ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.2 , No.1, Pages : 118-120 (2013)
Special Issue of ICACSE 2013 - Held on 7-8 January, 2013 in Lords Institute of Engineering and Technology, Hyderabad

A Study of Shot Peening on Tensile of Welded Stainless Steel 304

Pardeep Kumar[1], Dr. J.Singh Oberoi[2], Dr. Jaswanti[3], Kumar Gaurav[4]
[1,2]Mechanical Engg Deptt,Baba Banda Singh Bhadur College of Engg & Tech, Fatehgarh Sahib, Punjab, India
pardeeponnet40@gmail.com; jpsoberoi@gmail.com
[3]Electrical Engg Deptt, Chd. College of Engg. & Tech,Chandigarh, India. jaswanti98@yahoo. co.in
[4]Quality Manager,M/s Dayton Phoenix Electricals,India P. Ltd.

ABSTRACT

Austenitic stainless steel AISI 304 usually forms irregular weld beads during butt welding. Initiation of cracks is dependent on surface and near-surface conditions so that local stress field caused by surface roughness is important. Shot peening is a cold working process that changes micro-structure as well as surface characteristics in the surface layer. In the present work, the controlled shot peening has found to improve various mechanical properties such as surface roughness, hardness, tensile strength and fatigue strength of the welded joint. Double shot peening has been used as a low cost and simple method for increasing the surface finish of the welded joint. Double shot peening was done on the welded plates in which, heavy shot peening of 0.6mm cast steel balls at Almen intensity of 6A, was followed by micro-ball shot peening at low Almen intensity of 1A. This resulted in decrease of Ra by 0.6 to 0.7 microns as well as uniform surface finish of welded joints. The paper discusses the effect of shot peening on the butt welded joint.

Key words : Welded joint, Shot peening.

1. INTRODUCTION

Shot peening is a method of cold working in which compressive stresses are induced in the exposed surface layer of metallic parts by the impingements of a stream of cast steel shots directed at the metal surface at high velocity under controlled conditions. The major applications are related to improvement and restoration of mechanical properties and reliability of machine element by increasing their hardness, tensile strength surface finish, impact strength, fatigue strength etc. It is applicable to ferrous and non-ferrous parts but is mostly used on steel surfaces. Shot peening consists of throwing hardened steel balls at the surface to be peened. The steel balls, or shots, are thrown against the surface either by compressed air or by centrifugal force as rotating wheel fires the shot. The intensity of the process can be varied by regulating the size of shot, the hardness of shot, and the speed at which it is fired and the length of time, the work is exposed to the shot. The result of the interaction of material parameters with the shot peening parameters is generation of a residual stress, strain hardening of the weld surface and sub surface layers, changes in the microstructure and substructure of material, changes in surface condition and hardening characteristics of the material.

Mitsubayashi. M. et al. [1] suggested a method to improvement in fatigue strength by shot peening and selection of most effective peening condition. Shaw B.A. et al. [2] illustrated the role of residual stress on the fatigue strength of high performance gearing. Aggarwal et al.[3.4] found that the controlled shot peening improves hardness, causes relaxtion of residual stress and increases fatigue strength of EN45A spring steel. Austenitic stainless steel cannot be hardened by any form of heat treatment, in fact, quenching from 1000˚C merely softens them [5].

Shot peening is beneficial in the improvement of combined bending and torsional fatigue of the welded joint. The improvement in fatigue life was upto 100% [6].

In the present work, the controlled shot peening has found to improve various mechanical properties of the welded joint. Double shot peening has been used as a low cost and was done on welded plates in which, heavy shot peening of 0.6mmcast steel balls at Almen intensity of 6A, was followed by micro-ball shot peening at low Almen intensity of 1A. This resulted in increase in surface finish of welded joints. The paper discusses the effect of double shot peening on surface characteristics of the butt welded joint.

2. EXPERIMENTAL SETUP

The work piece Austenitic stainless steel-304 Grade was prepared according to ASTM A370 standard for various tests. For testing i.e tensile test and surface roughness test a flat plate of Austenitic Stainless steel- 304 grade having 920mm length, 100mm width and 10 mm thickness was taken as shown in figure 1. The composition is shown in table 1.

