“An expert is a person, who has made all the mistakes that can be made in a very narrow field”

- NEILS BOHR,

Danish physicist and Noble Prize winner

APTNESS OF PAPER/PAPERBOARD FOR REPLACING SUPs IN FOOD PACKAGING

AUTHOR – S.NARAYANAN
PRESENTER – N. HARIHARAN

TAMILNADU NEWSPRINT AND PAPERS LIMITED - UNIT 2
THIRUCHIRAPALLI

Picture source - www.sappi.com

TABLE OF CONTENTS

01 INTRODUCTION: THE RISE AND FALL OF PLASTIC

1933

Discovering the Accidental Wonder - Polyethylene

- ***Created by accident at a chemical plant in Northwich, England***

1965

Revolutionizing Convenience

- ***One-piece shopping bag is patented by the Swedish company Celloplast***

1997

A sea of consequences

- ***Discovering the Great Pacific Garbage Patch***

Source - https://www.unep.org/news-and-stories/story/birth-ban-history-plastic-shopping-bag

01 INTRODUCTION: THE RISE AND FALL OF PLASTIC

2002

Plastic bags: A flood of trouble

- ***Bangladesh, the first country to implement a ban on thin plastic bags***

2011

- **Worldwide, one million plastic bags are consumed every minute.**

2018

#BeatPlasticPollution

- ***#BeatPlasticPollution - the theme of World Environment Day, hosted by India***

Source - https://www.unep.org/news-and-stories/story/birth-ban-history-plastic-shopping-bag

THE DARK SIDE OF PLASTIC:
02 ENVIRONMENTAL ISSUES AND POLLUTION

Environmental Impact

- Green house gas emissions
- Clogging of drainage, land and Water Contamination
- Disrupts Ecosystems and threat to marine life

Economic Impact

- Negative impact on GDP
- Impacts fishing & shipping
- Cost of cleaning up and addressing its effects

Health & Social Impact

- Ingesting approximately 5 g of plastic every week (www.yourplasticdiet.org)
- Toxic chemical presence and Bioaccumulations
- Open burning releases carcinogenic substance

