"GALFLEX-COLOR"

Prepainted 55%Al-Zn Alloy Coated Steel Sheet with High Formability

1. Introduction

Higher durability and longer service life are increasingly required for construction materials in order to conserve resources and reduce maintenance work. Prepainted steel sheets are produced by applying polymer coatings on the substrates of zinc coated or Zn-Al alloy coated steel sheets and are widely used in the construction industry because of their excellent cost performance. In particular, prepainted steel sheets that use 55%Al-Zn alloy coated steel sheets as substrates exhibit excellent corrosion resistance, and their use is expanding in applications such as roofing and siding. However, the metal coatings of prepainted 55%Al-Zn alloy coated steel sheets are hard and as shown in **Fig.1**, tend to generate cracks at bent positions, which propagate to the upper paint films, degrade the surface appearance, and also induce corrosion. Due to this shortcoming, it is difficult to apply prepainted 55%Al-Zn alloy coated steel sheets at positions that are subjected to severe forming. NKK and NKK Steel Sheet & Strip Corporation planned to jointly develop and commercialize prepainted 55%Al-Zn alloy coated steel sheets that have excellent formability, to expand their range of application in the construction industry. By investigating metal coatings and paint films that affect formability, a unique technology was developed to obtain high formability. As a result, highly formable prepainted 55%Al-Zn alloy coated steel sheets were successfully developed and commercialized as "GALFLEX-COLOR". This paper outlines the development process.

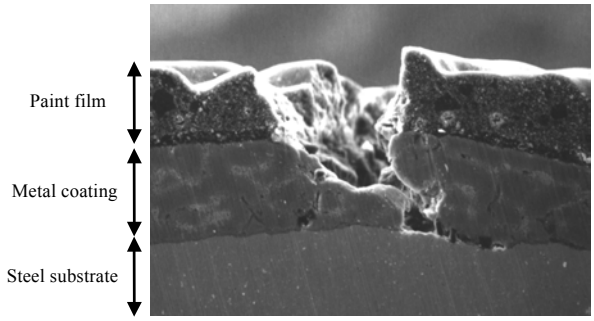


Fig.1 Cross section of a bent position of prepainted 55%Al-Zn alloy coated steel sheet

2. Approaches for obtaining formability

Three types of metal coated steel sheet are typically used as substrates of prepainted steel sheets: zinc coated steel sheets, 5%Al-Zn alloy coated steel sheets, and 55%Al-Zn alloy coated steel sheets. Zinc coated steel sheets and 5%Al-Zn alloy coated steel sheets provide higher formability, but less corrosion resistance, than 55%Al-Zn alloy coated steel sheets. "GALFLEX-COLOR" was developed to give high formability to 55%Al-Zn alloy coated steel sheets while maintaining their excellent corrosion resistance, as shown in **Fig.2**.

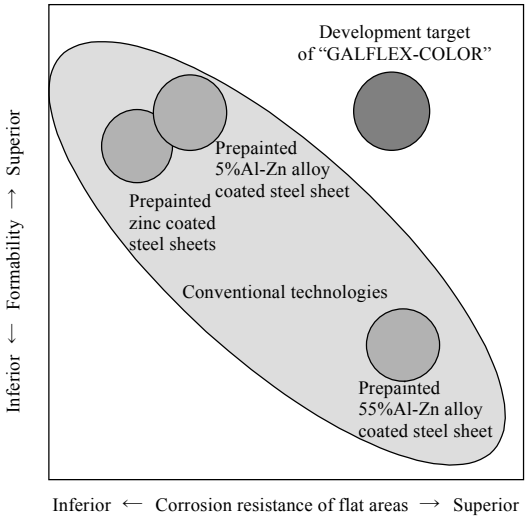


Fig.2 Position of "GALFLEX-COLOR"

The development concept of "GALFLEX-COLOR" is shown in **Fig.3**. High formability was successfully obtained in addition to excellent corrosion resistance inherent in 55%Al-Zn alloy coated steel sheets by giving both paint films and metal coatings higher formability than in conventional 55%Al-Zn alloy coated steel sheets.

