



**FOOD CONTACT
CENTER**



**FOOD CONTACT
SERVICES**

octima
organizzazione per la chimica e per la tecnologia innovativa dei materiali avanzati
organization for chemistry and innovation technology of advanced materials

Conference entitled

**FINISHED PRODUCT AND NEW
FORMULATIONS OF VARNISHES,
INKS, ADHESIVES AND VARIOUS
TYPES OF COATINGS IN
RESPONSE TO THE EUROPEAN
DIRECTIVES ON SUSTAINABLE
FOOD PACKAGING**

Tuesday, October 22nd 2024 - h 09,00 at the
NH Hotel Congress Centre,
Strada 1 - Milanofiori, Assago (Milan)
in conjunction with the third edition
of Paint & Coatings Italy trade fair.

Analytical evaluation of the barrier effects of coatings with a focus on the release of microplastics, referring to management of environmental claims such as plastic free.

Marinella Vitulli, Owner & Director, Food Contact Center & Food Contact Services



Marinella Vitulli– m.vitulli@foodcontactcenter.com

Senior Food Contact Specialist, Founder of Food Contact Center & Food Contact Services srl

- degree in Pharmaceutical Chemistry, currently Chemist and Food Contact Expert
- more than 20 years seniority in FCM
- Laboratory Director also for multinational companies
- key point in Western Europe for enterprises wanting to enhance their Quality Systems
- member of European technical tables





Food Contact Center & Food Contact Services



HQ: 1200 sq m



Laboratory: 600 sq m



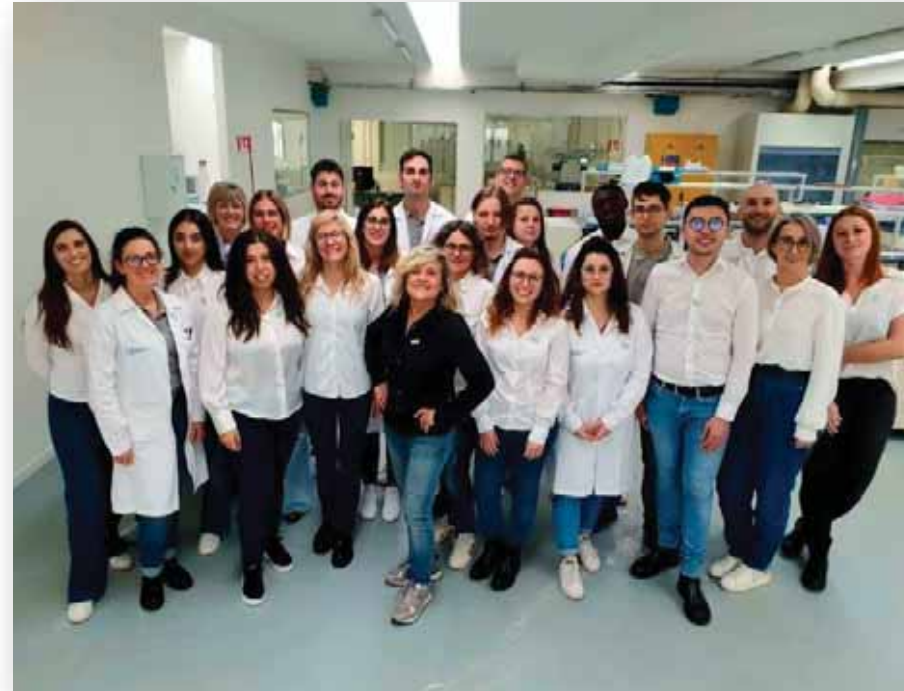
R&D Pilot Plant



27 food contact experts



microbiology department



www.foodcontactcenter.com



Laboratory expert in the field of FCM
Chemical, physical and microbiological tests.

"Our innovations are your success;
through research, we go beyond the standards.



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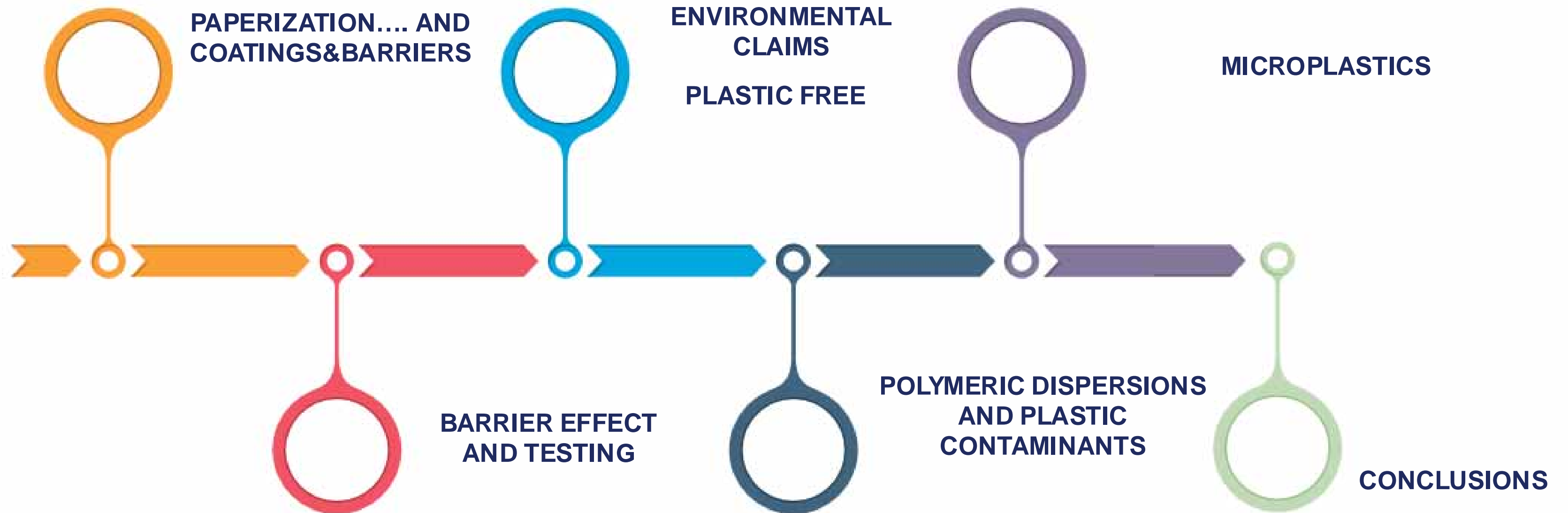
Business consultancy on food contact processes and materials/objects.



Analytical evaluation of the barrier effects of coatings with a focus on the release of microplastics, referring to management of environmental claims such as plastic free.



AGENDA:



PAPERISATION/PAPERIZATION... SLANG OR TECHNICAL TERM?



PACKAGING DIGEST

Food & Beverage | Pharma & Medical | Machinery | Trends & Issues | Technologies | Design | Sustainability

SIGN UP TODAY

Are We at the Tipping Point for 'Paperization' in Packaging Sustainability?

For July "Plastic Free" month, we look at the popular alternative: paper.

Paperisation: shifting from plastics to fibre-based packaging

Transition, driven by the need for sustainable solutions and changing consumer preferences, presents both opportunities and challenges for businesses.

12, 2024

Paperisation is like buying a house...

PAPERISATION PANEL:

Serena Pozza
Estee Lauder

Elodie Bugnicourt
4evergreen Ambassador,
Graphic

Annica Eldh
H&M Group

Hanna Kalliomäki
Paptic Ltd.

SMITHERS

SUSTAINABILITY IN PACKAGING

Sustainability in Packaging Barcelona 8-10 Oct 2024

Barrier and other functionality can be added at multiple points in the value chain, in multiple ways; where and how coatings are applied is as important as what coatings are used.



**THE PROCESS IS STARTED....
THE MARKET NEEDS NEW MATERIALS,
HAVING MORE RESISTANCE, TO GAS, WET,
GREASE...
THE SOLUTION CAN BE ACHIEVED ADDING
ADDITIVES IN THE PAPER... OR
USING A COATING**

There are benefits and challenges in coating during paper production vs during printing.

BARRIER? COATINGS?



Specialty Papers Europe 2024
3-4 September 2024
Austria Trend Hotel Savoyen Vienna, Austria

**MANY COMPANIES
ARE CURRENTLY
WORKING TO
DEVELOP
COATINGS/BARRIER**



Image Source <https://gmz.ltd/product/plastic-free-paper-hot-cups/>

CHEMICALS? SOLUTIONS?

-STARCH (STARCH IS A POLYSACCHARIDE MADE UP OF 1,4 LINKAGES BETWEEN GLUCOSE MONOMERS)

-MICROFIBRILLATED CELLULOSE
(IS DEFINED AS AN AGGREGATION OF CELLULOSE MICROFIBRILS OBTAINED BY DISINTEGRATION OF CELLULOSE FIBERS)

-MICROCRYSTALLINE CELLULOSE
IS GENERALLY OBTAINED FROM PARTIAL HYDROLYSIS OF CELLULOSE AND HAS A POLYMERIZATION LENGTH OF 40–200 UNITS.

-TROPICAL RED SEAWEEDS
(BIOBASED POLYMERS)

BARRIER? COATINGS?



CHEMICALS? SOLUTIONS?

-SILANES

Inorganic coating, silicon based.

-PVOH, SB = Styrene Butadiene

SA = Styrene Acrylate

Polymer Coatings

-PHA

Bio polymer coating

- OTHER POLYMERIC DISPERSIONS

- POLYURETANE PAPER COATINGS

Source Image: Yanxiyan

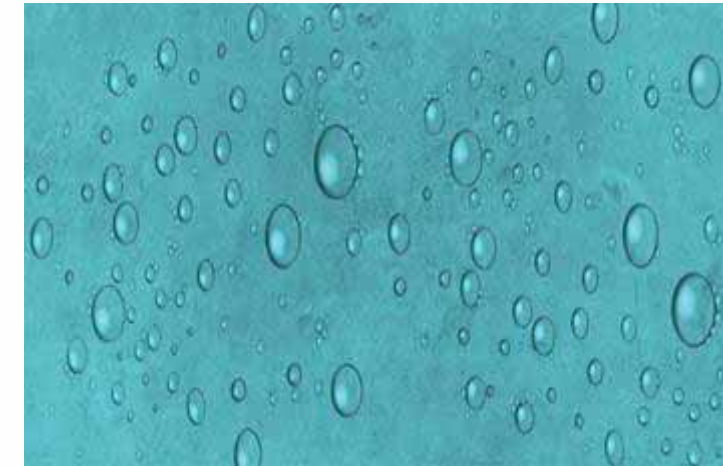


Figura 2. microforo sulla superficie



PROPERTIES? TESTING? A GOOD SCREENING METHOD

But there is a problem...

...Plastic is waterproof and paper isn't!

Paper needs to be **coated** to work.
But, the coating needs to keep the paper **recyclable** and be **pin-hole free**.

Guy Newcombe - Archipelago Technology

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13676

April 2001

ICS 55.040; 67.250

English version

Polymer coated paper and board intended for food contact -
Detection of pinholes



PINHOLE??

TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
TECHNISCHE SPEZIFIKATION

CEN/TS 14234

October 2002

ICS 67.250

English version

Materials and articles in contact with foodstuffs — Polymeric
coatings on paper and board — Guide to the selection of
conditions and test methods for overall migration

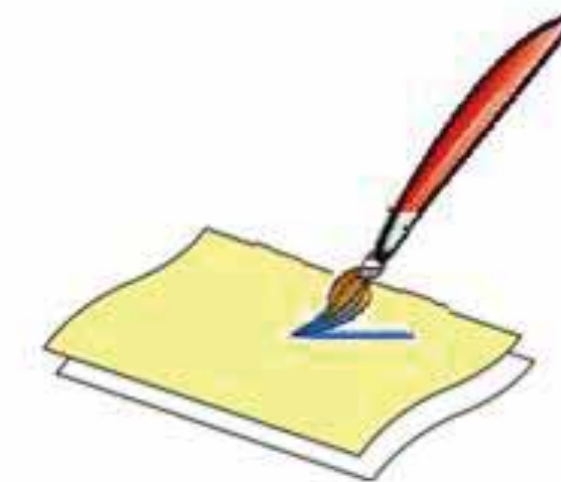
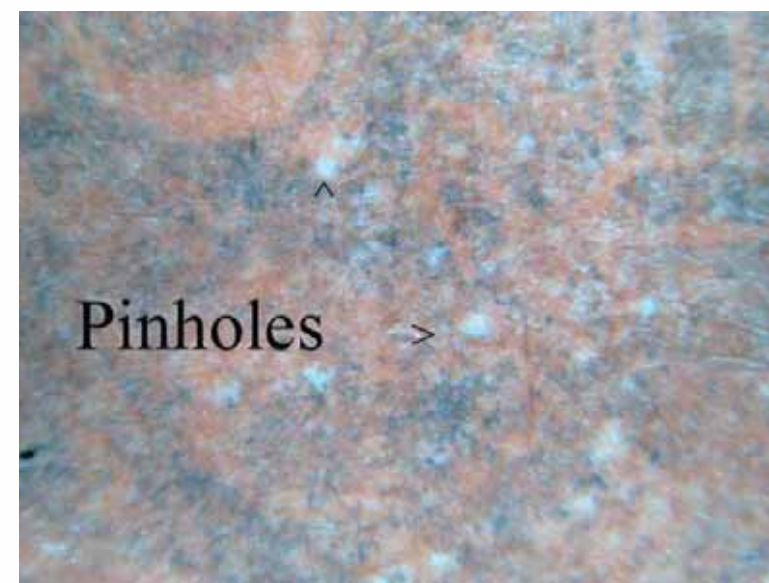


Image source: wikipedia

TESTING?



TESTING ON PAPER SAMPLES

Air Permeability (SCAN – P 60:87) according to Bendtsen

WVTR 23°C – 50% RH*

Heat resistance (e.g. 70°C)

Tear resistance (SCAN-P 11:96)

Tensile strength (SCAN-P 38:80)

Elongation (SCAN-P 11:96)

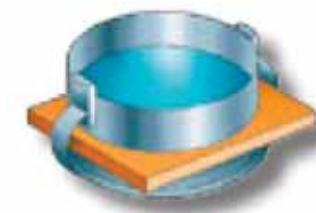
Tensile Energy Absorption (SCAN-P 11:96)

Burst (SCAN-P 25:81)

Water Absorption (Tappi T441-Cobb 1800)

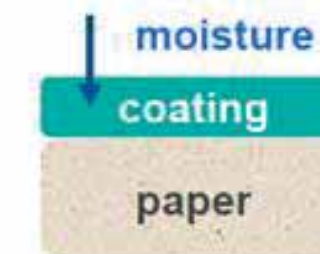
Greese resistance (Tappi T559- Oil Cobb)

(source image CMPC)



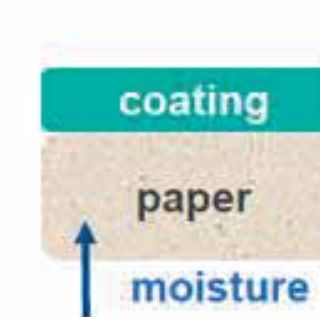
Two Testing Directions

Moisture Interface
at Coating (M to C)



M: moisture

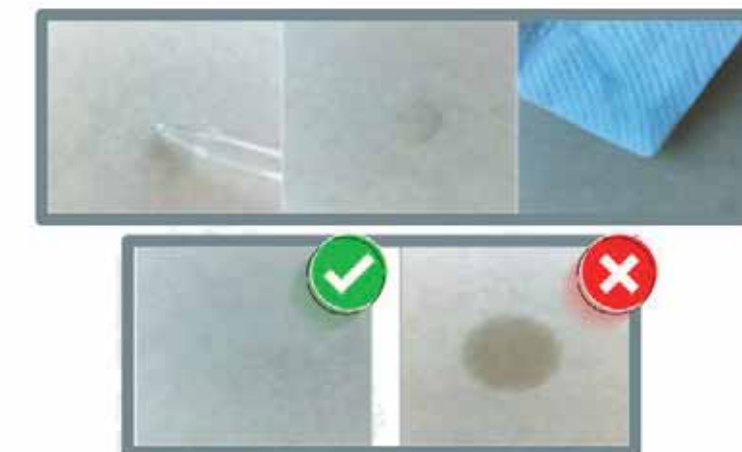
Moisture Interface
at Paper (M to P)



C: coating

P: paper

Bernhard Kainz - DOW



*Moisture vapor transmission rate (MVTR), also water vapor transmission rate (WVTR)

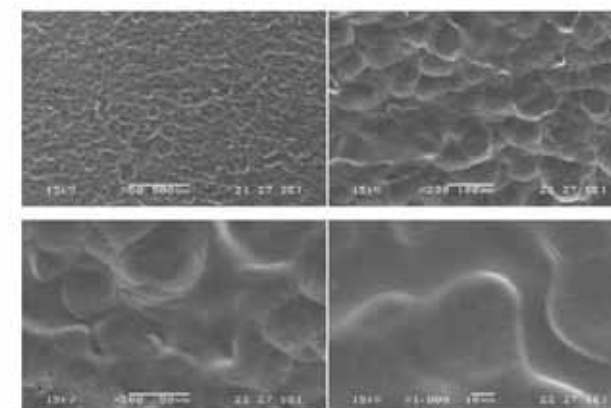


TESTING?

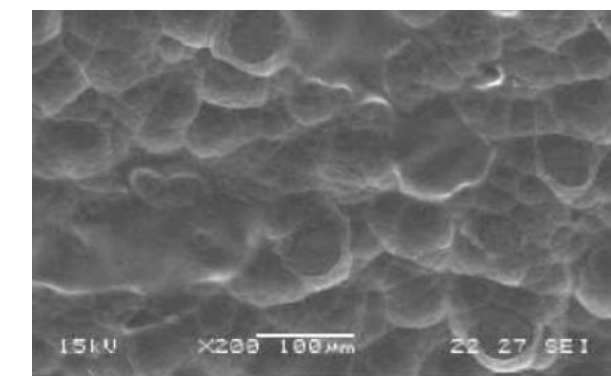
TESTING ON PAPER SAMPLES

Visual test

Scanning electron microscope (SEM) surface & crosscut samples



Microanalisi della superficie interna, bianca: non mette in evidenza la presenza di atomi diversi da carbonio e ossigeno.



Imaging

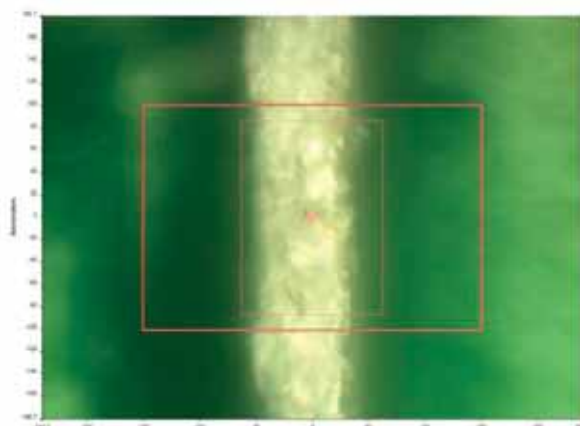


Fig.4: immagine del visibile

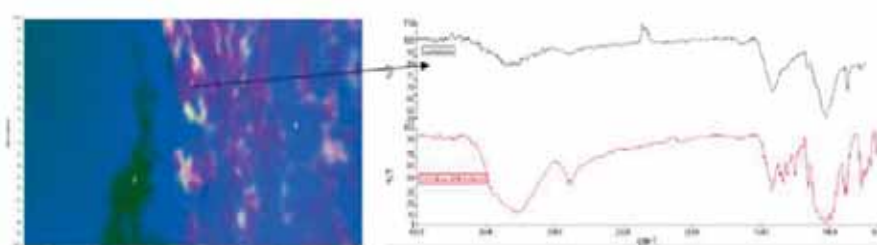
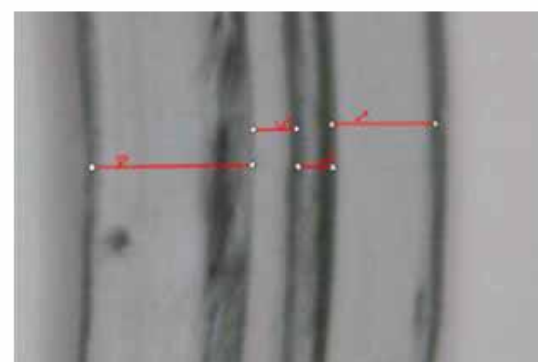


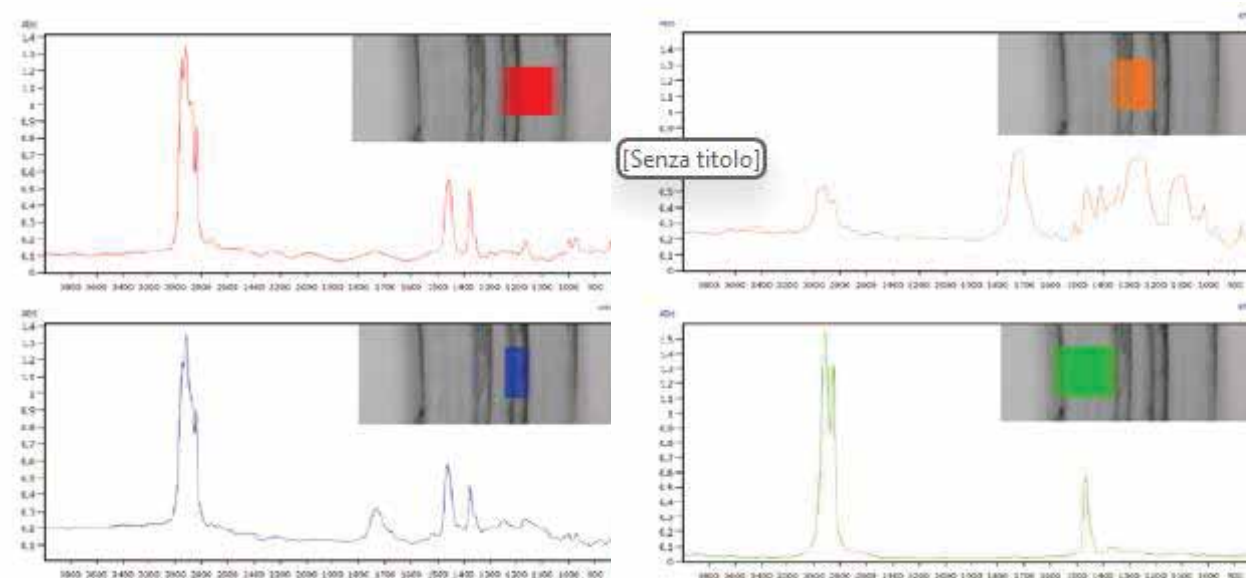
Fig.5: mappa chimica IR

Micro FT IR



No.	Length(µm)
1	27
2	9
3	11
4	42

Photographs and length measurement results of multilayer film cross sections (inside on left side of screen)



Transmission spectra and chemical image of each layer of multilayer film (First, second, third and fourth layers from the top)

