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Barrier design for the future

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two steps forward one step back

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Agenda

- Why we want barrier
- Barrier materials & construction
- Current vs Future requirements
- Requirement Gap
- Examples of progress & problems
  - Metal foils
  - Down-gauging

Why do we want packaging

Packaging

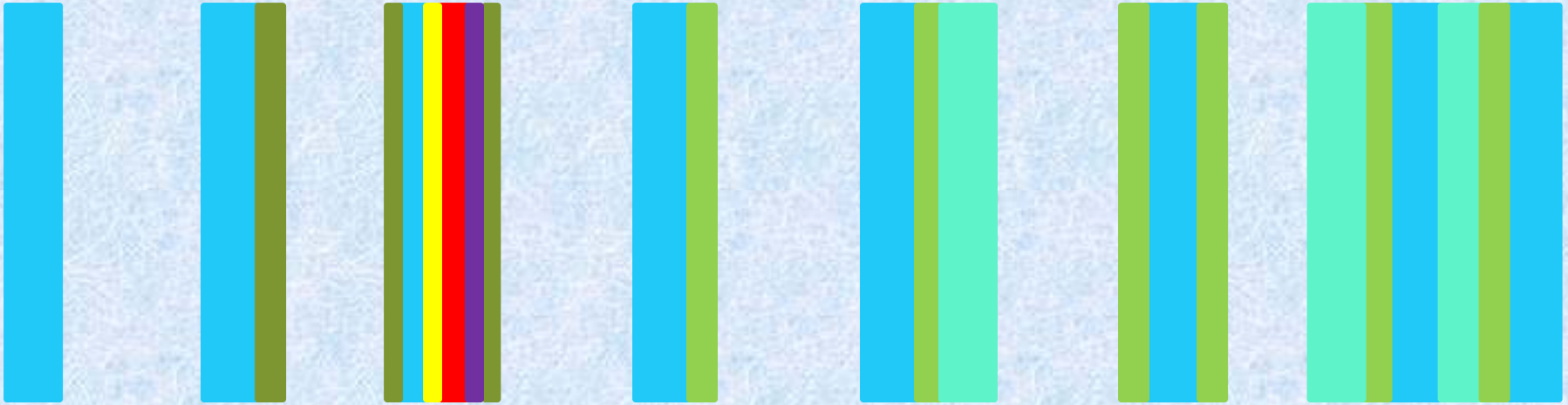
Preservation of goods

Protection against environmental, physical, and mechanical hazards (oxygen, water/moisture, light, contamination from micro-organisms, rodents, and insects, physical damage, chemical attack, etc.) during storage and distribution

Barrier materials

- **Metal** — Light/gas barrier
  - **Foil**
  - **Thin film metallization**
- **Ceramics** — Transparent gas barrier
  - **Thin film coatings**
- **Glass** — Transparent gas barrier
  - **Thin film coatings**
- **Paper** — Substrate
- **Polymers** — Substrate/barrier coatings
  - **Film**
  - **Thin film coatings**

Basic structures



Polymer substrate

Polymer Substrate + coating

Polymer multilayer substrate

Polymer substrate + metallization or lamination to foil or coating

Polymer substrate + metallization + lamination

Polymer substrate + double side metallization

Polymer substrate + metallization + lamination to metallized film

Polymers or coatings can be with or without fillers

Laminates can be with or without coatings

Future requirements

All the existing requirements

+

Fully re-cyclable or re-usable
Low carbon footprint

Where is the gap?

- Too much packaging
- Too much ends in landfill
- Materials not optimised
  - Thickness greater than might be
  - Mixed materials that prevent re-cycling

Metal foils

Why replace foil?

- Legislation
- Environmental
  - recycling
  - energy saving
- X-ray
  - particle detection
  - metal screening
- Microwave compatible
- Perceived cost saving

Replacing metal foils

- **Replace metal foil with thin metal coating**
  - **Reduce metal thickness from microns to nm**
  - **Reduces weight into landfill**
  - **Acceptable to most legislation that bans Al foil**
  - **Still does not allow screening for metal contamination**
- **Replace metal foil with transparent barrier**
  - **Inorganic or organic materials**
  - **As above + allows screening for metal contamination**

