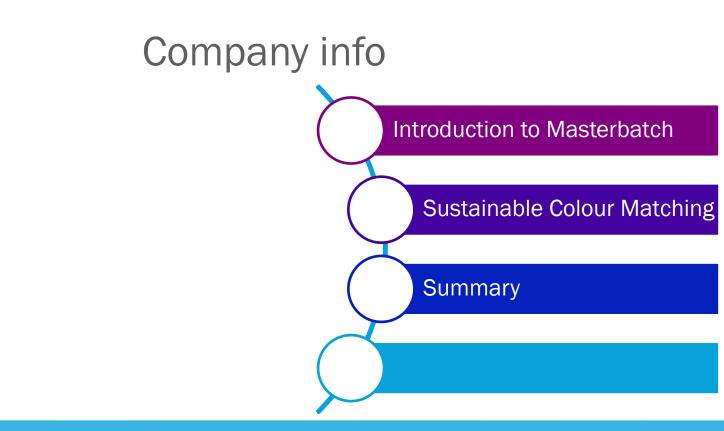
COLORANTSHOR TO SUSTAINARIE PATRIK ROHRER **R&D MANAGER** E-MAIL: PATRIK@DELTAQ.IE

DELTA

Moydrum Industrial Estate, Athlone, Co. Westmeath, Ireland Tol: + 353 (0)90 6486764 Fax: + 353 (0)90 6486766 Fmail: info@deltag.ie WWW.DeltaQ.ie **Tel:** + 353 (0)90 6486764 **Fax:** + 353 (0)90 6486766 **Email:** info@deltagie

PRODUCT

201H APRIL 2021



- Located in the heart of Ireland since 2005
- 35 employees
- Dedicated technical & regulatory service team
- 7 production lines with capacity over 40 tonnes per week
- € 10 m turnover







- 5 extrusion lines for masterbatches
- Batch size from 25 kg
- Broad range of carriers
- Library with over 7000 colours
- 4 days lead time for colour products





- Two compounding lines
- Batch sizes from 25 kg
- Variety of polymers and applications



Design of custom made compounds (colour, properties)



- Distribution of polymers and additives
- Stocking with next day delivery service
- Great supplier network
- Technical expertise for material selection





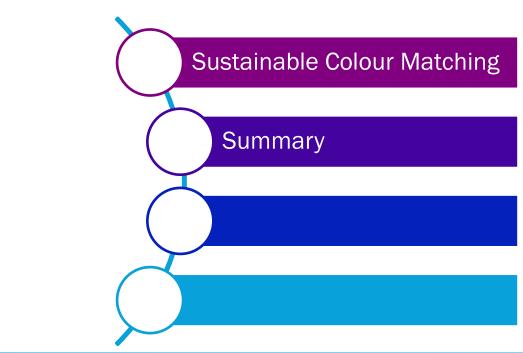
- Material testing & colour laboratory
- Tests according ISO or ASTM standards
- State of the art equipment



Technical guidance and support for product development

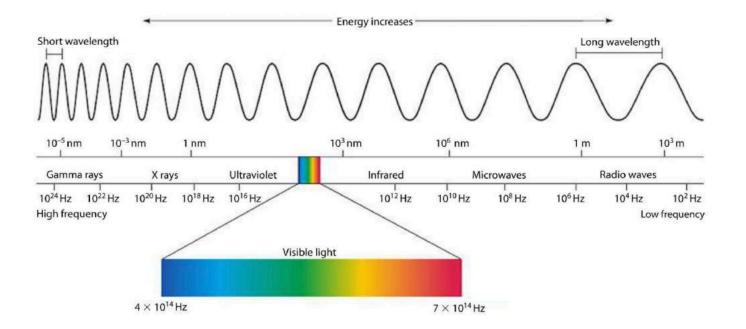






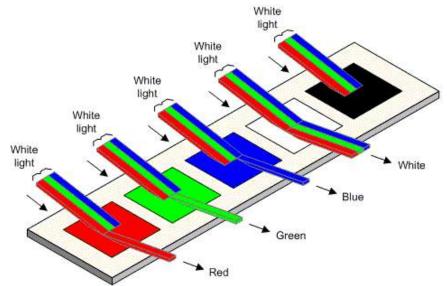
Nature of Colour

- Day light is a form of electromagnetic energy consisting of UV, visible and IR waves (Maxwell, 1861)
- Need to consider all sources of energy
- Visible light between 400 nm and 780 nm