Fig.4 compares the hardness of the metal coatings. The metal coating of "GALFLEX-COLOR" is softened to a level comparable to zinc coated steel sheets and 5%Al-Zn alloy coated steel sheets by structurally controlling the metal coating.

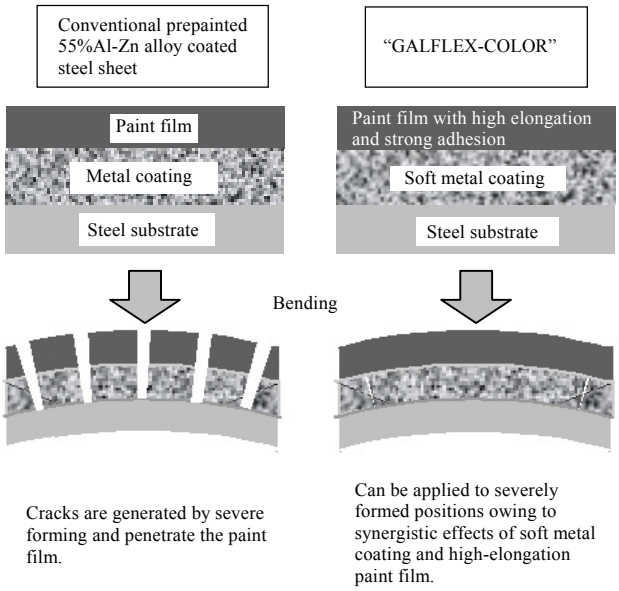


Fig.3 Development concept of "GALFLEX-COLOR"

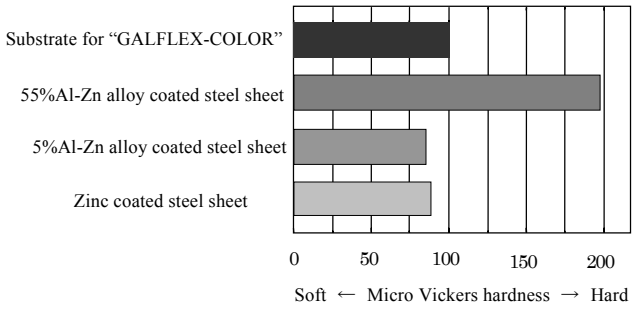


Fig.4 Comparison of hardness of metal coatings

Improving the formability of the paint film requires improving its elongation. In addition, strong adhesion between the paint film and underlying metal coating is essential for preventing surface damage such as scratch marks during or after forming processes. However, it is difficult to secure both high elongation and strong adhesion at the same time by conventional technology. By considering the polymer ingredients in the paint film, NKK developed a unique compound polymer, combining a polymer that is highly adhesive with another polymer that has excellent elongation. The company was thus successful for the first time in the world in improving the elongation of a paint film while maintaining its adhesion which is required for prepainted steel sheets used in the construction industry.

Fig.5 compares the surface appearances of bent positions of "GALFLEX-COLOR" and other types of prepainted steel sheet. Cracks generated by bending are markedly reduced in "GALFLEX-COLOR" compared with a conventional prepainted 55%Al-Zn alloy coated steel sheet. No cracks are generated in "GALFLEX-COLOR" by 3T bending, which is a higher level than for prepainted 5%Al-Zn alloy coated steel sheet, which up to now had been the most formable prepainted steel sheet used as a construction material. **Fig.6** shows the results of cyclic corrosion tests that were carried out to evaluate the corrosion resistance of bent positions of various prepainted steel sheets in a simulated atmospheric environment. "GALFLEX-COLOR" showed extremely small amounts of rust and blister formation at formed positions, verifying its excellent corrosion resistance at such positions. It has thus become possible to use highly corrosion resistant prepainted steel sheets in applications that require forming processes that are difficult to perform using conventional prepainted steel sheets due to limited formability.

