International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-07, Issue-02, MAY 2021

Porosity and Its Consequences on Weld Quality

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ABSTRACT - Effect of porosity distribution in the weldment of joint made of IS 2062 MS Plate with 6 mm thickness. Using two different electrodes one electrode (filler) for Root welding and other electrode (E6013) for cap and hot pass in the shield metal arc welding (SMAW) process was investigated. This paper provides a characterization of the porosity in term of the distribution, location and size of the pores in the weldment region. The existing pores resulted from the cause of the filler metal (ER70-S) at Root was compared with for weldment with E6013, the pores were mainly scattered the weldment used by electrode (E6013). From this investigation, it is exhibited that the pores only distributed and located mainly at the edges and at the root of the weldment with E6013 weld metal, however, in the center region. The distribution and location of pores in weld metal is believed due to the effect of convections in the molten metal, solidification rate and also from the gases induced during the weld process. Apart from this, results of tensile test indicated that the weldment was greatly affected the strength and ductility of two joints, whichwas revealed by subjecting the joints to tensile testingin UTM.

Keywords: Er6013, Er7018, SMAW, Porosity.

I. INTRODUCTION TO POROSITY

Porosity is caused by the absorption of nitrogen, oxygen and hydrogen in the molten weld pool which is then released on solidification to become trapped in the weld metal. Nitrogen and oxygen absorption in the weld pool usually originates from poor gas shielding. As little as 1% air entrainment in the shielding gas will cause distributed porosity and greater than 1.5% results in gross surface breaking pores. Leaks in the gas line, too high a gas flow rate, draughts and excessive turbulence in the weld pool are frequent causes of porosity. Hydrogen can originate from a number of sources including moisture from inadequately dried electrodes, fluxes or the workpiece surface. Grease and oil on the surface of the workpiece or filler wire are also common sources of hydrogen. Surface coatings like primer paints and surface treatments such as zinc coatings, may generate copious amounts of fume during welding. The risk of trapping the evolved gas will be greater in T joints than butt joints especially when fillet welding on both sides. Special mention should be made of the so-called weldable (low zinc) primers. It should not be necessary to remove the primers but if the primer thickness exceeds the manufacturer'srecommendation, porosity is likely to result especially when using welding processes other than MMA.

This can be found as pores that are evenly distributed throughout the weld bead, though placed randomly. Surface breaking pores is the term to describe high levels of distributed porosity to the extent that they reach the surface. Porosity is caused by gas particles getting absorbed into the weld pool while it is molten, and then being released when the pool solidifies. This can be because of poor gas- shielding. Other frequent causes of these kinds ofpores are leaks in the gas line, gas flowing a very high rate, and draughts. Sometimes, if there is turbulence inthe weld pool, it may cause pores. Porosity is a welding defect and is an undesirable outcome for any welding task. To be able to understand how to avoid porosity, you'd first have to understand why it happens. Moist electrodes can cause porosity since the moisture content of the weld metal would rise, and if steam gets driven out because of the heat from the welding process, it could cause small cavities in the weld metal. Porosity can occur when stainless steel electrodes and low-hydrogen electrodes aren't kept in the correct dry conditions.

FIGURE 1 : POROSITY ON WELDMENT

 DOI : 10.35291/2454-9150.2021.0254

ISSN : 2454-9150 Vol-07, Issue-02, MAY 2021

In low-hydrogen electrodes, some moisture is needed for better performance, but if the moisture levels get too high, the weld metal will be susceptible to porosity. If the parent metal or the electrodes are contaminated, the oil, grease, or even moisture that was present on the metal surface can contribute to the formation of gas because of the high welding temperatures, and this can cause problems of porosity once the weld pool begins to solidify. Air entrapment, such as in an inconsistent gas shield, as mentioned earlier, can also cause porosity problems. A correct connection between the gas hose and the equipment makes sure that air is not allowed to mix with the shielding gas and hence prevent any problems that could arise from it. Airflow and draughts around in the environment can also cause the gas flow to be restricted.

