ANTICORROSIVE TITANIUM DIOXIDE PIGMENT IN C0IL CIATINGS

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ABSTRACT: A new type of an environmental friendly anticorrosive pigment was developed simultaneously providing the hiding power of a white pigment. The product is based on a specific titanium dioxide carrier material which is inorganically surface modified with chemically active anticorrosive substances. The new pigment offers corrosion protection and light scattering at the same time, thus opening up new opportunities for formulations of anticorrosive coatings.

KEYWORDS: dioxide pigment, TiO2**,** anticorrosive pigment, characterized, developments**,** structural concept.

1. INTRODUCTION

In the field of anticorrosive coatings ongoing developments are characterised by the step-by-step replacement of environmentally critical pigments, the improvement of the organic coatings themselves, the reduction of volatile organic compounds and the development of effective water borne coatings. However, new coatings have to fulfil not only these ecological and technical demands but also economic considerations. The properties of the pigmentary powder and its application in several industrial waterborne and solvent based coatings haveb already been discussed in detail in [1].

2. MATERIALS AND METHODS

The structural concept of the new anticorrosive white pigment called "Hombicor" is illustrated in Figure 1 and named in this paper anticorrosive TiO2. This pigment is produced by covering a core pigment by layers of inorganic materials which impart the anticorrosive properties to that pigment. With this combination one may take advantage of several functions with one pigmentary product. By using a TiO2 pigment as a carrier material the properties of light scattering referring to the bulk material are completely maintained, and the chemically active surface area consisting of anticorrosive components is considerably increased compared to other contemporary anticorrosive pigments. A particle size analysis from different anticorrosive pigments is shown in Figure 2 using a logarithmic scale. The chemical composition of the resulting product corresponds to a modified rutile pigment and contains no hazardous substances.

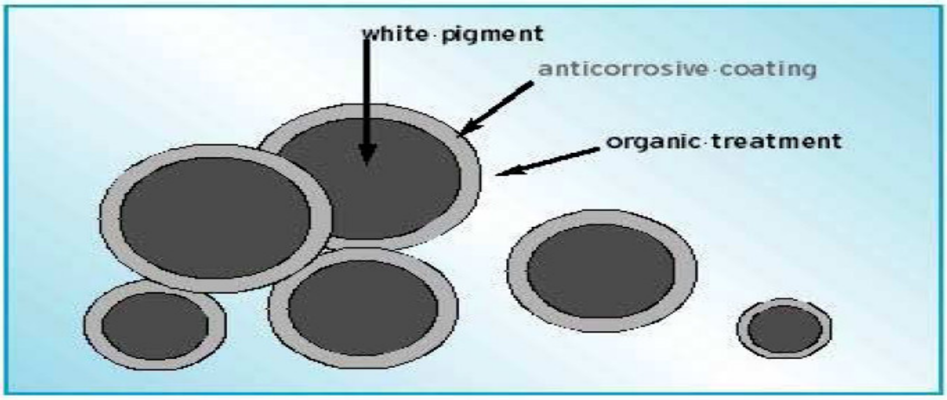

Fig. no. 1: Structural concept of the white anticorrosive pigment Hombicor

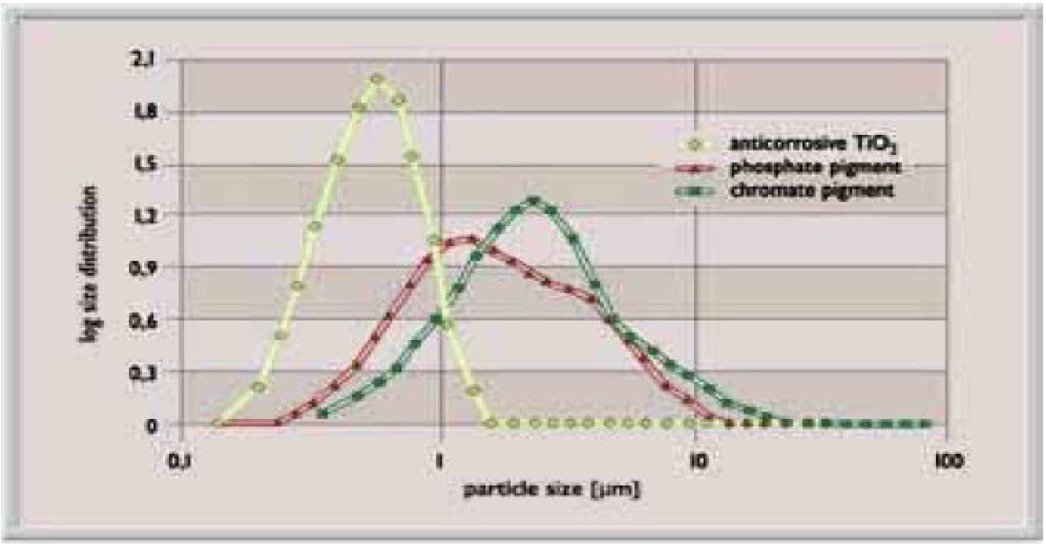

Fig. no. 2: Particle size distributions of different anticorrosive pigments

All experimental conditions for different waterborne and solventborne industrial coatings applications of anticorrosive TiO2 were supplied in the corresponding literature [4].

