



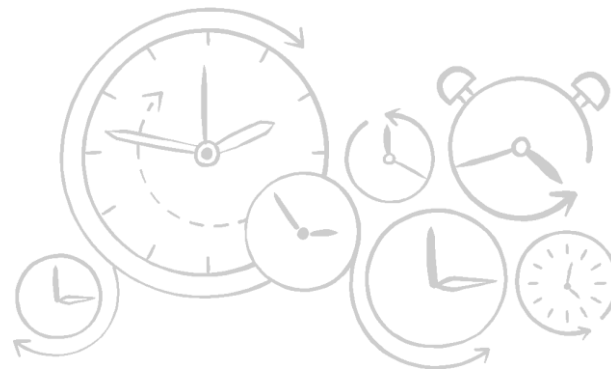
Overview on Latest Fire Reaction Technologies for Polyurethanes in Construction

L. Lotti, **M. Guandalini**, G. Vairo, A. Mercati
Research & Development
Dow Polyurethanes

Dow.com

Agenda

- Insulated Metal Panels and Fire Regulation
- Dow PIR Systems for next gen Construction Panels
- Conclusions



Insulated Metal Panels and Fire Regulation

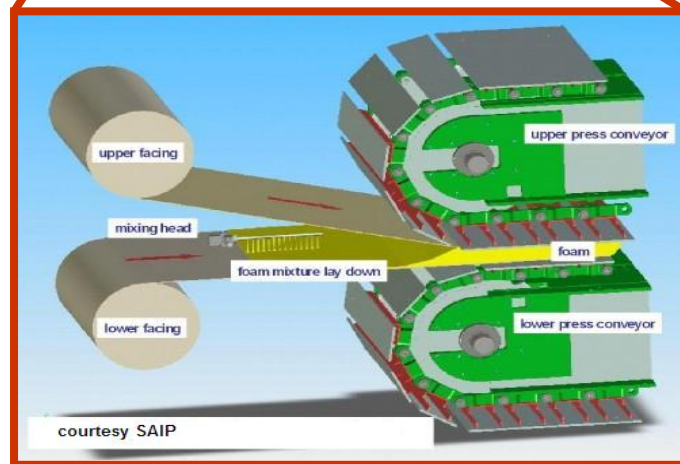
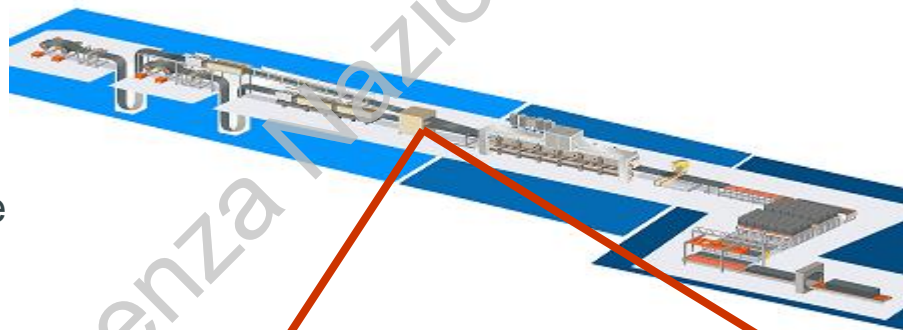
ANPE - 2a Conferenza Nazionale

Insulated Metal Panels

Polyurethane (PUR) and Polyisocyanurate (PIR) Insulated Metal Panels (IMPs) are the current systems of choice for light weight building envelopes.

Rigid-Faced Double Belt Lamination (RF-DBL) is a **continuous** process for producing steel-faced, foam-filled building panels.

VORATHERM™ CN series represents the broad PIR offering from Dow.



Fire Safety Regulation Overview

When construction products need to be in compliance with stringent **combustibility** standards for both fire reaction and fire resistance, **Polyisocyanurate** (PIR) foams are increasingly utilized due to their advantageous fire behavior.

Fire Reaction and Fire Resistance – National Regulations and Insurance Standards

Test	Type
Norm EN 13501-1 (Euroclasses) Test EN 11925-2 Test EN 13823 (SBI)	Fire reaction
FM 4880	Fire reaction
LPS 1181	Fire reaction
Norm EN 13501-2 Test EN 1363 Test EN 1364-1	Fire resistance
LPS 1208, BS 476-22	Fire resistance

Next Gen PIR Systems **from Dow**

ANPE - 2a Conferenza Nazionale

Dow VORATHERM™ PIR Series for Construction Panels

Anticipating Market Trends & Meeting Stringent Fire Standards

Metal panels insulated with Dow VORATHERM™ polyisocyanurate foam systems bring excellent performance that meets the **most stringent fire classification requirements** of the construction industry according to Euro-classes, FM-North American and other insurance standards.



