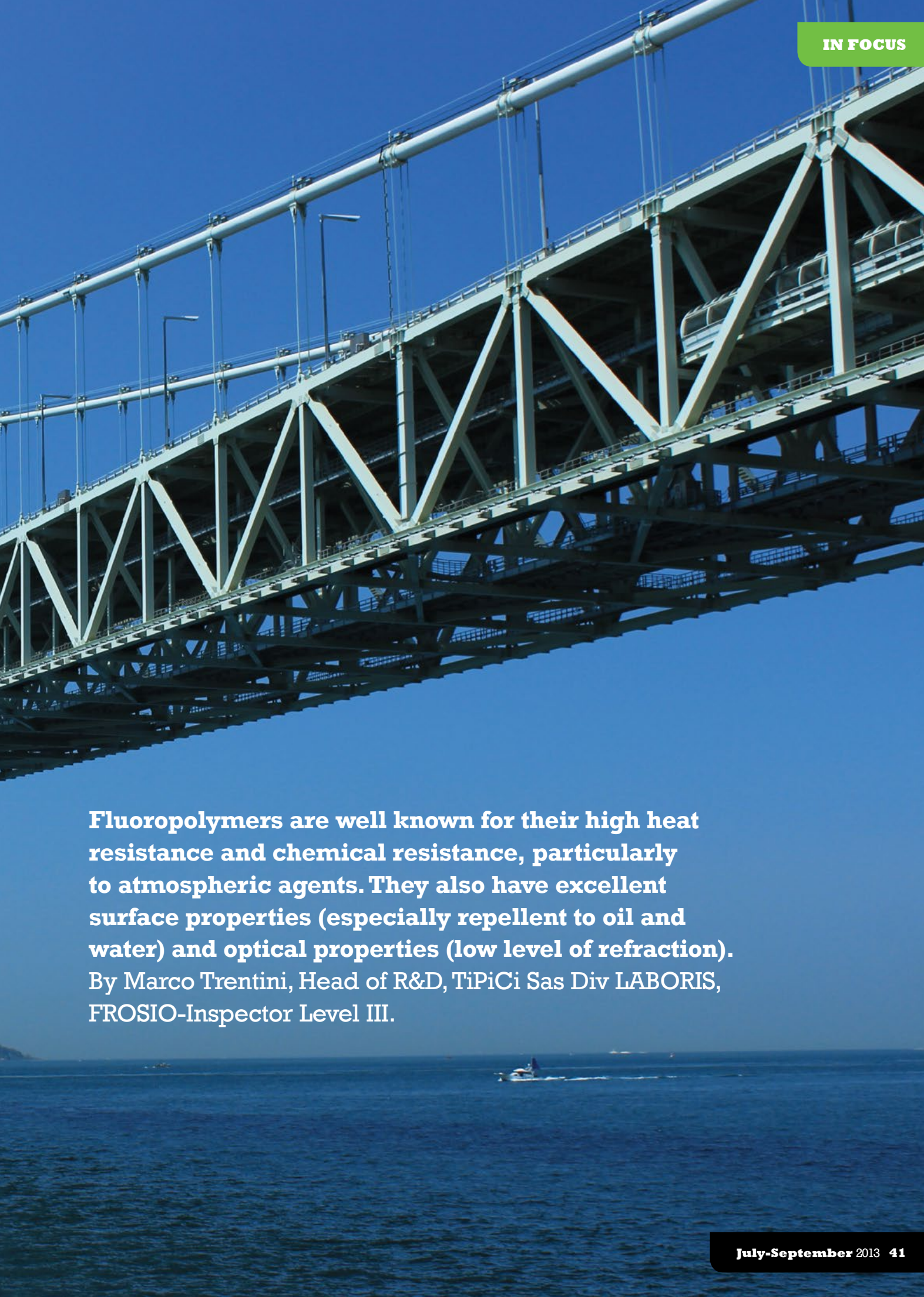


IN FOCUS

Bridging the gap





Fluoropolymers are well known for their high heat resistance and chemical resistance, particularly to atmospheric agents. They also have excellent surface properties (especially repellent to oil and water) and optical properties (low level of refraction).

By Marco Trentini, Head of R&D, TiPiCi Sas Div LABORIS, FROSIO-Inspector Level III.



