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STUDY ON DEFECTS IN STRAIGHT TUBE BUTT WELDING

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Abstract

For various purposes in Boiler assembling, Tubular Products like Economizer Re heaters, Super heaters are needed. Straight tube butt welding (STB Welding) is a process in which straight tubes are welded. In this process many small tubes are joined to form lengthy tubes. By these lengthy tubes the tubular products are manufactured. In STB welding various defects occurs. These defected joints are rejected. This rejection increases the production time and production costs. The root causes for the defects are found and studied. The important parameters that affect the weld quality in STB were found. The suitable remedies are suggested for overcoming the defects.

Keywords: *STBW, MIG Welding, Visual Inspection, Parameters, Remedies.*

1. Introduction

Welding is a process of joining two or more pieces of the same or dissimilar materials to achieve complete coalescence. This is accomplished by fabrication of vastly different components including critical structures like water wall panel, heat exchanger, pressure vessels, etc. Welding can be done with or without the application of filler materials called electrode. Welding joins different metals / alloys with the help of a number of processes in which heat is supplied either electrically or by means of a gas torch. In order to join two or more pieces of metal together by one of the welding processes, the most essential requirement is heat, pressure may also be employed, but this is not, essential in many processes. In the course of time, temperature difference in a body is reduced by heat flowing from different region of higher temperature of those of lower temperature. This process takes place in all substances such Assistant liquids and gases and also in solids. In comparison to other process of joining the metal, STB process can give 100% of strength and efficiency.

The objectives of the project are to reduce the defects in Straight Tube Butt Welding (STBW) machine. This is founded through a survey which is done on the welded joints by the STBW machine.

2. Straight Tube Butt Welding

Metal inert gas welding process (MIG) is widely used process in STBW process. MIG welding process is one of the many versatile processes grouped under the headings, Gas metal Arc welding process (GMAW). Among the group, MIG welding process was the first to be discovered. This was the result of the attempt made during 1940’s to develop a suitable welding process for steel and also a mechanize the same. Today it is a well established semi-automatic process, which can be easily mechanized or automated with a wide range of applications.

2.1 Principle

It is an arc welding process where in coalescence is produced by heating the jobs with an electric arc establish between a continuously fed metal electrode and the job. No flux is used but the arc and molten metal are shielded by an inert gas, which may be argon, helium, CO2 or a gas mixture. In MIG, the electrode is in the form of a write continuously feed from a spool. The rate of feeding the wire is controlled. GMAW is generally used because of its high productivity, it is also easy to use and it creates high quality welds at a lower overall cost. GMAW is generally done using DECP (Direct Current Electrode Positive) or DCRP. Alternating current is never used. DCEN (Direct Current Electrode Negative) is used with only one special electrode, called an emissive electrode. GMAW can be done using solid wire, flux cored or a specially coated solid wire electrode. The shielding gas or gas mixture must be used with GMAW. For every pound of solid electrode wire used. 92-98% becomes deposited Assistant weld metal. Some spatter occurs in the GMAW process. Very little stub loss occurs when continuously fed wire is used. There is a very thin glass like coating over the weld bead after GMAW. No heavy slag is required because a gas shields the weld area.

2.2 Machine Description

The GMAW unit consists of the following major components: Welding gun, Wire drive, Gas supply and suitable valves, Welding machine, Water supply system, Control unit.

2.3 Working

As the name itself indicates the machine can handle only straight seamless steel tubes. The work (i.e.) straight seamless steel tubes are held using chucks and it is automatically fed through the checks by rollers. The rollers are driven using hydraulic motors. At the middle of both the chucks there is a presence of bar stop. The bar stop is used to align the tubes during welding. In order to weld tubes with uneven thickness inserts are used. There is a presence of control panel to control the process parameters such as current, voltage, chuck speed, wire feed and oscillator speed etc. The wire feed is done by wire feeding mechanism and can be controlled using control panel while joining the tubes, the root layer is first welded by fixing some parameters and then oscillator is made to operate and the second layer is welded. The movements of welding torch and bar stop are automatically controlled pneumatically. The welding torch is water-cooled. The operating parameters plays an important role in weld quality and the defects are mainly caused due to the changes in operating parameters for each material separate operating parameter should be fixed.

3. Inspection

Visual inspection, which is the most widely used inspection method, is also the quickest, easiest, and cheapest. The only equipment commonly used is a magnifying glass (1 OX or less) and a flashlight or extension. Other tools, such as a bore scope and dental mirrors, are useful for inspection inside vessels, pipe, or confined areas. Visual inspection is always required in weld evaluation. However, it will not reveal interval defects or minute surface defects.

3.1 Examination prior to welding

Before welding, the faces and edges should be examined for laminations, blisters, scabs, and seams. Heavy scale, oxide films, grease, paint, oil, and dirt should be removed. Edge preparation, alignment of parts, and fit up should be checked. Welding specifications should be specific and state that all weld joints must be inspected for compliance with requirements for preparation, placement of consumable inserts, alignment, fit-up, and cleanliness.

3.2 Examination of welds during welding

Specifications should state that welds must be examined for conformance to the qualified welding procedure, detection of cracks in root pass, weld bead thickness, slag and flux removal, and preheat and inter pass temperatures, where applicable.

3.3 Examination of welds after welding

Specifications should state that welds must ‘be examined for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds. A weld is considered acceptable by visual inspection if:

(1) The weld has no surface flaws such as cracks, porosity, unfilled craters, and crater cracks, particularly at the end of welds.