3. RESULTS AND DISCUSSIONS

3.1. Anticorrosive primers protect industrial coatings

The replacement of TiO2 and anticorrosive pigments at the same time by the new product is possible. Typical primer formulations contain anticorrosive pigments and often TiO2 too, in a pigment volume concentration (PVC) of about 6% to 10% each. As the hiding power of the anticorrosive TiO2 is equivalent to a rutile pigment and its anticorrosive properties are comparable to e. g. zinc phosphates the application of this material in different binder systems is recommended within the same range of PVC, too. As a consequence, the addition of pure TiO2 pigments can be omitted in for instance grey or whiten coloured formulations. Meanwhile, the protective properties of anticorrosive TiO2 were demonstrated in several solventborne and waterbased coatings.

3.2. Anticorrosive effect within solvent and waterborne systems
In the field of solventborne primers an alkyd system containing a PVC of 6% anticorrosive TiO2 exhibited comparable results during salt spray exposure to a mainly zinc phosphate based formulation [1]. The same was demonstrated in a 2K-PUR coating in a comparison to a calcium aluminium polyphosphate based pigment [3].

The new product is especially recommended for waterbased primers. In comparison to zinc phosphate considerably superior results were obtained using anticorrosive TiO2, both in a PVC of 10% [4]. Also an alkyd emulsion coating demonstrated the benefits of this product during salt spray tests [3]. The same holds for a waterborne epoxy primer series, where different anticorrosive pigments and inhibitors were tested. In this study a combination of anticorrosive TiO2 with "Shieldex AC 5, L1" and "Alcophor 827" lead to distinctively better performances [5].

3.3. Anticorrosive TiO2 stabilizes coatings against UV
The weather stability of the anticorrosive TiO2 was investigated also by artificial weathering in comparison to a durable rutile grade suitable for outdoor exposure. The paint which contained anticorrosive TiO2 showed a better gloss retention and also a distinctively lower chalking compared to the other TiO2 pigment. Thus, the surface coating applied for anticorrosive purposes on the carrier material provides at the same time a high durability. From that point of view this product is also very suitable for applications of direct UV radiation contact, i.e. benefits are given in one coat paintings, for instance in the "do it yourself" market or for back side coatings on coil coatings.

3.4. Coil Coatings: thin films with good adhesive properties
Coil coatings applications are very demanding because of their thin dry film thicknesses and their high technological demands. Therefore, it was questionable whether the concept of an inert carrier material with a relatively low concentration of an anticorrosive surface coating would be successful.

The mechanical data were investigated for all different metallic substrates. Both, the single cross cut test and also the combination of cross hatch with the adhesive tape test were evaluated as 1 for all different recipes and on all steel or aluminium plates, pretreated with or without chromate. Thus, the replacement of the anticorrosive pigments in the original guide formulations has no influence on the adhesive properties of the coil coating primers.

Thus, the flexibility was unchanged by the replacements in the formulations on different types of substrates despite of the chromate-free aluminium substrates.

3.5. Salt spray test: minor differences on steel plates
The anticorrosive properties of the different coatings were evaluated by salt spray test for the steel plates and by the CASS method for the aluminium plates. The strontium chromate containing primer (7) was not used for the test series with the completely chromate-free steel and aluminium plates. The cut edge corrosion values are only shortly discussed withoutn figures.

For the aluminium alloys greater differences occurred.

For the chromate-pretreated steel plates the results of the salt spray tests are illustrated in Figure no. 3.

