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Preparation and Performance Evaluation of High-temperature Formic Acid Corrosion Coatings on HT250 Cast iron Surface

Zhaoliang Liu

JiangSu Maritime Institute,Nanjing, Jiangsu 211199, China

Abstract: The purpose of this study was to investigate the preparation and performance evaluation of high-temperature formic acid corrosion coating on the surface of HT250 cast iron. First, the basic characteristics of HT250 cast iron and formic acid are introduced, and the corrosion mechanism in high temperature formic acid environment is expounded. Secondly, the classification, application and preparation of high temperature coating technology are summarized. Then, the preparation method of HT250 cast iron surface coating is discussed in detail, including surface treatment technology, selection and preparation of coating materials and optimization of process parameters. Then, how to evaluate the performance of the coating was discussed through the high temperature resistance test, formic acid corrosion test, microstructure and surface topography analysis.

Keywords: HT250 cast iron; High temperature coating; Formic acid corrosion, High temperature resistance; Coating preparation; Performance evaluation

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Introduction

As a common engineering material, HT250 cast iron often faces the test of corrosive media such as formic acid in high temperature environment. Formic acid corrosion will not only cause the surface of the material to lose luster, but also may cause serious structural damage, affecting the safety and reliability of engineering equipment. Therefore, improving the corrosion resistance of HT250 cast iron in high temperature formic acid environment has become an urgent problem to be solved.

In the process of solving this problem, high temperature coating technology as an effective surface modification method has attracted much attention. By forming a special coating on the surface of the material, the corrosion resistance of the material can be improved and its service life can be extended. Therefore, the purpose of this study is to explore the preparation and performance evaluation of high-temperature formic acid corrosion coating on the surface of HT250 cast iron, so as to provide a new solution for improving the stability of materials in high-temperature corrosion environment.

1. Characteristics and formic acid corrosion mechanism of HT250 cast iron

As a common engineering material, HT250 cast iron is widely used in various industrial fields. Its excellent mechanical properties and wear resistance make it an ideal choice for many engineering structures and equipment. However, when HT250 cast iron is exposed to high temperatures containing corrosive media such as formic acid, its corrosion resistance is challenged.

Formic acid is a common organic acid, which is strongly corrosive to metal materials at high temperatures. In the formic acid corrosion environment, chemical reactions may occur on the metal surface, resulting in corrosion and damage to the material. HT250 cast iron in such an environment is prone to surface corrosion, oxidation and structural damage, which affects its service life and performance stability.

It is important to understand the corrosion mechanism of HT250 cast iron in formic acid corrosion environment for formulating effective protective measures. On the one hand, the mechanism and rule of corrosion can be revealed through in-depth analysis of the interaction between formic acid and HT250 cast iron surface. On the other hand, the study of various corrosion products and intermediates produced in the corrosion process is helpful to find methods and materials to inhibit corrosion.

In the study of formic acid corrosion mechanism of HT250 cast iron, it is necessary to consider not only the influence of chemical reaction, but also the microstructure and crystal morphology of the material itself. In particular, the microstructure characteristics of cast iron, such as the proportion of ferrite and pearlite, grain size and grain boundary structure, may affect its stability and corrosion resistance in corrosive environments.

Therefore, in-depth study of the characteristics of HT250 cast iron and formic acid corrosion mechanism will help us better understand the behavior law of materials in high temperature corrosion environment, and provide important theoretical support for subsequent coating design and protection measures.

2. Preparation method of high-temperature resistant coating on HT250 cast iron surface

In order to improve the corrosion resistance of HT250 cast iron in high temperature formic acid corrosion environment, coating technology is widely used in surface modification. The coating can form a protective film that effectively isolates the contact between the material and the corrosive medium, thereby extending the service life of the material. In the preparation of HT250 cast iron surface coating, the common methods include thermal spraying, chemical vapor deposition (CVD), physical vapor deposition (PVD) and solution method.

2.1 Thermal spraying method:

Thermal spraying method is a commonly used surface coating method, by heating the coating material to a molten or semi-molten state, and then spray to the surface of the substrate to form a coating. Commonly used thermal spraying technologies include flame spraying, arc spraying and plasma spraying. These technologies can prepare coatings with different structures and properties, such as ceramic coatings, metal coatings and composite coatings, which are suitable for different engineering environments and requirements.