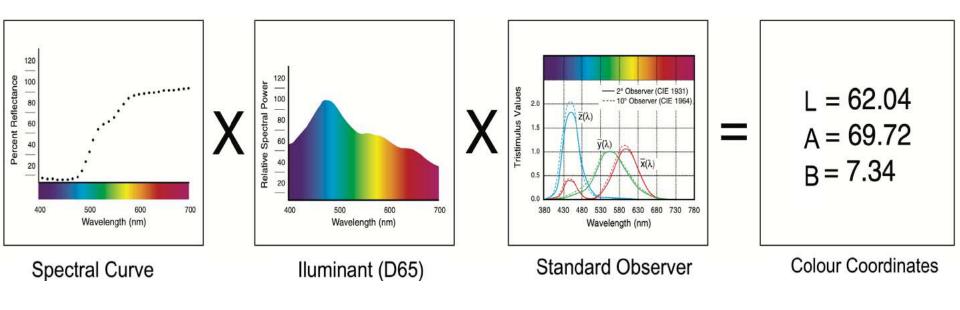
Nature of Colour

- Ideal white object Reflects 100 % of day light
- Ideal black object Absorbs 100 % of day light
- Absorbed light is transferred into heat, reflected light corresponding with colour of the specimen
- Colour sense is subjective -> two people can see different colours



Colour Space

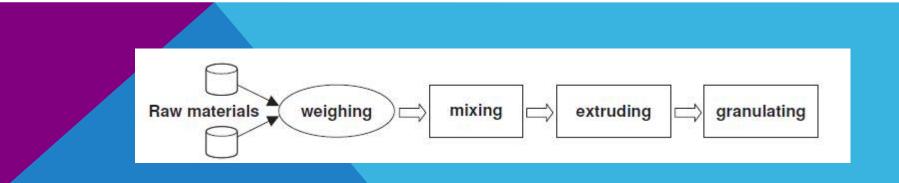
- Any colour space model (LAB, RGB, RYB, CMYK) can be calculated based on:
 - Spectral curve
 - Type of illuminant
 - Angle of observing





Masterbatch composition

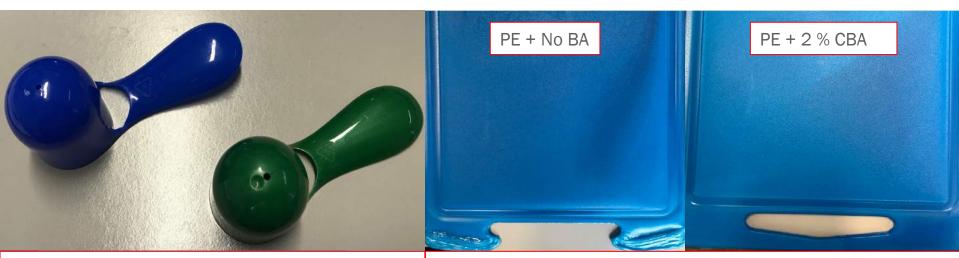
- Concentrated active ingredient on polymer carrier adding colour or other property to the final product
- Carrier is usually specific to the coloured material
- Diluted with prime or recycled material
- Typical masterbatch formulation is composed of:
 - Carrier
 - Lubricant
 - Pigment
 - Other additive filler, desiccant, etc.





