

Future outlook of Barrier Coating



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Abstract: *The barrier & water resistance property of paper & board are commonly achieved by application of Petroleum based derivative – Polyethylene (PE) due to their low cost & easy availability. However they are disfavored by limitations in fossil oil reserves, poor recyclability & lack of biodegradation & compost ability which aggravate the environmental & economic concerns.*

From a sustainable point of view, this has augmented the interested in biodegradable coatings across the packaging industry which can address the sustainability aspect while providing similar properties as Polyethylene so that consumers like us can enjoy the delicacy of beverages, ice creams, fast foods etc. These Biodegradable coating materials are of various kinds – PLA, PBS & Aqueous.

Introduction

Most common food serving & packaging products made out of packaging board with water proof coating are:

- Beverage cups– Used for serving beverages (Hot / Cold)
- Refill cups – Used of refilling of water and other beverages (Hot / Cold)
- Ice cream packs – For packaging of Family pack ice creams
- Ice cream cups – Used for serving of Ice cream scoops
- Food serving bowls – For Serving Gravy food etc.
- Tubs – For Serving of Pop corn, fried chicken etc.
- Clam shells – Used for Burgers
- Buckets – For serving oily & fried foods
- Salad trays – For serving salads, sandwich etc.
- Cake boxes – For cake boxes & Pastries
- Take away boxes and many more

All the above mentioned products are coated with a layer of PE/ PLA / PBS / Aqueous on one side or both sides. Now the requirement to do coating on 1 side or 2 sides will depend on application and purpose.

Results and Discussion

Side PE/PLA/PBS/Aqueous coatings are done majorly for items like hot beverage cups, cake box, water refill cups, ice-cream packaging, tubs, clamshells, buckets, take away boxes, Salad trays etc.

Side PE/PLA/PBS/Aqueous coatings are done majorly for cold beverage cups. Reason why 2 side coating required for cold beverage cups is when we pour a chilled beverage in to the cup; the water vapor in the air that comes in contact with cup gets cold and will turn in to water (Image shown below). This process is called “condensation”. Water forming on the outside of the cup will make the cup weak and soggy if not laminated with PE/PLA/PBS/Aqueous coatings. Hence both sides lamination is mandatory for cold beverage cups.

For ice-cream family packs, 2 side coating is mostly not required because converters do a lower gsm varnish post printing on the carton outer surface which is sufficient to withstand condensation effects.



Figure 1

End stages of packaging materials



Figure 2

Recycling: This means that an item is reclaimed and then broken down in to raw material and this raw material will be used to manufacture a new item.

Composting: This is a little simpler process. It means that the item is put into a compost bin or facility, allowing the item to break down into compost. The resulting compost product can be used in a variety of ways. Composting can be done at the consumer level or the industrial level. High quality compost is teeming with biodiversity and nutrients and can go on to agricultural land or your backyard garden. Lower quality compost (the kind that often comes out of industrial composting facilities) is typically sold to construction sites and similar operations.

Biodegradable: Biodegradables are anything that undergoes degradation resulting from the action of naturally occurring microorganisms such as bacteria, fungi, and algae. Although how quickly is not defined, biodegradable products are broken in way less time than non-biodegradable products like plastic for instance.

What's the difference? While all compostable material is biodegradable, not all biodegradable material is compostable. Although biodegradable materials return to nature and can disappear completely they sometimes leave behind metal residue, on the other hand compostable materials create something called humus that is full of nutrients and great for plants. In summary, compostable products are biodegradable, but with an added benefit.

Detailed view on coatings

PE stands for polyethylene. It's the type of plastic most commonly used around the world for plastic bags, packaging and containers. It's the most popular & majorly used coating on paper cups to make them strong and waterproof.

PE is petroleum-based, which can affect how long it takes for the cup to break down and as per recent reports it takes 30 years to degrade!! And they are not compostable. PE-lined cups can still be recycled, but



Figure 3

they have to go through a recycling process separate to other recyclables.

PLA stands for Poly Lactic Acid. It is a type of 'Bio plastic' which has been made from renewable resources such as Potato, Maze and Corn Starch. It is fully industrially compostable and is used for applications where you need to be able to see the product inside (such as clear straws) & where you need a 100% waterproof coating such as compostable cups.



Figure 4

The biggest advantage over PE is that PLA can be industrially composted. When it does break down, it leaves no harmful residue, including leaving no micro plastics. It breaks down in to water, CO₂, and bio-mass.

PBS stands for polybutylene succinate. This is very similar to PLA and Bio PBS is produced from renewable materials (corn, cassava, or sugar cane). Bio PBS is the environmentally friendly, 100% biodegradable, Industrial compostable and recyclable paper cup alternative to using plastic. Bio PBS coating withstands higher temperature beverages in comparison to PLA.

Aqueous coating is a water based dispersion coating of proprietary food grade chemical / polymer which gives water resistance and barrier property. This type of coated board (unlike a PLA lined board) can be recycled in standard paper recycling waste streams & they are home compostable. Environmentalists believe this to be the best material for making food-to-go packaging at this present time & future.



Figure 5

Parameter/ Property	PE (Polyethylene) coated	PLA /PBS coated	Aqueous coated
Coating GSM Required	Usually polycoated cups require medium range between 10 to 18 GSM coating to provide good barrier properties	Higher GSM of 25 to 30 coating is required to provide good barrier properties	Lower GSM of 5 to 12 GSM will also give excellent barrier properties
Source of resin	Petroleum derived resin	Vegetable extracted resin	Water soluble polymer
Barrier properties		Same	
Temperature withstand	Can withstand very hot beverages	Medium hot beverages	Can withstand very hot beverages
Sealing speed	Good	Slow (PLA starts softening at high speeds due to increased heat)	Good

Parameter/ Property	PE (Polyethylene) coated	PLA /PBS coated	Aqueous coated
Compost ability	No	Industrial compostable	Home compostable
Price comparison	Lower among all	50 % - 60 % more than PE	25 % - 35 % more than PE
Barrier properties		Same	
Heat Distortion temperature	High	PLA- Low PBS - High	High
Environmental Sustainability	Not good	Good	Best

Leading brands adaption to PLA & Aqueous coated

To date, many world class brands in Food & Beverages segment had started their internal studies and way forward to eliminate usage of plastic and a major part of it is to switching to more environmentally sustainable packaging products.

Starbucks worldwide had switched from PE coated cups to PLA coated cups and they also replaced plastic straws with PLA clear straws. As many observed, Starbucks only uses ceramic cutlery in their stores replacing the plastic ones. They are now keen to switching to aqueous coated cups.

Brands like Burger King, McDonalds' and Yum Brands have switched to Paper & PLA straws instead of Plastic straws and they are only using aqueous coated cups for certain states in India like Tamilnadu where there is stringent ban on single use plastics.

Subway has started using aqueous coated trays replacing the PE coated. Theobroma & few airlines have replaced

their PE coated cups to aqueous coated cups for certain applications.

Packaging industry considers that Bio Based polymers and aqueous coating have the great

Conclusion

potential to replace the fossil oil derived polymer for paper & board coating application. Bio polymer & aqueous coating not only gives the flexibility of Biodegradation & recyclability but also improve functionality of the coated surfaces. We are seeing many more brands gradually taking packaging material sustainability on the forefront and looking at Aqueous coated as a better choice for future. Government of India is also very keen on reducing the usage of plastics and they are enforcing ban on manufacturing, sale & use of many single use plastics effective from July 1, 2022.

References

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