ISSN No. 2455-5800
Journal of Scientific Research in Allied Sciences

Review Article

REVIEW PAPER OF WELDING PARAMETER ANALYSIS BASED ON STRENGTH

Dikendra Dewangan, Rupendra Kumar Marre

Production Engineering, GD Rungta college of Engineering and Technology Bhilai, India

Article history:
Submitted on: May 2017
Accepted on: June 2017
Email: info@jusres.com

ABSTRACT

This paper presents a study on the strength of welding joining of hybrid material, between alloy steel and mild steel by electric arc welding. The objective is to analyze the effect of welding on dissimilar plate of alloy steel and mild steel. The joining between alloy steel and mild steel by welding was built using electric arc welding. In this case variation of voltage and electrode and type of cooling will give the strength variation. Impact testing using hammer excitation and accelerometer response measuring techniques was used to measure strength properties of hybrid parts. Response are stored in tabulated form which will suggest about the welding parameter, suggesting parameter are apply by welding application to obtain best process parameter of welding and also suggest the effective parameter of welding

KEYWORDS— Welding, Strength, Voltage.

INTRODUCTION

Engineering structures are generally fabricated using a variety of fasteners such as bolted, riveted, welded joints etc. Joints are an integral part of most of the real structures. However, its behavior under dynamic condition has not yet been fully understood by the researchers. This is an impediment to accurate modeling. Joints have a great potential for reducing the vibration levels of a structure thereby attracting the interest of many researchers. These connections are recognized as a good source of energy dissipation and greatly affect the dynamic behavior in terms of natural frequency and damping [1-3]. This structural damping offering excellent potential for large energy dissipation is associated with the interface shear of the joint. It is thus recognized that the provision of joints can effectively contribute to the damping of all fabricated structures. The damping and its improvement in structural applications poses the biggest challenge to the practicing engineers.

Usually, such structures possess both low structural weight and damping. This situation calls for use of additional measures to improve the damping characteristics by dissipating more energy. However, increasing the damping capacity of a structure is not always easy and may often lead to the waste of energy during normal operating conditions. The monolithic structures can be used as a replacement, but unfortunately, they possess very low inherent material damping and are not cost-effective. One of the techniques used for improving damping is fabricating these structures in layers by means of joints which provide suitable means of energy dissipation.

The introduction of joints promotes the flexibility of the assembled structures and contributes adequately to the damping properties. Although most of the inherent damping occurring in real structures arises in the joints, but little effort has been made to study this source of damping because of complex mechanism occurring at the interfaces due to coefficient of friction, relative slip and pressure distribution characteristics. It is therefore important to focus the attention on these parameters for accurate assessment of damping capacity of structures. The role of friction is of paramount importance in controlling the dynamic characteristics of engineering structures. In applications where relative motion between surfaces in contact occurs, the effect of frictional forces, whether desirable or not, cannot be ignored.

A continuous model is characterized by a partial differential equation with respect to spatial and time coordinates which is often used for studying simple structures such as a uniform beam. Exact solutions of such equations are possible only for a limited number of problems with simple geometry, boundary conditions and material properties. The damping model of jointed structures is also developed based on the experimental data. In the present work, response surface methodology has also been adopted to develop the damping models of layered and jointed welded structures. Response surface methodology is a new statistical approach in which the experimental results of damping capacity are statistically analyzed considering the various factors affecting the damping.

REVIEW OF WORK

Damping in structures has historically been of great importance in nearly all branches of engineering endeavors, and it also happens to be one of the most difficult parameters to predict. Problems associated with vibration damping and noise control in structures has been a subject of comprehensive interest of scientists and researchers for a long time.

Notwithstanding the variety and immensity of work done within this domain of study, and despite all possibly most accurate solutions and arduous experiments, many aspects related to damping remain poorly examined. The study of damping and its improvement in many engineering structures is of paramount importance for controlling excessive vibration.

MATERIAL DAMPING

Material damping is related to the energy dissipation within the volume of material. This mechanism is usually associated with the internal reconstructions of micro and macro structure ranging from crystal lattice to molecular scale effects, thermo elasticity, grain boundary viscosity, point-defect relaxation, etc. [3]. The majority of published information on material damping is of empirical nature and the underlying physical effects are not fully understood. Besides, there are two types of material damping: hysteretic damping and viscoelastic damping.

Lacktin [1] explained that carbon is the most appropriate material for iron to make bond in steel; it also solidifies the inherent structures of iron. By experimenting with the different amounts of carbon present in the alloys, many properties like density, hardness and malleability can be adjusted. By increasing the level of carbon in steel, we can make steel more structurally delicate as well as harder at the same time.