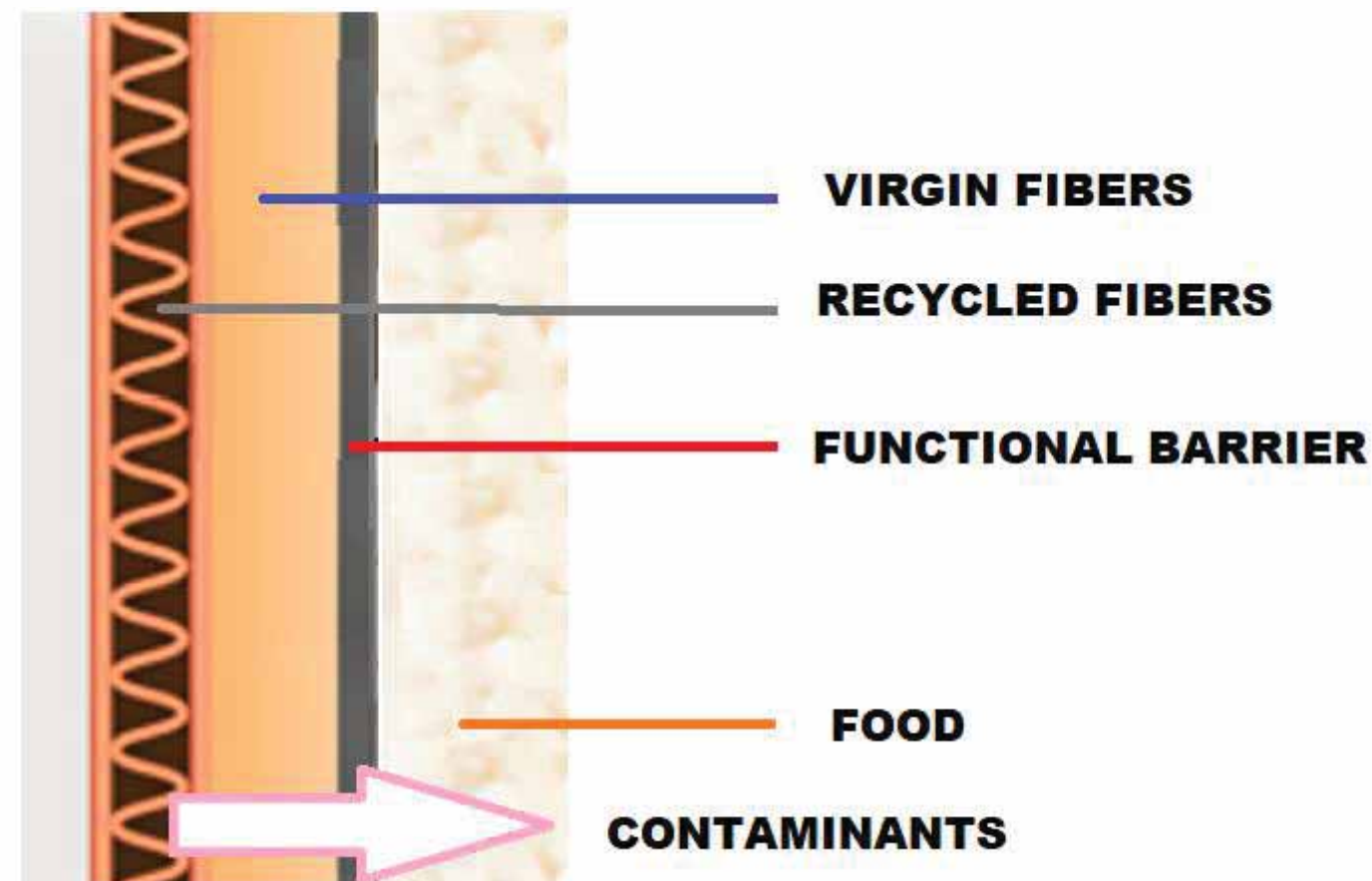


TESTING? SAFETY FIRST



When we talk about barriers, historically we are referring to the barrier against the transfer of gaseous substances and humidity. This barrier was designed for the organoleptic and microbiological protection of the food product.

Talking about safety and food contamination, the use of barrier layers has the function of containing the migration of all potentially migrating compounds



Functional barrier (Reg UE 10:2011 cons. 27)

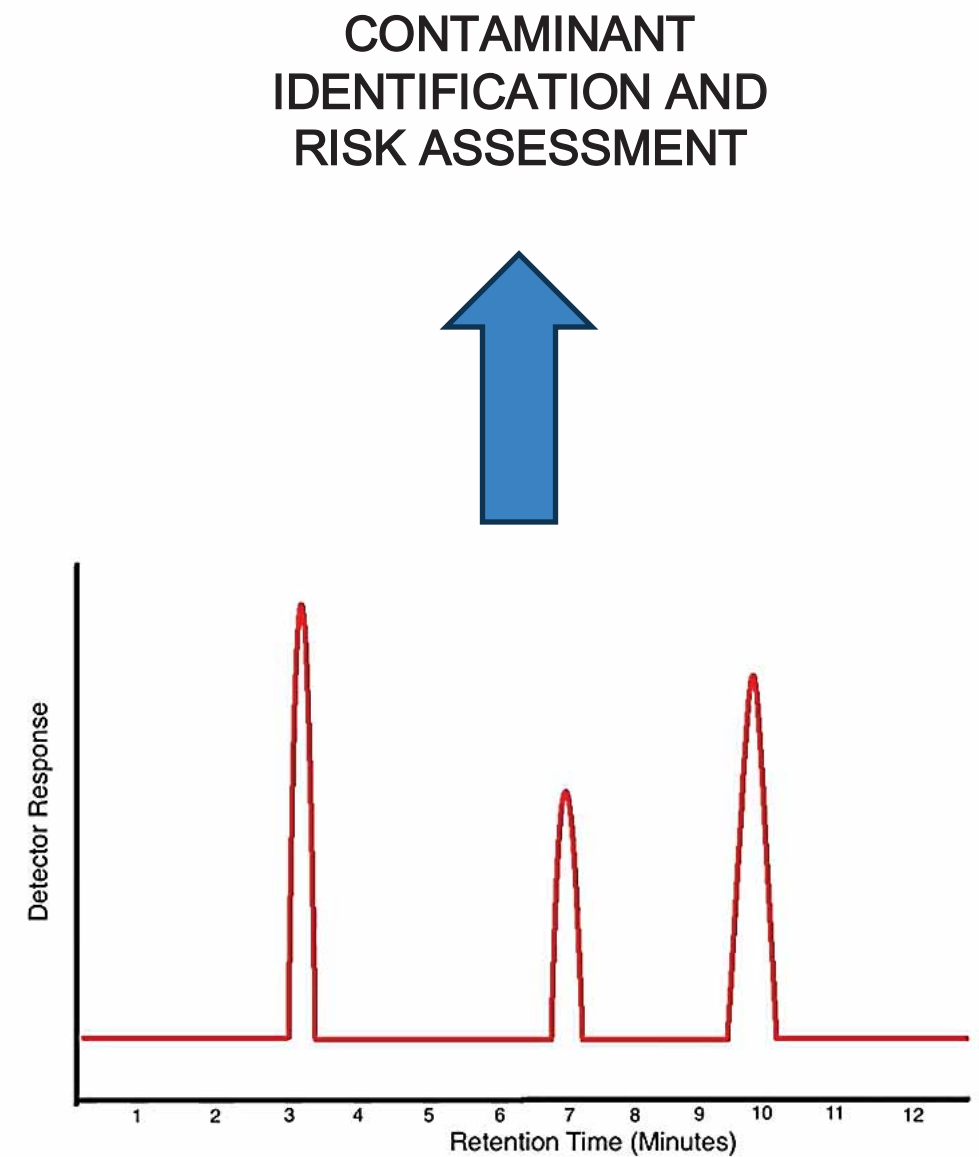
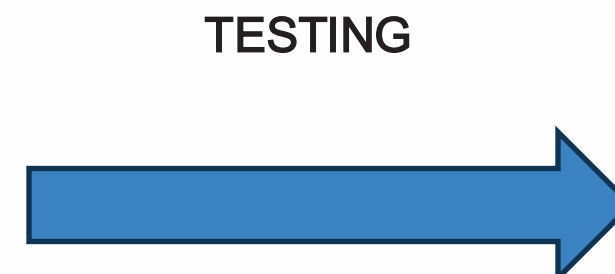
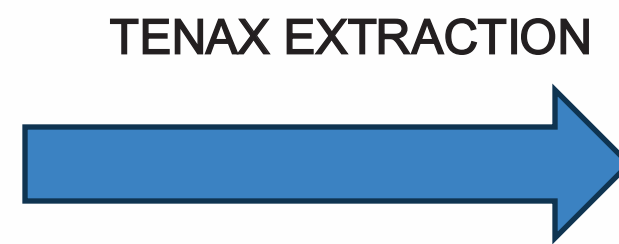
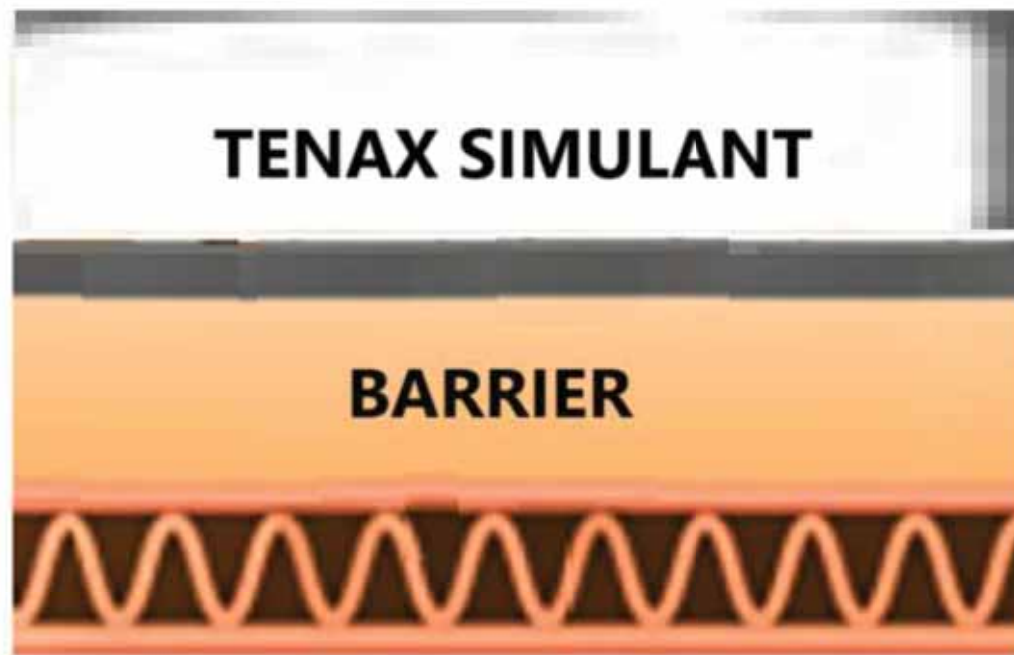
This barrier is a layer within food contact materials or articles preventing the migration of substances from behind that barrier into the food. Behind a functional barrier, non-authorized substances may be used, provided they fulfil certain criteria and their migration remains below a given detection limit. Taking into account foods for infants and other particularly susceptible persons, as well as the large analytical tolerance of the migration analysis, a maximum level of 0,01 mg/kg in food should be established for the migration of a non-authorized substance through a functional barrier

TESTING?

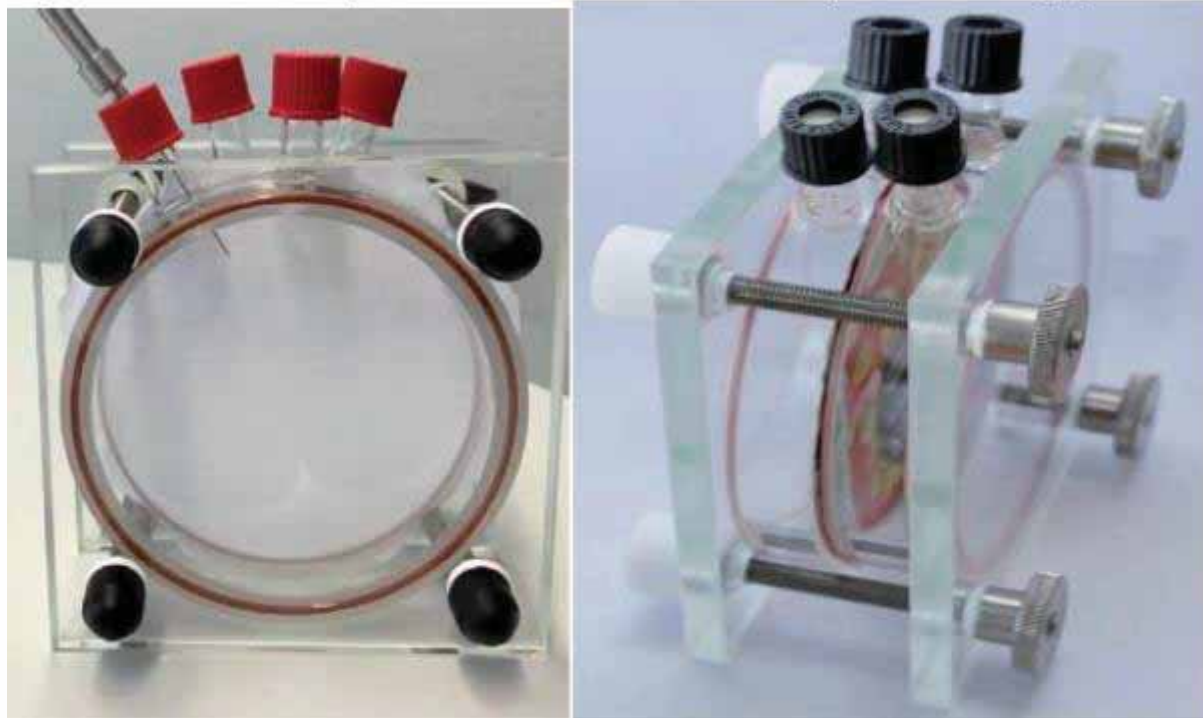


The coated sample is in a glass box and covered with the tenax simulat, after migration in different condition (at least 40°C 10 days), tenax is tested in order to check the migration of contaminants

1)Uttam et al. Mater. Res. Express 4 (2017)

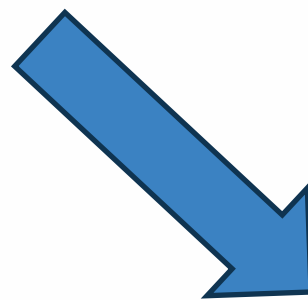


TESTING?

