

Stainless Steel Flake Paint, PHOENIX*

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1 Introduction

For rust prevention under highly corrosive environmental conditions such as in seawater and tidal winds, paints that exceed the conventional heavy-duty coating paint in corrosion resistance and durability have been desired. One of these paints which have been developed to meet this need is the stainless steel flake paint called **PHOENIX**, which made its debut on the market with the press release in the latter part of June 1986. Its outline is introduced here.

2 Features of PHOENIX

The shape of the stainless steel flake is shown in Fig. 1. A schematic diagram of the coating-film cross section of the stainless steel flake paint and that of a general paint are shown in Figs. 2 and 3 respectively. Namely, through its stainless flakes laminated in the film, the stainless steel flake paint demonstrates corrosion resistance and weathering resistance superior to those of the conventional paint. Conventional heavy-duty coating paints which contain the so-called flaky pigments such as glass flakes are sold on the market and demonstrating their respective characteristics. However, stainless steel flakes, compared with these pigments, have the out-

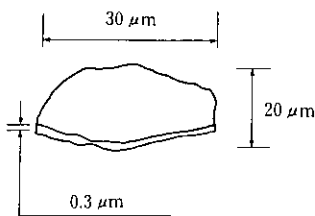


Fig. 1 Average size of a piece of stainless steel flakes

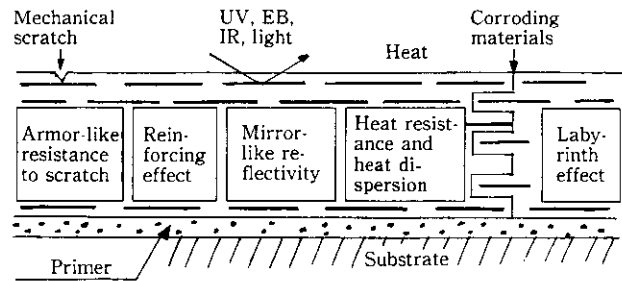


Fig. 2 Diagram of cross-sectional view of PHOENIX film

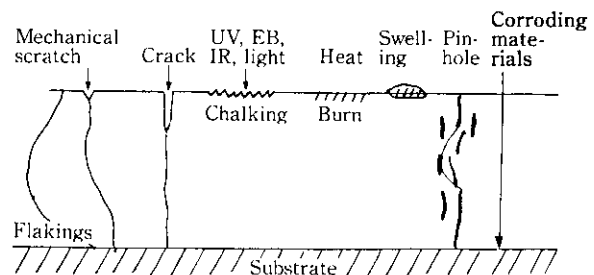


Fig. 3 Diagram of cross-sectional view of conventional paint film

standing features: (1) Thin shapes of the flakes give a greater labyrinth effect and (2) stainless steel flakes have better mechanical properties and durability.

The stainless steel flake paint PHOENIX naturally has the above-mentioned features of stainless steel flake paint, and also has several additional features. One of them is the special surface treatment^{1,2)} of the stainless steel flakes, whereby the wettability between the stainless steel and resin which was unsatisfactory in the past has been drastically improved, thereby successfully solidifying stainless steel flakes and resin. The cross section of the PHOENIX paint film is shown in Photo 1, which indicates neat lamination of stainless steel flakes.

Embodying such principles and techniques, PHOENIX demonstrates superior performance not only to conventional paints but also to existing stainless steel flake paints sold on the market. As an example, the

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Photo 1 Cross-sectional view of PHOENIX film

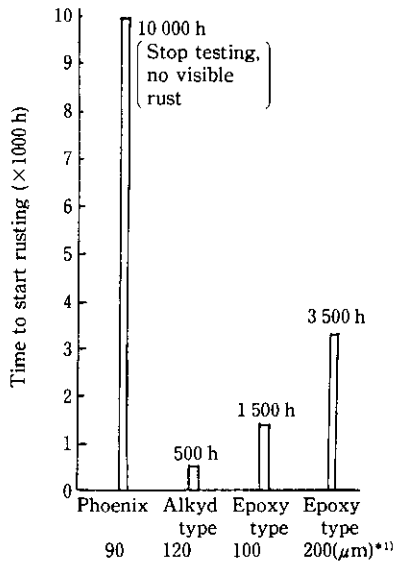


Fig. 4 Results of salt spray test on PHOENIX (epoxy and acrylic urethane type) and conventional paints (*¹Dry film thickness)

result of a salt spray test (a comparison in time until the paint film develops an anomaly such as a swelling) is shown in Fig. 4.