Masterbatch v Combi-batch

- Colour masterbatch
 - Combination of one or more pigments
 - Objective is to colour the article
- Combi-batch
 - One or more pigments combined with other additives
 - Objective is to colour final product but also modify other material properties



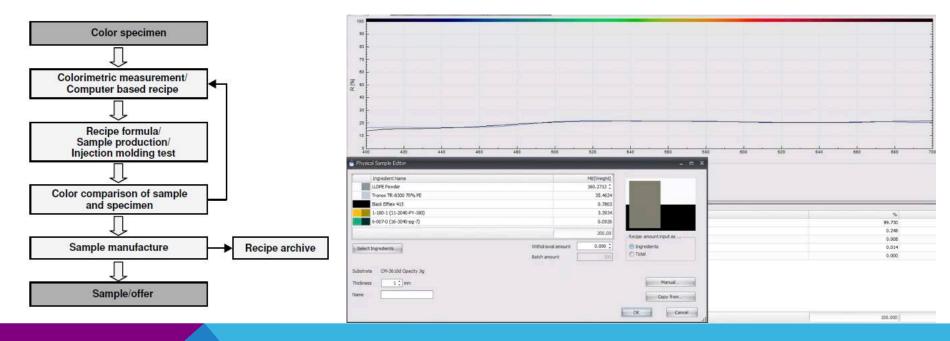
Masterbatch Application

Combi-Batch Application



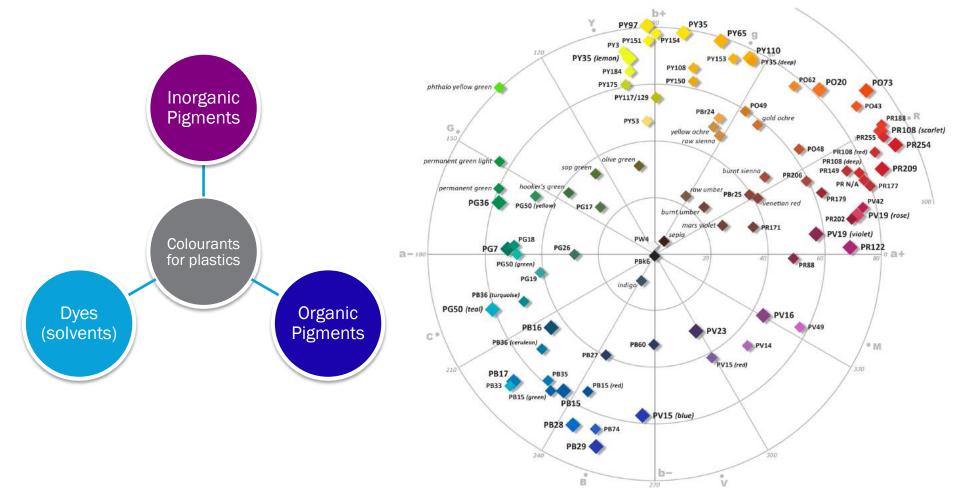
Colour Matching

 Colour is matched using historical data, pigment prediction software and experience



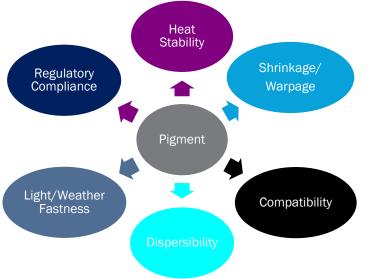
Pigment Classification

 Each pigment, dye has own CAS number and colour index (Pb 15.1, PG 7, PB 29 RS, PR 254, SG 3, SR 135, etc.)

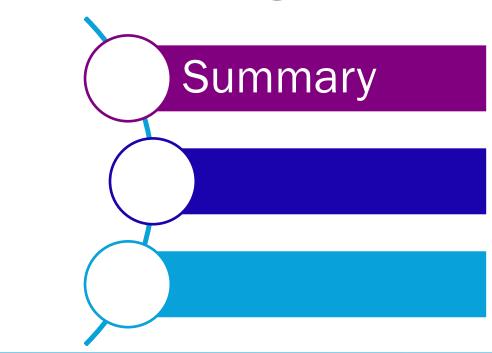


Important Pigment Properties

- Shrinkage/Warpage Dimensional changes caused by organic pigments
- Heat stability/Compatibility Stability of pigment when exposed to specific heat or chemical environment
- Dispersibility Function of how easy/difficult is to mix pigment with polymer
- Migration Ability of pigment migrate through specific polymer
- Lightfastness & Weather fastness Outdoor stability of pigments
- Regulatory Compliance Suitability of pigment in different food or medical applications