Fig -1

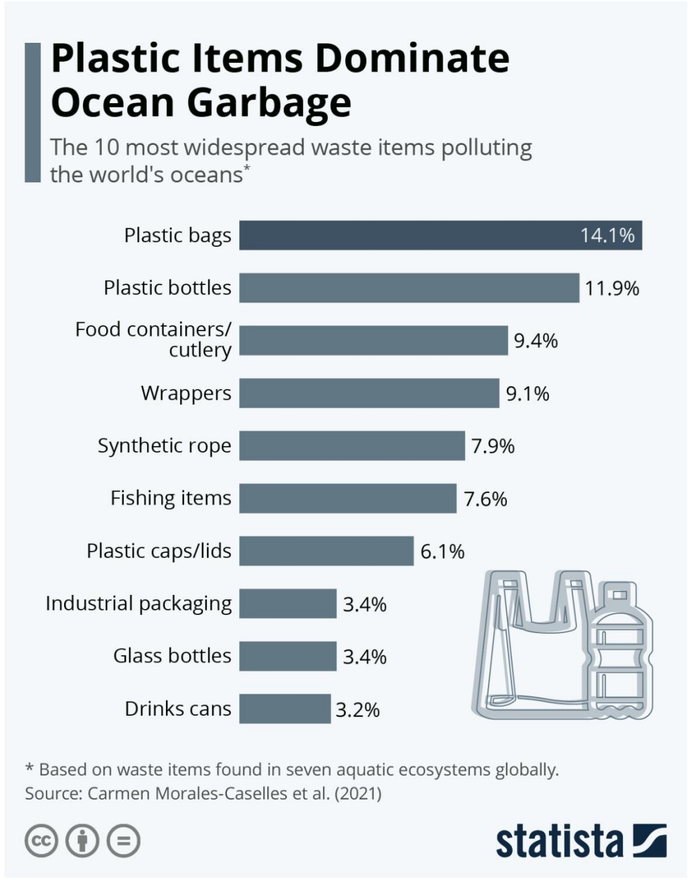

Fig -2

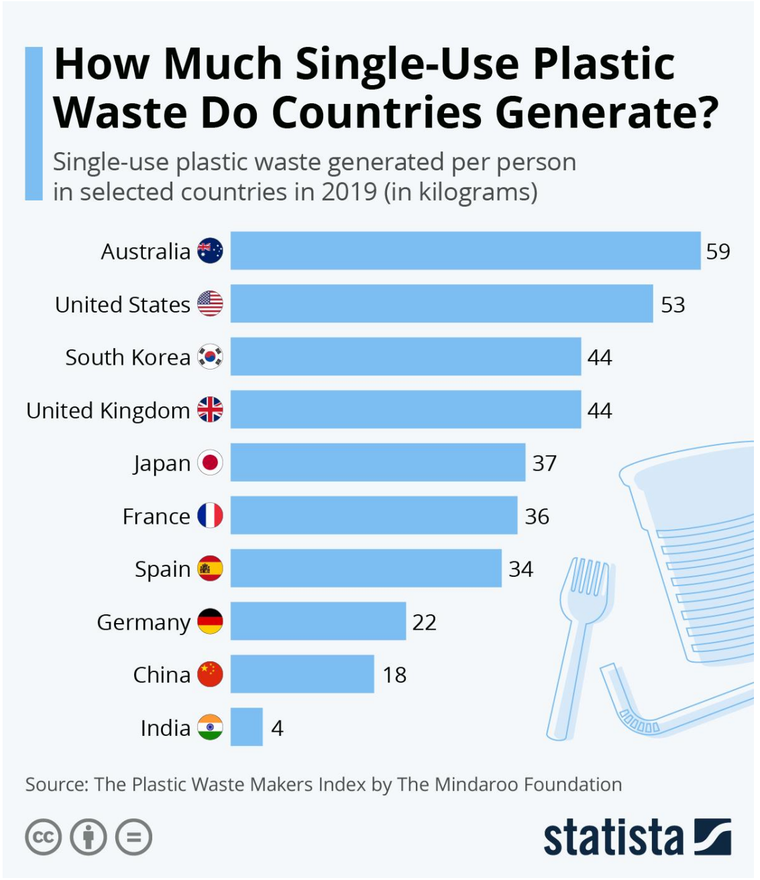
Fig -3

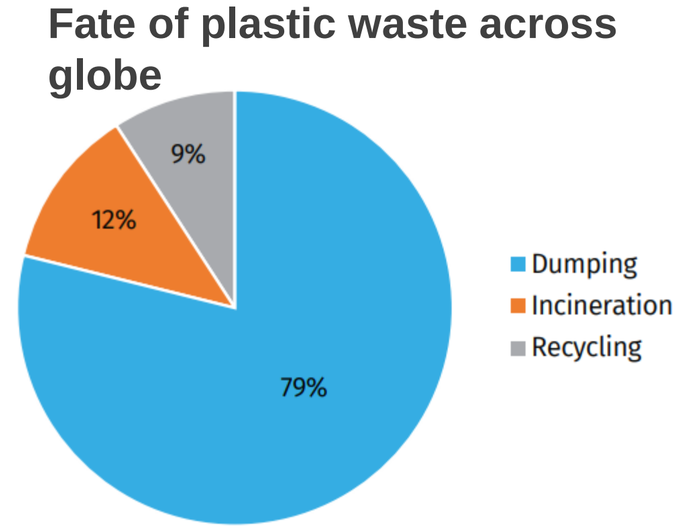
Fig -4

Fig-1 -https://www.nationalgeographic.com/magazines/l/plastic/index-ps.html
Fig -2 - https://www.boredpanda.com/plastic-crisis-impact-on-wildlife-national-geographic-june-issue-cover/
Fig -3&4 - https://timesofabetterindia.com

THE DARK SIDE OF PLASTIC:
02 ENVIRONMENTAL ISSUES AND POLLUTION







Source: Ronald Geyer et al 2017. "Production, use, and fate of all plastics ever made." Science Advances Vol. 3

Source - Carmen Morales-Caselles et al (2021)

Source - The Plastic Waste Makers Index by The Mindaroo Foundation

THE ROLE OF INDIVIDUALS AND GOVERNMENTS IN COMBATING THE PLASTIC CRISIS

03

Role of the individual in reducing plastic pollution

- **Abiding the rules of Governments**
- **Use SUPs alternates**
- **Awareness on detrimental effects of SUPs**
- **Practicing appropriate waste disposal methods**

https://www.indiascienceandtechnology.gov.in/featured-science/ban-single-use-plastic-items-will-promote-planetary-health