Fluoropolymers were introduced in the thirties and have since been applied as surface and substrate coating materials with the above-mentioned properties, and have been an essential material in a large range of factories on a wide range of machinery. In 1982, Asahi Glass developed a fluoro-olefin vinyl ether copolymer, (shortened to FEVE) which it manufactured under the brand name LUMIFLON. It was the first solvent-soluble fluoropolymer for coatings that can be cured under room temperature conditions. In Japan, due to a Ministry of Infrastructures ruling, since 2005 every bridge must be protected with FEVE-based coatings. One of the best known examples is the Akashi Bridge, also known as the Pearl Bridge, which is the longest suspension bridge in the world at 3,911m long and 282.8m tall. Inaugurated on April the 5th 1998, it connects the city of Kobe, on Honshu Island, to the Island of Awaji through a main span 1,991m long.

One of the main reasons that the FEVE-based coatings were selected is that regardless of the continuous improvements in non-fluorinated coatings, only fluoropolymer-based coatings are able to meet the American Architectural Manufacturers Association (AAMA 2605.2) standard for high-performance organic coatings on architectural extrusions and panels. According to the standard, the coating is required to be exposed in a tropical climate (Florida) for ten years. After that time the colour mutation ΔE must be less than 5 and the brightness mutation $\Delta Gloss$ must be less than 10%.

However, Japan represents only one example of how Fluoropolymers have been used over the last 25 years. It has estimated that more than 15,000 structures have been protected worldwide with FEVE-based fluorinated polymers. More famous architectural examples include Ferrari Park in Abu Dhabi and the Mercedes Museum in Stuttgart.

When unprotected iron is exposed to air, submerged in water, or buried, it is vulnerable to corrosion that can cause considerable damage. There are various different ways to protect iron structures from corrosion; Standard UNI EN ISO 12944 is about protection through painting, taking into consideration all the main factors to achieve appropriate protection from corrosion.

Atmospheric environments are classified in six categories of atmospheric corrosivity in UNI EN ISO 12944-2.



Ferrari Park in Abu Dhabi is also protected by FEVE-based fluorinated polymers © Donaldytong