- **NB. Often the barrier performance is reduced**

Foil - Reducing costs

Aluminium foil			
Thickness	Price/kg	Price/sq m	
microns	$	$	
6.35	3.97	0.07	
7.24	3.86	0.08	
7.62	3.86	0.08	
8.89	3.75	0.1	
Toray			
Metallized OPP			
thickness microns			grade
13	5.71	0.07	PCN
11	5.82	0.06	PCF
11	6.04	0.06	PC-2
Metallized PET			
thickness microns			
12	4.52	0.08	TPEu 35.30
12	3.64	0.06	RI
12	3.86	0.07	TPEu 34.10

Some costs presented at a conference that show the cost savings may not be all that is expected

From paper presented by Wolfgang Decker at AWA European conference

Foil – reducing energy

Energy	MJ/sq m	16	12	15	12	6
Equivalent	kWhr/sq m	4.4448	3.3336	4.167	3.3336	1.6668
	kg CO_2 /sq m	2.66688	2.00016	2.5002	2.00016	1.00008
Microns	PET	12	M12			
Microns	OPP			15	M20	20
Microns	Aluminium	7		7		
Microns	PE	50	50	50	50	
Microns	OPP					M20
M=metallized						

Tray 20cm x 30cm		Weight	Energy	Energy	CO_2 Emissions
chiller to oven use		gm	MJ	kWhr	Kg
Aluminium foil	90 microns + lid	22	4.09	1.136202	0.6817212
PET	200 microns + lid	17	3.57	0.991746	0.5950476
% reduction				**12.71**	

Replacing metal foils

- **Replacement material is often more than just metallized film**
- **If the replacement is a mixed polymer it may result in the replacement cannot be recycled but only down-cycled, incinerated or sent to landfill – (worse than the foil)**

Vacuum coffee laminate

- **Requirements**
- **Oxygen barrier** **<1.5cc/sq m/day**
- **Drop back – processing** **+/- factor 2 - 4 max**
- **WVTR** **<0.5 g/sq m/day**
- **Light protection** **OK**
- **Printing – improved quality – metallized gold**
- **Bond strength** **>1N/15mm**
- **Machinability** **no static charge**

Coffee bag laminate

ply #1 (a) (b) ply #2 (b) ply #3

48g PET / ink / adh / .00035 AL /PE / 3 mil LLDPE

PET printed on inner surface
Adhesive
Foil
Extruded PE adhesive
LLDPE Sealant layer – e.g. heat seal

stock bags for coffee use this structure.
Known as : 3 ply foil based lamination - adhesives ignored

Vacuum coffee laminate

- **Down gauging**
- **1 3 ply to 2 ply**
  - **OPA/met PET/PE or PET/Al foil/PE 107 microns**
  - **to OPA/met/PE or PET/met/PE 85 microns**
- **2 further down gauging**
  - **15 mic. OPA / met / 45 mic. PE special 60 microns**

Limitation – material stiffness – pack does not easily hold open for filling – further down gauging needs to use higher stiffness material

Vacuum coffee laminate

- **Recycling - spot the problem**

  - **OPA/met PET/PE or PET/Al foil/PE 107 microns**
  - **to OPA/met/PE or PET/met/PE 85 microns**
  - **15 mic. OPA / met / 45 mic. PE special 60 microns**

  None of these laminates are based on a single polymer

  It is possible to get a Heat Seal grade of PET and so in theory it is possible to produce a metallized PET to achieve the performance - although maybe not the cost

Product re-cycling

Product → **same Product** → **re-cycling**

Product ⇒ **lower quality product** = **down-cycling**

Product ⇒ **incineration**

Homopolymer - clean - grind - reprocessing → **homopolymer**

Mixed polymer laminate cannot be fully recovered and thus has to be re-cycled into a lower grade product or incinerated

Image of Packaging

- **It depends who you talk to**

- **Too much packaging - overpackaging**
- **Not responsible**

Or

- **Delivering against customer requirements**

Paper/polymer laminate

Paper + polymer laminate

Promoted as a recyclable material

Users encouraged to peel paper from polymer & recycle separately

Image of company is of caring, responsible, environmentally positive

The reality is different.

Polymer is a 3 layer structure of PET/Nylon/PET that is very difficult to recycle & hence there are few or no facilities to recycle the material

The company knows that all the material will end in landfill

This type of behaviour makes consumers distrust the packaging industry

Comments

- **Reductions in packaging tend to be driven by cost savings – rather than including environmental effect**
- **Governments, the packaging industry and scientists need to agree consistent preferred solutions**
- **New developments need to include recycling as part of the targets**

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Thank you for listening

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