Exprimentation of Underwater Welding

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***Abstract*—This paper enlightens about the use of varied, exaggerated & intensive manufacturing tool "welding" under the water, which was formerly just used in the atmospheric fabrication works only. By the advent of special waterproof electrodes, the engineers proved to the world that one can also perform all the welding operations in the presence & continuous water. It also laid to repair or sometimes to replace the underwater structures, offshore structures which may get fail soon at the deeper water level. It also encompassed the use of various underwater welding techniques & some other new technologies which are emerging up in the field of underwater welding like: Automation welding.**

***Index Terms*— Underwater Welding, Emergency Repair Works, Types, Principle of Operation, Techniques of Performing the Underwater Weldments, Inspection Techniques, Future Scope, and New Emerging Technologies**

I. INTRODUCTION

Now a days in all the fabrication works welding has become a very important tool. The application of welding hasbecome so varied and extensive that it would be no exaggeration to say that there is no metal industry and no branch of engineering that doesn't involve the use of welding as a manufacturing tool. As per the application to requirement,the similar welding processes can be applicable within the atmosphere. But if one wants to do the welding below water then these processes would not be applicable, since they are not designed for that application. Hence underwater welding came into existence. At the offshore structures, underwater platforms and all the marine applications where there is a presence of water or there is a continuous contact of water called splash zone, it is a major concern.

The main difficulty which is faced is due to continuous corrosion of underwater structures, it is necessary to repairthem continuously or to replace them with another one. Under water welding has now become an important tool in the fabrication industry for joining the steel on the offshore platforms, under water structures, pipelines, ships and in many other applications. The underwater structures of after getting corrode away there are chances that they will get fail at the deeper water level and the maximum failure is at shallow depth. So the repair works and welding jobs at these levels is a most technologically challenging task.

II. HISTORY

Underwater welding began during the worldwar1 when the British navy officers used it to make the temporary repairs on the ships. These repairs consisted of leaking rivets of the ship hulls. Earlier the underwater welding was restricted to salvaging operations and the emergency repair works only. Also it was limited to the depth of 10 meters only. As underwater welding process consisted of use of special waterproof electrodes which were developed in the year 1946 by: `Vander willigen'. During the early stage of the underwater welding, it was just applied to weld and patch so that repairwork would be performed. As the time passed and more experience was gained, the ambitious individuals and the companies joined the forces to improve the results and to establish achievable specifications.

III. AREA OF USE OF UNDER WATER WELDING

- New construction and installation of offshore structures, subsea pipelines and harbor facilities.
- For maintenance and repair works
- The repair works include the damage caused by fatigue and accidents offshore and oil platforms.
- Repair works and sometimes replacement of damaged subsea pipelines-sections, repairing of holes in the ship'shull or
- Corrosion damage to the harbor facilities.

- Mostly used for repairing work of ships, offshore oil platforms and pipelines.

IV. COMMONLY MATERIALS BEING WELDED BY UNDERWATER WELDING

Includes- Steel, Stainless Steel, Copper, Aluminum.

Welder / Diver

Welder/Diver:

For performing the task of underwater welding accurately and of very high quality, welder must have sufficient qualification and experience too. Welder/diver is a certified welder who is also an commercial diver and capable of performing tasks associated with commercial subsea work, weld setup and preparation and has the ability to weld in accordance with AWS D3.6 specification for underwater welding and cutting and other related activities. Welder/diver qualifications and experiences required for the given work always vary from one project to another. Most of the welding contractors require their welding/diver to be `jack of all trades' means that the welder/diver must be capable of performing underwater cutting, rigging, inspection, maintenance and photography in addition to underwater welding.

V. CLASSIFICATION OF UNDERWATER WELDING

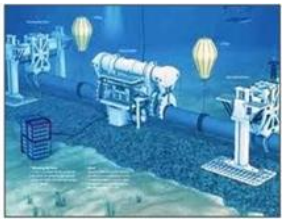
A. Welding in the WET Environment

This method is primarily intended for temporary repair works, emergency repair works and salvage operations in the shallow water. This type of welding results in the poor quality of welds which will not last longer. It is a very cheap & economical method. By this method due to the electrolysis of water, pockets of hydrogen & oxygen gases are created. Alsoit leads to inferior weld qualities like increased porosity, reduced ductility, Hydrogen embrittlement. Weld metal is quickly quenched by the seawater. This method is used when the time and money are short and the function needs to be maintained. Wet welding is carried out at ambient water pressures with the welder/diver in the water using waterproof electrodes with no barrier present in between welding rod and the one which is being welded.

B. Welding in the DRY Environment

Welding in the dry environment influences the method of creating a chamber without the influence of water and carrying out welding process. This method is a very convenient method since the resultant welds are very strong, long lasting. Dry welding results in the highly improved performance of the welding process and hence high quality of weldscan be obtained compared to the wet welds. The chamber in the dry welding is filled with the breathable gas at a prevailingpressure. Welding in the dry environment is categorized into:-

B.I.Hyperbaric Welding



Dry hyperbaric welding was discovered by Russian metallurgist- konstain khrenov in 1932. In hyperbaric dry welding, a chamber is sealed around the structure to be welded and is filled with the breathable gas at a prevailing pressure.This method provides the high quality weld joints that meet radiography and code requirements. The chamber is sealed intothe structure and filled with the mixture of 90-95% helium and 5-10% oxygen. Here the bottom portion of the chamber is exposed to open water and is covered by grating to equalize the chamber pressure to the outside sea water pressure at a certain depth. The chamber provides the welder/diver with all the necessary equipments required for the welding in a dry environment.

