

Analysis of production process of low hydrogen electrode

Hao Li

Sichuan Xiye New Materials Co., Ltd., Chengdu, Sichuan 611700, China

Abstract

The common defects in the production of low hydrogen electrode are put forward, and the main factors affecting the production process of low hydrogen electrode, such as the surface quality control, the characteristics of the powder, the binder in the electrode skin, the control of water glass, powder mixing and baking, are discussed. The reasonable production process parameters are used for the production of large specifications and low hydrogen welding electrode, which solves the problems of easy cracking, low yield, high energy consumption and large consumption, and the production process fully meets the requirements of large-scale production.

Keywords

Low hydrogen electrode, defects, production process, influencing factors.

1. Preface

With the development of welding materials at home and abroad, the electrode proportion in gradually reduced, in the Chinese market electrode proportion for a long time will still occupy a large share, currently in low hydrogen electrode, refractory brittle heat resistant steel electrode, urea grade stainless steel electrode, large line energy high toughness low hydrogen electrode, super austenitic stainless steel electrode, high temperature heat resistant stainless steel electrode field, there is still a lot of market development space, therefore, for special electrode manufacturing process still has great application research value[1].

Due to the diversity of special electrode production, many articles are studied from different angles. The production process of high alloy wear-resistant reactor welding electrode was discussed in document [2]. The effect of water glass on electrode quality control was studied in literature [3]. Literature [4] explores the online monitoring and automatic control device. This paper will study the impact of low hydrogen electrode coating.

2. Common defects in low hydrogen electrode production

Common defects of low hydrogen welding rod include: eccentricity, drug skin shedding, hair strip, abrasion, compression, drug skin cracking, impurities, Baotou, broken head, welding rod bending, indentation, welding core and drug skin exceeding size exceeds, bamboo joints, grinding tail unclean, foaming, etc

There are many reasons for the defects in electrode production, which can be generally divided into the following situations:

Caused by improper operation control in coating equipment and production: eccentric, hair strip, abrasion, crushing, Baotou, broken head, indentation, welding core and drug skin size exceeding the standard, bamboo joints, unnet grinding tail, welding rod bending, etc.

Raw materials and binder caused by: drug peel peeling, drug skin cracking, drug skin impurities, eccentric instability, welding rod foaming, etc.

Caby improper setting of baking process parameters: skin cracking, rod color difference, skin strength difference, core rust, etc.

Other factors, including the uneven powder caused by unreasonable powder mixing process setting, drug skin dry powder impurities, drug skin cracking caused by unreasonable formula design, poor drug skin coating pressure, etc.

3. Main factors affecting the process of low hydrogen welding electrode

Low hydrogen electrodes are usually produced by oil pressure machine. There are many factors affecting the coating quality and yield of low hydrogen electrode products in the appearance quality. The following aspects are discussed from the welding core, powder material, binder, powder mixing process, and baking process.

3.1. Influence of welding core

According to the different varieties of welding core produced by electric electrode will have different materials of welding core, including stainless steel, low carbon steel, nickel-based alloy, copper alloy, etc. Different kinds of welding core strength and hardness and thermal expansion coefficient differences have a great impact on the coating of the electrode. The strength and hardness of stainless steel, low carbon steel welding core is conducive to the coating of wire feeder wire delivery pressure is easy to press, nickel-based alloy, copper alloy welding core is soft, is not conducive to wire delivery, will make the electrode coating pressure is not too smooth. In addition, the thermal expansion coefficient of stainless steel welding core, nickel-based alloy and copper alloy is higher, which is very different from the thermal expansion rate of the pharmaceutical skin, and it is easier to produce the pharmaceutical skin cracks when baking at high temperature. The production of low hydrogen electrode usually uses low carbon steel welding core, making the electrode medicine skin less inclined to crack.

For the low hydrogen welding electrode, the oil stain, rust spot (yellow and black spot) and surface finish have a great impact on the coating properties of the welding electrode. Core pull need to pull powder lubrication, but if the core after pulling surface oil overweight will make the skin and the core between a layer of oil film, is not conducive to the skin coating on the core, also will be in the subsequent baking skin crack, if the surface of the core rust will affect the subsequent storage and use of the electrode, surface finish on coating wire smooth influence is larger. Usually, the drawing of the low hydrogen welding electrode core should be used as far as possible. Before the coating, the surface quality of the welding core should be carefully checked. For the welding core with excessive oil pollution and more rust spots, the cleaning, rolling washing and sand blowing methods should be used to treat the surface of the welding core before coating production.