3 Types of PHOENIX

At present, PHOENIX comes in five types as shown in Table 1. All of them show excellent performance mentioned earlier, but it is true that the performance varies with the types of resins used. The field where PHOENIX arouses the greatest interest is the field of super-heavy-duty coating paint which exceeds the performance of the conventional heavy-duty coating paint. To such field, we recommend PHOENIX types E and AU, which use an epoxy resin and acrylpolyurethane resin, respectively. A field in which PHOENIX arouses interest, other than the field of heavy-duty coating, is a heat-resistant paint, and many inquiries come for PHOENIX type SC which uses a silicone resin as a base. This wide response may be an indication of dissatisfaction with the present heat-resistant paint, reflecting the diverse environment in which substrates are placed.

Table 1 Types of PHOENIX

Type	Resin	Application
E type	Epoxy resin	Heavy duty coating
AU type	Acrylic urethane resin	Heavy duty coating, weather resistance-coating
CR type	Chlorinated rubber	Anti-corrosive coating
PA type	Phthalic acid resin	General purpose coating
SC type	Silicon resin	Heat resistant coating

Therefore, when PHOENIX type SC is to be used, individual consultation with the user is usually held.

4 Standard Painting System

PHOENIX has excellent coating performance, and can prevent rust generation for a very long time, if it is coated on the rust-free surface of steel. However, it has no ability to reduce rust into iron, nor ability to prevent rust from growing with water and oxygen which the steel has already adsorped. Therefore, a good surface preparation before coating is essential.

PHOENIX contains stainless steel flakes having a large specific gravity and tends to precipitate. Therefore, it must be sufficiently stirred, and while maintaining such a state, must be carefully painted so that necessary thickness of a coated film of uniform composition must be deposited.

Such a procedure is necessary for general painting but in the case of painting with PHOENIX, a little more caution is required.³⁾ A typical example of standard coating system using PHOENIX types E and AU is given in Table 2. Example 1 is a silver finish using PHOENIX type AU. Compared with the silver finish using aluminum paint, the AU finish is slightly somber, and is evaluated to be subdued and deep. Example 2 is a color finish in which coloring is a "must" as is typical in the red-and-white aerial beacon on a smokestack. The finish coat in such a case is given by a paint not containing stainless steel flakes. There is no restriction on the types of the finish-coat paint. Any colored paint on the market

Table 2 Standard painting system of PHOENIX

	Example 1	Example 2
	Silver finish	Colour finish
Surface preparation	SIS 055900 Sa 2 and over	
Primer	E primer	E primer
Middle coat (1)	E type (1)	E type (1)
Middle coat (2)	E type (2)	E type (2)
Middle coat (3)	—	E type (3)
Finish coat	AU type	Kawakaron U

will do, but since the use of PHOENIX is expected to give the so-called "super-heavy-duty coating," we recommend, as a top-coat paint, the urethane resin paint, **KAWAKARON U**, which has excellent weathering resistance and corrosion resistance. If more weathering-resistance is required, a fluorine resin paint, **KAWAKARON FR** can be used.

All the above examples presuppose the surface preparation, for example, of Sa 2 and over in SIS 05 59 00 (Swedish standard for "Pictorial surface preparation standard for painting steel surfaces"), which completely removes rust, or presuppose the coating of the zinc-based shop primer. The following examples provide procedures to be used when the base metal has not been given such surface preparation.