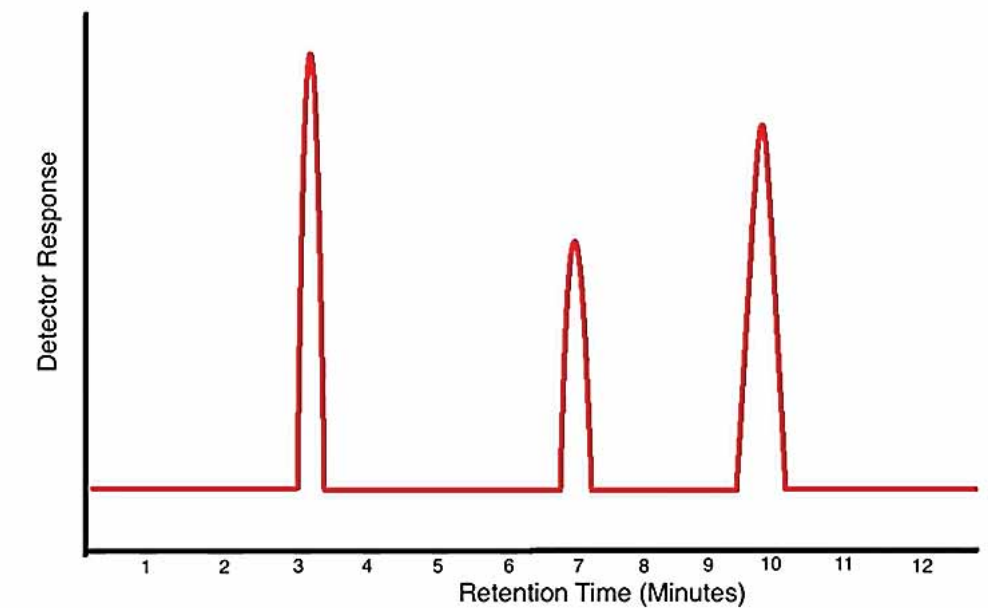


There is a Nitrogen flux; the cell is connected with a valve to a trap and then directly to the GC

2)Ewender et al (2013) migration in a permeation cell under nitrogen flux



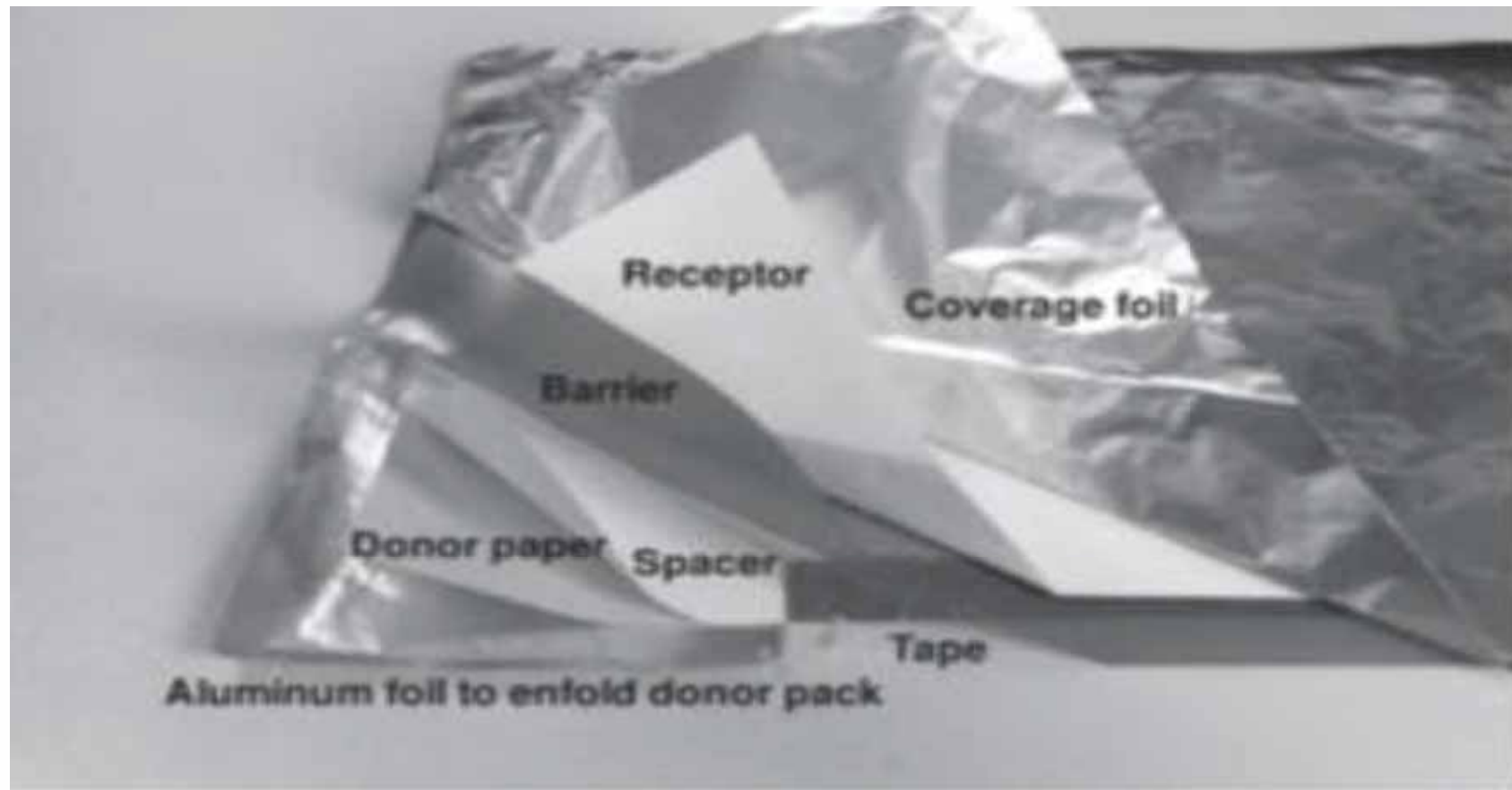
TESTING



CONTAMINANT
IDENTIFICATION AND
RISK ASSESSMENT



TESTING?



A silicone paper is used as a simulant and the experiment is made between two aluminium foils