3.2. Impact of powder material

In welding, in order to achieve slag production, gas production, excessive alloy, protective melting tank and other purposes, the electrode medicine skin is composed of minerals, alloy powder, binder, etc., the characteristics of the powder have a great impact on the coating of the electrode. Marble, fluorite, quartz, ferroalloy and other poor viscoplastic powder is not conducive to the electrode pressure coating, titanium dioxide, clay, mica and other viscoplastic and elastic powder can improve the drug skin pressure coating. Sodium fluorosilicate (potassium), tungsten powder and other easy to heat, fast drying powder is not conducive to pressure coating. Iron silicon, iron manganese, iron titanium and other surface active powder is easy to react with water glass and bubble, the passivation treatment needs before use, some atomization process can not be improved after the passivation. Passivation is usually dry and wet.

The granularity combination of the powder has a great influence on the coating performance of the welding rod. The appropriate particle combination makes the powder have good fluidity, air permeability and plastic toughness, which is conducive to the coating pressure of the

welding rod. The powder with good coating performance has the following characteristics: with a certain viscose plasticity, elasticity, air permeability, suitable slip and granularity combination.

3.3. Effect of binder

Binder in powder plays an important role in the pressure of electrode, usually of the following types:

Powder ders adhesive bonding in the skin:

Can increase the plasticity, elasticity, lubrication of the skin, this kind of powder has the dual effect of improving the welding performance and improving the coating performance of the electrode, such as titanium dioxide, white mud, mica, talc, bamboo powder, wood powder, cellulose, bleite and so on.

Powder added to improve coating:

This kind of material can significantly increase the viscoplasticity, elasticity, lubricity of the powder, mainly organic matter and chemical products, such as CMC, sodium alginate, calcium alginate, microcrystal fiber, soda ash, etc.

3.4. The Influence of water glass

Water glass, also known as bubble flower alkali, an alkali metal silicate, is the main binder in electrode manufacturing. The concentration and viscosity control of water glass in the manufacture of welding rod.

Parameters of the characteristics of the reaction water glass

Modulus: the ratio of silica to alkali metal oxide (molar ratio). At present, the commonly used water glass module is between 2.4 and 3.2, and the production of low hydrogen electrode uses more water glass module between 3.0 and 3.2.

Concentration: Usually expressed by Pomo. Temperature has a certain influence on the pombe. The higher the temperature, the lower the specific gravity, and the lower the pombe.

Viscosity: can be measured by viscosity meter, viscosity value is affected by modulus, concentration and temperature. The measurement method also has an influence on the viscosity value, including the selection of the rotor, the time of the measurement, and the reasonable measurement range is selected according to the torque size of the viscosimeter.

Some characteristics of water glass in the electrode press coating

The most suitable temperature for electrode suppression is 18~20°C. Spring and autumn is the most suitable season for electrode suppression. In order to improve the bonding of water glass in winter, the water glass can be heated to about 20°C before adding water glass. Sodium water glass bonding nature is better than potassium water glass, potassium water glass stability arc is better, according to the requirements of different types of welding rod can choose pure sodium, pure potassium, potassium and sodium mixed water glass, low hydrogen welding rod usually use 1:1 or 3:1 potassium and sodium mixed water glass is more.

Adverse reaction of water glass when pressing the electrode: Water glass will react with Mn and Si in the drug skin to produce part of silica and gas, which will make the powder bond worse, the drug skin foam, the reaction will accelerate the hardening of the powder is not conducive to the electrode pressure coating. It can be improved by the passivation of ferroalloy, or by adding an appropriate amount of potassium permanganate to the water glass to delay the reaction time of water glass and ferroalloy.

Water glass will also react with calcium oxide, barium oxide, magnesium oxide, so that its modulus decline, powder hardening loses elasticity, plasticity makes the powder pressure coating becomes worse.

3.5. Influence of powder mixing process

This thing is divided into two stages: dry powder and wet powder. Dry powder is to mix powder evenly, dry powder equipment including conical mixer, V mixer, planetary mixer (vertical), double S mixer (horizontal), grinding mixer, etc.; wet powder is added in evenly mixed powder water glass stirring to suitable coating state, wet mixing equipment including planetary mixer (vertical), double S mixer (horizontal), grinding mixer, etc. Different manufacturers use one or two combinations of dry powder mixer to mix.

The mixed powder should have a certain sticky plastic, elastic, slippery, non-stick hand. Usually low hydrogen welding rod is spherical particles, hand pinch up to feel elastic, toughness, non-stick hand. The appropriate wet mixing time and coating pressure of welding electrodes of different varieties and specifications are different, so we need to explore the appropriate powder mixing parameters in practice.