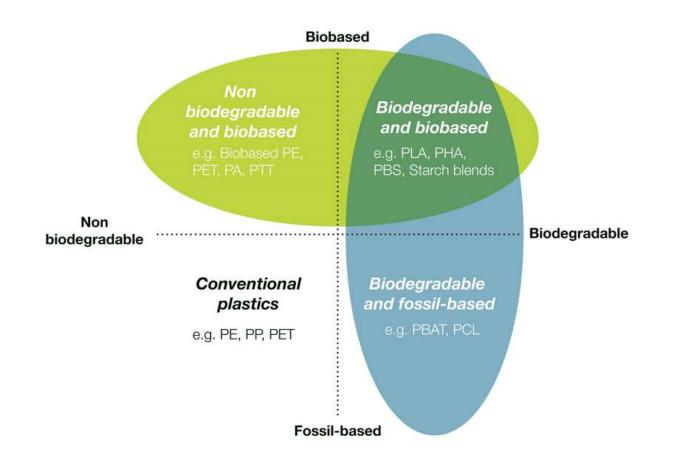






Sustainable Colour Matching

Classification

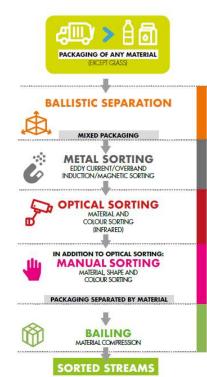


(Bioplastics' material coordinate system, 2015)

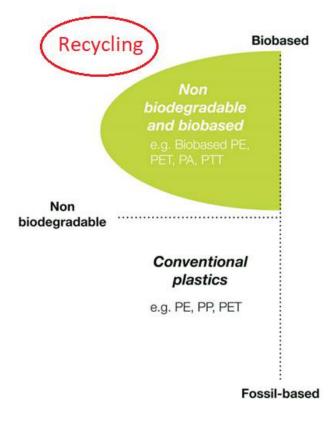
Sustainable Colour Matching

Non-biodegradable Materials

- Standards
 - ISO 15270:2009 Guidelines for the recovery and recycling of plastic waste
 - COTREP Guidelines
- Non-biodegradable polymers are sustainable only if recycled correctly





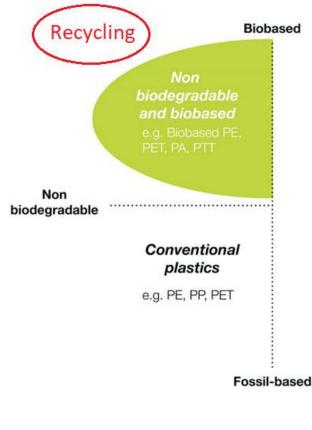




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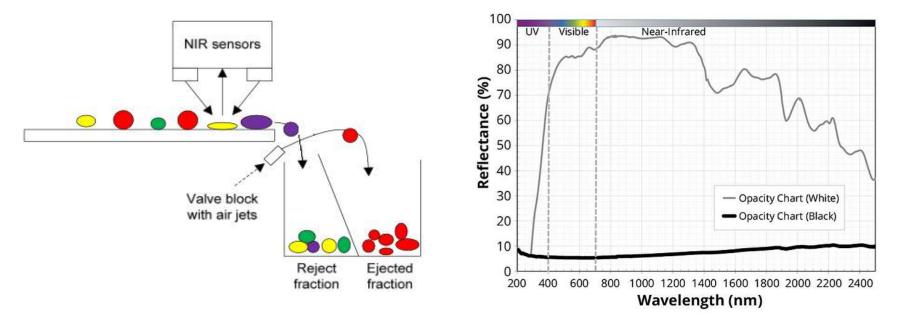
1	10 codes of conduct for Design for Recyclability for Polyolefin Packaging Design (Borealis)	12	Design for recycling guidelines for PET thermoformed trays: Clear transparent to be recycled even in food applications (PETCORE Europe)	
2	Circular Analytics guidelines	13	RECOUP guidelines (RECOUP) Recyclability of plastic packaging: Eco-design for improved recycling (COTREP)	
3	Circular Packaging Design Guideline (FH Campus Wien)	14		
4	2020 rate list for recycling household packaging (Citeo)	15- 22	RecyClass design for recycling guidelines (RecyClass and Plastics Recyclers Europe):	
5	cyclos-HTP (Institute cyclos-HTTP)	-	 HDPE Coloured Containers HDPE Natural Containers PE Coloured Flexible film PE Transparent Flexible film PO Pots, Tubs, Blisters & Trays PP Coloured Containers PP Natural Containers PP Transparent Natural Flexible film 	
6	Design 4recycling. Design plastic packaging so it can be recycled (Der Grüne Punkt)			
7	Design for Recycling Guidelines (SUEZ.circpack [®])			
8	Design Guide for PET Bottle Recyclability (EFBW and UNESDA)			
9	Designing for a Circular Economy Guidelines (CEFLEX)	23	3 Recycled plastics - Practical guide for integrating recycled plastics into the electrical and electronic equipment (Eco-systemes)	
10	European PET Bottle Platform initiative – EPBP (EPRO, EuPR, Petcore, UNESDA and EFBW)	24	Reuse and recycling of plastic packaging for private consumers (Network for Circular Plastic Packaging, on behalf of the Danish Plastics Federation)	
11	Packaging 4 Recycling (EXPRA)	25	Round Table Eco Design of Plastics Packaging (IK Industrievereinigung Kunststoffverpackungen e.V)	



