New Products & Technologies

Thin Organic Composite Coated Steel Sheet with High Corrosion Resistance for Automobile Body Panel, "PLASCOAT® K V"*

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1 Introduction

Thin-layered organic composite-coated steel sheets, in which a chromate film and a 1 μm organic composite coating are applied to a Zn-Ni alloy-coated steel sheet, have already won wide acceptance from motor manufacturers in response to their needs for a corrosion-resistant outer panel material with both excellent formability and weldability.[1] Good corrosion resistance of coated steel sheets can be obtained by applying an organic composite film, a chromate film, and a Zn-Ni coating layer to a steel sheet. While a thicker organic composite film provides outstanding corrosion resistance, it may impede electric current flow, hence, reducing weldability. Therefore, the optimum coating thickness to maximize corrosion resistance and maintain weldability must be found.

Kawasaki Steel has investigated this problem and found a suitable organic resin for thin-layered organic composite coating. The application of this resin led the successful development of the thin-layered organic composite-coated steel sheet PLASCOAT® K V.

2 Coating Composition

A schematic cross section of PLASCOAT K V is shown in **Fig. 1**. It is composed of a non-rinsed type of chromate film (80 mg/m^2 of chromium) and a 1-μm organic composite film of silica and epoxy-based special hydrophilic organic resin over a Zn-Ni alloy coated steel (coating weight 20~30 g/m^2). Conventional organic composite-coated steel sheet such as Zincrometal® (ZM) and Zincrometal K II® (K II)[2] have electrically conductive Zn powders in the film. To improve the formability and weldability and to obtain a thinner coating, the metallic powder was excluded from PLASCOAT K V.

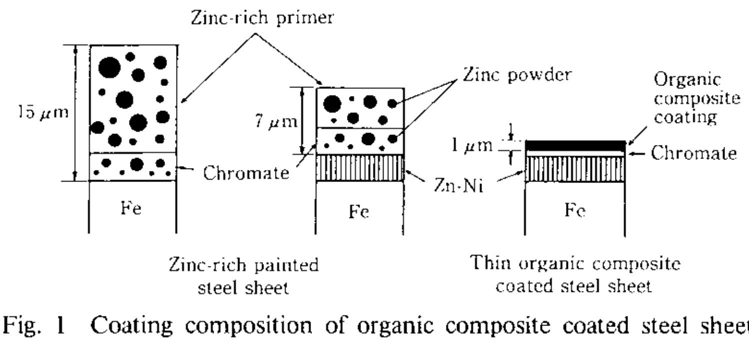

Fig. 1 Coating composition of organic composite coated steel sheet

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3 Corrosion Resistance

Figure 2 shows the unpainted corrosion resistance of a Zn-Ni alloy-coated steel sheet (EZN) and EZNs with various organic composite films. A cyclic corrosion test (CCT) was used for the evaluation of hydrophobic and hydrophilic resins with and without chromate. The corrosion resistance of the K V coated EZN was better than that of plain EZN. Throughout this study, it was also found that the corrosion resistance was better with hydrophilic resin B than with hydrophobic resin A.

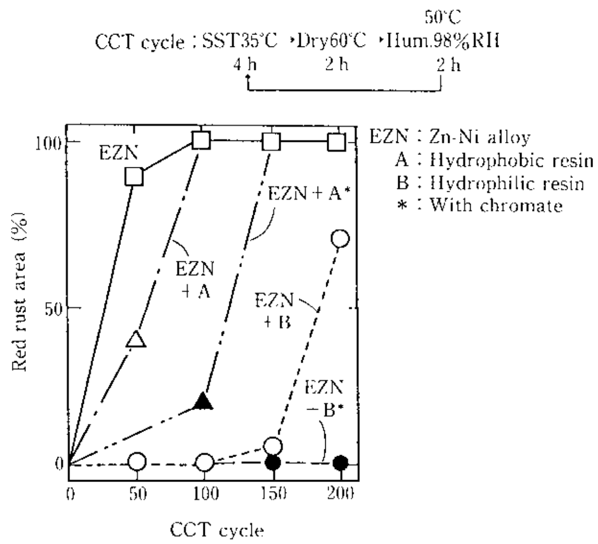

Fig. 2 Effects of resin type and chromating on the corrosion resistance of the organic composite coated steel sheet