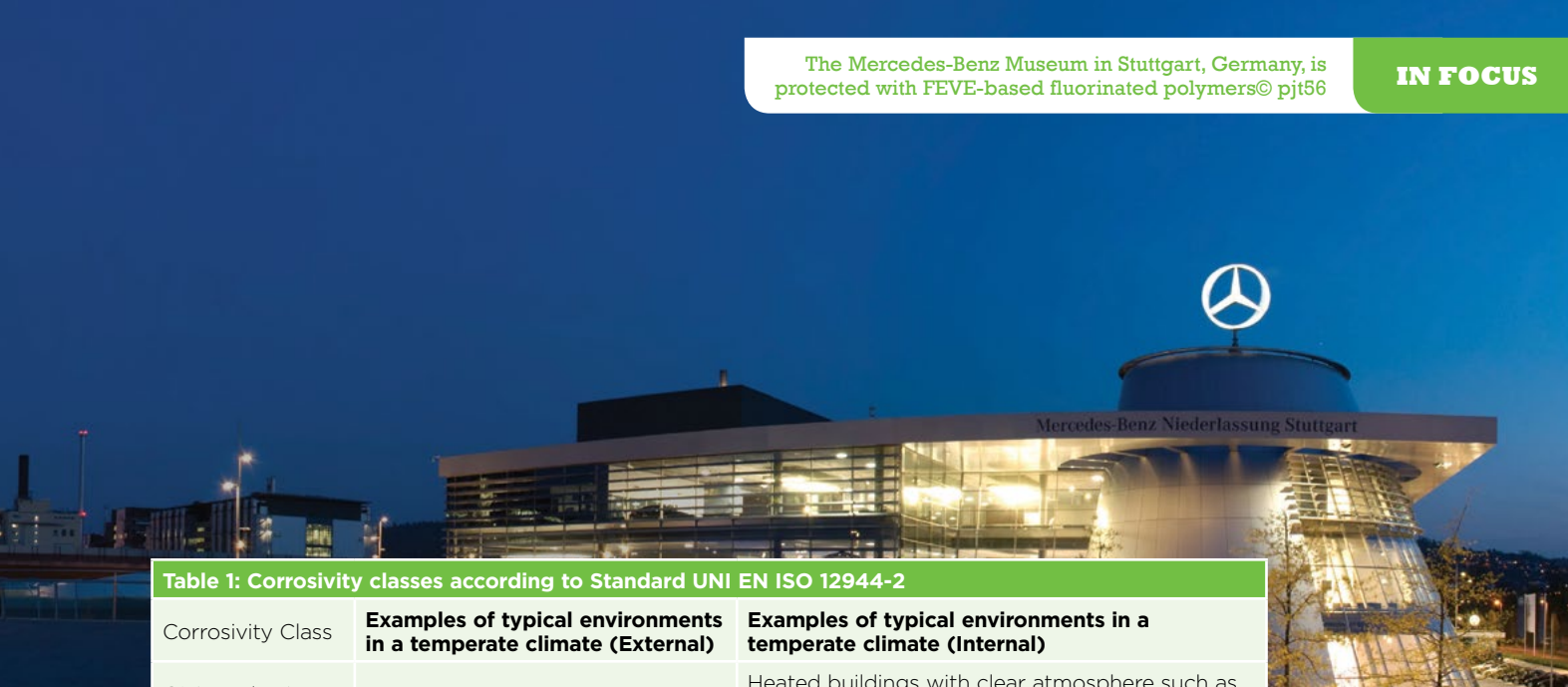


Table 1: Corrosivity classes according to Standard UNI EN ISO 12944-2

Corrosivity Class	Examples of typical environments in a temperate climate (External)	Examples of typical environments in a temperate climate (Internal)
C1 (very low)	-	Heated buildings with clear atmosphere such as offices, stores, schools and hotels etc
C2 (low)	Environments with low levels of pollution, especially natural areas	Heated buildings vulnerable to condensation, such as Storages and sport clubs etc.
C3 (Medium)	Urban or Industrial environments with moderate sulphuric anhydride pollution Coastal areas with low salinity	Production units with high humidity levels and a certain pollution level such as food industries, dry-cleaners, Breweries and cheese factories etc
C4 (high)	Industrial and coastal areas with moderate salinity	Chemical plants, such as swimming pools and coastal drydocks
C5-I (very high industrial)	Industrial areas with high humidity and an aggressive atmosphere	Buildings or areas with nearly permanent condensation and a high level of pollution.
C5-M (very high marine)	Coastal and offshore areas with high salinity	Buildings or areas with nearly permanent condensation and a high level of pollution

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As protective coating effectiveness is generally minor compared with structure activity service duration, the ability to maintain or re-paint the coating must be properly considered during the planning and engineering stage.

The level of coating degradation prior to the first important maintenance intervention must be discussed between all the parties involved and be established according to Standard UNI EN ISO 4628 from part 1 to part 5, if not stated differently. According to standard UNI EN ISO 12944-1 durability is expressed in three categories:

- Low (L) from 2 to 5 years
- Medium (M) from 5 to 15 years
- High (H) more than 15 years.

However, durability doesn't represent a duration guarantee - it is a technical consideration that could help the buyer when drafting the maintenance schedule. UNI EN ISO 12944 Part 6 specifies the methods and laboratory test conditions necessary to evaluate the protection of steel structures from corrosion which are provided by painting.

The above-mentioned test results (neutral salt spray test, water condensation test, chemical resistance test and water immersion test) must be considered as a guide when choosing the appropriate coatings and not as detailed information to establish durability.

RANGE DEVELOPED

TiPiCi, through studies and tests carried out by its Div.LABORIS, has developed a complete range of water-based products registering under its own brands and has qualified the systems according to the UNI EN ISO 12944 Standard.

One of the most interesting coatings is system TIPICI-MT-0065, which has qualified for C5M (Marine) and C5I (Industrial) with high (H) durability.

TIPICI-MT-0065 for C5M (Marine) and C5I (Industrial) (H)		
N° coat	Product Type	Dry film thickness
1	Water-based zinc rich epoxy primer (HYDROGUARD® Zinc)	70µ
2	High Build water-based epoxy Intermediate (HYDROGUARD® HB)	190µ
3	Water-based Fluorinated polyurethane topcoat (HYDROTHANE® FL)	40µ
Painting system total dry film thickness: 300µ		

HYDROGUARD® Zinc is a water-based zinc rich epoxy primer according to regulation SSPC Paint 20 Level 1. It is supplied with zinc powder ASTM D520 Type 2 and its metallic zinc percentage on dry film thickness is 88% (by weight).