2.2 Chemical Vapor Deposition (CVD) :

Chemical vapor deposition is a method of deposition of chemicals in a gas on the surface of a substrate at high temperatures to form a coating. By controlling the reaction conditions and deposition parameters, a coating with good crystallization and densification can be prepared, with excellent high temperature resistance and chemical stability. However, the equipment of CVD technology is complicated, the cost is high, and the operation is difficult, which limits its popularization and application in engineering applications.

2.3 Physical Vapor deposition (PVD) :

Physical vapor deposition is a method that uses physical methods to deposit solid materials on the surface of the substrate to form a coating. Commonly used PVD technologies include vacuum evaporation, magnetron sputtering and laser pyrolysis. The coatings prepared by these technologies have high crystallinity and densification, excellent wear resistance and corrosion resistance, and are suitable for engineering fields with high requirements.

2.4 Solution method:

The solution method is a method by which a solution containing the coating material is coated on the surface of the substrate, and then the coating is formed by heat treatment or chemical reaction. The commonly used solution methods include hot impregnation, electrochemical deposition and spraying. These methods are simple, low cost and suitable for large area and complex shape substrate coating preparation.

To sum up, there are a variety of preparation methods for HT250 cast iron surface coating, and the appropriate method can be selected according to the specific requirements and application environment. In the process of coating preparation, it is necessary to consider the selection of coating materials, the optimization of process parameters and the regulation of coating structure and properties to achieve the best high temperature formic acid corrosion resistance.

3. Performance evaluation of HT250 cast iron surface coatings

To evaluate the performance of HT250 cast iron surface coating, it is necessary to consider both high temperature resistance and formic acid corrosion resistance.

3.1 Evaluation of high temperature resistance:

The stability of the coating in high temperature environment is one of the important indicators to evaluate its high temperature resistance. The structure stability and surface morphology of the coating were observed by placing the coating samples in a high

temperature furnace to simulate the high temperature conditions in the working environment. At the same time, thermogravimetric analysis and thermal cycle testing can be used to evaluate the mass loss and performance changes of the coating under high temperature conditions.

3.2 Evaluation of formic acid corrosion resistance:

In corrosive media containing formic acid, the corrosion resistance of the coating is one of its key properties. The corrosion resistance of the coating in formic acid corrosion environment was evaluated by accelerated corrosion test or simulated corrosion test under real working conditions. By observing the degree of corrosion on the surface of the coating, the corrosion products formed and the combination between the substrate and the coating, the corrosion resistance of the coating can be comprehensively evaluated.

Based on the above two evaluation results, the performance of HT250 cast iron surface coating in high temperature formic acid corrosion environment can be fully understood. In the evaluation process, factors such as the selection of coating materials, the optimization of the preparation process, and the regulation of the coating structure and performance can be combined to further improve the performance stability and durability of the coating to meet the needs of different engineering environments and application requirements.

Peroration

The preparation and performance evaluation of high temperature formic acid corrosion resistant coating on HT250 cast iron surface were studied in this paper. By analyzing the characteristics of HT250 cast iron and formic acid, the corrosion mechanism in formic acid corrosion environment was discussed. The classification, application and preparation method of high temperature coating technology are further introduced, and the preparation method of coating is mainly discussed, including surface treatment technology, selection and preparation of coating materials, and optimization of process parameters. The high temperature resistance and formic acid corrosion properties of the coating were tested and evaluated, and the influencing factors of the coating properties were investigated by analyzing the microstructure and surface morphology. Through the in-depth analysis of the corrosion mechanism of HT250 cast iron and formic acid, as well as the comprehensive application of high temperature coating technology, this study aims to provide a feasible coating technology scheme for the engineering field, and provide scientific basis for material design and engineering application. At the same time, the comprehensive evaluation of coating properties will provide useful guidance for future research and engineering practice. Through this study, we hope to provide a new perspective for the application of cast iron materials in high temperature formic acid environment, and contribute new ideas and methods to the research and engineering applications in related fields

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About the author:

Zhaoliang Liu, male (1990.01), Han nationality, native city of Hengshui, Hebei Province, Master, lecturer, research interests: Marine engineering technology, Marine diesel engine