(2) The weld metal and base metal are fused. The edges of the weld metal should blend smoothly and gradually into the adjacent base metal. There should be no unacceptable overlap or undercut.

(3) The weld profiles conform to referenced standards and specifications. The faces of fillet welds may be slightly convex, flat, or slightly concave, as determined by use of suitable gages or templates. The minimum size of each fillet leg is specified on the applicable drawings or welding procedure. For butt welds, the amount of weld bead reinforcement or the height of the surface of the weld above the base metal surface should be no greater than the welding specification allows (These standards should be developed early in a job, and should represent acceptable, borderline, and reject able conditions. When there are several critical joints, a separate standard may be prepared for each).

4. Defects

Most of the defects encountered in welding are due to an improper welding procedure. The following defects are found in STBW using visual inspection method:

4.1 Incomplete Penetration

When the weld bead does not penetrate the toe of a fillet weld but only bridges across it. Welding current has the greatest effect on penetration. Incomplete penetration is usually caused by the use of too low welding current and can be eliminated by simply increasing the ampere. Other causes can be the use of too slow travel speed and an incorrect torch angle. Both will be allow the metal to rise in front of the arc acting as a cushion to prevent penetration. The arc must be kept on the leading edge of the weld puddle.

4.2 Lack of Fusion

The most common cause to lack of fusion is poor welding technique. Either the weld puddle is too large (travel speed too slow) and the weld metal has been permitted to roll in front of the arc. Again the arc must be kept on the reading edge of the puddle. When this is done the weld puddle will not get too large and cannot cushion the arc. Another cause is the very wide weld joint. If the arc is directed down the centre of the joint the molten weld metal will only flow and cost against the side wall of the base plate without melting them. The heat of the arc must be use to melt the base metal. This is accomplished by making the joint narrower or by directing arc towards the base plate. When multiples welding thick material aspic bead technique should be used whenever possible after the root passes. Large weld beats bridging the entire gap must be avoided.

4.3 Under cutting

The under cutting is a defect that appears as a groove in the parent metal directly along the edges of the weld. It is most common in lap fillet welds. But can also be encountered in fillet and butt joints. This type of defects is most commonly caused by improper welding parameters particularly the travel speed and arc voltage. When the travel speed is too high, the weld bead will be very peaked because of its extremely fast solidification. The force of surface tension have drawn the molten metal along the edges of the weld bead and piled it up along the center. Melted portions of the base plate are affected in the same way. The undercut groove is where the melted base materials has been drawn in to the weld and not allow towed back properly because of the rapid solidification. Decreasing the arc travel speed will gradually reduce the size of the undercut and eventually eliminate it. When only small or intermittent under cuts are present, raising the arc voltage is using a leading torch angular also correcting action. In both cases, the weld will become flatter and welding will improve.

4.4 Porosity

The most common causes of porosity are atmosphere contamination, excessively oxidized work piece surface, in add quote deoxidizing alloys in the wire and the presence of foreign matter, can be caused by Inadequate shielding gas flow, Excessive shielding gas flow.

4.5 Longitudinal cracking

Longitudinal on center line cracking of the weld bead is not often encounter in MIG welding. These defects occur only when the weld is too small to with stand the service stress involved.

4.6 Burn Through

It is melting of particles of pipe metal due to excess of heat. Burn through forms due to unbearable heat over that is a main cause of burn through. When there is gap in root of weld joint burn through occurs. Some time welding arc temperature raises when welding current increases is higher arc temperature leads to burn through.

4.7 Excessive Penetration

Portion of weld that have completely penetration in to the tube wall causing metal drips in tube I.D. due to improper weld nozzle centering.

5. Results and Discussions

The root causes for these defects are analyzed using visual inspection and here we suggest some remedies to overcome the defects and also found the important process parameters which affect quality of welding.

5.1 Remedies

To avoid Lack of Penetration Weld joints must not be narrow, Welding current should be adjusted to appropriate level, Electrode feed must be in a control level, Wire should be placed at the center of grove, Arc length should not be too long, and Rotation of the chucked must be control, sufficient root opening. To avoid Lack of Fusion Sufficient heat input, correct size of electrode should be chosen, Position of electrode should be corrected, clean weld surface before welding, Torch oscillation should not be too narrow, proper gas mixture. To control the Undercut, travel speed should not be too long, Welding voltage should be maintained at correct level, The chosen electrode should not have large diameter, Arcs should not be too long, Clean weld surface prior to welding, Welding current must not be too high, Electrode should not be inclined at time of welding. To eliminate use low-hydrogen welding process, increase shielding gas flow, one pre-heat or increase heat input, clean joint faces and adjacent surfaces, change welding conditions and techniques, use copper-silicon filler metal reduce heat input, use E6010 electrodes, use electrodes with basic slugging reactions. Proper alignment of tubes in root of weld joint, Bore should be concentric at ends, Welding current should be adjusted to appropriate level, Rotation of chuck must be controlled, Wire stick out should not be too short to avoid excess Penetration.

5.2 Parameters

The various parameters that affect the weld quality in STB are as follows.

1. Weld current
2. Arc voltage
3. Arc travel speed
4. Chuck speed
5. Gas mixture
6. Wire feed rate
7. Oscillator speed.

6. Conclusions

In this project all the possible welding defects occurring in Straight Tube Butt Welding Machine (STBW) is analyzed. For each type of defect the remedial action is suggested. Using these suggestions we can reduce the welding defects. The important parameters which affect the STBW were also found.

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