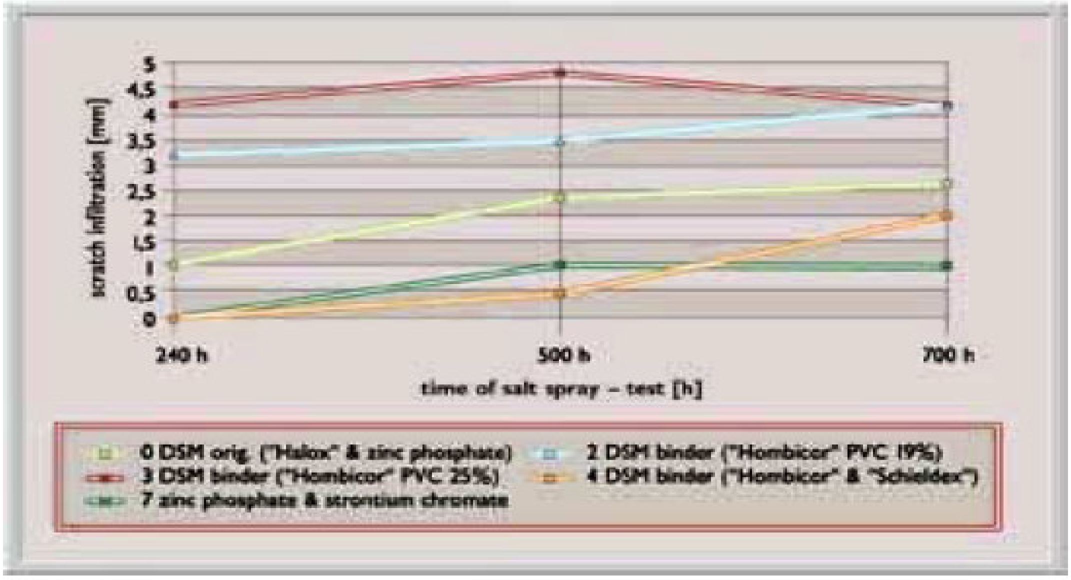

Fig. no. 3: Infiltration of chromate-pretreated steel panels upon salt spray test with different coil coating primers

The same formulations were tested on the chromate-pre-treated aluminium panels. After 750h of salt spray test an increased corrosion protection was observed by the substitution of the initial anticorrosive pigments by anticorrosive TiO2 only or in combination with ion exchange silica. With an increasing concentration of anticorrosive TiO2 from primer (2) to (3) the corrosion infiltration at the scratch decreased. With formulation (4) using anticorrosive TiO2 and ion exchange silica at the same time equal results could be achieved. These results obtained with coatings (3) and (4) were also comparable to the SrCrO4-containing formulation (7) as demonstrated in Figure no. 4.

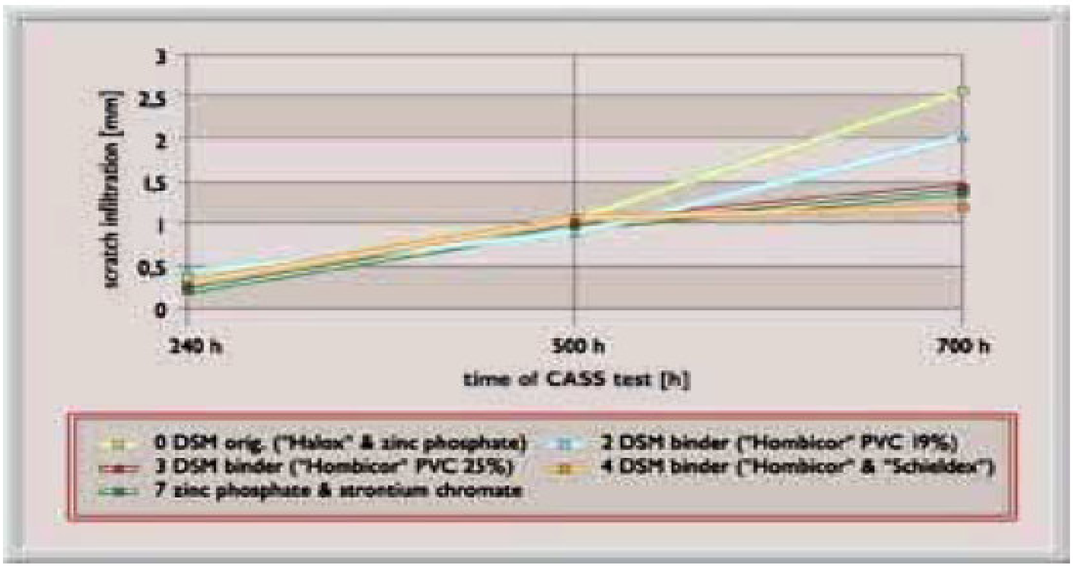

Fig. no. 4: Infiltration of chromate-pretreated aluminium panels upon CASS test with different coil coating primers

3.6. Optimising of anticorrosive effect on chromate-free metal panels is necessary

The completely chromate-free metal panels were investigated again by the series (0) to (4) replacing the pigments in the initial DSM formulation and by another chromate-free reference formulation (9) applying ion exchange silica and "Irgacor". The results from salt spray tests on steel panels are shown in Figure no. 5.