3.6. The Influence of the baking process

Welder rod baking equipment can be divided into box furnace, trolley furnace, chain furnace, etc., according to different baking stages can be divided into pre-drying furnace, low temperature furnace, high temperature furnace, etc. Welder baking can be divided into the following stages:

Pre-baking: usually the temperature is below 60-70°C, mainly to harden the electrode surface quickly, to avoid indentation and adhesion in subsequent baking. According to the different varieties of electrode production selection, some electrode production does not require pre-baking.

Low temperature baking: usually temperature 70-80°C, 100-120°C), baking more than 80-90% of the water in the electrode, slow heating and time-consuming.

High temperature baking: the general temperature is 250-300°C, 350-400°C, the electrode drying thoroughly, to make the electrode skin does not crack and maintain a certain skin strength. High moisture electrodes are not bake at high temperature.

Rebaking: the general temperature is 250-300°C, 350-400°C, drying the water absorbed in the process of storage and transportation, low hydrogen electrode, acid stainless steel electrodes need to be rebaking, high moisture electrode, moisture resistance, high packaging level can be stopped baking.

Characteristics of different types of electrode baking process

Cellulose type, ordinary welding rod: containing cellulose, bamboo powder, wood powder and other organic matter is more, belongs to the high moisture welding rod, the highest baking temperature in 150°C, 250°C below.

Low hydrogen welding electrode: the baking temperature in the high temperature stage is 350-400°C, and some ultra-low hydrogen welding electrode can reach 380-450°C;

Stainless steel electrode: acidic (titanium calcium type, rutile type) early baking temperature in 250-300°C, currently increased to 350-380°C; alkaline stainless steel electrode in 250-300°C.

Overacking electrode: contains more alloy powder, usually baking temperature of 280-300°C.

Common defects and causes in welding rod baking

Cracking: the low temperature baking time is too short, the heating speed is too fast, the oven temperature is too high, the water glass concentration is too low, too high, when the pressure medicine skin is too dry, the powder particles are too fine.

Bubbles: the low-temperature baking time is too short, the heating goes up too fast, the water glass concentration is too high, the drug skin is too wet, the pressure is too small, and the ferrous alloy passivation does not do well to react with the water glass.

Rusting: the drying air and moisture discharge parameters are not set.

Drug skin after moisture absorption: high water ordinary electrode is easy to produce, adsorption water is not fully dried.

Welder color difference, Yin and Yang surface: the temperature in the furnace is not uniform, the chain drying room is not good.

4. Trial production of low hydrogen and large specification electrode

Due to the large thickness of $\Phi 5.0$, our company has faced the problems of rod cracking, low yield, high production consumption and high energy consumption in the previous production. Through the improvement of production process, the low hydrogen electrode represented by J507 $\Phi 5.0$ improves the pressure coating greatly by taking the following measures.

Control the surface quality of the welding core, fully clear the rust on the surface of the plate element before pulling out, control the production of yellow and black spots, and use low oil pulling powder to reduce the amount of oil carried on the surface of the welding core.

The amount of CMC in the drug skin is increased appropriately to improve the adhesion of the drug skin, and mica is appropriately added to increase the elastic plasticity of the welding strip drug skin.

Using 1:1 potassium and sodium mixed water glass, find out the reasonable water glass concentration and addition amount, and control the coating pressure at 120~140MPa.

Using planetary powder mixer (vertical) for wet powder, wet powder time control in 8~12 minutes, too short time will make uneven mixing, too long will make the water glass and skin reaction and fever, resulting in the skin dry hard is not conducive to pressure coating.

It is appropriate to reduce the temperature of the low temperature stage and to control the high temperature baking temperature at 350°C.

The yield, energy consumption and material consumption of the trial-produced electrode can be greatly improved, and the improved production process fully meets the requirements of mass production.

5. Conclusion

By controlling the oil and rust spots on the surface of the core can improve the electrode pressure coating, adding titanium dioxide, mica and other raw materials can improve the powder plasticity and elasticity, avoid by alloy passion silicon, iron manganese and water glass reaction and foaming, appropriate add CMC, soda ash and other adhesives to improve powder viscosity, reasonable control the concentration and viscosity of water glass, and by the reasonable powder and baking process parameters can reduce the production of electrode defects in production. The yield, energy consumption and material consumption of the large specification and low hydrogen welding electrode have been greatly improved, which can meet the requirements of large-scale production.

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About the author: Li Hao (1975- -), male, master of engineering, senior engineer, mainly engaged in welding material development, production process management, product quality control and other work. E-mail: lihaoty@qq.com.