(Support to the Circular Plastics Alliance in establishing a work plan to develop guidelines and standards on design-for- recycling of plastic products, 2020)

Sorting & Recycling Mechanism

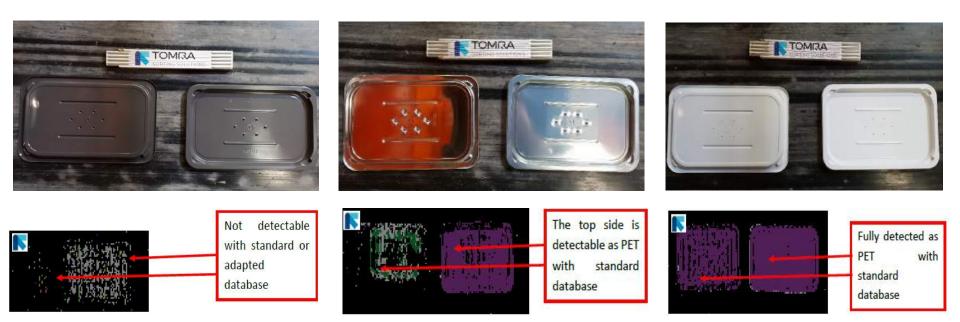
- Mechanism of optical sorting is based on near infrared technology (NIR)
- High speed optical NIR detectors
- Sorting is based on material's molecular absorption or reflection
- Reflected IR signal creates a characteristic fingerprint of the material (TSR value)



Sustainable Colour Matching

Sorting & Recycling Challenges

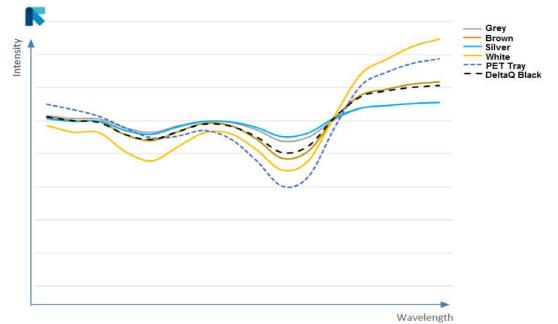
- Carbon black absorbs all NIR light from the sorting device
- Formulations with carbon black content over 0.03 % are not detected by NIR detector
- Formulations with metallic pigments are difficult to recycle
- Clear trays made of virgin PET ≄ environmentally friendly, over 40 % higher carbon footprint (A Comparative Life Cycle Assessment of Meat Trays Made of Various Packaging Materials, 2019)



