The Design of Fusion Bonded Epoxy Coating Device for Subsea Pipe Joint Coating

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Keywords: Subsea pipeline, Pipe, Laying, Anticorrosion, FBE, Joint coating.

Abstract. In order to meet the technical requirements of fusion bonded epoxy (FBE) powder anticorrosion technology for welding piping joint coating of subsea pipelines, to realize the FBE anticorrosion and connection during the laying of subsea pipelines, the design of FBE coating device for subsea pipe joint coating during pipeline laying is carried out. According to the construction technology requirements of FBE, the overall design of FBE coating device for subsea pipeline laying is carried out. The design points of spraying rotary frame, powder spraying room, powder spraying equipment and powder recovery equipment are described in detail. According to the design, the FBE coating device for subsea pipeline laying is completed.

Introduction

After the pipeline welding and derusting, the welding joints of the pipe ends should be joint coating during the construction of subsea pipelines. The anticorrosive coating formed by the FBE anticorrosion coating is excellent, and is compatible with the mainstream main pipeline coating (FBE, 3LPE, 3LPP coating) [1]. FBE coating has great advantages in avoiding cathodic protection shielding, reducing corrosion cost and improving laying efficiency.

In order to meet the requirements of FBE powder anticorrosion coating for welded joints in pipeline laying, and to realize the FBE anticorrosion joint coating work and large-scale application in pipe laying process, the design of FBE coating device for subsea pipeline laying has been carried out. Then it can further enhance the corrosion resistance and construction efficiency of the node coating, and enhance the safety and reliability of the operation of the offshore pipeline.

Overall Structure Design of the FBE Coating Device

In the cabin of the vessel, the FBE coating of the welded joint of the subsea pipeline belongs to the local closed small space operation. At the same time, according to the high cost of the pipeline laying, it is necessary to work as efficiently as possible in each stage of the pipe laying process so as to improve the efficiency of the whole pipe laying. For the design of the FBE coating equipment for the laying of the subsea pipeline, the equipment needs to realize the high efficiency and environmental spraying operation, and the non fused powder can be automatically recovered and separated to achieve the zero pollution to the environment.

According to the own characteristics of the FBE coating and the requirements for the application of the subsea pipeline laying to the welding joint coating [2-4], the design of the FBE coating device for the laying of the subsea pipeline is carried out. The designed FBE coating device for subsea pipeline laying is shown in Fig. 1. The FBE coating device for subsea pipeline laying mainly include spraying rotary frame, powder spraying room, powder spraying equipment, powder recovery equipment.
Design of Sprayed Rotating Frame

According to the expected function, the design of the spray rotating frame is shown in Fig. 2. The whole structure of the equipment adopts a straight U type structure, which can realize fast loading and disassembly of the sprayed rotating frame at the welding joint coating part of the pipe, and it is convenient for the equipment to take the position quickly[5,6]. The outer frame mechanism plays the role of overall positioning and supporting, and the two outer frame mechanisms are connected by rotating mechanisms.

The rotating mechanism is installed in the guide wheel slot of the outer frame mechanism. Through the drive motor on it, the rotation mechanism can be rotated around the central axis of the pipe by the gear meshing transmission, and the device can rotate around the center line of the pipe in 180 degrees. Then it realizes the function of rotating around the center line of the pipe.

Design of Powder Spraying Room

The design of the powder spraying room consists mainly of the inner box and the outer box[7], as shown in Fig. 3. The inner box provides nebulization space for FBE. A hollow interlayer is formed between the inner and outer boxes to form a dust recovery channel. A spray gun mounting hole is arranged symmetrically at the bottom of the inner and outer box, and a spray gun is installed. The bottom of the outer box is provided with two recovery air duct interfaces, which is beneficial to the recovery of the uniformity of the wind force in the recovery channel, and to ensure the recovery effect.

The powder spraying room is installed on the multi degree of freedom adjusting device of the powder spraying room[8]. The multi degree of freedom adjusting device of the powder spraying room is fixed on the guide rail of the rotary mechanism by bolts.