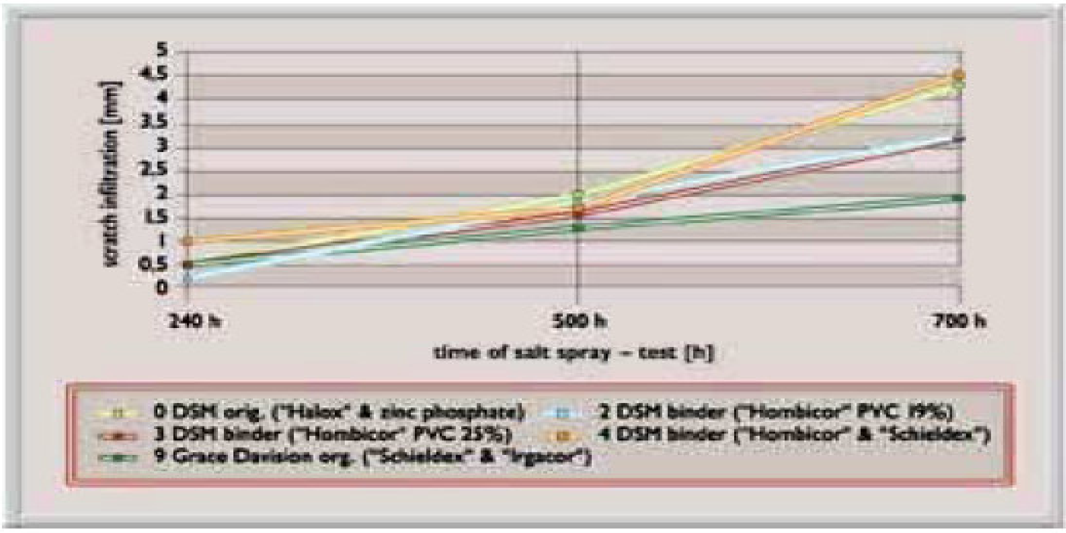

Fig. no. 5: Infiltration of chromate-free steel panels upon salt spray test with different coil coating primers

3.7. Adhesion on chromate-free

The results of the corresponding chromate-free aluminium plates are illustrated in
Figure no. 6. In general, the infiltration values on these chromate-free aluminium plates were significantly higher compared to the initial aluminium substrates. The lower corrosion protection might be due to the treatment of the panels themselves and/or on account of the reduced adhesion and flexibility as observed by the tests of the mechanical properties.

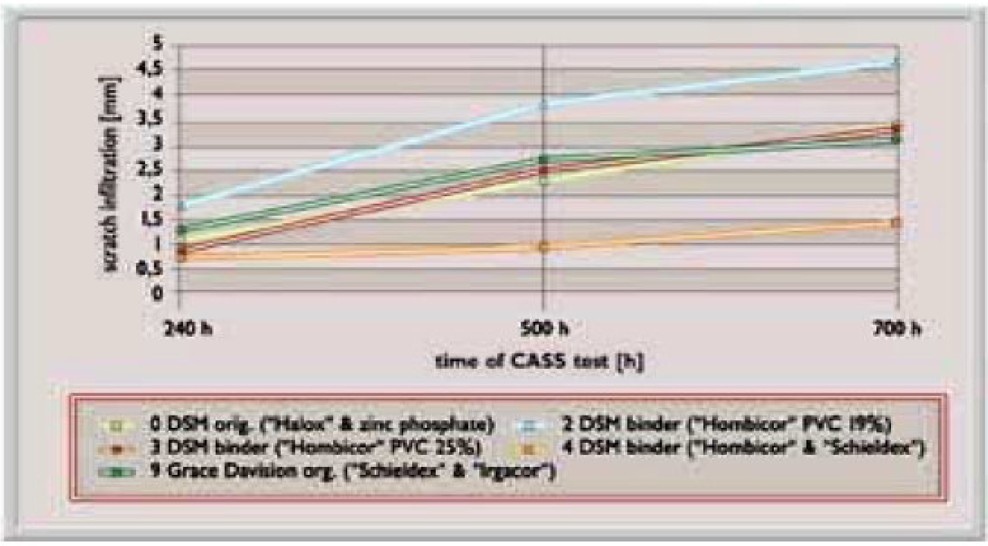

Fig. no. 6: Infiltration of chromate-free aluminium panels upon CASS test with different coil coating primers

4. CONCLUSIONS

Referring to the initial guide recipe (0) the substitution with anticorrosive TiO2 lead to comparable infiltration results in the formulation (3). However, a considerably increased corrosion protection was obtained with the pigment combination of ion exchange silica and anticorrosive TiO2 in (4). These findings were also significantly superior to the guide formulation (9).

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