Sustainable Colour Matching

Sorting & Recycling Challenges

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Sustainable Colour Matching

General guidelines for non-biodegradable masterbatch

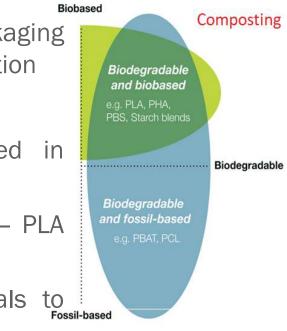
- Guidelines for sustainable masterbatch used with non-biodegradable polymers:
 - The main recycled materials are PE, PP, PET.
 - Based on heat cycles, antioxidants & odour absorbers need to be considered.
 - Translucent/light colours are easier for recycling
 - If dark shade colour is needed, do not use carbon black!
 - If pearlescent or metallic pigments are used, the product requires NIR testing
 - Consider density when colour matching & using inorganic additives.
 - When matching in recycled polymer, consider clarity/opacity modifiers
 - Consider if end user can benefit from mechanical & flow modifiers
 - Consider if colour correctors can help to the end user's product.



Sustainable Colour Matching

Biodegradable/compostable materials

- Standards
 - ISO 13432 Packaging Requirements for packaging recoverable through composting and biodegradation
- DeltaQ works against ISO 13432
- Biodegradable materials need to be composted i industrial or house composters
- Most enquiries in field of biodegradable polymers PLA & Arboblends
- Wide range of alternative biodegradable materials to commodity polymers (i.e. Arboblends)





Biodegradable/compostable materials

- ISO 13432 states that:
 - 90 % of materials have to be broken down into CO₂, H₂O % minerals withing
 6 months
 - Maximum of 5 % of additional non-compostable ingredients (like colourants & carrier) is allowed
 - Each component of the 5 % total cannot exceed 1 % of content in the final article
 - The end user must test the product against test methods in ISO 13432
 - ISO defines set limits for volatile substances, heavy metals and fluorine:

Element	Max Concentration [ppm]	Element	Max Concentration [ppm]
Zn	150	Cr	50
Cu	50	Мо	1
Ni	25	Se	0.75
Cd	0.5	As	5
Pb	50	Fluor	100
Hg	0.5		



Biodegradable/compostable materials - Colouring

- Inorganic pigments such as cobalt, ultramarine & iron oxide based pigments, etc. can be used up to 1 %
- Chemical character of organic pigments, i.e.
 phthalo blue 15.3 contains 11 % of copper in the structure, must be considered
- Information from suppliers regarding used chemicals are required
- Dyes are not fully recommended due to migration (depending on crystallinity of given polymer, some PLA grades can be coloured with dyes)

Colour Index [1]	Concentration in the final product [%]
PY 180	< 1
PY 191	< 1
PO 64	< 1
PR 254	< 1
PR 170	< 1
PR 122	< 1
PR 57.1	< 1
PV 15	< 1
PV 19	< 1
PV 23	< 1
PB 15.1	0.045
PB 15.3	0.045
PG 7	0.08

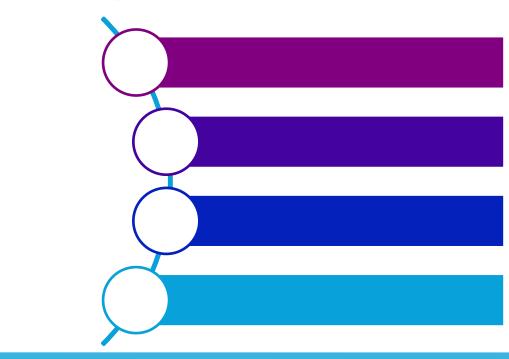


Biodegradable/compostable materials -Colouring

- DeltaQ formulates coloured masterbatches for biodegradable polymers according to ISO 13432
- Majority of DeltaQ masterbatch formulations is used at 2 or 3 %
- Carriers are usually based on standard commodity polymers
- If required, polymer specific carrier can be offered
- Colour is always matched in specific biodegradable polymer due to differences in base colour
- It is recommended to evaluate biodegradability on the end product



Summary



Summary

- DeltaQ recognizes increased demand in sustainable enquires for bio and non-biodegradable colour concentrates
- NIR detectability & carbon black content is the main limitation when recycling coloured articles
- Most colours can be formulated using NIR friendly principles
- Non-biodegradable ingredients and colourants can be used for colouring of biodegradable polymers up to 5 % (ISO 13432)
- Contact DeltaQ in case of further help & future project

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PRODUCT

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