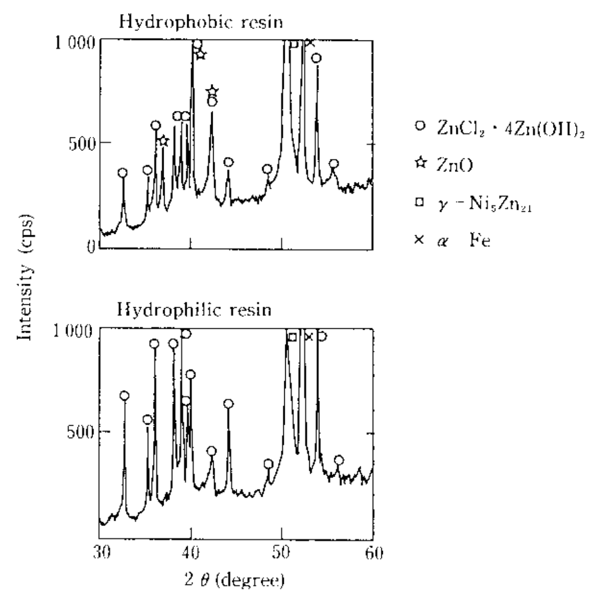

Fig. 3 X-ray diffraction patterns of organic composite coating steel sheets after 7 day-CCT (without chromating)

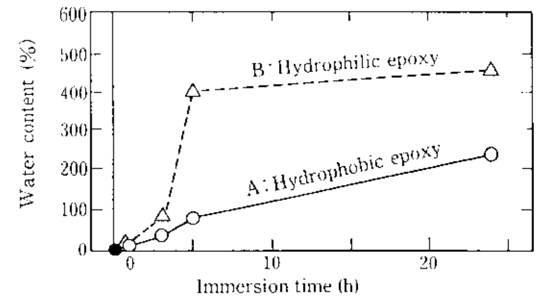

Fig. 4 Effect of resin type on water content of coating with immersion time

An X-ray diffraction analysis of EZN specimens coated with the hydrophobic and hydrophilic organic composite films was conducted after a 7-day CCT, the results being shown in **Fig. 3**. It was found that the type of corrosion product formed during CCT differed according to the type of resin used for the coating. Coating with hydrophobic resin A formed ZnO, which was less protective against further corrosion. However, coating with hydrophilic resin B formed only protective $ZnCl_2 \cdot 4\,Zn(OH)_2$, providing high corrosion resistance.

Figure 4 shows the results of a water adsorption test with the two types of resin. Hydrophilic resin B, which is used for PLASCOAT K V, shows greater water adsorption than hydrophobic resin A, which provides high corrosion resistance by restraining the formation of ZnO.[3)]

4 Electropaintability

When an organic composite-coated steel is used for an automobile panel, the organic composite film offers electric resistance during electropainting, which often brings about a poor appearance. Since most panels for automotive use are electropainted, this problem must be solved.

Figure 5 shows the electric resistance of EZN and

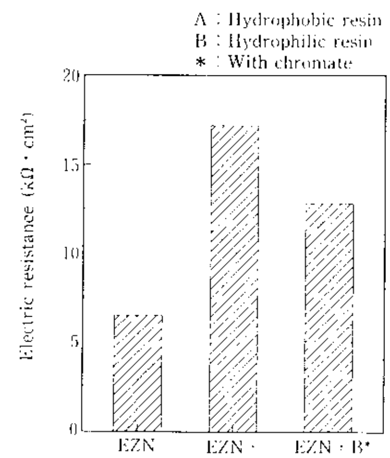

Fig. 5 Electric resistance at the initial stage of cationic electropainting

EZN with organic composite film coatings at the initial stage of electropainting. The electric resistance of the hydrophilic resin composite-coated EZN is three times that of the uncoated EZN. PLASCOAT K V with hydrophilic resin has a lower resistance which is about twice that of EZN. This means that the use of hydrophilic resin decreases the electric resistance during electropainting, which creates good electropaintability.

