

Functional Pre-painted Steel and Galvanized Steel Products : “KIWAMI,” “OASYS,” “APPEAR-CLEAN,” and “GALFLEX” and Functional Galvanized Steel Product : “SANITA”[†]

1. Introduction

Recently, the demand for various functional products has grown in the steel sheet market for the construction of roofs and outer panels. JFE Galvanizing & Coating’s products have been used in various uses to meet the market needs requiring anti-bacterial and anti-mold properties (“PURE-CLEAN”), anti-static electrical performance (“CLEAN-ACE”), and anti-heat resistance (“BAKE-CLEAN”), etc. This article introduces the attractive products which have environmental features (“high reflection of infrared rays” and “infestation-blocks of cockroach”), aesthetic function (surface contamination resistance after rain), and durability during exposure (acid resistance, excellent color retention during exposure, good flexibility, and anti-scratch resistance).

2. Functional Pre-painted Steel Products of JFE Galvanizing & Coating

2.1 Environment-friendly Steel Products (Characteristics of High Reflection of Infrared Rays)

As global warming worsens, the need to reduce CO₂ emissions and electric power consumption is growing. Sunlight consists of approximately 50% infrared rays, which will be converted to thermal energy¹⁾ on the roof of houses or factories. This thermal energy will make the surface temperature of the roof rise, thus making the rooms in these houses or factories hotter. Highly reflective pre-painted steel products contain the special pigments in the painted layer, on which the infrared rays are more reflected and the amount of surface temperature upturn will reduce accompanied to less heat absorption, thereby the amount of heat going into the house inside through the steel sheets will be suppressed (Fig. 1). So in case of the high infrared rays reflective pre-painted steel sheets are used for roof, electric power consump-

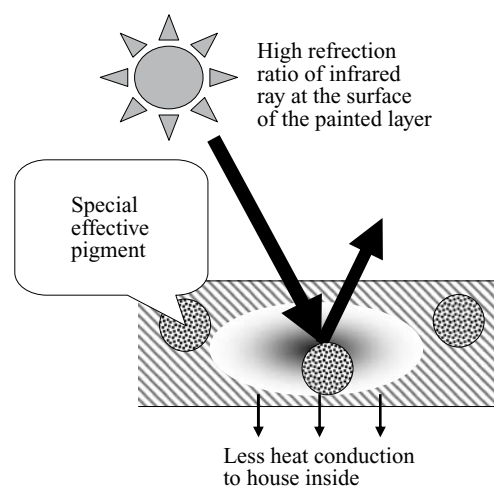


Fig. 1 Less heat conduction from the surface of the functional pre-painted steel

tion of the air conditioner is expected to reduce compared to the case of conventional pre-painted steel sheet.

In an exposure test conducted in summer, difference of temperature of inside of roof between 2 kinds of the gray-colored sheds made by pre-painted steel sheets (Type A: conventional pigment was involved in the painted layer, and Type B: “special effective pigment” was involved in the painted layer), temperature on the inside of roof of Type B was confirmed at the maximum 14°C below compared to the one of Type A. Different surface colored pre-painted steel sheet contained in the special pigment which highly reflects infrared rays, shows a different result on the degree of reduction in temperature compared to the conventional pre-painted steel sheet. For example, when black-colored was tested at the laboratory scale, the difference of temperature of inside of the steel sheets was approximately 20°C between conventional pre-painted steels and new-typed pre-painted steel sheets contained of the special pigment, which highly reflects infrared rays, in the painted layer.

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2.2 Aesthetic Function Products (Surface Contamination Resistance after Rain)

When pre-painted steel products are used for outer panels for a certain period of time, vertical streaks of dirt may appear on the surface. This is “contamination by rain” which occurs when particles of dirt remain on the surface of the panel and are NOT washed off by rainfall. The surface of conventional pre-painted steels has a water-repelling characteristic, and so surface of the panels is partly covered as raindrops, forming sphere-like and run off (in this case, contact angle with water is approx. 80–90°). On the other hand, the painted surface of new-type pre-painted steel products shows hydrophilic characteristics due to rain or moisture in the atmosphere (in this case, contact angle with water: less than 60° or equal). Consequently, contamination by rain is effectively suppressed. When the panels, made with both type of steel sheet above mentioned, were simulated under the partial rainfall condition at the outdoors of Chiba City for three months and their surfaces were observed, such pre-painted steel products with hydrophilic characteristics was found to greatly improve the visual aspect of their surface contamination by rain (Photo 1).

