

# Recycling tests of FR-EPS with and without MB PS POX 20-4

*...Work in progress...*



**RECYCLING XPS-EPS:  
NO POLLUTTANT!!!**  
Best material to be recycled!

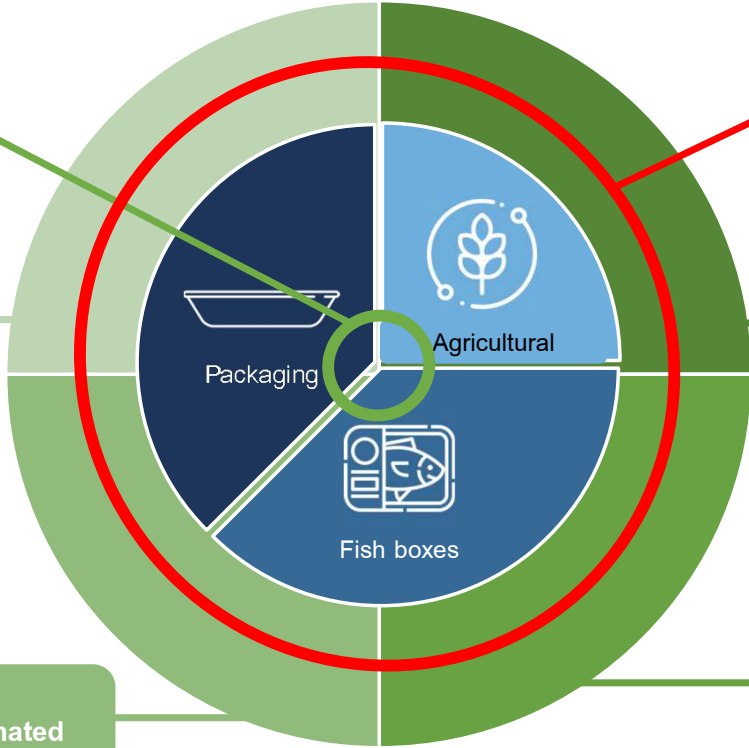
**RECYCLING XPS-EPS:  
POLLUTTANT!!!**  
Worst material to be recycled!

EPS:  
Pollutant HBCD

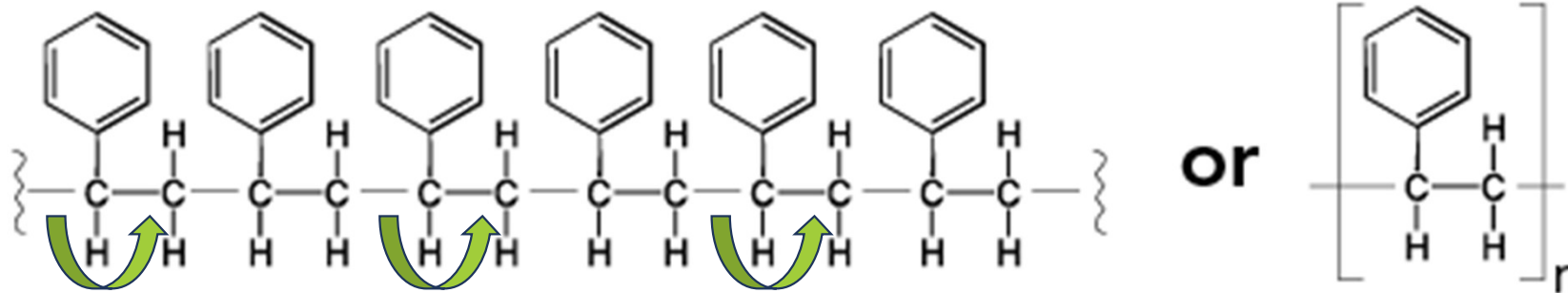
EPS Building:  
pollutant Concrete

EPS, XPS:  
Pollutants halogenated  
Flame retardant

XPS Food:  
Pollutant organic waste



# Polystyrene



RADICALS  $R^*$

MFI INCREASE

RADICALS  $R^*$  + OXYGEN

BROWN, BLACK COLOR

# FR EPS challenge

Gabriel technology produced 2 formulation:

## FR EPS MFR

GPPS: 99%

Monomeric FR: 0.6%

GC BIB 96 peroxide: 0.3

## FR EPS PFR

GPPS: 99%

Polymeric FR: 0.9%

BIB 96 peroxide: 0.3

# Recycling tests

## TEST SCHEDULE

- Extrusion of pure material **EPS MFR** at 250°C, 270°C, 290°C
- Extrusion of **EPS MFR** + 2% «MB PS POX 20-4» at 250°C, 270°C, 290°C
- Extrusion of **EPS MFR** + 4% «MB PS POX 20-4» at 250°C, 270°C, 290°C
  
- Extrusion of pure material **EPS PFR** at 250°C, 270°C, 290°C
- Extrusion of **EPS PFR** + 2% «MB PS POX 20-4» at 250°C, 270°C, 290°C
- Extrusion of **EPS PFR** + 4% «MB PS POX 20-4» at 250°C, 270°C, 290°C

