Study on High Temperature Oxidation Behavior of Silicon-Containing Weathering Steel

C. Cemin
Universidade de Caxias do Sul, Brazil.

Abstract
Iron and steel materials are becoming more and more important in people's daily life. They are indispensable basic materials in industry. In industrial development and industrial system, iron and steel materials are the most commonly used materials in construction. The role of development is becoming more and more important. At present, steel industry has reached an advanced level in some fields, and weathering steel usually contains a lot of alloying elements, and silicon-containing weathering steel is one of them. When weathering steel is subjected to high temperature During oxidation, more complex oxidation behaviors will appear on the surface. When the weathering steel is oxidized, it means that the skin of the steel has defects, which greatly reduces the quality of the steel product. This article is to explore the high-temperature oxidation behavior of silicon-containing weathering steel, understand the mechanism of high-temperature iron oxide and propose corresponding treatment measures.

Keywords
Silicon-containing, weathering steel, high temperature oxidation

Introduction
At present, a lot of alloying elements are added to steel in steel manufacturing, and high temperature oxidation reactions will also occur in this process. During the oxidation process, the surface structure of weathering steel will be more complicated, and the oxidized steel after high temperature It has a great influence on the mass loss of steel [1]. Therefore, in order to achieve the required quality of steel and improve the core competitiveness and market competitiveness of enterprises, enterprises pay more and more attention to the research of silicon-containing weathering steel, and the high-temperature oxidation of silicon-oxygen-containing weathering steel in iron and steel enterprises is becoming more and more current, issues that need resolving [2]. In order to improve the quality of products, iron and steel enterprises must continue to carry out steel technology innovation, and conduct in-depth research on silicon-containing iron oxide, which is the focus of this article [3].

1. High temperature oxidation of weathering steel
Oxidation occurs on the surface of the metal. The surface of the metal contains some alloy elements. Under the influence of high temperature, an oxidation reaction occurs [4]. The most common high-temperature oxidation is the oxide formed by iron and oxygen. The reaction of this oxide is The reaction is faster at high temperature, and the oxidation is slower at room temperature. Therefore, the oxidation reaction of weathering steel will be more intense at high temperature. Through the research on weathering steel at high temperature, the oxidation of industrial production and life in reality can be analyzed Behavioral detection to solve the problems caused by high-temperature oxidation, thereby improving the surface quality of silicon-containing weathering steel products, thereby reducing the waste of steel resources due to high-temperature oxidation [5]. The role of silicon is to improve the oxidation resistance of the surface of the iron sheet, by adding a small amount of silicon to
increase the oxidation resistance of steel, thereby reducing the waste of steel. The function of containing silicon is to reduce the oxidation reaction between the body and the oxide layer, and have a certain protective effect on the body. When the silicon content reaches 0.15%, a silicon layer is formed during high temperature oxidation [6]. Through research, it is found that the surface layer of weathering steel is composed of ferric oxide, ferric oxide, etc. By adding a large amount of silicon, the oxidation reaction of the silicon-containing surface layer will be greatly reduced. However, ferric oxide has a high effect on scale and can improve the passivation of steel. Steels with a higher silicon content will have an inner oxide layer [7].

The formation process of the weathering steel oxide layer is rich in oxygen at the initial stage of oxidation. After the formation of the remote outer iron sheet of the weathering steel, the oxidation will enter the body. During this process, oxygen and silicon will form silicon oxide. During the process, a certain amount of silicon oxide layer will be consumed to stop the growth of the oxide layer. However, after a period of time, the increase of iron ions in the outer layer of weathering steel will continue to increase the oxidation rate of weathering steel. During this process, the oxidation of the outer layer will gradually increase, will always pass through the silicon-poor layer, and continue to oxidize to form an inner oxide layer. At this time, the high-temperature oxidation of weathering steel will continue to repeat.

2. Research content of high temperature oxidation of silicon-containing weathering steel

This article uses steel as the main material to explore the influence of high temperature oxidation temperature, time and environmental behavior on oxidation. It is necessary to conduct in-depth research on oxidation, explore its oxidation kinetics and the evolution of the structure and composition of weathering steel the law. It is necessary to conduct further in-depth exploration of silicon-containing weathering steel, understand the problems of the intermediate billet of weathering steel with red oxidation and the surface layer of weathering steel without red oxidation, conduct a systematic analysis, and change the quality of the surface layer of weathering steel through an in-depth understanding of weathering steel and propose corrective measures.

3. Measures to improve the surface layer of weathering steel

First of all, what needs to be done is to analyze and understand weathering steel according to the different environments of weathering steel. To understand the environment of weathering steel, such as 5% oxygen plus 95% nitrogen, 15% oxygen plus 85% nitrogen, 31% oxygen plus 69% nitrogen and a series of environmental factors such as volume fraction. Stand for an oxidation temperature of 500 to 1 thousand, and an oxidation time of 3 to 5 hours. Secondly, according to these different oxidation conditions, the oxidation measurement and oxidation analysis of silicon-containing weathering steel are carried out. Through the analysis of the oxidation environment, the corresponding oxidation activation ability is obtained, so as to establish the oxidation kinetics model [8].