Sometimes, during the solidification process, excess oxygen that comes out of the weld metal because of the reduced solubility can react with other gases in the air and form carbon monoxide, which can also cause porosity Because of this DE oxidants are usually added to the electrodes and filler metals, and sometimes even the parent metals to remove excess oxygen content. If these DE oxidants are not enough, or inadequate, the excess oxygen will form carbon monoxide and can result in porosity. If the arc length is too high, such as due to high voltage, the magnitude of the shielding is reduced and can cause the air in the atmosphere to be trapped in the weld pool, which can then cause porosity when it solidifies. Surfaces that are exposed to the open air and can be affected by the atmospheric conditions are more prone to porosity because of the likelihood of contamination. Any air that enters the weld puddle can cause porosity when it begins to solidify.

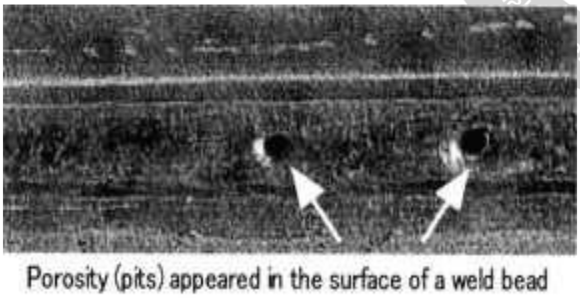

FIGURE 2: POROSITY APPEARED IN SURFACE OF WELD BEAD

II. PREVENTION OF POROSITY

CLEAN SURFACES:

Keeping the welding material – the surface, the metals, and the equipment – clean can help reduce porosity. By making sure you aren't carrying out the welding process on a surface that has grease and moisture, you can prevent porosity and even unsound welds that may end up need reworking.

SURFACE COATINGS:

Clean the joint edges immediately before welding.

CHECK GAS FLOW:

Powerful gas flow can cause the air around it to get disturbed and result in mixing. By keeping the gas flow at the recommended level depending on the application, you can get a great weld with minimal porosity, and even improve your welding efficiency.

III. RESULTS AND DISCUSSIONS: PENETRATION TEST

Spatter on the face side of the welded joint. This is due to excess heat input and inappropriate electrode. Porosity and Lack of penetrations on the root side of the weld joint. Porosity occurred due to dampness in the flux coating of the electrode or inappropriate electrode**.** Lack of Penetration occurred due to the imperfect welding position.

FIGURE 3: SPATTER ON FACE SIDE OFWELD

FIGURE 4: POROSITYTENSILE TEST:

Tensile specimen broken at the welded zone it was observed that ultimate strength of the weld joint 398.5 N/mm2 which is less than the ultimate strength of both parent metals i.e., Mild steel (440N/mm2) andsteel.

FIGURE 5: SPECIMEN AFTER TENSILE TEST

BENDING TEST:

Bending test was performed on weld joint of Stainless

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steel and Mild steel plate on the universal Testing machine capacity of 400KN.we performed test on root side and face side of the welded joint and it was observed that the metal to be welded by using E6013 electrode by using SMAW technique on Stainless steel and Mild steel together is able to resist bending up to 120°.The bend test is a simple and inexpensive qualitative test that can be used to evaluate both the ductility and soundness of a material.It is often used as a quality control test for butt-welded joints, having the advantage of simplicity of both test piece and equipment.

FIGURE 6 : SPECIMEN AFTER BENDING

CONCLUSION

In this mild steel were joined using shield metal arc welding with E6013 electrode.E6013 electrode is not suitable for joining mild steel plates byusing shield metal arc welding because we have seen defects like porosity, spatter and lack of penetration on weld joint. The tensile strength and bending test and liquid penetration test were investigated. The ultimate tensile strength of dissimilar metal weld joint is weak as per report. It can resist upto 120 °.

REFERENCE

[1] Suppliment to the welding Journel July 2002.Sponsored by the American welding society and welding research council.

[2] Shamsul Bahariu Jamaludin, mazlec mohd noor, mechanical properties of dissimilar welds between stainless steel and mild steel vol.795: pp 74- 77, 2013.

[3] Ameen a. nassar, Rafil M.Lefta and Muthanna and

j. abdhulsada, Experimental study of the effect ofwelding electrode types on Tensile pr operties of low carbon steel ASI 1010 Vol.163-173 October 2018.

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