2.3 Long-life Characteristics

2.3.1 Acid resistance

When a strong acid such as sulfuric acid comes in contact with conventional pre-painted steels, the painted layer might be hydrolyzed and damaged. Recently, prob-



Conventional pre-painted steel New type of pre-painted steel

Photo 1 Surface appearance of the pre-painted steels after the exposure test (3 months at Chiba City)

lems of acid rain with SO_x gas as the result of industrial growth of the continent of China have been reported²⁾ to be carried to Japan by the wind crossing over national borders and made worse the situation. This problem might cause damage to pre-painted steel sheets used for roofs, etc.

JFE Galvanizing & Coating has developed and manufactured a series of pre-painted steel products with excellent acid resistance by incorporating a special polymer paint in the painted layer.

2.3.2 Excellent color retention during exposure

In conventional pre-painted steel sheets, the color and gloss of the surface usually fades and adhesion of the painted layer will deteriorate with time, due to the affect of ultraviolet rays involved mainly in the sunlight. Such color fading and gloss deterioration characteristics must be improved for the purpose to extend the life of pre-painted steel products. JFE Galvanizing & Coating has improved the color retention of pre-painted steel sheets during exposure by optimizing polymer ingredient used for the pre-painted layer (Fig. 2, color retention SWOM* 1 000 hours).

2.3.3 Scratch resistance

Conventional “TSUYAKESHI” (frosting) pre-painted steel sheets have better performance than “TSUYAARI”(gloss) pre-painted steel sheets in terms of less-scratched on the painted layer with the addi-

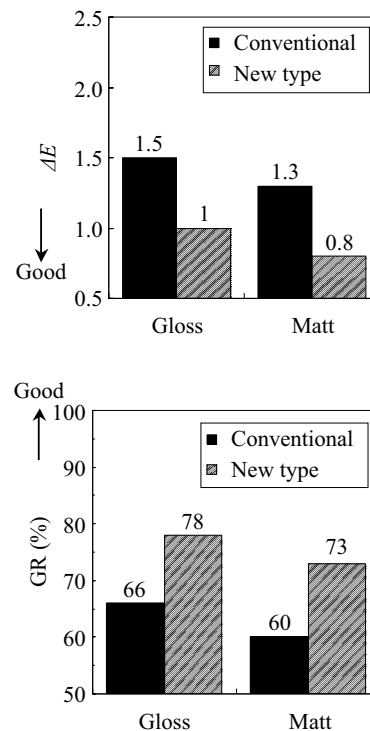


Fig. 2 Color retention after 1 000 hours exposure by SWOM

*SWOM : Sunshine WEATHER-OMETER®

Table 1 Functional pre-painted steel products

Type of painted layer	Products name	①	②	③	④
Polyester	JFE color GL Type-T	○			
	JFE color GL Type-A		○		
	APPEAR-CLEAN		○		
	JFE color GL New-TAISETSU	○		○	
	JFE color GL OASYS	○		○	
	JFE color GL KIWAMI	○		○	○
Fluoro-carbon polymer	JFE color F20GL Type-T	○		○	
	JFE color F20GL Type-A		○	○	
	JFE color GOKU-FULON GL	○		○	○

Reference:

- ①High reflection of infrared rays at the painted layer surface
- ②Cleaner surface appearance after rain
- ③Acid durability
- ④Anti-scratching

tional aggregate elements. To further improve their anti-scratch resistance, pre-painted steel sheets containing organic and inorganic aggregates in the pre-painted layer have been developed by JFE Galvanizing & Coating. A wear test using a rotating ring (JIS K 6902 (JIS: Japanese Industrial Standards) showed that this new product greatly reduced wear to 1/3 of that of conventional “TSUYAKESI”(frosting) pre-painted steel sheets.

Some examples of these pre-painted steel products of JFE Galvanizing & Coating which have high reflection of infrared rays, acid resistance, anti-scratch resistance and surface contamination resistance, are listed in **Table 1**.

2.3.4 Good flexibility

On the painted layer of pre-painted steel sheets with GL (Galvalum steel sheet)** as substrate, cracks, which may deteriorate the corrosion resistance sometimes originate from the coated layer after the sharp bending. For such kinds of use, JFE Galvanizing & Coating have improved the corrosion resistance at sharply bended part can be almost the same level as flat parts by softening the GL coated layer with the special treatment³⁾. This functional product is called as “GALFLEX” and provided correspondent to the customers’ request.