CONTAMINANT IDENTIFICATION AND RISK ASSESSMENT

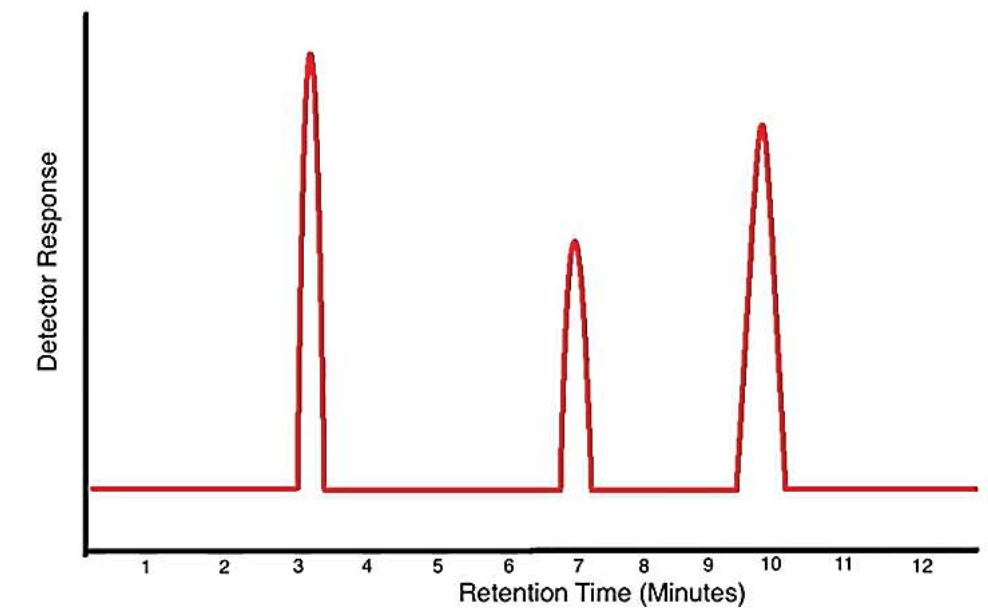


3)Grob et al. (2014) Packaging, technology and science

SILICONE PAPER EXTRACTION



TESTING

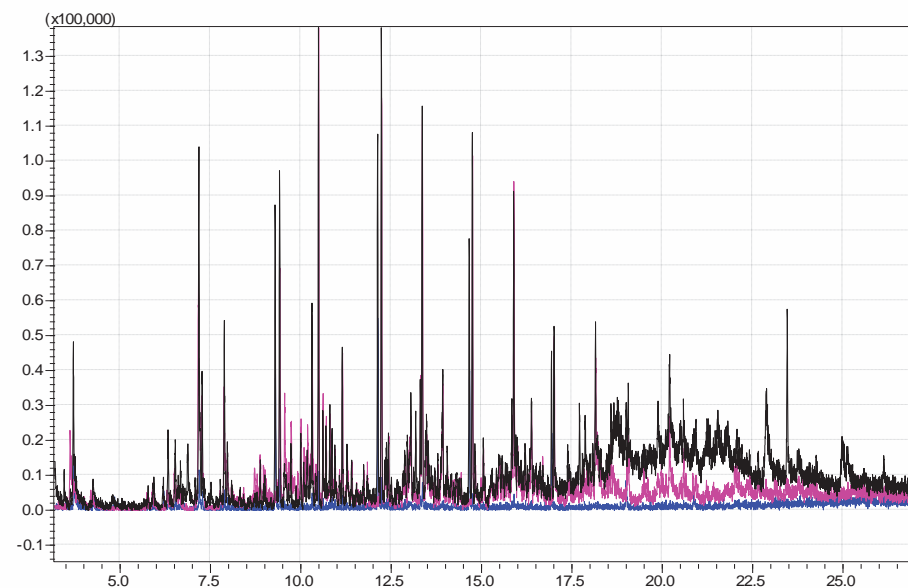
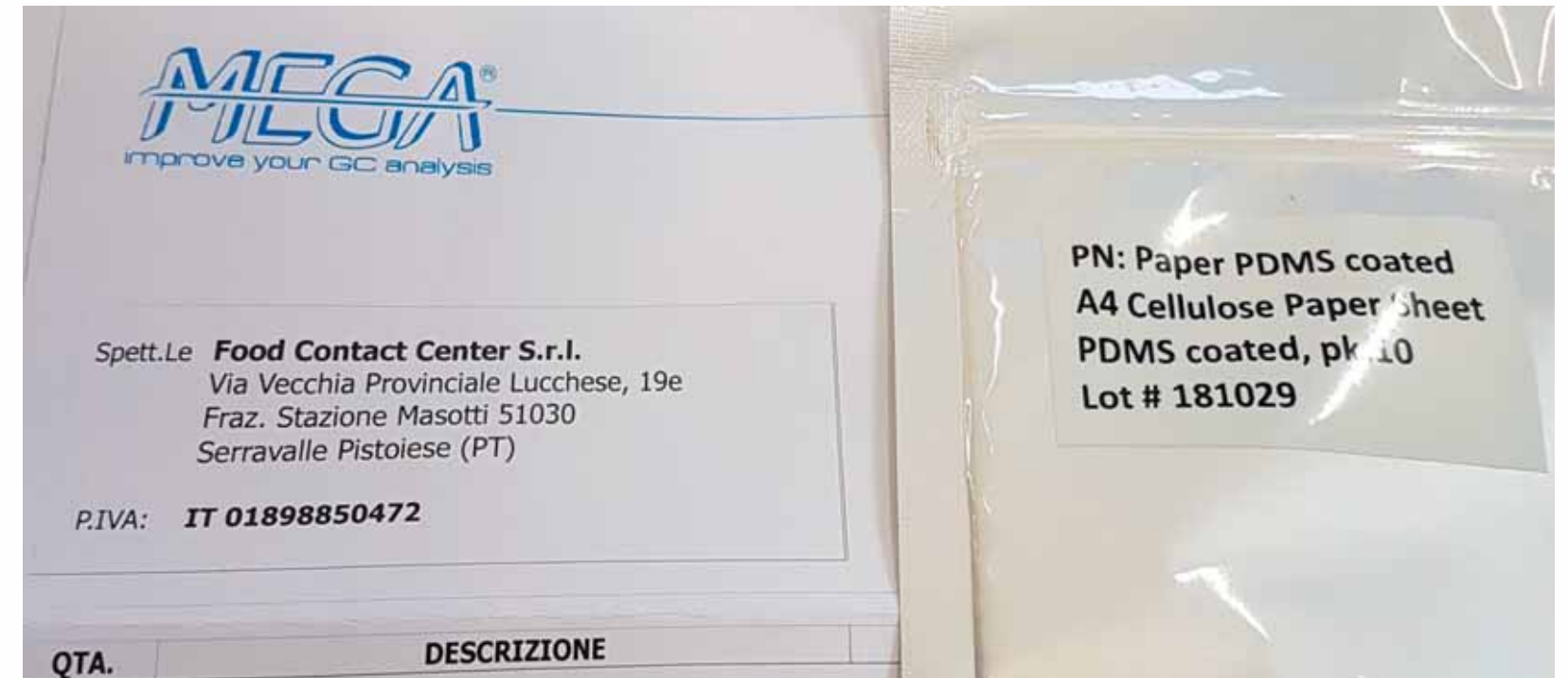




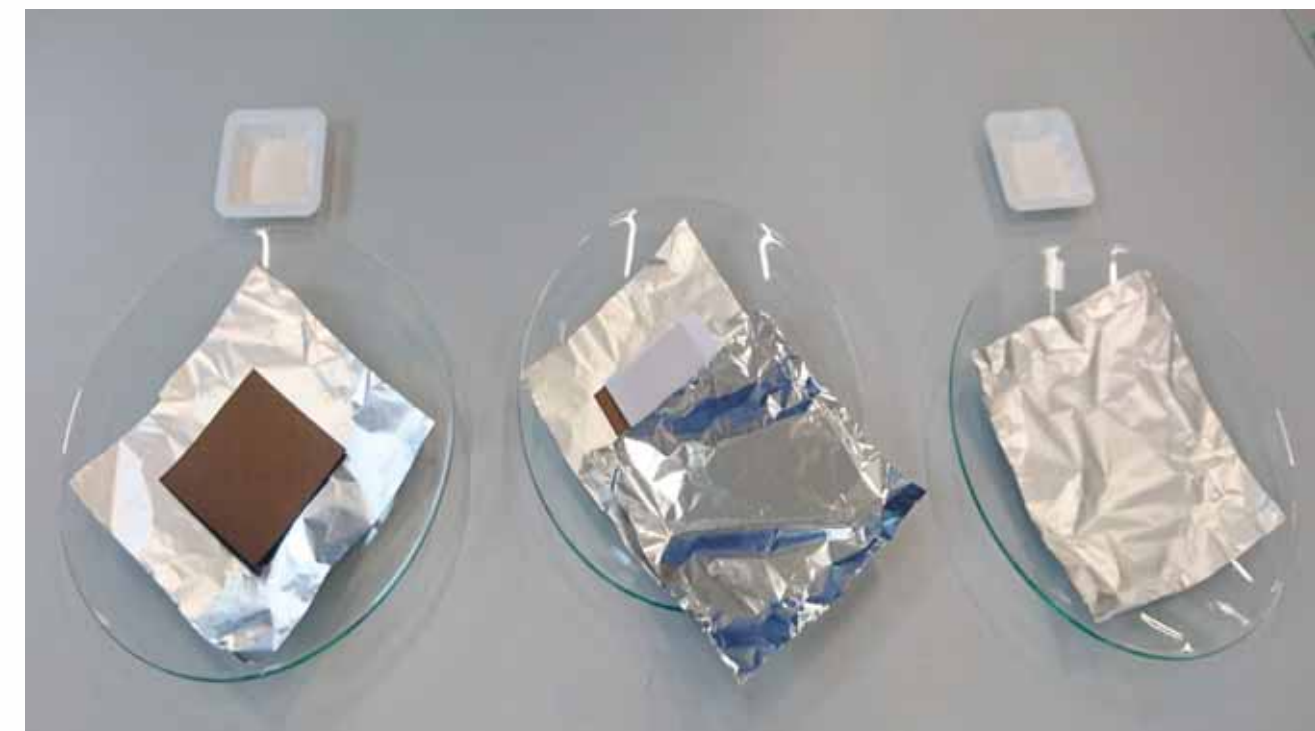
TESTING?

The silicon paper is used as receptor,
as new food simulant

In our experience aluminium foil need to be purified before the use, we have done organic extraction of hydrocarbons from commercial aluminium foils , and we have found some aliphatic hydrocarbons (below m/z 85 extraction of chromatograms)