04

A SUSTAINABLE SHIFT:
EMBRACE THE POWER OF PAPER/PAPERBOARD

- **Paper is more sustainable option**
- **Cellulose fibers primarily from wood.**
- **Other sources: non-wood crops, agri residues like Bagasse and waste papers.**
- **Paper is recyclable and biodegradable**
- **Easy recycling ability - Hydrogen bond between cellulose fibres**
- **Paper-based alternatives suits food packaging by meeting the safety standards**
- **Revolutionise food packaging with necessary modifications**

04

A SUSTAINABLE SHIFT:
EMBRACE THE POWER OF PAPER/PAPERBOARD

- **Aesthetics and purity demands in food packaging - virgin grade materials**
- **ECF bleaching**
  - **less the environmental impact,**
  - **negligible generations of dioxins and chlorinated organic compounds.**
- **Good Manufacturing practices makes a more sustainable approach.**
- **Usage of regulated substances is essential**

ECF
ELEMENTAL
CHLORINE FREE

05

SUSTAINABLE SOLUTIONS AND ALTERNATIVES TO PLASTIC

- **Food packaging - Water vapour transmission, Oxygen permeability, Oil and grease diffusion .**
- **New material developments - compostable and recyclable**
- **Polymer synthesis & modifications through coploymerization, polymer blending, nano-composite technology etc...**
- **Polypropelene (PP) and Polyethelene possess highest hydropobicity**
- **The available bio based barriers solely cannot outperform – need right combination**
- **Cost equivalent and consistent Performance over inventory period.**

Differences between Conventional and Bioplastics

Conventional Plastics	Bio-plastics
Mostly made from fossil fuels and petrochemicals.	Produced from natural resources
Non-renewable and Non-biodegradable	Renewable & Biodegradable
Emits high amount of greenhouse gases	Emits fewer greenhouse gases. Considered carbon neutral.
Environmentally polluting	Environmentally friendly
Takes more time to disintegrate into smaller particles	Utmost biodegradation occurs in 6 months in controlled microbial composting condition

06 BARRIER COATING TRIALS: EXPERIENCES

PLA Extrusion Trial: Observations & Solutions

- PLA – renewable and compostable alternative.
- Modifications in extrusion machine
- Temperature settings as per PLA -TDS
- The extrusion trial in cup stock - approx 20 gsm of PLA coating.
- Extrusion trial in paper for pouches
- Cup blanks conversion and cup making trials
- Good heat sealing and water barrier properties

Fig1-PLA coated cup blanks & cups

Fig2-PLA coated paper pouches

06 BARRIER COATING TRIALS: EXPERIENCES

Water based Barrier coating trial

- Better film coverage - preferable metering techniques :

  Curtain > Air knife > bar > blade

- Barrier coating trials in online and offline mode with blade/bar metering

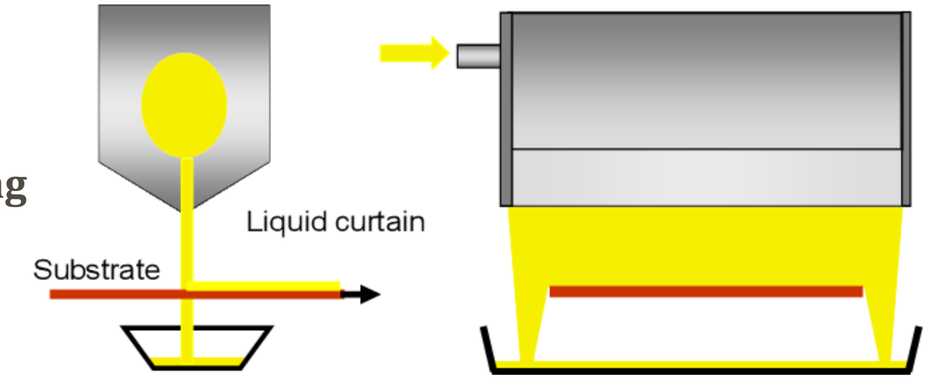


Fig1-Curtain coating – Principle diagram

Observations & Solutions:

- Single coat - Penetration of barrier chemical
- Double coat – Primer and barrier chemical
- Pinholes
- Blocking

  a) chemical modification

  b) installation of air curtains

  c) removing jumbo rolls in small quantities/diameters;

  d) Immediate re-winding of jumbo rolls

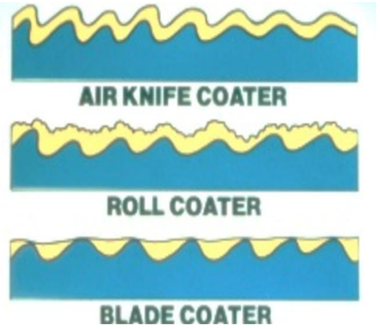


Fig 2 - Coating lay vs coating method

Fig-1-https://www.semanticscholar.org/paper/Modelling-of-the-curtain-coating-process-as-a-basis-M%C3%A9ndez/0b1b624b9972f6a555188c05c3d989b95c754ca8
Fig-2-https://www.semanticscholar.org/paper/The-Modification-of-a-Curtain-Coating-Formulation%3A-Schoenfelder/8bfe9c15d6f1d7714d4b754bc8aaa59c38a1b41d

06 BARRIER COATING TRIALS: EXPERIENCES

Water based Barrier coating trial

Observations & Solutions:

- Cleaning of dried barrier material
- Chiller roll arrangement.
- Offline coating trial.

Fig - Cup bottom joint

Cup Conversion Observations:

- Coated Surface characteristics
- Sticky nature - blank punching at lower rate.
- Repeated jamming in cup conversion
- Cup evaluation – bottom leakage

07 FOOD CONTACT REGULATIONS/COMPLIANCE

- Packaging's Primary purpose - Protection of the good
- Food contact regulations & compliance are paramount for direct contact and are country-specific

- Paper/paperboard for food contact :
  - Should not pose any health hazard;
  - Should not alter organoleptic properties;
  - Should not change composition of food.

- During manufacturing Food contact materials:
  - Good Manufacturing Practices (GMPs)
  - Must use regulated substances

Country	Regulation
USA	FDA Title 21 CFR 174.5 - General provisions applicable to indirect food additives
European union	European Commission Regulation (EC) No. 2023/2006 - Good manufacturing practice for materials and articles intended to come into contact with food.
China	National Standard for Food Safety GB 31603-2015 - General Hygienic Specifications for Production of Food Contact Materials and Articles

07 FOOD CONTACT REGULATIONS/COMPLIANCE

Compliances applicable for paperboard meant for food contact applications.

Country	Compliance
USA	US FDA 21 CFR 176.170 & US FDA 21 CFR 176.180 Part 176: Indirect Food Additives: Paper and Paperboard components. Sec. 176.170: Components of paper and paperboard in contact with aqueous and fatty foods. Sec. 176.180: Components of paper and paperboard in contact with dry food.
Germany	German BfR XXXVI
EU	EU (EC) 1935/2004
India	BIS:6615
China	GB4806.8 and GB 9685

08 CHALLENGES

PLA – (Poly Lactic Acid)

- **Availability & high cost**
- **Demands Sound knowledge in extrusion and application**
- **High purity of Lactic acid or lactide for PLA of high quality, high molecular weight and high yield.**
- **Optically impure PLA may create metabolic issues.**
- **Pure PLA is a brittle material and warrants blending of soft biodegradable polymer for flexibility.**
- **Distinguishing PLA coated material from conventional plastic coated material**

08 CHALLENGES

Water Based Barrier Coatings

- **Blocking issue**
- **Pin holes**
- **Primer coating is inevitable.**
- **Chemical odor in hot beverages.**
- **Permanence of heat sealing over storage.**
- **Leakage at bottom of joint in cups.**
- **At present, the Cost of Bio-based Compostable / Water based barrier materials are higher by 3–4 times**

09 WAY FORWARD

- **Shift towards biodegradable and compostable plastics is crucial.**
- **Currently, PLA is the leading compostable plastic for paper and paperboard coatings.**
- **Water based barrier coating materials are also increasingly becoming attractive.**
- **The collective effort of manufacturers of paper/paperboard & barrier coating chemicals, guidance by regulatory authorities will facilitate further developments for mass replacement of SUPs with Paper/Paperboard.**

Join us in leading the change towards sustainable solutions for a greener future.

All good things come to life with a Price tag.

There is a cost for protecting our mother Earth - Environment

Thank you