PLAIN CARBON STEEL

Plain carbon steel is essentially an alloy of iron and carbon which also contains manganese and a variety of residual elements. These residual elements are added in a smaller amount. The American Iron and Steel Institute (AISI) has defined a plain carbon steel to be an alloy of iron and carbon which contains specified amounts of Mn below to a maximum amount of 1.65 % wt., less than 0.6 % wt. Si, less than 0.6 % wt. Cu and which does not have any specified minimum content of any other deliberately added alloying element [2]. It is usual for maximum amounts (e.g. 0.05 % wt.) of S and P to be specified. As carbon content rises, the metal becomes harder and stronger but less ductile and more difficult to weld. Higher carbon content lowers steel melting point and its temperature resistance in general [3].

Y. Uematsu et al. described the significant effect of elevated temperature on fatigue strength of ferritic stainless steels. When this material characterized in terms of fatigue ratio, fatigue strength still decreased at elevated temperatures compared with at ambient temperature. At all temperatures studied, cracks were generated at the specimen surface due to cyclic slip deformation, but crack initiation occurred much earlier at elevated temperatures than at ambient temperature. Subsequent small crack growth was considerably faster at elevated temperatures even though difference in elastic modulus was taken into account, indicating the decrease in the intrinsic crack growth resistance. Fractographic analysis revealed some brittle features in fracture surface near the crack initiation site at elevated temperatures [4].

Okayasu et al made an examination of the fatigue properties of the two-phase ferrite/martensite low carbon steel; he found that the fatigue strength of steel is found twice as high as that of the as-received steel. [5]

Tayanc et al. presented that fatigue strength of steel increased when compared with as-received materials. They have obtained the highest fatigue strength in the annealed steel that received specimen has higher fatigue strength or higher endurance to fatigue failure than DPSs but for low cyclic life. [6]

Hyde et. al. [8] studied finite element creep and damage analysis were performed for a series of new, service aged, fully repaired and partially repaired circumferential welds in CrMoV main steam pipes under an internal pressure and a uniform axial stress, using simplified axis symmetric models. Thickness of pipe was 63.5mm, angle 150 and welding width is 46 mm. Authors conclude that, because of complex nature of the problem exact analytical solutions cannot be obtained for the stresses and strain within welds under creep conditions. Weld width on the failure life is relatively small.

Renet al. [9], investigate the effects of welding wire composition and welding process on the weld metal toughness of submerged arc welded pipeline steel and concluded that the contents of alloying elements need to vary along with the welding heat input. The microstructures mainly consisting of acicular ferrite can be obtained in weld metals using the wires with a low carbon content and appropriate contents of Mn, Mo, Ti-B, Cu & Ni, resulting in the high low-temperature impact toughness of weld metals.

Mercadoet al. [10] while conducting study on influence of the chemical composition of flux on the microstructure and tensile properties of submerged-arc welds shows the importance of the selection for flux composition in order to improve the mechanical properties of steel welds.

Chan et al. [11], while describing a software system for anticipating the size and shape of submerged arc welds told that the system consists of a specially designed interface for welding/materials/design/fabrication engineers, automated plotting for parametric studies, a simplified data base for storing/editing/retrieving frequently used welding parameters and pictorial graphics for displaying weld size and shape.

Muruganet al. [12], while discussing the effect of submerged arc process variables on dilution and bead geometry in single wire surfacing said that the control parameters are required to be fed to the system according to some mathematical formulation to achieve the desired end results. The responses, namely, penetration, reinforcement, width and dilution as affected by open-circuit voltage, wire feed-rate, welding speed and nozzle-to-plate distance, have been investigated.

Sharmaet al. [13] while doing the analysis of Flux Consumption in Twin Wire Submerged Arc Welding Process with unequal wire diameters concluded that flux accomplishes different functions including covering the arc, elimination of spatter and smoke, control of arc stability, governing the bead shape and influencing weld chemistry. Therefore, the flux consumption remains a function of process parameters and directly influences the productivity of the process. Unequal wire diameters lead to more stable magnetic file with less deflection, thus, results in lesser flux consumption.