Tenax blank
Silicon paper blank
Solvent extraction blank

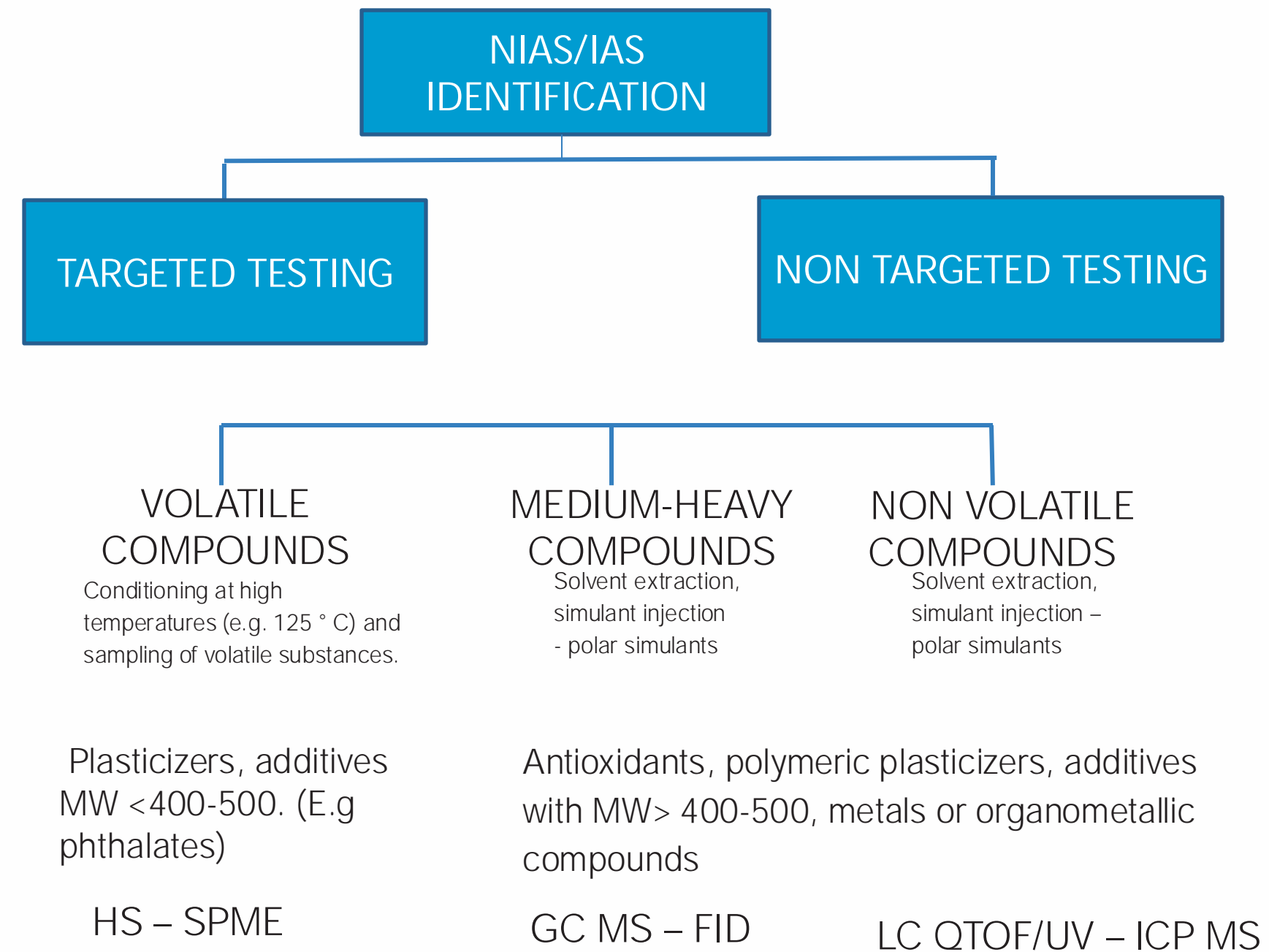


IAS... and NIAS -ANALYTICAL CHALLENGES

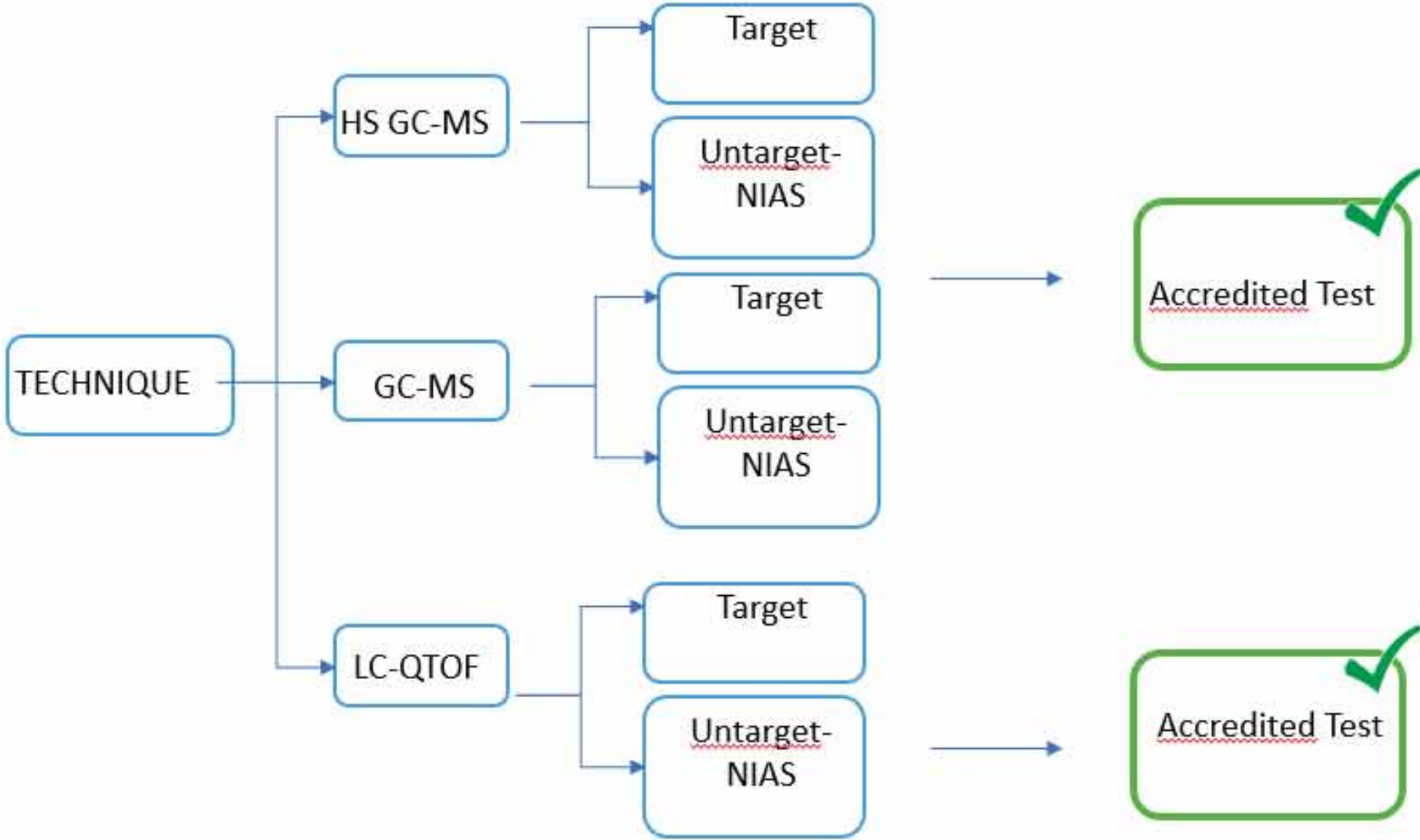
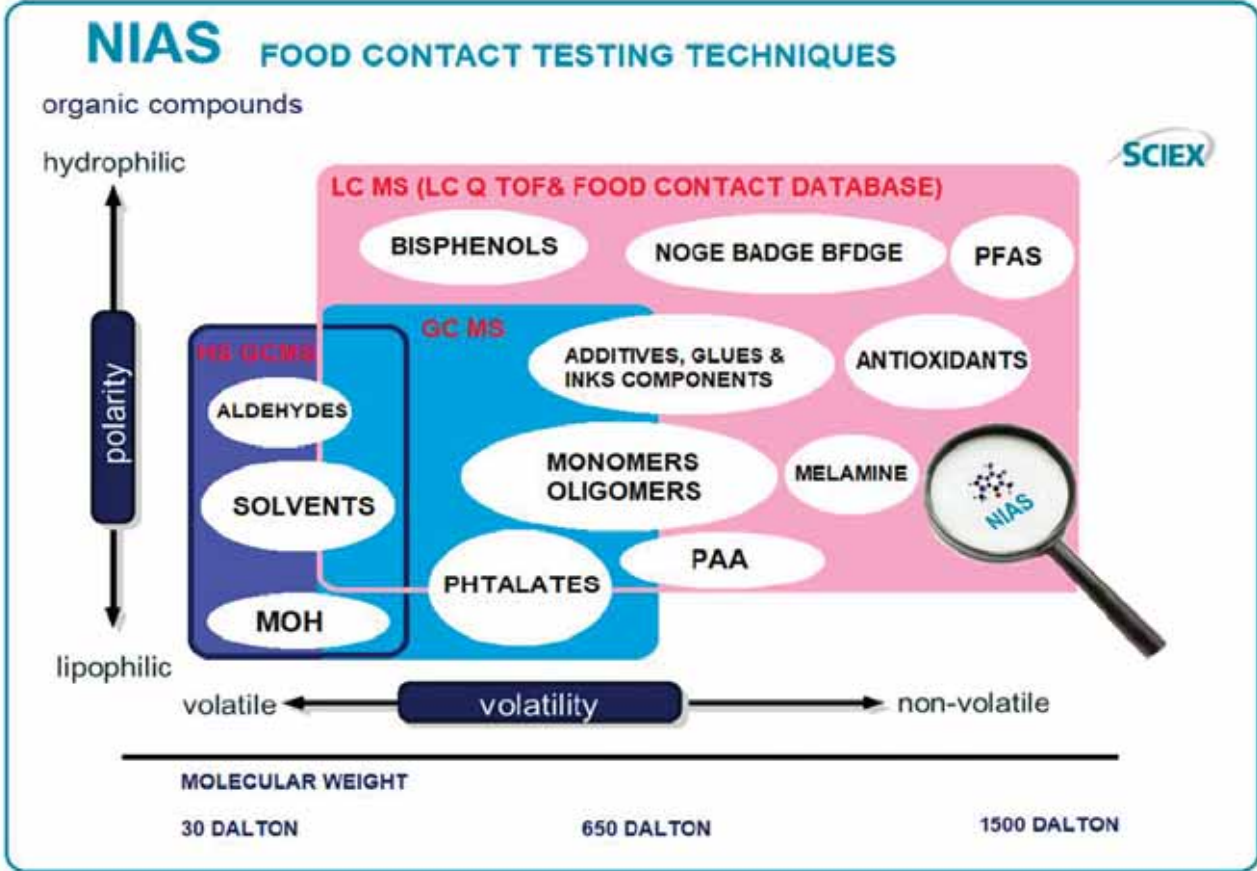


IAS & NIAS

- **IAS** (Intentionally Added Substances): specifically added during the manufacturing process of materials, having a function in the manufacturing process or in the final product.
 - Raw materials – starting substances
 - Monomers
 - Additives
 - Solvents
 - Colourings
- **NIAS** (Non intentionally added substances): impurities in the substances used, reaction intermediate formed during the production process, or products of reaction or decomposition.
 - Additives degradation
 - Polymer degradation
 - Residues
 - Neoformed products
 - Impurities



ANALYTICAL CHALLENGES



More than 10 years to build a Library of 12000 compounds



Food Contact Center Srl

Via del Redolone 65
51034 Serravalle Pistoiese PT

Allegato al certificato di accreditamento n. 1786L

Materiali a base di plastica ed articoli destinati a venire in contatto con gli alimenti/Plastic materials and articles intended to come into contact with foodstuffs

Denominazione della prova / Campi di prova	Metodo di prova	Tecnica di prova	O&I
Composti organici semi volatili (Valutazione semi-quantitativa)/Semi volatile organic compounds (Semi-quantitative evaluation) (0,01 - 10 mg/Kg simulante)	MHTH088 rev.1 2023	GC-MS	
Composti organici non volatili (Valutazione semi-quantitativa)/Non volatile organic compounds (Semi-quantitative evaluation) (0,01 - 10 mg/kg simulante)	MHTH089 Rev.1 2023	HPLC-HRMS	



IF BARRIER EFFECT IS WORKING.....



RECYCLABLE...

PLASTIC FREE PRODUCT.....
OFFICIAL DEFINITIONS?



Image Source <https://gmz.ltd/product/plastic-free-paper-hot-cups/>



MANY LABELS, JUST GOOGLING...

ENVIRONMENTAL CLAIMS



EN ISO 14024

**TYPE I:
Eco-Labels**
Voluntary *THIRD PARTY*
CERTIFICATION program that
uses multiple criteria

EXAMPLES:



Single Product Line
or Criteria

EXAMPLES:



EN ISO 14021

**TYPE II:
Green Claims**
Self Declarations
by Manufacturers

EXAMPLES:
CFC-Free
Dolphin Friendly
Recycled Content

EN ISO 14025

**TYPE III:
Environmental Impact**
Voluntary *THIRD-PARTY*
VERIFICATION* program that uses
quantifiable
environmental data

EXAMPLES:
Environmental Product Dec-
larations (EPD)
No evaluation;
only verification

*business-to-business declarations
and labels require independent
verification of the data only, not
third-party certification. Business-to-
consumer declarations require third-
party certification.



EN ISO 14021:2016/A1:2021

Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling) - Amendment 1: Carbon footprint, carbon neutral (ISO 14021:2016/Amd 1:2021)

ENVIRONMENTAL CLAIMS



EN ISO 14021:2016/A1:2021

Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling) - Amendment 1: Carbon footprint, carbon neutral (ISO 14021:2016/Amd 1:2021)



3.1.17 sustainable development

development that meets the needs of the present without compromising the ability of future generations to meet their own needs

5.4 Statements like "free of..."

An environmental claim of "... free" shall only be made when the level of the specified substance is no more than that which would be found as a trace contaminant or background level.

5.5 Sustainability claims

The concepts involved in sustainability are extremely complex and still under study.

At the moment there are no definitive methods to measure sustainability or confirm its achievement. Thus, no assertion of must be made achieving sustainability.

ENVIRONMENTAL CLAIMS



Brussels, 22.3.2023
COM(2023) 166 final
2023/0085 (COD)

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on substantiation and communication of explicit environmental claims (Green Claims Directive)

*On top of requirements on substantiation and communication applicable to all types of claims, this proposal builds on the requirements of the proposal on empowering consumers **banning labels based on self-certification**, and provides additional safeguards to improve the quality of ecolabelling schemes by requiring the following transparency and credibility requirements*

The ‘self-certified’ sustainability labels, where no third-party verification and regular monitoring takes place as regards compliance with the underlying requirements of the sustainability label are prohibited.

- SUPPORT DOCUMENTATION
- THIRD-PARTY VERIFICATION



BUT WHAT IS A PLASTIC?

The following definitions are based on the following relevant standards and provisions.

- Regulation (EC) No. 1907/2006 (REACH)
- Regulation (EU) No. 10/2011 Commission Regulation on plastic materials and articles intended to come into contact with food
 - Single Use Plastic Directive
 - Directive 94/62/EC regarding packaging and packaging waste (PPWR proposal)
 - DIN 55405
 - DIN EN ISO 472 Plastics - Glossary of technical terms (ISO/TC 61/SC1)
 - EN 13130-1 Materials and articles in contact with foodstuffs - Substances in plastics subject to limitations - Part 1: Guidelines for test methods for the specific migration of substances from plastics into foodstuffs and test foods, the determination of substances in plastics and the selection of contact conditions with test foods
 - EN 643 Paper, cardboard and paperboard - European list of standard waste paper grades

ENVIRONMENTAL CLAIMS



Definition of plastic:

The term plastic is understood to mean a polymer material which may have additives or other added substances and which may act as the **main structural component of finished end products**.

Definition of polymer:

The term polymer is understood to mean a substance consisting of molecules characterized by a chain of one or more types of monomer units within a certain molecular weight range...

Substances having polymeric nature, used in specialty papers?

ENVIRONMENTAL CLAIMS



In Italy, paper packaging intended for food contact is regulated by law DM 21.03.73. In this decree there are interesting info relating to the composition of paper, that can be used in the evaluation of the "Plastic Free" claim. Italian legislation authorizes in the case of paper food packaging, for which migration tests are required and consisting of at least 75 percent fibrous materials, a maximum of 10 percent of filler substances and a maximum of 15 percent auxiliary substances. In fact, the following sentence is reported:

*... The presence, in trace quantities, according to good industrial technique, of technological processing aids with the function of reactives, **dispersion**, flotation and drainage agents, anti-foam and anti-slime agents is permitted;*

Among the auxiliary substances that can be used in paper and present in the positive lists of the Italian Ministerial Decree, there are substances soluble or non-soluble in organic solvents, which are organic substances also of a polymeric nature.

Even the German guidelines, BfR Recommendations XXXVI Paper and board for food contact, contains the same compositional informations

ENVIRONMENTAL CLAIMS



The risk assessment necessary to determine the food contact compliance of the items must take into account the use of any polymer dispersions, but this does not change the definition of paper ...

Even evaluating paper from a recycling point of view, to be included in the definition of "paper to be recycled", products made up of multiple materials must be predominantly composed (in a predominant, i.e. > 50% by weight) from paper and cardboard, as per UNI EN 643 standard.