HYDROGUARD® HB is a high build water-based epoxy intermediate that can be applied in up to 200 microns of dry film thickness.

Finally HYDROTHANE® FL is a water-based fluorinated polyurethane topcoat formulated with FEVE resins that bestows a very high stability from light and chemical attack.

The TIPICI-MT-0065 paint system is close in typology, products involved, and final dry film thickness, to the Coating system N° 1 named in the NORSOK M-501 standard. The paint system has also largely withstood the tests required by the UNI EN ISO 12944 standard for corrosivity categories C5M (Marine) and C5I (Industrial), with high (H) durability.

Test Proceeding for category C5-M and C5-I					
Class	Durability	Chemical Resistance (ISO2812-1)	Water Immersion (ISO 2812-2)	Water Condensation (ISO 6270)	Neutral Salt Spray (ISO 7253)
C5-I	Low	168h	-	240h	480h
	Medium	168h	-	480h	720h
	High	168h	-	720h	1440h

SYSTEM BENEFITS

There are two main benefits to using the TIPICI-MT-0065 paint system;

The first one is linked to it having brilliantly withstood a complete series of qualifying international tests. The second, and more interesting, is linked to its considerable reduction in Volatile Organic Compounds (VOCs).

Whilst in the US the Environmental Protection Agency (EPA) has developed standards that exonerate fluorinated coatings from having to respect emission limits, in Europe standards are being evolved to reduce VOC Levels to 250/350 grams per litre, which are only achievable through water-based product utilisation.

Paint System TIPICI-MT-0065 VOC Level comparison with respect to a similar solvent-based system				
N° coat	Product Typology		VOC	
1	Solvent Based Zinc Rich Epoxy Primer	HYDROGUARD® Zinc	>400g/l	<60g/l
2	High Build Solvent based Epoxy Intermediate	HYDROGUARD® HB	>200g/l	<60g/l
3	Solvent based Fluorinated Polyurethane Finish	HYDROTHANE® FL	>300g/l	<80g/l

Painting system total thickness: 300µ

CONCLUSIONS

In general, anticorrosive protection segments could be separated into Industrial (which includes agricultural machines, cranes and presses etc) and Protective (which includes valves, actuators, chemical and oil plants and bridges etc).

The main difference between these two segments is the “life and utilisation conditions” of items coated. The Protective segment is likely to see the biggest levels of corrosion and environmental attacks, conditions not usually present into the Industrial segment, which can be sporadic and limited events.

This implies that protective coatings used in these two segments would differ largely in formulating/basic chemistry, to grant different performances. These would be expected to be more superior and technological in the Protective segment and more standardised in the Industrial.

In the Industrial segment water-based protective coatings are widely used, but it has to be said that performance has sometimes been limited, especially when the cost factor plays a starring role. It is for this reason that in the Industrial segment these products are sometimes called ‘iron befoulers’ by some skilled people in anticorrosion business.

The Protective segment is very different in this sense because it is governed by painting specifications (which are often obsolete), and they don’t usually consider product innovations, which more often dictates that they stick with solvent-based international brand products.

However, recently well-known international engineering companies have started to show an interest in water-based protective systems, which is a sign that times are changing even in the Protective segment. TiPiCi has introduced its own water-based protective systems into the market where specifications leave the buyer free to choose between solvent-based and water-based products.

TiPiCi was (15 years ago) the first Italian business in the anticorrosion sector to formulate a water-based silicone coating that was high temperature resistant and was actually applied on valves that could work up to 400° C. At the same time, water-based epoxy paint systems with/without a water-based polyurethane topcoat (even metalized and customer coloured), which didn’t need to comply with any international

painting specification, were supplied by the company for use on actuators.

Ultimately, water-based products are less common in the Protective sector than in the Industrial, but where they are utilised they are the result of high quality technologies able to satisfy the pressing requirement for anticorrosion properties in the Heavy Industry segment. ■

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