The multi degree of freedom adjustment device of the powder spraying room can drive straight reciprocating along the radial direction of the pipeline under the driving of the cylinder. The cylinder is equipped with a limit switch that can adjust the feed distance of the cylinder, which can precisely adjust the feed distance of the cylinder. A speed control valve is installed on the cylinder to regulate the feed speed of the cylinder and ensure the smoothness of the cylinder feed. Adopting cylinder feed control to the powder spraying room, the powder spraying room can be placed quickly.
The powder spraying room can adjust the radial distance to the powder spraying room when the sprayed rotating frame is installed and disconnected from the pipe. It can protect the powder spraying room and adapt to the precise positioning requirement of the different pipe diameter.

Design of Powder Spraying Equipment

The powder spraying equipment is studied, and the powder spraying equipment is shown in Fig. 4.

The powder spraying equipment includes four powder spraying controllers, and the powder spraying controller has an electrostatic loading function module, a cleaning module and an accurate powder control module.

The four dusting controllers can be independently controlled under manually control mode or automatically controlled under automatic control mode.

The powder spraying controller controls the powder size by gas volume control to ensure the uniformity of the spraying. At the same time, the amount of powder can be adjusted continuously.

The electrostatic loading function module of the powder spraying controller can control whether the static electricity is loaded or not, and it can also control the size of the static voltage separately according to the technological requirements.

Cleaning module is added to the powder spraying equipment according to the spraying process requirements. After a powder spraying process is completed, the cleaning module of the powder spraying equipment is automatically started to clean up FBE in the powder spraying pipe. The cleaning module can be set to cleaning time until the FBE in the powder spraying pipe is cleaned to meet the demand of the next powder spraying work.

The adjustment of the powder spraying equipment also includes the atomization nebulization gas regulation. According to the spraying technology needs, the powder quantity adjustment and atomizing nebulization gas regulation are carried out. The powder spraying equipment can be controlled manually or automatically.

In the automatic control mode, the corresponding process parameters are input into the microcomputer computer of the control system, and the automatic spraying of the powder spraying equipment can be realized. The powder spraying equipment can automatically store 20 related spraying processes and can select the corresponding process according to different technological requirements.
Design of Powder Recovery Equipment

The powder recovery equipment mainly uses negative pressure recovery technology to complete the recovery of the not fused powder, as shown in Fig. 5. The cabinet of the powder recovery equipment is a closed structure. Under the suction action of the centrifugal fan, the inside of the box body presents a negative pressure state.

In the process of the FBE anticorrosion joint coating work of the pipeline, the FBE, which is not fused and aggregates into the collection box, is recovered to the cabinet of the powder recovery equipment under the negative pressure of the cabinet, and then is settled down to the bottom of the cabinet under the action of gravity, and then separated from the mixed air containing the FBE.

When the FBE with certain quality is settled at the bottom of the cabinet, it is necessary to clean up the FBE from the cabinet to achieve zero pollution to the environment.

![Image of the powder recovery equipment]

Figure 5. The powder recovery equipment.

The powder recovery equipment has the function of automatic cleaning of the filter core. After a period of work in the powder recovery equipment, the powder recovery equipment automatically introduces the outside pressure air to the filter core from the inner of the filter core, blowing out the FBE powder adsorbed on the outer surface of the filter core, improving the permeability of the filter core and prolonging the service life of the filter core.

The Testing of Device

According to the design drawings, the device was processed, as shown in Fig. 6. The testing of device work has been carried out. The results show that the device can be installed in place quickly and conveniently, realizing the precision of FBE spraying control and the recovery of the not fused FBE, and reaching the pre designed corresponding function.

![Image of the FBE coating device for subsea pipeline laying]

Figure 6. FBE coating device for subsea pipeline laying.

Summary

According to the construction technology requirements of FBE, the design of FBE coating device for subsea pipeline laying is completed. The device is mainly composed of spraying rotary frame, powder spraying room, powder spraying equipment and powder recovery equipment.
The design work of each component of the FBE coating device is carried out. The functional characteristics, the principle and the function of each part are described, and then it can guide the follow-up related technology research.

The testing of device results show that the device can be installed in place quickly and conveniently, realizing the precision of FBE spraying control and the recovery of the not fused FBE, and reaching the predesigned corresponding function. It laid the foundation for subsequent related process experiments.

Acknowledgement

This research was financially supported by the Scientific Research and Technology Development of CNPC (Key Technology of Subsea Pipeline Construction).

References