Among other opinions, it is relevant the position paper of [EPDLA](#), the European Polymer Dispersion and Latex Association:

..... When using polymer dispersions, the polymer content in the final product can be as low as 5%, so that **we are convinced that such articles should not be seen as "plastic**

ENVIRONMENTAL CLAIMS



DIN 55405 standard

DEUTSCHE NORM		Dezember 2014
	DIN 55405	DIN
ICS 01.040.55; 55.020		Ersatz für DIN 55405:2006-11
Verpackung – Terminologie – Begriffe		
Packaging – Terminology – Terms and definitions		
Emballage – Terminologie – Termes et définitions		

Plastic

Ethylene-vinyl alcohol copolymer (EVOH)

- Polyamide (PA)
- Polyethylene (PE)
- Low density polyethylene (PE-LD)
- High density polyethylene (PE-HD)
- Polypropylene (PP)
- Polystyrene (PS)
- Polyethylene terephthalate (PET)
- Polyvinyl chloride (PVC)
- Polycarbonate (PC)
- Polyvinylidene chloride (PVDC)
- Cellophane

Items are plastics when the polymer constitutes the main material of the finished product..... “the main structural component of finished end products”.



PLASTIC FREE PAPERS



.....



EN ISO 14021:2016/A1:2021

Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling) - Amendment 1: Carbon footprint, carbon neutral (ISO 14021:2016/Amd 1:2021)

5.4 Statements like "free of..."

An environmental claim of "... free" shall only be made when the level of the specified substance is no more than that which would be found as an acknowledged **trace contaminant or background level**.

ENVIRONMENTAL CLAIMS: PLASTIC FREE... AND MICROPLASTICS?



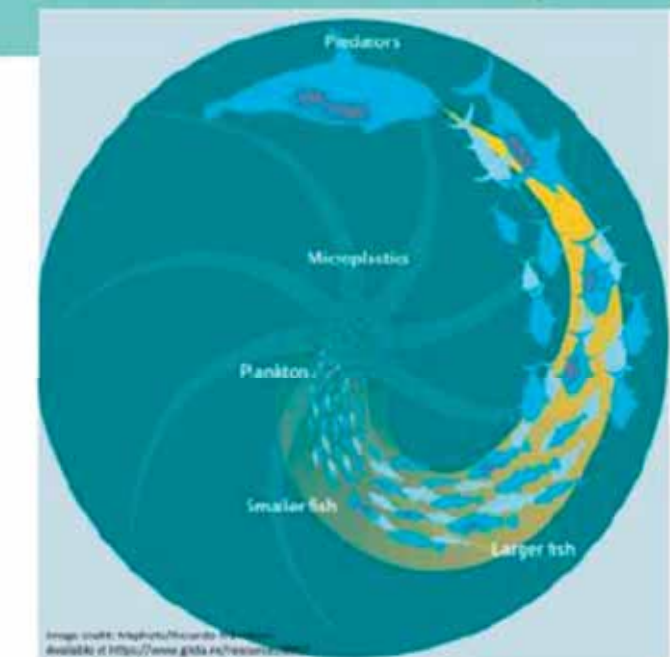
WHAT ARE THE MICROPLASTICS TO EVALUATE.... THOSE ADDED INTENTIONALLY OR EVEN THOSE RELEASED?

- Deliberately produced

One of the main sources of primary nanoplastics in the marine environment is cosmetics and personal hygiene products.

- Resulting from fragmentation

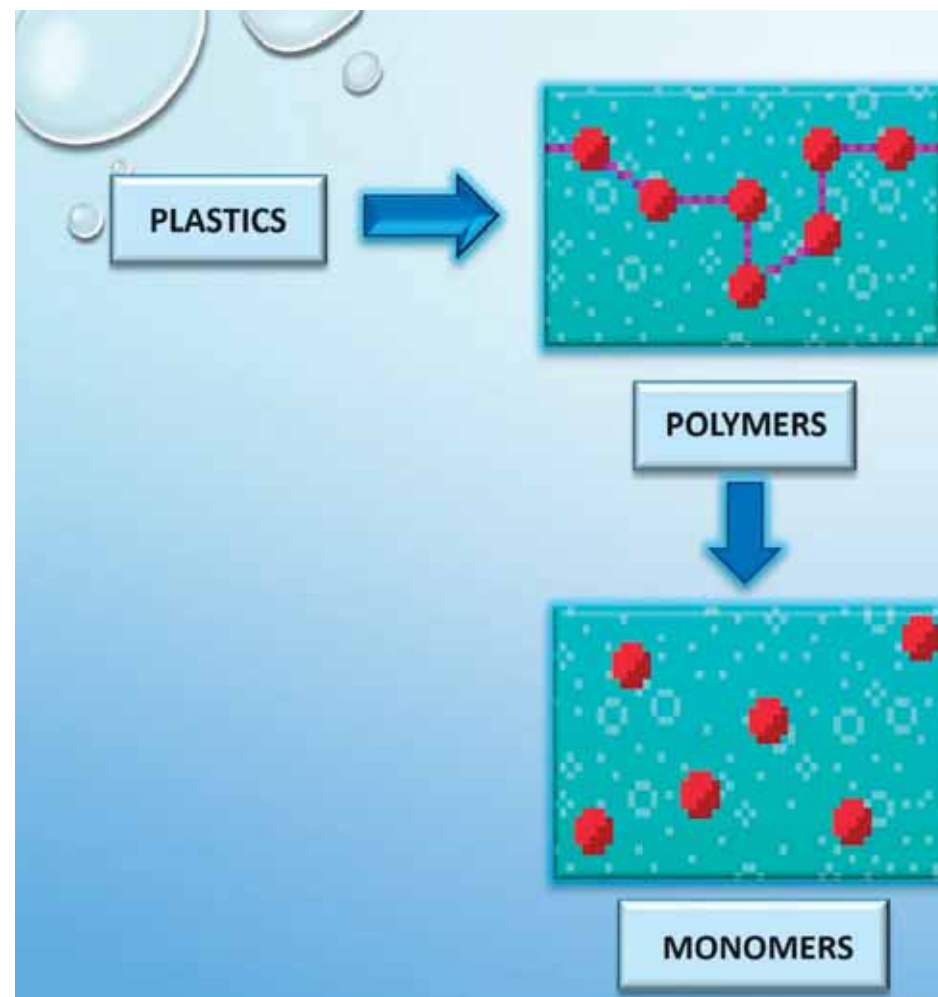
Secondary nanoplastics derived from postconsumer waste as well as from meso- or microplastics via degradation pose a specific challenge to the marine environment





THE ANALYTICAL METHODS

It is important to point out that many experts express a fundamental doubt:



Does the test identify microplastics?

Or maybe we detect the presence of monomers and oligomers, which are blocked by filters with particular porosity????

ENVIRONMENTAL CLAIMS

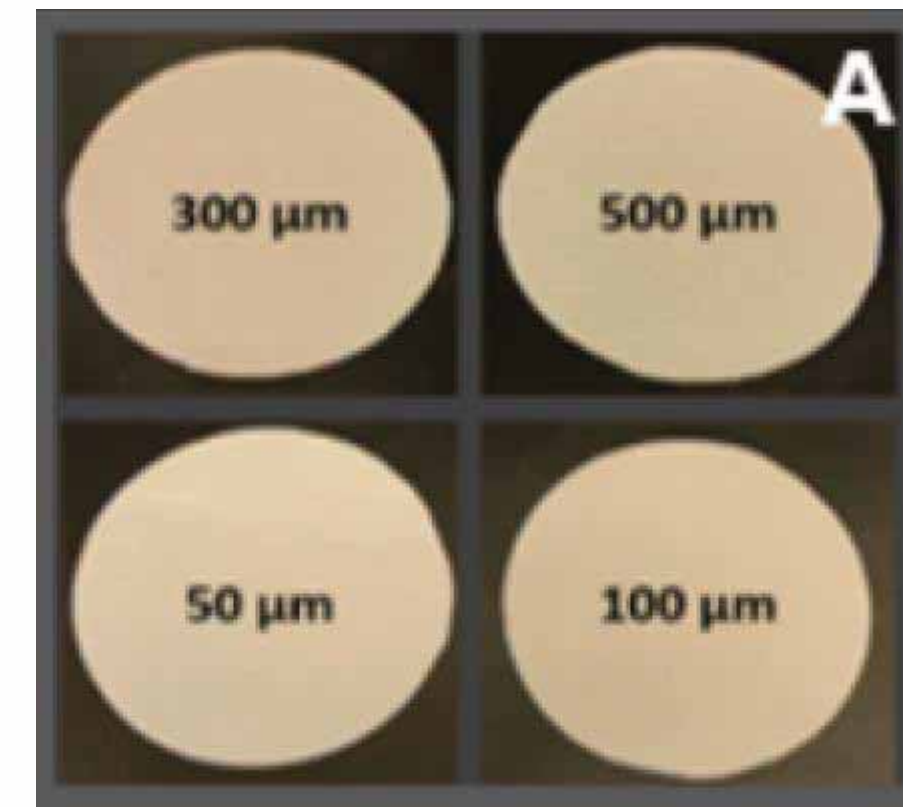
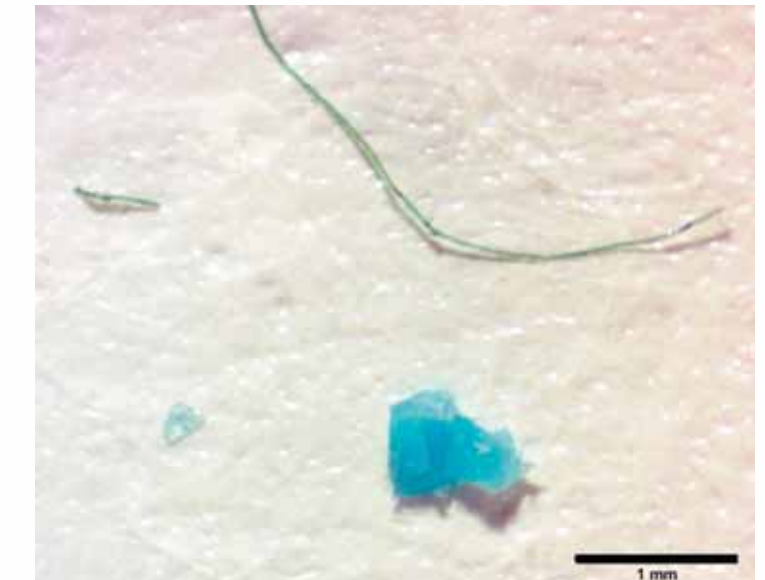
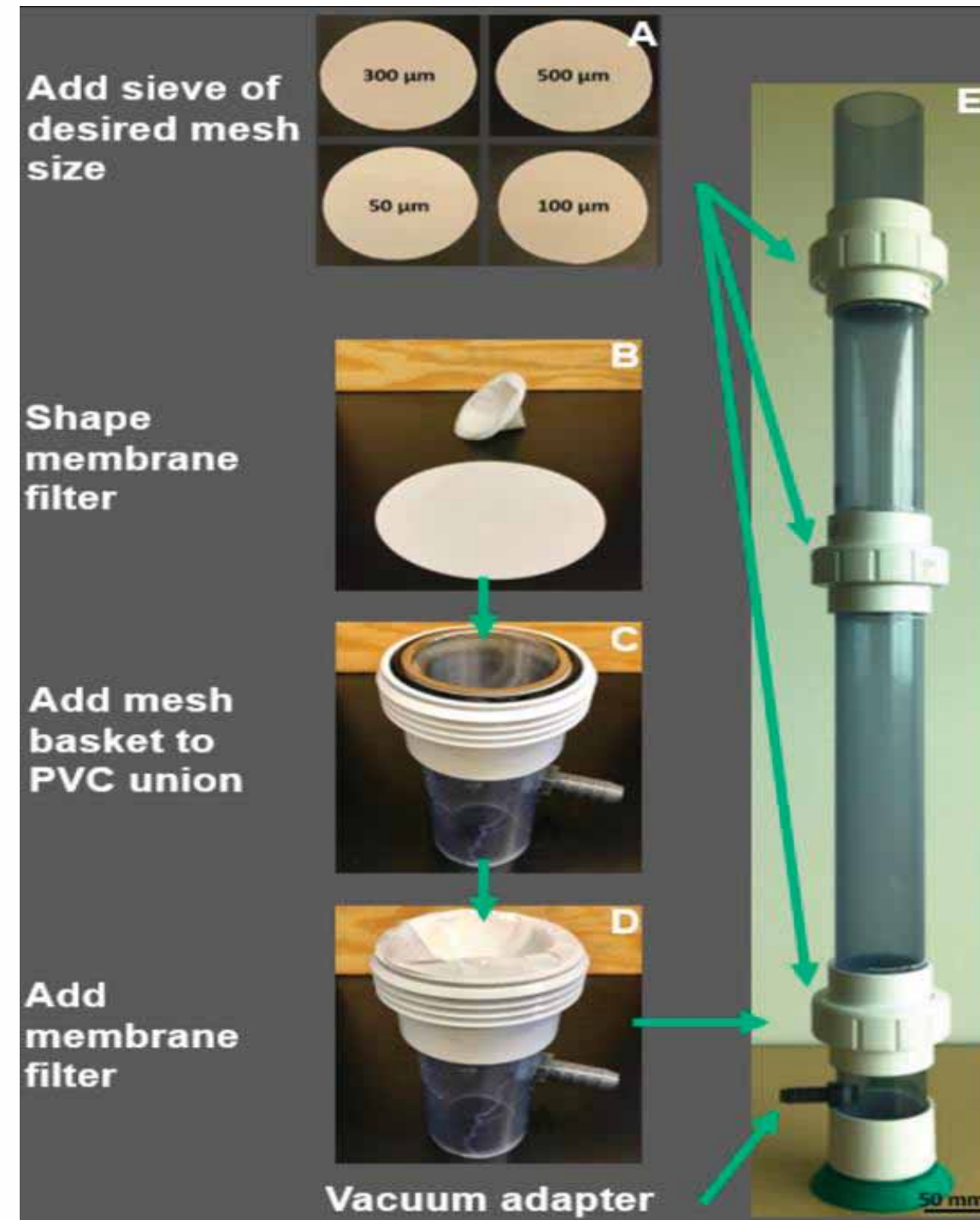