DISCUSSION

As a result, the deployment of welded layered beams is becoming increasingly common in the machine tool industry and fabricated construction. Many structures are made by connecting structural members through joints. Due to very low material damping of built-up structures, sufficient damping has to come from the joints. Damping in built-up structures is often caused by energy dissipation due to micro-slip along frictional interfaces (e.g., at welded joints), which provides a beneficial damping mechanism and plays an important role in the vibration behavior of such structures. Telescopic beam is one of the important parts in the spreader. It is a box shaped beam with four welds joining the two webs and two flanges of different grades of high strength steels. Hardness is the resistance of a material to permanent indentation. It is not a material property but an empirical test. Vickers hardness test was developed in 1924 by Smith and Sandland at Vickers Ltd to measure hardness of the materials. A pyramid shaped indenter is used to make the indentation by applying a test force F and then hardness of the material is measured by measuring the length of the diagonal of the indentation made on the material surface [6]. Tensile test is the most fundamental type of mechanical test. It can be either force controlled or displacement controlled experiments. In force controlled experiments, a material is being pulled and its behavior to react to the forces applied in tension is determined, while in displacement controlled experiments a constant increasing displacement is applied as a load. The stress and strains are determined from the cross-sectional area and length. After performing tensile test, a curve is obtained which tells about the behavior of the material. Properties of the material like elongation, ultimate tensile strength and ductility are computed. The relation between stress and strain is observed to be linear for small strains while for large strains it is no longer linear. Elongation in the specimen can be expressed as a relative measurement called 'strain'. Strain can be expressed as 'engineering strain' or 'true strain'. Engineering strain is the ratio of change in length to the original length while true strain is based on the instantaneous length of the specimen. The electrode is specified by the effective welding strength. For a full penetration butt weld, the throat dimension is usually assumed as the thickness of the thinner part of the connection. Even though a butt weld may be reinforced on both sides to ensure full cross-sectional areas, its effect is neglected while estimating the throat dimensions. If the stresses are uniform across the welding thickness, the average stress concept may be applied to determine its strength. Connections with partial penetration welds with welding on only one side is generally avoided under tensile load due to the eccentric loading involved.

CONCLUSION

The study of the various works, review that, the selection of the suitable process parameters are the primary means by which acceptable heat affected zone properties, optimized welding electrode and minimum residual stresses are created. Some researchers realized that the mechanical properties of weld are influenced by the composition of the base metal and to a large extent by the weld electrode and shape relationship as well. To propose the best suitable welding electrode for maximum tensile, impact strength and for minimum hardness of HAZ and distortion for plate welding application by making test variation of electrode.

REFERENCES

[1]. Lakhtin Y.M., Engineering Physical Metallurgy and Heat Treatment. Mir Publ., 1977.

[2]. Oberg, E., Machinery's Handbook, 25th ed., Industrial Press Inc., 1996.

[3]. Smith, W.F. and Hashemi, J., Foundations of Materials Science and Engineering, 4th ed., McGraw's - Hill Book, 2006.

[4]. Uematsu Y., Akita M. and Nakajima M., Effect of temperature on high cycle fatigue behaviour in 18Cr–2Mo ferritic stainless steel, International Journal of Fatigue, vol.30, Issue 4, Apr., 2008, pp.642–648.

[5]. Alp T., and Wazzan A., The influence of microstructure on the tensile and fatigue behavior of SAE 6150 Steel, 2002, pp.351-359.

[6]. Bayram A., Uguz A., and Ula M., Effect of microstructure and notches on the mechanical properties of dual-phase steels, mater. Charact, vol.43, 1999, pp.259-269.

[7]. N, Ren, M. Zan, "Constructing effect of weld & heat affected zone on deformation behavior of welded tubes in numerical control bending process", Journal on material processing technology (2012).

[8]. T. H. Hyde, J. A. Williams, A. A. Becker. Sun, "A review of the finite element analysis of repaired welds under creep conditions", Review of FE analysis of repaired welds OMMI (Vol. 2, Issue 2) Aug. 2003.

[9]. De-liangRen, Fu-ren Xiao, PengTian, Xu Wang and Bo Liao, Effects of welding wire composition and welding process on the weld metal toughness of submerged arc welded pipeline steel, International Journal of Minerals, Metallurgy and Materials Vol.16: 65-70 (2009)

[10]. Ana Ma. Paniagua-Mercado, Victor M. López-Hirata and Maribel L. Saucedo Muñoz, Influence of the chemical composition of flux on the microstructure and tensile properties of submerged-arc welds. Journal of Materials Processing Technology. 169: 346-351 (2005).

[11]. B. Chan, R.S. Chandel, L.J. Yang and M.J. Bibby, A software system for anticipating the size and shape of submerged arc welds. Journal of Materials Processing Technology, Vol. 40: 249-262 (1994).

[12]. N. Murugan, R.S. Parmar and S.K. Sud, Effect of submerged arc process variables on dilution and bead geometry in single wire surfacing. Journal of Materials Processing Technology, Vol. 37: 767-780 (1993).

[13]. Abhay Sharma, Navneet Arora, Bhanu K. Mishra, Analysis of Flux Consumption in Twin-Wire Submerged Arc Welding Process with Unequal Wire Diameters. Trends in Welding Research, Proceedings of the 8th International Conference ASM International: 626-630 (2009).