

Fig. 2 Shielded Metal Arc Welding (SMAW)

For underwater wet welding with shielded metal arc welding (SMAW) technique, direct current is used and usually polarity is straight [Khanna, 2004]. Electrodes are usually water proofed. Furthermore, it is flux coated which causes generation of bubble during welding and displaces water from the welding arc and weld pool area.

Hence, the flux composition and depth of flux coating should be optimized to ensure adequate protection. Electrodes for shielded metal arc welding are classified by AWS as E6013 and E7014 [Khanna, 2004]. Versatility, simple experiment set-up, economy in operation and finished product quality are notable advantages of the technique. However, during welding, all electrical leads, lighting gear, electrode holder, gloves, etc., must be fully insulated and in good condition. Ferrite electrodes with a coating based on iron oxide should be used as they resist hydrogen cracking. Flux cored arc welding is another technique which could not yet competed with SMAW because of reported excessive porosities and problems with underwater wire feeding system [Oates, 1996].

X. FLUX CORED ARC WELDING

Flux Cored Arc Welding (FCAW) is a commonly used high deposition rate welding process that adds the benefits of flux to the welding simplicity of MIG welding [Khanna, 2004]. As in MIG welding wire is continuously fed from a spool. Fig. 3 shows the schematic of flux cored arc welding process. Flux cored welding is therefore referred to as a semiautomatic welding process. Self shielding flux cored arc welding wires are available or gas shielded welding wires may be used. Less pre-cleaning may be necessary than MIG welding. However, the condition of the base metal can affect weld quality. Excessive contamination must be eliminated. Flux cored welding produces a flux that must be removed. Flux cored welding has good weld appearance (smooth, uniform welds having good contour). Flexibility in operation, higher deposition rate, low operator skill and good quality of the weld deposits are the notable advantages of flux cored arc welding. However, presence of porosities and burnback are the problems associated with the process.

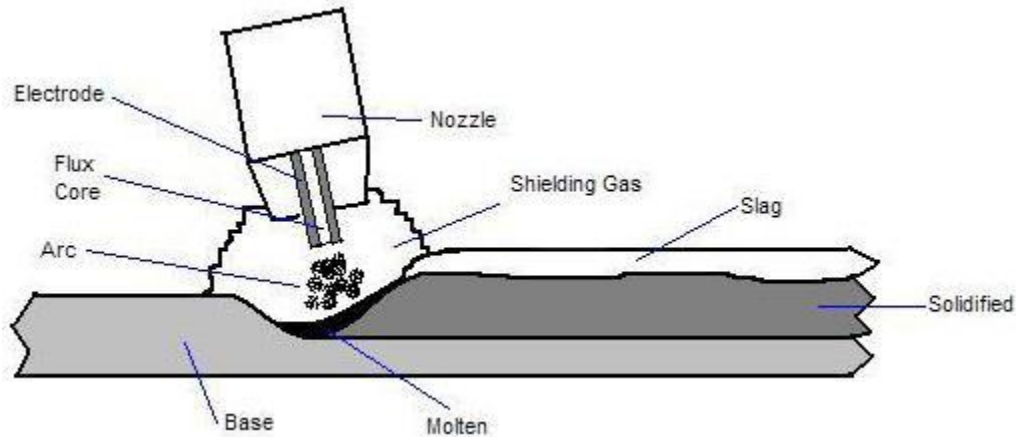


Fig. 3 Flux Cored Arc Welding (FCAW)

Recent development of nickel based flux cored filler materials have provided improved wet weldability and halogen free flux formulation specifically designed for wet welding application [Oates, 1996]. Similarly, improved underwater wet welding.

XI. CHARACTERISTICS OF A GOOD UNDER WATER WELDING

1. Requirement of inexpensive welding equipment, low welding cost easy to operate, flexibility of operation in all positions.
2. Minimum electrical hazards, a minimum of 20 cm/min welding speed at least.
3. Permit good visibility.
4. Produce good quality and reliable welds.
5. Operator should be capable in supporting himself.
6. Easily automated.

XII. APPLICATION OF UNDERWATER WELDING

The important applications of underwater welding are:

1. Offshore construction for tapping sea resources.
2. Temporary repair work caused by ship's collisions or unexpected accidents.
3. Salvaging vessels sunk in the sea.
4. Repair and maintenance of ships.

XIII. UNDERWATER WELDING – FUTURE SCOPE OF RESEARCH

Considerable research effort has been made to improve process performance and control strategies for the various underwater welding processes over the last half century. However, there are still many problems to overcome. The major efforts on research and development should be focused on the following topics:

1. Automation of the underwater joining and inspection of the welded structures.
2. Mechanized underwater welding for actual Investigation of the potential of using a robot manipulator for underwater ultrasonic testing of welds in joints of complex geometry.
3. Application of advanced welding technique, like friction, laser welding and understand the behavior of

materials after the welding and process optimization.

4. Invention of new welding techniques and explore the possibility of its application in underwater welding.
5. Generation of research data book on weld ability of materials during underwater welding.

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