The first procedure is the application of PHOENIX to galvanized steel. Galvanized steel is also widely used for heavy-duty coating. Under the rigorous environment such as in Okinawa, however, it is said that elution of zinc is significant. In such a case, the use of PHOENIX is conceivable for the purposes of repairing the galvanized steel or its protective film. Then we recommend **E Primer-Z** for PHOENIX, which has a good adhesive property to galvanized steel, instead of E primer, shown in examples 1 and 2.⁴⁾

The second procedure is recoating. In this case also, the Sa 2-and-over surface preparation by dry or wet sandblasting is desirable. However, there are cases in which sandblasting is impossible. In such cases, we provide **E primer-T** for PHOENIX which has a good adhesive property to the aged film and is applicable also to a rusty surface, instead of E primer shown in examples 1 and 2. For the aged film, any type of film is all right, but it must be one or two years old after coating. This aged film must be a "live" film, and the "dead" film which has lost the adhesive property, rust around the live film, and oil and dirt which adhere to the live film must naturally be completely removed. If their removal is insufficient or if the substrate under the live film consists of mill scales, the durability of PHOENIX will be significantly reduced. When rust is generated by the above-mentioned causes, it is necessary to carry out touch-up coating as early as possible like in the case of other paints.

Besides the above, various types of standard painting systems have been set up.³⁾

5 Applications of PHOENIX

Main applications of PHOENIX are shown in **Table 3**. These are fields which require so-called "heavy-duty coating." Applications of PHOENIX will bring about a great advantage by the prolongation of recoating cycles to facilities which require considerable shutdown time to execute recoating work, which require large-scale scaffolds, or which are highly-elevated or hazardous.

Table 3 Main application of PHOENIX

Industrial plants	Structures such as chemical plants and waste water treating facilities, general structures, and outside surfaces of pipings, tanks, smoke-stacks
Steel towers	Power transmission towers, radar towers, radio towers, lighting towers
Bridges	Road bridges, water-pipe bridges, railway bridges, pedestrians' bridges
Ships	Exposed decks, top parts of superstructures, cargo holds
Civil engineering and port facilities	Marine structures, sea-berth structures, aqueduct works, steel-pipe piles, steel sheet pilings
Buildings	Steel-skeleton structures, general buildings, roofs
Concrete structures	Water distribution basin, sedimentation basin, filtration basin
Others	General facilities under rigorously corrosive environment

Also, when energy saving and unmanned operation are set going in the future, applications of PHOENIX to major machinery and equipment under corrosive environment as well as small-sized machinery and equipment at site which will support these major ones are expected to obtain advantages of enhancement of dependability and lowering of the repair cost by long-term maintenance-free operation. In addition, the use of PHOENIX in applications requiring its long-term corrosion resistance is being expanded with the cooperation of users.

6 Actual Application Records of PHOENIX

The first event of actual equipment painting as the practical application test of PHOENIX was the partial coating of *303 unloader* at Chiba Works in 1983. Since then the coated areas, including about 1 500 m² of structures outside of the Company, have exceeded 6 000 m². Most coated areas belong to members which are in contact with seawater, equipment exposed to tidal winds, and facilities which are liable to be splashed with chemicals or to be in contact with their vapors, all of which require heavy-duty coating.

Major examples, within the premises of the Company, are the safety tower at Mizushima Works and Ashiya Training Center pool, *609 tank* at Chiba Works, and the company-flag and safety-flag hoisting poles at Kawatetsu Steel Tube Co., Ltd. Except the Training Center pool, all were given a silver finish. Examples out-

