poly Lactic Acid, vegetable gums, Casein, galactomannans are gaining significant role in the field of bio-plastics as well as barrier coating compositions.

For hygiene and aesthetic sense, kraft paper inner line is coated with clay combined barrier coating for better look. It gives feel like plate for food.

Certain types of high quality steel engineering items deserve moisture and corrosion resistant packing like bearings etc. Interleaving paper is used for steel sheets to make abrasion free, moisture resistance and corrosion resistance.

Maxim Specialty Chemicals Perspective and Product Range of Barrier Coatings:

Maxim always consider novel and innovative products for Odour problems, Cracking problems and now Barrier Coatings. Our concept and approach based on bio-degradable, sustainable approach.

Maxim Specialty Chemicals produce chemicals to apply Barrier Coat for food grade paper cups and packaging utilities at the range of 3-5 gram/Square meter paper.

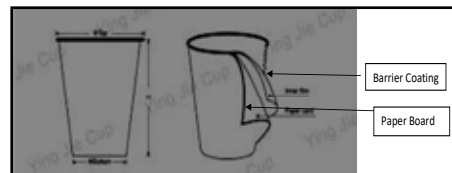
Maxim produces different grades of Barrier coating chemicals under the Max-Coat series for varied applications such as vapour permeability resistance, Grease and Fat resistance in particular. We are in the process of developing corrosion resistance grade for metal wrappings. Most of raw materials are Green and Bio-degradable as mentioned in.

BIODEGRADABILITY OF GREEN CHEMISTRY BARRIER COATED PACKAGINGS

I saw in several paper mills in earlier days that they use to re-pulp cup stock and envelop cuttings, window envelopes as bright and economic raw materials for recycle.

Most of the mills experience yield loss due to plastic segregated from HD Cleaners and used to dump the same at outside mill premises. They do not know what to do with this plastic and eventually it used to accumulate and not biodegradable.

Plastic films, single use plastic bags, polythene covers are highly hazardous to environment and poor cattle are victims feeding in scrap materials.



Recycled pulp hand sheets show heavy colored specks with PE coating, where as Biodegradable coating give clean white pulp sheet with very few specks.

It easily disintegrates, easily bio-degradable in soil, no toxic in soil and no harmful chemical traces after decomposition in soil as bio-compost.

CONCLUSION:

It should be our ultimate goal to give eco-friendly, biodegradable and sustainable barrier coatings for paper packaging products for their repulpability. This will not help in reducing the pollution load but also help in the circular economy.

In post covid era, we have seen more professionals shifting to WFH (work from home) culture which changed their preference for home delivered food items instead of eating at restaurants. We are also witnessing a large number of people shifting from offline to online shopping. All these factors will lead to greater demand for various packaging grades. So now it's all the more important that we use green barrier chemistries for such packaging items.

In such a scenario, there is immense scope of eco-friendly, biodegradable, plastic replacement, sustainable food packing paper and boxes etc.

Maxim Specialty Chemicals is doing it's best to support this cause hence trying to come up with suitable, eco-friendly, repulpable, biodegradable barrier coating products under the brand "Max-coat" with best manufacturing practices at the earliest.

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6. Some Google search pictures to represent theme – Images for representation purpose only.



Population is the worst part of pollution. Man encroaches Water, Land, Sky and Space everything for his comfort and dump plastics and scrap everywhere harming other animals.

Under the Sea, Over the Land, Fish, Cattle, Birds everything is suffering with plastic wastes generated with human greed.

Biodegradable packaging material is only and only ultimate solution for all these.

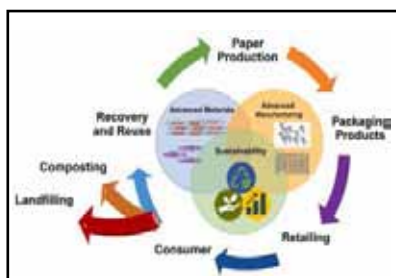
Plastic may be cheaper, but it makes future will be very costlier to survive.



We shall be little careful like this bird)

Bio-degradability of Barrier Coating Packings in time:

Circular economy is crucial part of sustainability and eco-friendly setup.



Bio-degradability and recycleability are essence of barrier coated products. If they do not perish in soil after duration of disposal, we will perish and our industry is disposed off.

Easy recovery and reuse are prime significance. I have seen in lot of garbage areas that collection and segregation of single use plastic and recycle is a herculean task beyond possibility as they fly everywhere.

A barrier coated packaging material should have prime functions of hot liquid barrier, heat sealability, anti-blocking(not to stick together), machineability, re-pulpability and compostability.