ECO-CONCEPTION OF AN ANTICORROSIVE HYBRID COATING APPLIED AT LOW THICKNESS

I/ INTRODUCTION

N.O.F. Metal Coatings Europe (NOF MCEU) is at present the European Leader of protective coatings based on lamellar metallic particles mainly of Zinc and Aluminium and applied at "low" thickness (6-8 µ), in the market of fasteners, brake discs… especially in the automotive sector.

N.O.F. MCEU delivers its products, via a licencees network, to the whole European automotive companies (Export ~ 85 %).

Due to its affiliations, N.O.F. MCEU is also able to deliver worldwide products approved by European automotive companies and vice versa.

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II/ PROJECT

N.O.F. MCEU has for a long time introduced waterborne products on the market. The innovation which has been presented to “CEFIC AWARDS 2010” is in keeping with the constant approach of N.O.F.MCEU, to increase durability of protective coatings and decrease their impacts on environment and human health and safety, in the objective of sustainable development.

The main “challenge” of this project was to design a waterborne material with a drastic decrease of Volatile organic compounds (V.O.C.) and as a consequence, to reduce CO_2 emissions in the environment during application process, by decreasing organic solvents amount :

Objective was : Reduction of organic solvents amount from 17% - 25% (current N.O.F. MCEU products) to 4%-5%.
It results of this big effort : more than 90% of solvents is water

Let’s note : Current materials of our worldwide competitors are completely in organic phase (no water)

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II/ PROJECT

Beyond this main objective, this new version had to take into account the following needs :

- Compound in aqueous phase (more than 90% of solvents is water) which contains Zinc and Aluminium particles

- Hybrid (Organo-mineral) structure of the binder : important for Thermal resistance of coatings

- Compound is methanol (Toxic) and ethoxylated nonylphenol (endocrinian effects) free

- Taking into account European environmental directives
  Ex. : “Heavy metals” or metals under health regulations free (chromium free)

- …

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II/ PROJECT

This new version has to fulfil different functional properties :

- high level of anticorrosion performances even after mechanical damages
- thermal resistance
- mechanical properties
- chemical resistance
- …,

and other constraints have to be taken into account :

- good stability in terms of viscosity, non hydrogen emission, settling … to allow a delivery in Europe in one component
- cost
- …

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III/ TECHNOLOGY

The Project started in 2004 and to satisfy objectives and properties, different approaches and research were done on different elements of the composite structure of the material :

- the hybrid structure of the matrix by using a sol gel approach to reach the different specifications

- the introduction of metallic particles (Zinc – Aluminium…) to secure sacrificial protection against corrosion and to get a good liquid stability

- the additives to optimize production and application process

- …

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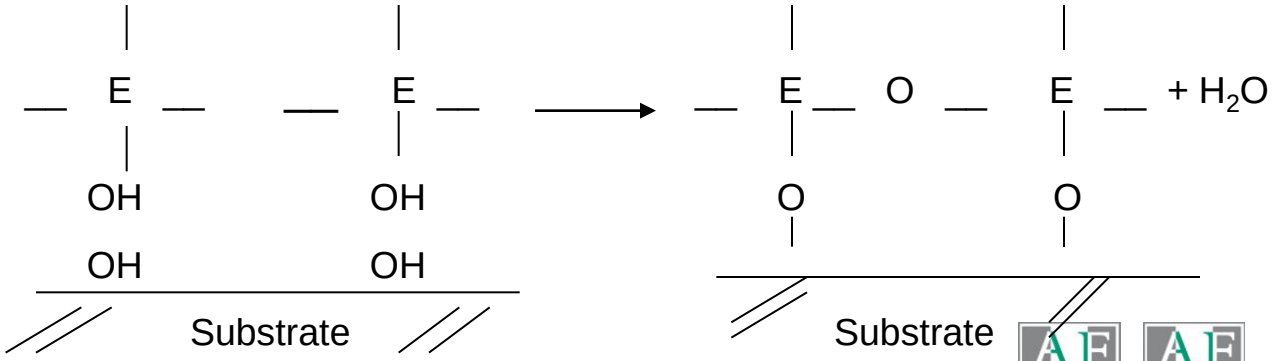
III/ TECHNOLOGY

III_1/ The binder structure

The Hybrid structure is based on a Sol Gel technology. This technology is not really new but its use is rather recent.

The binder design (choice of monomers) and the binder process were very important (key point) to get :

- a reproducible organo-mineral structure (species – molecular weight distribution …)
- a stability of the liquid solutions (homogeneity – viscosity – pH…)
- a well adapted reactivity (time / temperature) of the system, to obtain a reproducible tridimensional network (due to crosslinking) and adhesion to the substrate



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III/ TECHNOLOGY

III_1/ The binder structure

All variables of the process have to be defined and industrially under control. This has been done with the help of two Universities for some characterizations and get a better understanding of some reactions.

This part is very important, because the reproducibility of a lot of properties such as :

- stability / wettability (surface tension – rheology) of the aqueous material

- crosslinking reactivity (time / temperature) / film formation

- adhesion / porosity / anticorrosion / mechanical properties / chemical resistance / thermal resistance / hydrophobicity – hydrophilicity / …, of the dry coating after curing

are depending on the reproducibility of the Hybrid structure of the binder.

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III/ TECHNOLOGY

III_2/ Sacrificial protection

Beyond the chemical nature of the used binder, the pigmentary system has a preponderant influence on the protective function of the coating.

The sacrificial protection of coating applied on steel (2 coats of a compound – 6/8 µ - curing) is mainly due to Zinc and Aluminium flakes.

It is not easy to introduce Zinc and Aluminium flakes in water and avoid :

- H_2 emission
- heterogeneity of the dispersion
- settling of particles
- liquid instability / surface interactions
- desorientation of particles in the film
- …

} bad anticorrosion and properties of the dry film

On the other hand, anticorrosion is better by using flakes instead of spherical particles but, these problems are higher and more difficult for solving due to their larger surface accessibility (x 3 to 4).

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IV/ INTEREST OF THIS INNOVATION

IV_1/ For users

The potential users of this technology are applicators which are subcontractors of worldwide automotive companies. The main advantages for them are :

- A working environment less generative of harmful effects (low diffused emissions) due to :

  * low amount of organic solvents in the waterborne material : only ~ 4-5% instead of 17% to 25% for the current NOF MCEU products.
    NB : our worldwide competitors are mainly in organic phase (without water)
  * methanol and ethoxylated nonylphenols free
  * the material fulfils European environmental directives and REACH requirements (no chromium or toxic / regulated heavy metals)

- A reduced volume of V.O.C. and CO_2 emitted in the atmosphere during application process. This allows to avoid investments and maintenance costs in equipments to treat V.O.C.

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IV/ INTEREST OF THIS INNOVATION

IV_2/ For N.O.F.MCEU

- This important progress with respect to our competitors reinforces the image of N.O.F. MCEU as an innovating company of “ecological” products; R&D has always been a major axis in the development strategy of N.O.F.MCEU.

- This allows N.O.F. MCEU to consolidate its market share

- This results in an easier control of solvents cost of the material

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V/ SITUATION OF THE PROJECT

- This project took several years. It has involved all sectors and employees of the Company with respect to the development steps.

- Important investments were dedicated to this innovation in the production process

- Pilot applications are done since 2007-2008 on industrial lines to validate the technology.

- This compound is now under an extension phase on different European lines

↳ This innovation was especially relevant to reinforce competitiveness of N.O.F. MCEU in the market of anticorrosion coatings based on lamellar metallic particles, in the field of metallic parts for Automotive.