Overall migration from biodegradable plastics into aqueous food simulants

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PLASTICS

Everywhere!
In contact with foodstuff
Is it safe?

BPA
IRGANOX 1076
Caprolaktam
Prymary aromatic amines
Formaldehyde
.
.
.
Substances are dangerous!
HOW AND WHY?

• Sight, smell, taste?

• Health care! -> Regulation
• Overall and specific migrations
  Standard analytical methods
  Accredited laboratories
  Accredited according to EN 17025
BIOPLASTICS

• Biodegradable or biobased or both
  – New materials
  – Packaging -> FCM

• Foodstuff – various conditions
  – Salts
  – pH
  – Fats
  – Temperature
  – Time...

It become’s interesting
SAMPLES

• Commercially available and products of the PLASTiCE project*
  – 3 PLA
  – 5 termoplastic starch *foil
  – 1 PHA *tubes
METHODOLOGY

• **FT-IR**
  – Characterization of the material
  – Identification of the dry residue

• **Simulants**

• **Migration:** article filling, cell, immersion

• **Surface determination**
MIGRATION CONDITIONS

- **Council Directive (82/711/EEC)** Testing migration of the constituents of plastic materials and articles intended to come into contact with foodstuffs

- **Council Directive (85/572/EEC)** laying down the list of simulants to be used for testing migration of constituents of plastic materials and articles intended to come into contact with foodstuffs with amendments, taking into account actual use of samples

- **EN 1189**
  - Selection of the migration conditions EN 1189-1
  - Immersion EN 1189-3
  - Article filling EN 1189-9
  - Cell EN 1189-5
# MIGRATION CONDITIONS - overview

<table>
<thead>
<tr>
<th>Sample</th>
<th>Method</th>
<th>Migration conditions / Food simulant-T [°C]-t [h]</th>
<th>Sample surface / Volume [dm²/mL]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACup1</td>
<td>AF</td>
<td>3 % acetic acid – 40 - 24</td>
<td>1.97/250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 % EtOH – 40 – 24</td>
<td></td>
</tr>
<tr>
<td>PLA_Deli_bowl</td>
<td>AF</td>
<td>3 % acetic acid – 40 – 24</td>
<td>1.73/250</td>
</tr>
<tr>
<td>PLA_cup_2</td>
<td>AF</td>
<td>3 % acetic acid – 40 - 24</td>
<td>1.98/250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 % EtOH – 40 – 24</td>
<td></td>
</tr>
<tr>
<td>StarchCup</td>
<td>AF</td>
<td>3 % acetic acid – 70 – 2</td>
<td>1.76/250</td>
</tr>
<tr>
<td>Starchknife</td>
<td>TI</td>
<td>3 % acetic acid – 70 – 2</td>
<td>1.36/136 (two knifes in each parallel)</td>
</tr>
<tr>
<td>Starch_bag_trash</td>
<td>MC</td>
<td>3 % acetic acid – 40 – 24</td>
<td>2.34/190</td>
</tr>
<tr>
<td>Starch_bag_carrier</td>
<td>MC</td>
<td>3 % acetic acid – 40 – 24</td>
<td>2.34/190</td>
</tr>
<tr>
<td>Starch_foil</td>
<td>TI</td>
<td>3 % acetic acid – 70 – 2</td>
<td>1/100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 % acetic acid – 40 – 24</td>
<td></td>
</tr>
<tr>
<td>PHA_tube</td>
<td>TI</td>
<td>3 % acetic acid – 70 – 2</td>
<td>1.13/113 (1 bigger and 1 smaller tube in each parallel)</td>
</tr>
</tbody>
</table>
RESULTS – visual inspection

• **PLA** at used migration conditions no visual changes were detected

• **Thermoplastic starch:**
  – Bags 😊
  – Laminated cup ~
  – Foil ~
  – Knife – change of color

• **PHA** no visual changes observed
RESULTS – overall migration

• **PLA** overall migrations from all samples into all simulants after first and third cycle are **below level of detection**

• **Thermoplastic starch:**
  – Laminated cup: 1 cycle 😊
  – Bags: 😊, although they are not intended for FC
  – Knife: Exceeds limits for 300 %
  – Foil: **first cycle exceeds limits, third cycle 😊 prewashed** – lower overall migration, still **exceeds the limit**

• **PHA** sample exceeded the limit up to 700 %, third cycle better, **influence of simulant**

• Materials are appropriate for food contact, it is important to consider actual use, all materials are not for all uses
THINGS TO DO IN THE FUTURE

• FT-IR: new materials, no database for characterization
• Dry residue: identification: FT-IR, NMR... at the moment we still can not say which substance migrated

• Specific migrations?
• Reported tests are of an exploratory nature, were done on a limited set of available samples and should not be used as a direct basis for general material selection.
THANK YOU FOR YOUR ATTENTION

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