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SEAFRONT

Synergistic Fouling Control Technologies

Deliverable 5.27: IP to formulate the fluoropolymer emulsions into water based coating formulations.

Delivery date: M48 (January 1st 2018)



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1 Introduction

Deliverable 5.17 has been delivered with the aim to formulate fluoropolymer emulsions into water based coating formulations which can then be used to coat test pieces which will be subsequently used for hydrodynamic and fouling control testing in both laboratory and in-field situations in WP4 and WP5.

2 Partners involved

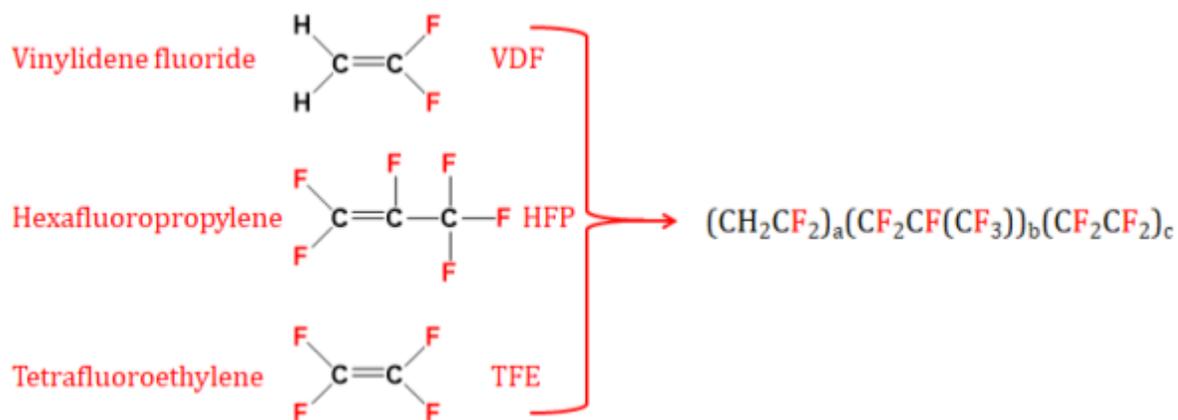
International Paint Marine & Protective Coatings (IP)
Solvay Specialty Polymers S.P.A. (SSP)

3 Description of technology delivered

The fluoropolymers to be formulated were elastomers made by SSP by copolymerizing fluorinated vinyl monomers. These materials are used commercially under the Tecnoflon® brand name.

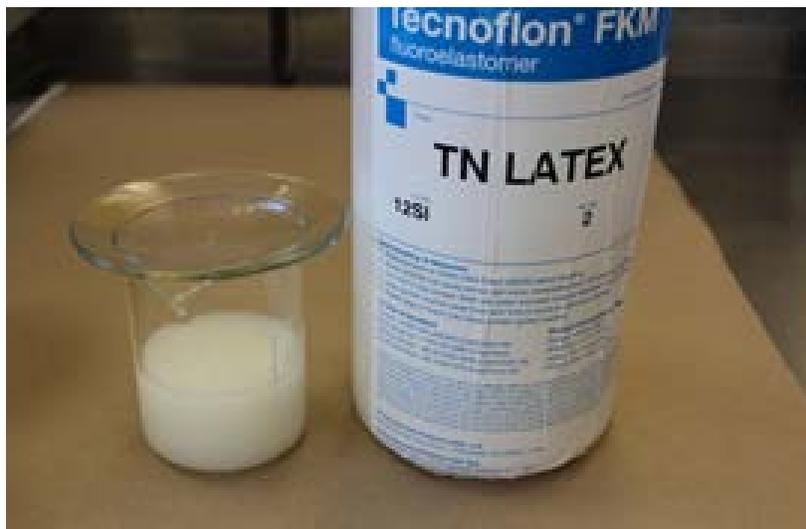
Tecnoflon® fluoroelastomers and perfluoroelastomers are designed for demanding sealing applications in aggressive chemical and high heat environments such as those found in the Automotive, Aerospace, Oil & Gas, and Energy markets and where high purity and long service life are essential. They are compatible with a wide range of fluids and chemicals including automotive lubricants, fuels, and additives. Typical end use products include O-rings, seals, gaskets, and complex molded parts.