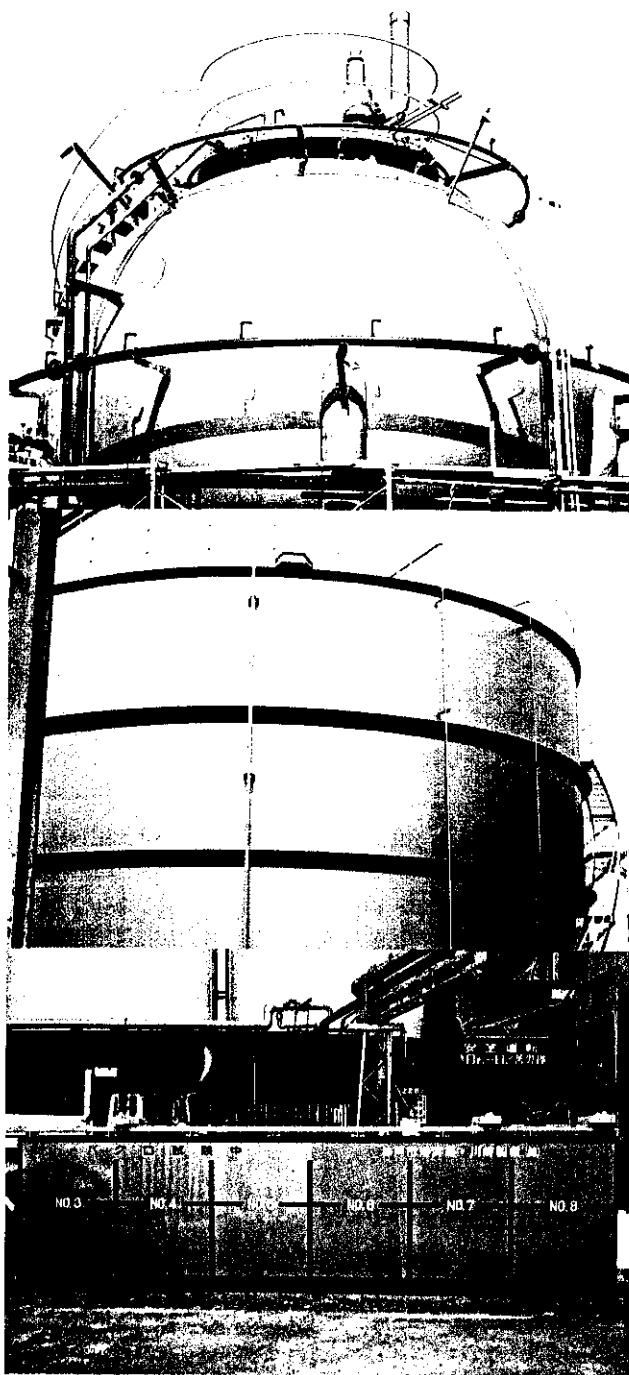


Photo 2 Examples of PHOENIX coating
Upper: 609 tank at Chiba Works
Middle: 403 tank at Chiba Works
Lower: Anti-tidal steel doors of the Port & Harbor Bureau of Kobe City Government

side the Company include anti-tidal steel doors, power receiving cubicles both at No. 4 Jetty and at Suma of the Port & Harbor Bureau of Kobe City Government, DOP tank top plate of Chisso Petrochemical Co., and tanks at Kizugawa Oil Terminal of C. Itoh & Co. Example in the overseas country is foundation piles for the plant in Algeria constructed by Nikki Co., Ltd. A few of these examples are shown in **Photo 2**.

7 Concluding Remarks

PHOENIX demonstrates excellent characteristics which exceed those of conventional heavy-duty coating paints. Its coating does not require any method completely different from the one for conventional heavy-duty coating paints, and with a little caution, it will give excellent film performance.

References

- 1) Kawasaki Steel Corp.: Jpn. Kokai 61-228073
- 2) Kawasaki Steel Corp.: Jpn. Kokai 62-27436
- 3) "Kawasaki Steel Corp's Stainless Steel Flake Paint Phoenix", booklet printed by Kawasaki Steel Corp., Chemical Div., in Japanese, May (1986)
- 4) "Phoenix painting to galvanized steel", Technical report by Kawasaki Steel Corp., Chemical Div., in Japanese, October (1985)