Subsea Pipeline Hyperbaric Welding Technology

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ABSTRACT

Welding is the most efficient and reliable method for subsea pipeline construction, accelerating the development of offshore construction. Underwater welding is performed in the special condition, it came into being in 1917 in subsea structure repair field, and it has been further developed in the 1990s. Underwater welding involved wet welding, dry welding and dry hyperbaric welding. Subsea pipeline maintenance and repair can be operated in wet or dry environment. The dry hyperbaric welding system involves a large hyperbaric cabin. Compressed air is injected into the habitat, then the pipeline welding can be carried out in dry environment. The advantage of dry hyperbaric welding is low content of hydrogen and low cooling speed. During the last few years, the author has been in charge of the dry hyperbaric welding research project, and this paper outlines the welding technology and the operational systems developed and built in order to provide an offshore service where these technologies are needed in the future.

KEY WORDS: Underwater welding; Repair; Hyperbaric; Subsea pipeline; TIG.

INTRODUCTION

Welding is the most efficient and reliable method for subsea pipeline construction, accelerating the development of offshore construction. Underwater welding is performed widely in subsea pipeline repair. Underwater welding involved wet welding, dry welding and dry hyperbaric welding. Dry hyperbaric welding technology can eliminate the side effect of wet environment and the seal of dry welding between the cabin and pipeline. The author took part in the research of dry hyperbaric welding during the last 3 years, and the research methods and achievement is introduced in this article. The dry hyperbaric welding system involves a large hyperbaric cabin. Compressed air is injected into the habitat, and then the pipeline welding can be carried out in dry environment. The advantage of dry hyperbaric welding is low content of hydrogen and low cooling speed. For the pressure in the cabin is almost the same as the sea water, so it is easy to achieve dynamic seal, and convenient for operation adjustment. In order to carry out the research of the welding program, we design a hyperbaric system to simulate the welding condition in our laboratory.

Much research about 16Mn pipeline welding was carried out under the pressure of 3bar and 5bar and 7bar. All the specimens were tested by RT and mechanical test, and the result met the standard of AWSD3.6M and API STD1104.

RESEARCH EQUIPMENT AND MATERIALS

Simulation Hyperbaric Cabin

As shown in Figs 1, the system was made up of hyperbaric gas supply cabin, welding cabin, piping system, automatic welding machine, video system, and gas inspection and control system. Mixed hyperbaric gas was prepared by the supply cabin, then transport to the welding cabin by the piping system. All the welding job was carried out by the automatic welding machine, and the welding process was recorded by the high speed video. Figs. 1.

Welding Materials

tungsten electrode: \( \phi 3.2\text{mm} \)
solder wire: AWS5.18 ER70S-6, \( \phi 0.8\text{mm} \)
pipe line: 16MnR, 6 inch
protect gas: argon

Environment Gas

For the low cost, air is the ideal environment gas. But for the reason of high content of oxygen, the higher the pressure in the cabin the easier the material to burn. Safety is a basic problem that we met. And another problem is the high content of oxygen and nitrogen. In order to achieve