Benefits:

- Excellent fire properties
 - Good thermal insulation
 - Balanced processability
 - Remarkable panel durability
 - Lightweight and structural strength
 - Customizable to meet customer and specification requirements
 - Compliant with the most demanding standards in various geographies
- = A great choice for a variety of panel applications

The next level PIR construction panel technology is **free of halogenated** flame retardants enabling **best fire rating**

The recent development work focused in combining the best class fire reaction performance with a more **sustainable profile** of the final IMP: the novel PIR technology has been commercialized as **VORATHERM™ CN 100 Series**.

VORATHERM™ CN 100 Series PIRs allows manufacturers of IMPs via RF-DBL to produce panels able to meet the growing interest in **halogen-free** flame retardant additives for construction insulation materials while retaining the **stringent flammability performance** required by the construction industry.

VORATHERM™ CN 100 Series insulated metal panels have proven to be able to achieve:

- Euroclass **B-s1,d0**
- **FM 4880** approval

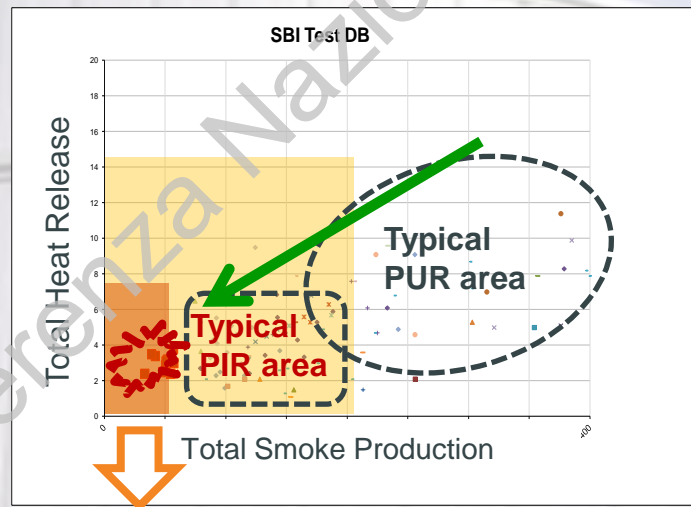
Introducing
Dow VORATHERM™
CN 100

- ✓ Halogen Free PIR
- ✓ Euroclass version
- ✓ FM 4880 version

Halogen-Free PIR for Euroclass performance



- The first letter in the classification is about heat release and flame spread
- the “s” in the classification refers to the smoke production from s3 to s1 (from high to low) is assigned based on measurements of total smoke production (TSP) and smoke growth rate (SMOGRA) using the SBI apparatus described in EN 13823
- PIR cored IMP typically can achieve B-s2,d0 class

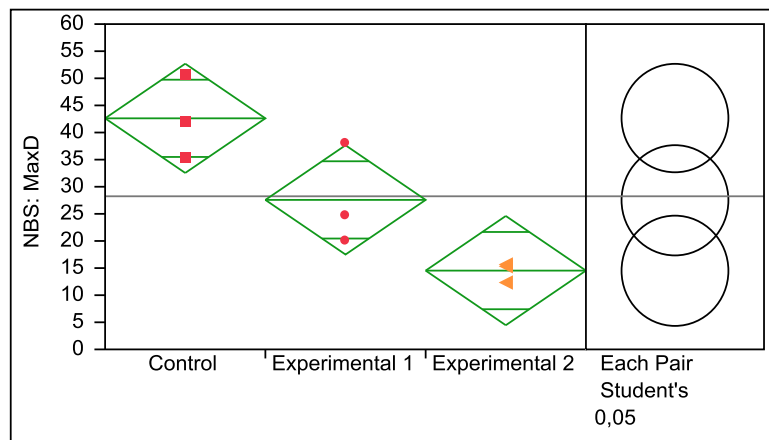


Achieving B-s1,d0

Reducing smoke generation from s2 to s1 is a **breakthrough** performance improvement and **B-s1,d0** is the best class achievable with organic insulation

Halogen-Free PIR for Euroclass performance

- The NBS smoke density chamber described in ASTM E662 was used as laboratory screening tool.
- The laboratory work was focused on the substitution of current FR package with **halogen free flame retardants**, with the dual target of increasing the profile of **sustainability** and the fire safety performance.
- The **optimization** of isocyanate index, aromatic content and FR type and content led to the confirmation of the research hypothesis: an improved NBS chamber performance (reduced Ds) was obtained



Dow VORATHERM™ CN 100 Series

Euroclass Rating

- The best performing halogen free experimental material resulting from the laboratory work was scaled up for the production of IMP and their commercialization
- **VORATHERM™ CN 100** Series is the family of products resulting from this development study and is available to panels manufacturers
- Worth to remind that in SBI test, the panels' joint plays a very important role and only those panels having the proper joint configuration and cored with high performance PIR foam can achieve highest fire classification
- As an example of performance achievable with VORATHERM™ CN 100, Panels A and X have achieved s1 smoke rating, while Panel C is slightly above the TSP threshold and resulted in a very good s2 rating (close to s1). Worth to mention that typically the conventional PIR available in the market have a smoke opacity well above the TSP threshold value