B.II.Cofferdam Welding

It is an type of dry welding in which welding is carried out in dry in the air, where the rigid steel structure to house the welders is sealed against the

side of the structure to be welded and is open to the atmosphere. Other than the steel, plywood and rubberized canvas or any other suitable material can be used. The weld chamber used is so designedand custom builded to accommodate the braces and other structural members whose centerlines may intersect at or near thearea that is to be welded. The size, dimensions and configuration of the weld chamber depends upon the area that must be encompassed and no. of welders that must be working in chamber at same time for achieving the state of dry welding, high pressure must be achieved by preparing the enclosure to be filled with the Helium gas under high pressure for pushingback the water and the welder being supplied with breathing mask and protective equipments. The greatest advantage is that: the weld metal is not in contact with the water which is accomplished by evacuating the chamber by the displacement of water by air or suitable gas mixture. Another advantage of the dry welding are: incremental in the stable welding operation, reduction in the hydrogen problem, lower quench rate of weld and base metal and restoration of weld strength and ductility. Welding is performed in the chamber, immune to ocean currents and marine animals. The warm, dry habitatis well illuminated and has its own environmental control system. The disadvantage of the dry welding are: large quantities of the complex equipments are required for which chamber is extremely complex. Chamber once used can't be used for another one.

Welding in the DRY Environment-Hyperbaric and Cofferdam

VI. PRINCIPLE OF OPERATION

Mainly it includes the power source. The power source as AC should not be used since it will continuously fluctuate and will not quickly respond to the welding operations. Hence DC power source should be selected with 300-400 amperes rating and with negative electrode. The DC current machine should always be grounded to ship. The welding circuit includes the knife switch which is operated on the surface by the assistant upon the signal of welder/diver.The main reason for the use of the knife switch is that it cuts off the welding current. For gripping the electrode, electrode holder with the twisted head is utilized. All the types of electrode holders are extra insulated against water electrode types used confirm to AWS E-6013 classification. The electrodes must be thoroughly insulated, waterproofed so that the water will not come in contact with the metal parts. The work lead is attached with 3 feet from the point of welding & is perfectly insulated to avoid leaks.

VII. UNDERWATER INSCEPTION

Underwater inspection includes the visual photographic examination of the various underwater structures and repairs and NDE such as Magnetic Inspection (MI), Ultrasonic Inspection (UI) and Radiographic Inspection (RI). In the typical underwater inspection the underwater inspector is equipped with the light and camera. In order to carry out the proper visual and NDT check, blast cleaning has to be carried out to remove all the seawater organisms that grow on the underwater structure. Latest development in the underwater inspection is the use of ROV's. These machines are operated by an ROV pilot**.**

Welder/ Diver Performing Underwater Inspection by NDT Method

VIII. RISKS INVOLVED

There are some risks which are involved during the underwater welding which are mentioned below:-

Electric Shock: There is a possibility of electric shock when the equipment is not properly insulated, or when thepower supply is not shut off immediately when the welder terminates the arc during welding.

Explosion**:** Arc welding produces the hydrogen and oxygen. Pockets of gases can build up and are potentiallyexplosive.

Nitrogen Narcosis**:** A health hazard normally experienced by divers during the diving activity when the safety stops at certain level is not adhered to.

Curiously, the risk of drowning is not listed with the hazards of underwater welding.

For the welded structures, inspection of welds after welding may be more difficult than welds made above water.

There is a risk of defects that may remain undetected and may cause failure in the long run.

IX. SAFETY RULES

Some necessary precautions should be carried out such as:

- Follow employer's safety practices.
- Fumes and gases can be hazardous to your health.
- Arc rays can injure eyes and skin.
- Use adequate ventilation while welding.
- Wear suitable eye protection and protective clothing. Do not touch live electrical parts.
- Wear rubber gloves.
- Only change the electrode, when it is cold.

X. SCOPE FOR FUTURE DEVELOPMENT

Now-a-days, wet metal arc welding technique is carried out for the underwater welding but the qualities of welds are not much good due to the hydrogen embrittlement. Presently, the research work is carried towards the automation in which robots are used for underwater welding & allied activities. Their examples are THOR-1(TIG-Hyperbaric Orbital Robot) is developed where the diver performs the pipe fittings, installs the trac and orbital head on pipe and the rest of the process is automatic.

REFERENCES

[1] TWI Knowledge summary- Underwater welding.
[2] Underwater welding magazine-Commercial Diving.
[3] Divers Academy International
[4] Atlantic Welding& Fabrication center.
[5] D.J Keats, Manual on wet welding. ISBN 1-899293-99-X
[6] W. Lucas, International Conference on computer technology in welding.
[7] Jyotsana Dutta Majumdar - underwater welding-present status and future scope.-1813-8535-ANAME Publication.
[8] S. K .Hajrachowdhary-Elements of workshop technology-vol-1-mediapromoters&publishers pvt.ltd.
[9] Dr. R.P. Arora- Manufacturing process-II – Techmax publications, pune.
[10] www.globalspec.com/industrialdirect.
[11] www.robotwelding.com/spotweldingrobot
[12] www.weldingdirect.com
[13] www.binzel-abicor.com/products/accesories.