Images: doi:10.3791/57969

Pretreatment and filtration procedures

- Digestion
- Density flotation
- **Filtration**

Most labs perform filtration.



ENVIRONMENTAL CLAIMS

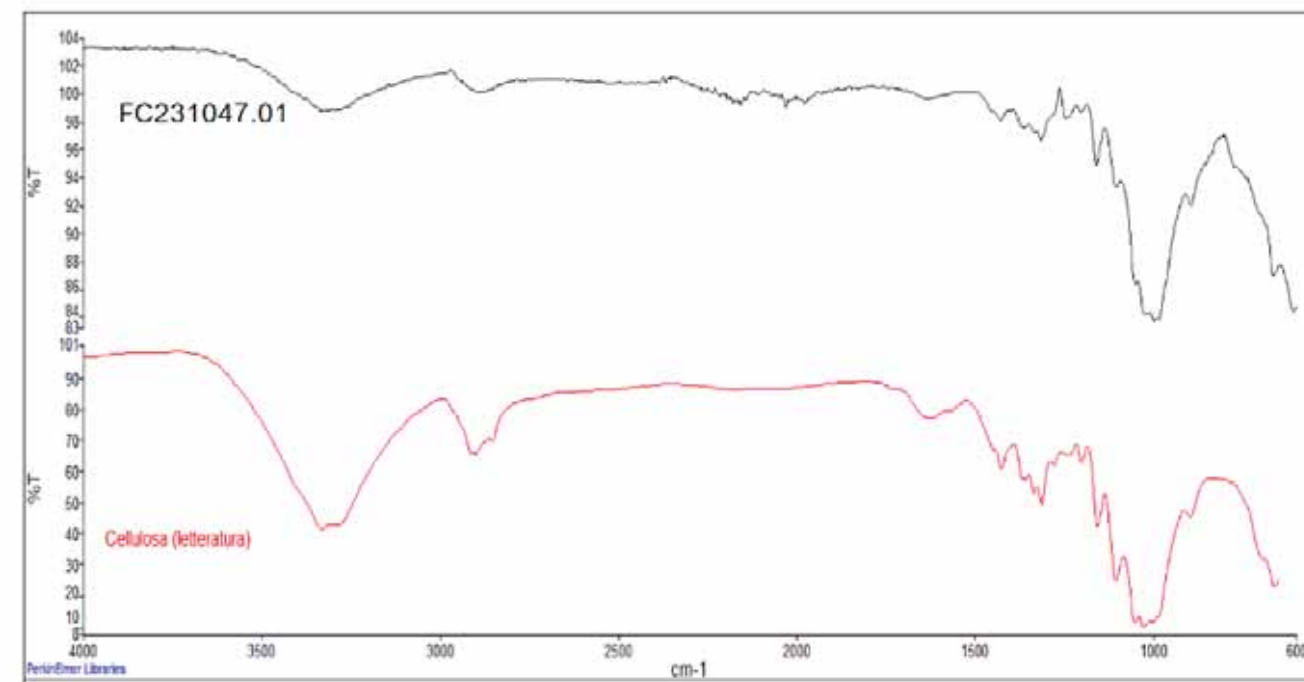


The evaluation of paper and cardboard contaminants to support environmental claims

Practical case verification of the possibility of declaring paper Plastic Free - ANALYTICAL EVALUATION

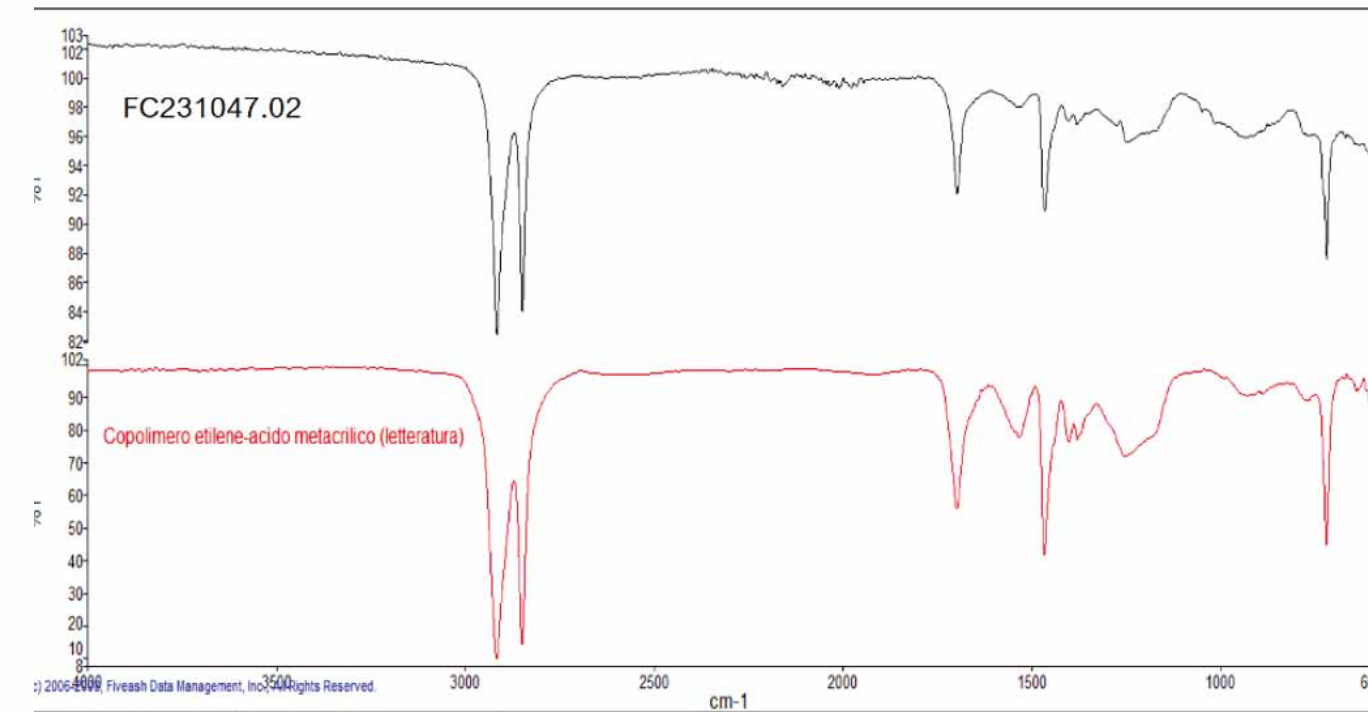
The two paper samples object of this study (glass and straw) were characterized by FT-IR analysis with ATR accessory, thermogravimetric analysis (TGA) and DSC analysis (Differential Scanning Calorimetry) to investigate the possible presence of polymeric compounds present in the matrix.

Sample 1



In figure 1 the sample 1 is compared with the library reference that provided the best match. The FT-IR analysis shows the **typical signals of Cellulose**.

Sample 2



In figure 2 the sample 2 is compared with the library reference that provided the best match. The FT-IR analysis shows the typical signals of the ethylene-methacrylic acid copolymer (the analysis was carried out on the inside of the glass). **It is therefore a polymer coating.**

ENVIRONMENTAL CLAIMS



MICROPLASTIC ANALYSIS ON AQUEOUS EXTRACT

The two samples were subjected to analysis of the cold and hot aqueous extract obtained according to the provisions of the UNI EN 645:2019 and UNI EN 647:1994 standards, to identify the release of microplastics. The results obtained are shown in the following table, where A indicates the cold extractions and B indicates the hot extractions.

	Acque destinata al consumo umano: 1047.01 A - FC231047.01 A			Acque destinata al consumo umano: 1047.01 B - FC231047.01 B			Acque destinata al consumo umano: 1047.02 A - FC231047.02 A			Acque destinata al consumo umano: 1047.02 B - FC231047.02 B		
	Particelle su campione (N/L)			Particelle su campione (N/L)			Particelle su campione (N/L)			Particelle su campione (N/L)		
	20-50um	50-100um	100-500um	20-50um	50-100um	100-500um	20-50um	50-100um	100-500um	20-50um	50-100um	100-500um
Polyethylene	0	0	0	59	0	0	30	30	30	0	0	0
Polypropylene	71	36	0	593	296	178	502	30	0	915	30	30
Polyethylene terephthalate	0	9	0	1482	0	0	30	0	0	30	0	0
Polycarbonate	27	0	0	415	0	0	0	0	0	0	0	0
Polystyrene	0	0	0	59	0	0	0	0	0	0	0	0
Polytetrafluoroethylene	0	0	0	711	59	0	30	0	0	30	0	0
Polyvinyl chloride	0	0	0	3497	0	0	0	0	0	0	0	0
Polyamide	53	0	0	16952	771	237	0	0	30	295	0	0
Polymethyl methacrylate	124	9	0	59	0	0	0	0	0	0	0	0
Polyurethane	9	0	0	5868	296	0	30	0	30	30	0	0
Acrylonitrile butadiene styrene	9	0	0	2312	0	0	0	0	0	0	0	0
Other particles	604	80	62	5157	771	415	1358	177	118	6554	295	30

From the data reported, in the case of the SAMLPLE 1 the release of polymeric material (presumably polymer dispersions added in the production of paper) under hot extraction conditions is highlighted

ENVIRONMENTAL CLAIMS



Case History conclusions

Based on characterization tests carried out on the samples, it is possible to state that there are no plastic materials in the SAMPLE 1, since these materials were not present in the characterization testing carried out. But the hot extraction of the SAMPLE 1 shows the presence of polymeric components

IN CONCLUSION BOTH ITEM HAVE A POLYMERIC COMPONENT...

IS IT POSSIBLE TO DECLARE THE «PLASTIC FREE»??



COATING AND BARRIER MUST BE CHARACTERIZED

PLASTIC FREE PAPERS



???

- ❑ Plastic free claim is a self-certified sustainability label
- ❑ Plastic/Polymers can be detected only as trace contaminants
- ❑ It's important to check the presence/release of microplastics or other polymeric components

- SUPPORT DOCUMENTATION

- THIRD-PARTY VERIFICATION



Thanks for your kind attention!

. . . questions?



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