# MFI results: Monomeric FR EPS

MFI (150°C/5kg)	EPS MFR	EPS PFR	EPS MFR	EPS PFR	EPS MFR	EPS PFR
	250°C		270°C		290°C	
	0% MB PS POX 20-4	145.1	38.8	148.5	77.1	150
2% MB PS POX 20-4	3.6	2.2	6.7	11.5	27	36.5
4% MB PS POX 20-4	1.9	1.1	3.1	2.3	7	5.7

# Pictures of extruded material



Extrusion of **EPS MFR** at 250°C

MB PS POX 20-4 [%]	MFI [150°C/5 KG]
0	145.1
2	3.6
4	1.9

# Pictures of extruded material



Extrusion of **EPS MFR** at 270°C

MB PS POX 20-4 [%]	MFI [150°C/5 KG]
0	148.5
2	6.7
4	3.1



# Pictures of extruded material



Extrusion of **EPS MFR** at 290°C

MB PS POX 20-4 [%]	MFI [150°C/5 KG]
0	150
2	27
4	7

# Additional info and Comments

- All extrusions were carried out with a twin-screw laboratory extruder at 150 rpm to reach a dwell time in the extruder of approximately 50s.
- As can be seen from the photos and MFI values, increasing the extrusion temperature increases the MFI. The photos and MFI values show that EPS MFR extruded without the addition of the MB PS POX 20-4 tends to break polymer bonds to and degradate the polymer.

# MFI results: Polymeric FR EPS

MFI (150°C/5kg)	EPS MFR	EPS PFR	EPS MFR	EPS PFR	EPS MFR	EPS PFR
	250°C		270°C		290°C	
	0% MB PS POX 20-4	145.1	38.8	148.5	77.1	150
2% MB PS POX 20-4	3.6	2.2	6.7	11.5	27	36.5
4% MB PS POX 20-4	1.9	1.1	3.1	2.3	7	5.7

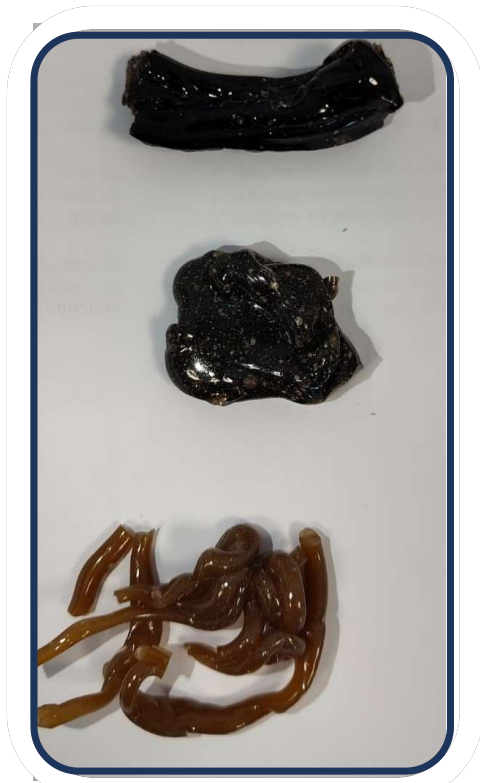
# Pictures of extruded material



Extrusion of **EPS PFR** at 250°C

MB PS POX 20-4 [%]	MFI [150°C/5 KG]
0	38.8
2	2.2
4	1.1

# Pictures of extruded material



Extrusion of **EPS PFR** at 270°C

MB PS POX 20-4 [%]	MFI [150°C/5 KG]
0	77.1
2	11.5
4	2.3

# Pictures of extruded material



Extrusion of **EPS PFR** at 290°C

MB PS POX 20-4 [%]	MFI [150°C/5 KG]
0	93.7
2	36.5
4	5.7

# Additional info and Comments

- All extrusions were carried out with a twin-screw laboratory extruder at 150 rpm to reach a dwell time in the extruder of approximately 50s.
- Comparing the photos and MFI values of the formulation containing the monomeric flame retardant with the formulation containing the polymeric flame retardant, it can be seen that the polymeric flame retardant is more sensitive to radical attack than the monomeric flame retardant.

# Conclusions

MFI (150°C/5kg)	EPS MFR	EPS PFR	EPS MFR	EPS PFR	EPS MFR	EPS PFR
	250°C		270°C		290°C	
0% HBCD CHILLER	145.1	38.8	148.5	77.1	150	93.7
2% HBCD CHILLER	3.6	2.2	6.7	11.5	27	36.5
4% HBCD CHILLER	1.9	1.1	3.1	2.3	7	5.7

By increasing the concentration of MB PS POX 20-4 the MFI decreases. Although the MFI of EPS with the monomeric flame retardant is higher than that of EPS with the polymeric flame retardant, with the addition of the MB PS POX 20-4 ,the MFI of EPS MFR improves compared to the MFI of EPS PFR.



**THANK YOU FOR  
YOUR ATTENTION**