5 Other Characteristics

For automotive body panel use, an organic composite-coated steel sheet should not harm either the formability or weldability, and should also ensure good paint adhesion. No chromium dissolution should occur during the phosphating process, which is indispensable as a pretreatment before painting.

The test results for paint adhesion and Cr dissolution in the phosphating bath are summarized in **Table 1**, proving the good characteristics of PLASCOAT K V.

Figure 6 shows the result of evaluating the formability of EZN and various conventional organic composite-coated steel sheets. The peeling degree of PLASCOAT K V is smaller than that of the conventional organic composite-coated steel sheets. PLASCOAT K V also displays as good or better anti-powdering property than EZN.

Table 1 Characteristics of PLASCOAT K V

Item	Results
Cr dissolution in phosphating bath	None
Paint adhesion after 3 coat coating	
(a) Initial adhesion test (1-mm cross hatching→peeling off)	No peeling off
(b) Wet adhesion test (Hot water immersion(40°C × 240 h → 2-mm cross hatching→peeling off)	No peeling off

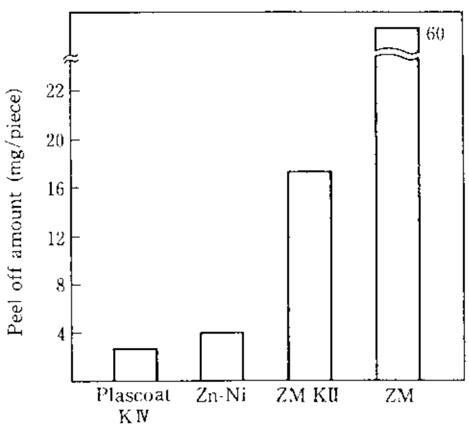

Fig. 6 Peeling off amount of various precoated steel sheets after cylindrical cup drawing

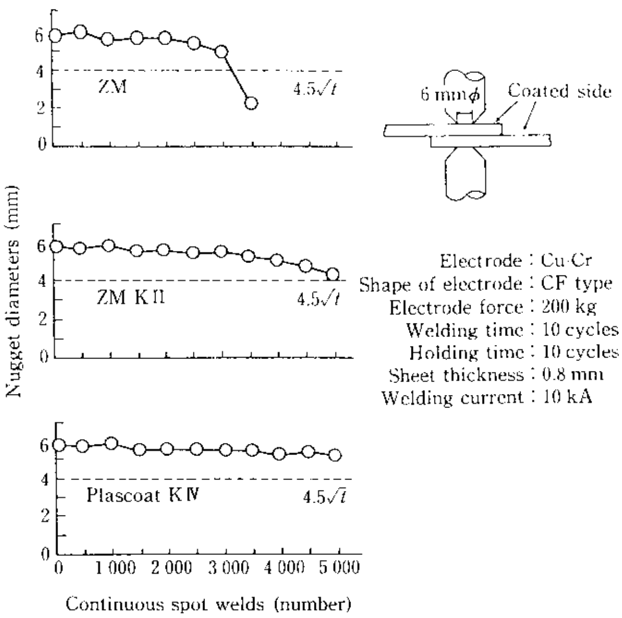

Fig. 7 Continuous spot weldabilities of Zincrometal, Zincrometal K II and PLASCOAT K V

Figure 7 shows the continuous spot weldability of various organic composite-coated steel sheets. Stable nuggets were obtained on PLASCOAT K V, even after 5 000 welds in the continuous spot welding test, which is much better than the weldability of both ZM and K II.

6 Concluding Remarks

PLASCOAT K V developed by Kawasaki Steel utilizes a thin-layer organic composite coating on Zn–Ni alloy-coated steel sheet. The organic resin in the composite film of PLASCOAT K V possesses hydrophilic properties which provide good corrosion resistance and electropaintability. The product also shows good performance as automotive panel in terms of formability and weldability. PLASCOAT K V has currently won wide acceptance from motor manufactures as an excellent coated product fully answerable to the severe customers' needs for quality and performance.

Reference

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2) S. Tsugawa, T. Mohri, S. Kobayashi, and T. Ichida: SAE Tech. Paper, 850004, (1985)
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