Industrial Run	Panel thickness (mm/in)	THR (MJ)	FIGRA (W/s)	TSP (m ²)	SMOGRA (m ² /s ²)	Rating
A	80/3.1	3.5	30.2	< 50	3.4	B-s1,d0
A	150/5.9	2.7	22.0	< 50	2.3	B-s1,d0
C	100/3.9	2.7	39.0	50-55	6.1	B-s2,d0
X	50/2.0	1.6	13	< 50	1.0	B-s1,d0

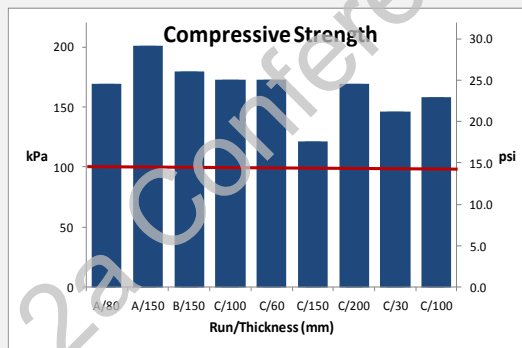
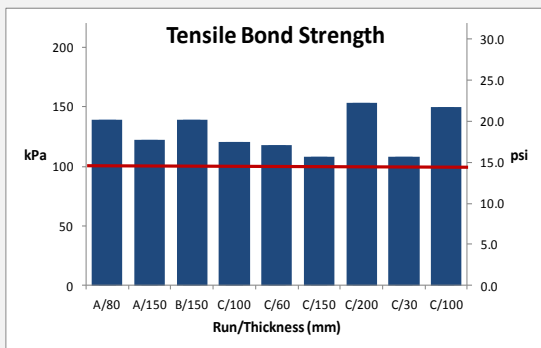
Panels A and X have the proper joint design, suitable to achieve highest fire classes

Dow VORATHERM™ CN 100 Series

Mechanical Properties

All the key mechanical properties are above the threshold value typically requested by the industry.

Adhesion to the metal facing, measured as Tensile Bond strength (TBS), and Compressive strength at 10% deflection are always above 100 kPa (14.5 psi)



In addition, industrial panels have been submitted to full scale **accelerated aging tests** and to **extensive field tests** with excellent results, in line with industry standards for top quality products.

- Real wall assembly
- Heating-cooling cycles
- Check for aesthetics defects (waving, blistering)



Halogen-Free Flame Retardants PIR for FM 4880

- Similarly and leveraging onto the development of VORATHERM™ CN 100 Series, targeting the European fire reaction standards, Dow developed a novel halogen free FR PIR technology, suitable to pass the Factory Mutual **FM 4880 flammability characterization test**
- Aiming to match the different blowing agent technologies commonly used in the North American market, two different versions, respectively based on **pentane** isomers and **HFC 245fa**, were developed
- Panels produced at **ce|de|pa** * were submitted to the orientation test at the FM Research Institute according to the FM 4880 Approval fire propagation apparatus
- Both foams, 245fa and pentane blown, **passed the FSPc criteria**, and the experimental materials developed are available to be tested by the IMPs industry

* Continuous Panel Development Center

ce|de|pa
CENTRO DE DESARROLLO DEL PANEL EN CONTINUO



Dow VORATHERM™ CN Series PIR

A Broad Range of Solutions

	VORATHERM™ CN 600	VORATHERM™ CN 800	VORATHERM™ CN 100
Typical Certification			
Reaction to Fire *	up to Euroclass B-s2,d0	up to Euroclass B-s2,d0	up to Euroclass B-s1,d0
Resistance to Fire *	EI-15	EI-30/60	EI-30/60
Typical Thermal Insulation Values			
Initial Lambda mW / (mK) at 10 °C	18 - 20		
Typical Processability			
Temperature of Conveyor (°C)	40-50	60-65	60-65
Adhesive Layer	Not Required	Available on Request	Available on Request

* Numerical flame spread or fire classification are not intended to reflect hazards presented by this or any other material under actual fire conditions.

Conclusions

ANPE - 2a Conferenza Nazionale

Conclusions

- **Dow VORATHERM™ CN Series** are the stratified PIR offering from Dow to the manufacturers of Insulated Metal Panels
- **Dow VORATHERM™ CN 100 Series** are the latest development featuring unique combination of top fire rating and improved sustainability
- **Dow VORATHERM™ CN 100 Series** are designed to meet up to **B-s1,d0** Euroclass, the most severe rating achievable by a organic insulating material, combined with a more **sustainable** profile due to the absence of any halogenated flame retardant
- **Dow Developmental PIR** foam formulation technology, free of any halogenated flame retardant, and specifically designed for the US market, has demonstrated to pass the **FM 4880** convective flame spread test and is available to be tested by the IMPs industry



**Thank
You**

L. Lotti, **M. Guandalini**, G. Vairo, A. Mercati
Research & Development
Dow Polyurethanes