**GL : Galvalum (hot-dip 55% aluminum-zinc alloy coated steel sheet: called “GL” in this paper).

3. Functional Coated Steel Products by JFE Galvanizing & Coating

JFE Galvanizing & Coating has developed and started commercializing a new coated steel sheet named “SANITA” which make cockroaches NOT get at the once-approached portion.

Cockroaches have some learning ability touching something with their antennae or legs, taking into the mouth, and feeling discomfort if they touch and take particular substance into the mouth. Consequently, they tend NOT to get at the same place again. We incorporated this instinct into the zinc-coated steel product and named as “SANITA” which contains the chemical component (belonging to the pyrethroid group) that cockroaches find unpleasant in the chemical treatment layer. This pyrethroid group component consists of the outermost surface layer of the coated steel sheet and is stabilized by baking, so “SANITA” shows the excellent and long-termed “infestation-blocks of cockroaches” characteristics, which is estimated by “infestation-blocking ratio” and was more than 95% or equal through the various investigation test. When commercial spray goods for cockroaches are used, generally, typical effective period is estimated for only a few months at most because of the evaporation of active chemical component. On the other hand, “infestation-blocks of cockroaches” characteristics of “SANITA” is still effective after the accelerated tests (50°C and RH 75% for 8 months) and expected to keep for longer (**Fig. 3**). This test result after 8 months is said to be corresponding to the result ‘after 10 years at room temperature.’

“Infestation-blocking ratio” is defined as,
(Infestation-blocking ratio)

$$= (A - B)/(A + B) \times 100 (\%) \dots\dots\dots(1)$$

where,

A: Number of cockroaches swarming around a reference steel sheet,

B: Number of cockroaches swarming around SANITA.

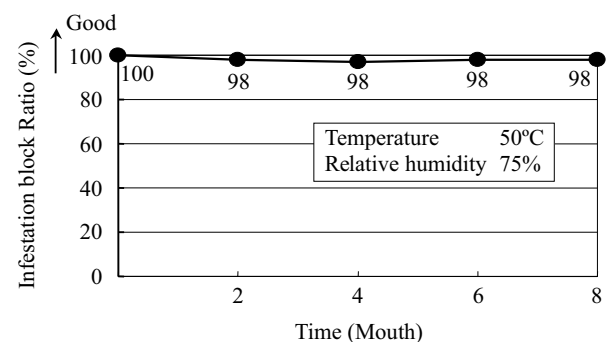


Fig.3 Infestation block ratio after the accelerated treatment

Regarding the safety for human of “SANITA”, we studied the LD50 value of “SANITA” with rats, and found it was ‘the same level as that of salt’.

4. Summary

Various functional pre-painted steel products and coated steel products manufactured by JFE Galvanizing & Coating were introduced.

In addition to “PURE-CLEAN” which has excellent anti-bacterial and anti-mold properties, “CLEAN-ACE” which has excellent anti-static electrical performance, and “BAKE-CLEAN” which has excellent heat resistance, we have commercialized the following series of pre-painted steel products:

- (1) “OASYS” and “New-TAISETSU” which have excellent high reflection of infrared rays, acid resistance, and color retention during exposure,
- (2) “KIWAMI” which has excellent high reflection of infrared rays, acid resistance, color retention during exposure, and scratch resistance,
- (3) “Type T” which has excellent high reflection of infrared rays,
- (4) “APPEAR-CLEAN” and “Type A” which have excellent surface contamination resistance after rain for aesthetic function,
- (5) “GALFLEX” which has good flexibility, and
- (6) “GOKU-FULON” which has a coating layer of fluoro-carbon polymer with high color retention, excellent high reflection of infrared rays, acid resistance and scratch resistance.

We also introduced coated steel products, including “SANITA” which has infestation-blocking performance (especially against cockroaches) by maintaining core functions such as corrosion resistance. Recently, we line-uped not only Galvanized steel sheet type but also Galvalium type, Pre-painted steel sheet type and Stainless steel sheet type.

JFE Galvanizing & Coating is going to manufacture and commercialize the products that meet customers’ needs of now and in the future.

Infestation-blocking steel sheet products, series of SANITA, were jointly developed and commercialized with Earth Chemical Co., Ltd. and Ishihara Chemical Co., Ltd. in Japan. We would like to mention to thank Earth Chemical Co., Ltd. and Ishihara Chemical Co., Ltd. for their lots of kindness and sincerity.

References:

- 1) Japan Metal Roofing Association. “Materials used for metal roofing and outer panels.” p. 124.
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- 3) NKK Technical Report. 2002, no. 176 , p. 102–103.

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