In the context of Seafont these materials were explored to see if such polymers can be used as an alternative to existing biocide free fouling control technologies due to their low surface energy, elastomeric nature and high chemical resistance. Additional benefits that this class of material may offer over the current state of the art are that they may provide greater abrasion resistance, less contamination and better application simplicity.



Tecnoflon® monomer composition

The material chosen for formulation and supplied by SSP to IP was Tecnoflon® TN; this was an aqueous latex of VDF, HPF and TFE.

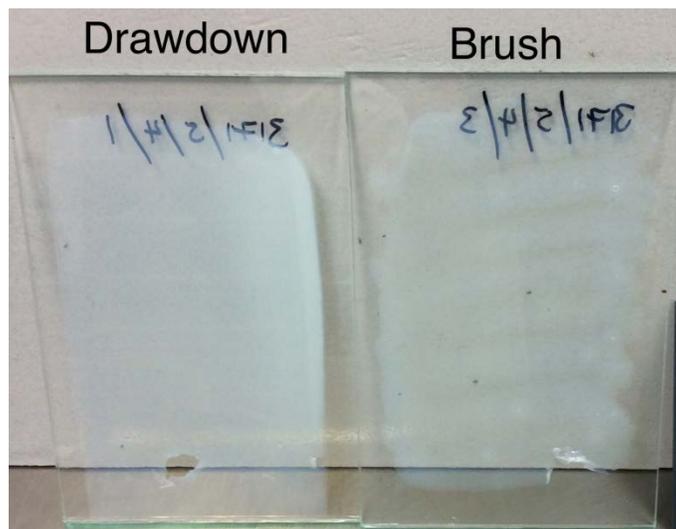


Tecnoflon® TN sample

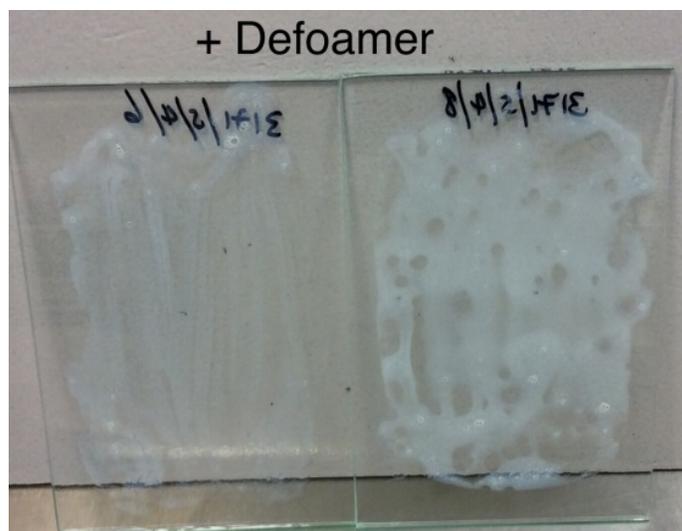
The latex was cast as films using the unmodified as received dispersion using a wire-wound drawdown bar applicator, flat bar film applicator and professional quality brush. Good films were formed when either of the draw down techniques was used. Some aeration was seen in these first trials but when defoamers intended to alleviate the issue were used had the opposite effect the route was abandoned.



Wire-wound drawdown bar applicator (left), flat bar film applicator (middle) and professional quality brush (right).

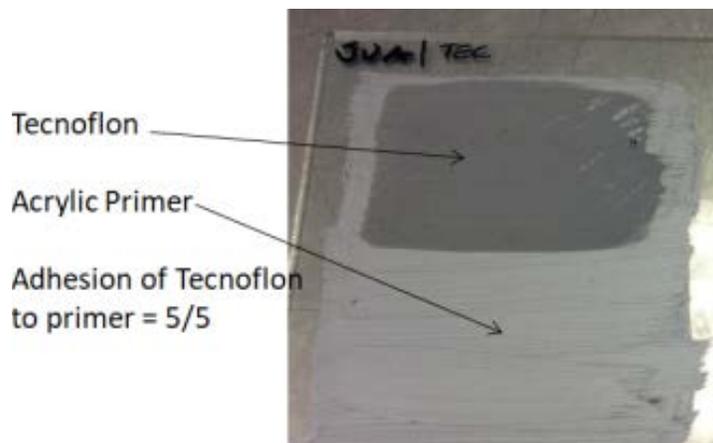


Drawdown and brush application to glass



Drawdown and brush application to glass with additional defoamer additive

Adhesion to IP in-house primer coatings was assessed and a good performing system was found when using an epoxy tie coat. Films were cast directly to the primer with good adhesion being seen despite these polymers being not crosslinked or covalently bound to each other as the primer is a crosslinked thermoset and the Tecnoflon® being an inert thermoplastic.