Select some oxidized samples and use corresponding oxidation observation tools to observe the oxidized samples, such as magnifying glass, electron microscope, etc., to understand the surface structure of weathering steel through the study of oxidized samples, and observe and analyze the oxidized surface of weathering steel. The effect of oxidation temperature, time, and environment on the surface of oxide scale is obtained, and then the high-temperature oxidation is deeply explored.

Analyze the surface layer of weathering steel with red oxide scale and the surface layer without red oxide scale, use X-ray and other tools that can explore the oxide scale, study the surface defects of weathering steel, and obtain the red oxide scale and weathering steel. The formation mechanism of oxide surface oxidation, thus providing strategies for reducing defects in red weathering steel surface.

4. The surface layer of weathering steel does not produce red oxidation removal measures

Through the understanding of weathering steel, the oxidized surface layer that does not produce red is discussed. Weathering steel containing silicon plays an important role in anti-oxidation. When weathering steel is in a high temperature environment, it will form olivine. Its melting point Higher, the melted ferrosilicon tetroxide will gradually penetrate into the surface of the weathering steel, which will make it difficult to remove the oxidation on the surface of the weathering steel, and the remaining oxide scale will continue to penetrate deep into the weathering steel at high temperature. In this way, the weathering steel and oxygen will be fully based again, so that the material on the surface of the weathering steel will be converted into ferric oxide. Through in-depth analysis of ferric silicon tetroxide, it is known that red oxidation and no redness appear on the surface of weathering steel cause of oxidation. The penetration degree of ferrosilicon tetroxide is closely related to the high temperature time, temperature and environment. When the silicon content is greater than 0.2, red defects will appear on the surface of the weathering steel, and the silicon content of different steel types will appear. The space for their adjustment is It cannot be controlled, so the most effective way is to reduce the oxygen content in the furnace, and the temperature in the furnace reaches above 1100 degrees. Through high temperature oxidation and silicon content control, the oxidation behavior of the surface
layer of weathering steel can be reduced and weakened. It is also necessary to control the tempering time and tempering temperature of the weathering steel. Although the silicon content can remove the surface oxidation of the weathering steel, for some scale-containing steels, it is necessary to use advanced technology to remove the scale content, so that after high temperature, only then can the degree of oxidation on the steel surface be reduced [9].

Various elements are used to selectively oxidize. The properties of each element are different. Adding silicon can reduce the oxidation of the surface layer of weathering steel. Using various elements to oxidize the alloy, the oxidation is divided into two types, one is that red oxidation occurs, and the other is that red oxidation does not appear, so different elements should be added according to different situations to reduce the degree of oxidation, thereby improving the quality of steel and providing better services for industrial development. To control the red color of weathering steel. Oxidation defects, mainly control the penetration of the grid to reduce the degree of oxidation, and make corresponding control adjustments for the combustion and smelting, the oxygen content in the steel furnace and the heating area, according to various experimental data and the properties of related elements. Carry out high-temperature oxidation control, so that the silicon element can be truly integrated into the weathering steel, and the quality of the steel can be improved. In this regard, when enterprises carry out industrial production, they should combine the two according to the characteristics of steel and trace elements, and carry out different methods of oxidation prevention and control measures for the high temperature oxidation of two different types of weathering steel. So as to produce higher quality steel materials for enterprises, reduce the waste of steel, increase the efficiency of steel use, and promote the healthy development of iron and steel enterprises [10].

Conclusion:

This article mainly focuses on the oxidation of weather-resistant steel. By oxidizing weather-resistant steel under high temperature conditions, it can be concluded that adding an appropriate amount of trace elements can change the oxidation reaction on the surface of the rear bumper, thereby improving the weather resistance. Control the oxidation of the steel surface, reduce the common form of oxidation reaction, provide a theoretical basis for reducing oxidation, avoid the waste of steel resources, and improve the quality and output of steel. To master the purpose of this research, first of all, it is to analyze the principle of oxidation, master the principle of oxidation of weathering steel, and provide an important theoretical basis for controlling the reaction of oxidized steel to reduce the oxidation of the surface of weathering steel. The other is to control the surrounding environment, time and temperature of the weathering steel, so as to obtain the reason for the surface oxidation of the weathering steel under the influence of these external forces, and find a solution through the cause. The last purpose is to analyze the surface layer of weathering steel with red oxidation and without red oxidation. At the same time, different methods are used to deal with these two surface oxidations. For red oxidation, some silicon elements need to be added, and there is no red oxidation. It is necessary to reduce the addition of some other elements to provide more convenient measures for reducing these two oxidations.

References

[9] Stoecker A, Leuning N, Hameyer K, et al. Correlating magnetic properties of ferritic NO electrical steel containing 2.4 m.% Si with hot