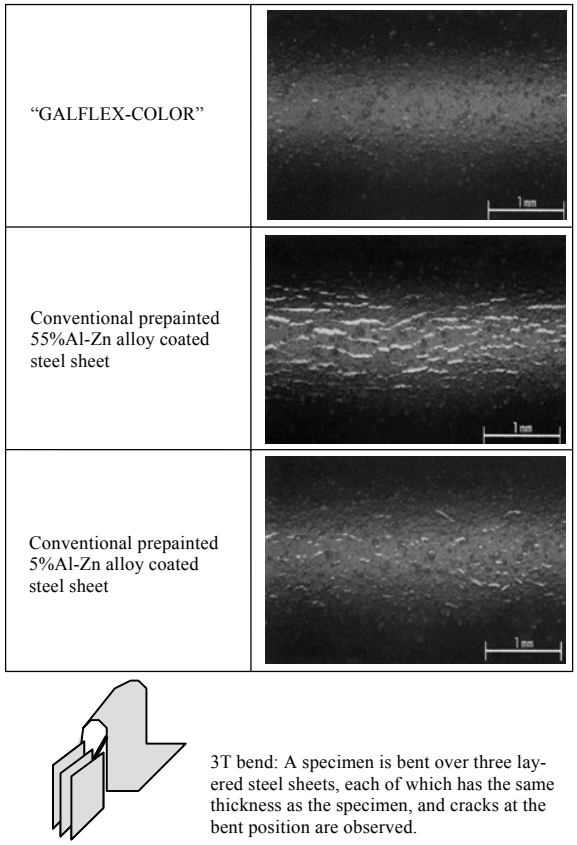
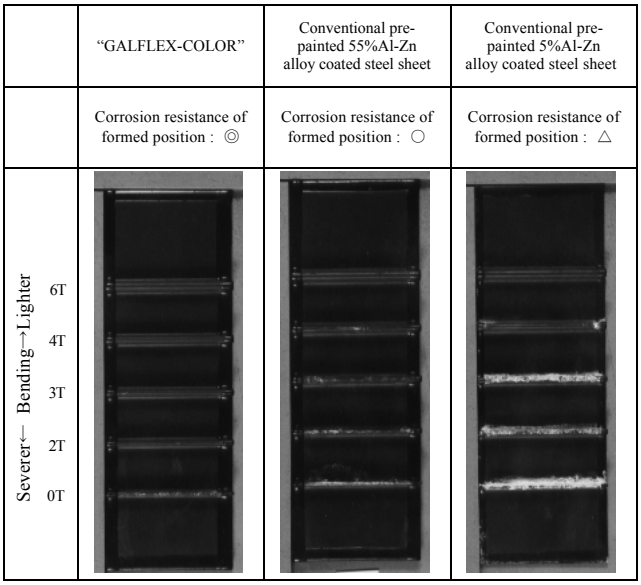


Fig.5 Close-up views of 3T bent positions

3. Conclusions

The commercial production of "GALFLEX-COLOR" was started in April 2001. This new product is highly regarded by customers as it has excellent corrosion resistance and formability, and also satisfies the requirements for longer service life and design versatility as a construction material.



The cycles defined by JIS K5621 were repeated 560 times, with one cycle taking 6 hours.

(Corrosion resistance)
◎: Extremely excellent, ○: Excellent, △: Slightly inferior

Fig.6 Appearance of bent positions after cyclic corrosion resistance tests

<Please refer to>
Keiji Yoshida
Coated Products Research Dept.,
Material & Processing Research Center, NKK
Tel : (81) 44-322-6150
E-mail : keiji@lab.keihin.nkk.co.jp
Toshiyuki Ohkuma
Construction Material Development Section,
NKK Steel Sheet & Strip Corporation
Tel : (81) 44-322-1138
E-mail : Toshiyuki_Okuma@ntsgw.keihin.nkk.co.jp