Direct overcoating of the acrylic primer with Tecnoflon® TN

Mechanical properties testing of the fluoroelastomers showed similar tensile strength to crosslinked PDMS. However, being thermoplastics they showed a higher element of plastic (irreversible) deformation on tensile testing

Contact angle testing of the fluoroelastomers showed a lower hydrophobicity than PDMS and when blended with Perfluoropolyether (PFPE) fluids interesting contact angle behaviour was seen: rapid changes of contact angle after an induction time from when the water droplet is placed on the surface. This behaviour strongly suggests a rearrangement phenomenon at the surface is taking place.

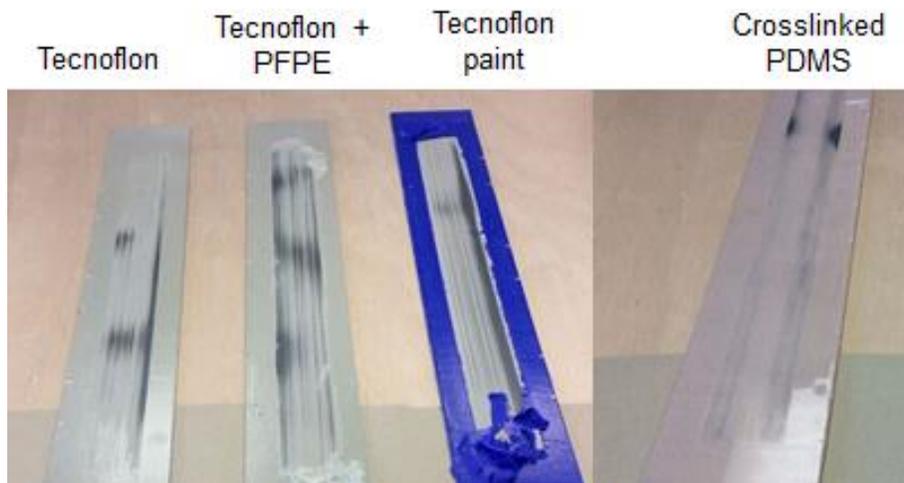
	Water	CH ₂ I ₂
Tecnoflon® TN	61.5	71.9
PDMS	99.1	57.3

To assess the suitability of the Tecnoflon® systems for a pigmented paint composition a formulation was prepared which mimics the properties and appearance of commercial fouling release finish coats – same pigmentation & rheology control at equivalent dry film volume content. A stable paint was successfully made.



Blue pigmented Tecnoflon® formulation

Abrasion resistance testing was conducted using P60 sandpaper. Tecnoflon® performed differently to PDMS. With PDMS a gradual wearing down of the film was seen with a significant amount of material remaining attached. With Tecnoflon® films the tearing occurred away from the primer layer and the coating was stripped away as free film. An investigation into why the primer adhesion was apparently lost after preconditioning the panel for 3 days is planned.



Test panels after abrasion testing

Blends of Tecnoflon® blended with Perfluoropolyether (PFPE) fluids were prepared at 93:7wt% solid polymer to fluid. The fluid does not mix in well and latex coagulation is seen.

4 Conclusions

The aim of this deliverable was to formulate fluoropolymer emulsions into water based coating formulations to be used to coat test pieces for hydrodynamic and fouling control testing in both laboratory and in-field situations in WP4 and WP5.

- The unformulated latex could be applied using drawdown techniques and good adhesion was achieved to commercial primer schemes.
- Using defoamers was unsuccessful in alleviating the mild aeration.
- It could be readily combined with fillers, pigments and rheology modifiers to produce a viable paint formulation.
- When blended with PFPE fluids the latex became unstable.

5 References

None