Table 1: Chemical composition of austenitic stainless steel - 304.

Steel	C	Si	Mn	P	S	Ni	Cr
304	.08	0.75	3.0	0.042	0.03	10	18

Then this work piece is divided in to two parts i.e. in the length of 460mm with the help of power hacksaw machine with special cutting blade used for cutting Stainless Steel as shown in figure 2.

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.2 , No.1, Pages : 118-120 (2013)
Special Issue of ICACSE 2013 - Held on 7-8 January, 2013 in Lords Institute of Engineering and Technology, Hyderabad

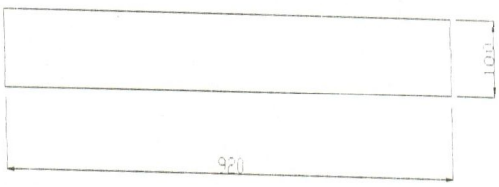

Fig.1: Austenitic stainless steel-304 plate of 10mm thickness.

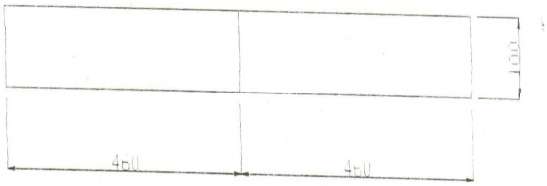

Fig. 2: Parting of 10mm thick plate.

After parting in two parts these two pieces were butt welded as shown in figure 3. Edge preparation was done before welding. Single V joint was prepared because it was used for the steel thickness 8 - 16mm for arc and gas welding. The work piece was cleaned before welding with the help of wire brush to remove any dust or oil etc. Arc welding was used to join these pieces. A special electrode was used for welding stainless steel - 304 grade. ESAB made electrode was used for welding stainless steel , which is used for welding stainless steel up to 308 grade.

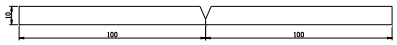

Fig.3. Edge Preparation (all dimensions are in mm).

After welding specimen were prepared for tests (Tensile test & Surface roughness test) as per ASTM A370 standard. The material was cut in different pieces with the help of power Hacksaw machine. The first part and the last part was scrap because the initiation and stoppage of welding may have defects.

Different specimens were prepared for tensile test as shown in figure.4. These specimens were required to perform the test for shot peening and double shot peening.

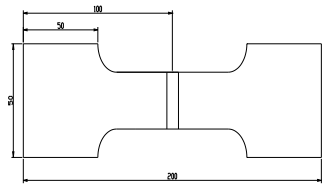

Fig.4: Specimen for Tensile Test

The shape and size of work piece for surface roughness was given in figure 5.

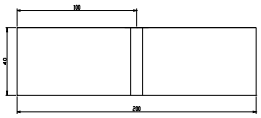

Fig.5: Specimen for Surface Roughness Test

The shot peening was done by using centrifugal wheel. The cast steel shots of 0.6mm diameter were used to shot peen the specimens. An Almen strip of size 76mm X 19mm X 1.3mm thick was used to measure the intensity of shot peening [5]. The specimens were shot peened at an intensity of 6A on Almen gauge. This is followed by low Almen intensity of 1A for double shot peening.

3. RESULT AND DISCUSSIONS

A. Tensile Strength

The sample was stretched slowly by fixing it in two jaws until it brakes. It was found that the tensile strength of short peened sample was higher than that of un-shotpeened sample (Table 2). This was due to the induction of residual stress upto certain depth of the surface by shot peening. The mean values of tensile strength were shown in figure 6 at 4 point. It was also found double shot peening does not much effect on the tensile strength but it improves the surface finish of the specimen.

TABLE 2. SHOT PEENED SAMPLE

S. No.	Untreated sample	Shot peened samples	
	Tensile Strength (MPa)	Tensile strength of shot peened sample (MPa)	Tensile strength of double shot peened samples (MPa)
1	512.24	572.34	568.63
2	506.47	561.27	553.32
3	515.28	580.21	571.47
4 (mean)	511.33	571.27	564.47

ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.2 , No.1, Pages : 118-120 (2013)
Special Issue of ICACSE 2013 - Held on 7-8 January, 2013 in Lords Institute of Engineering and Technology, Hyderabad

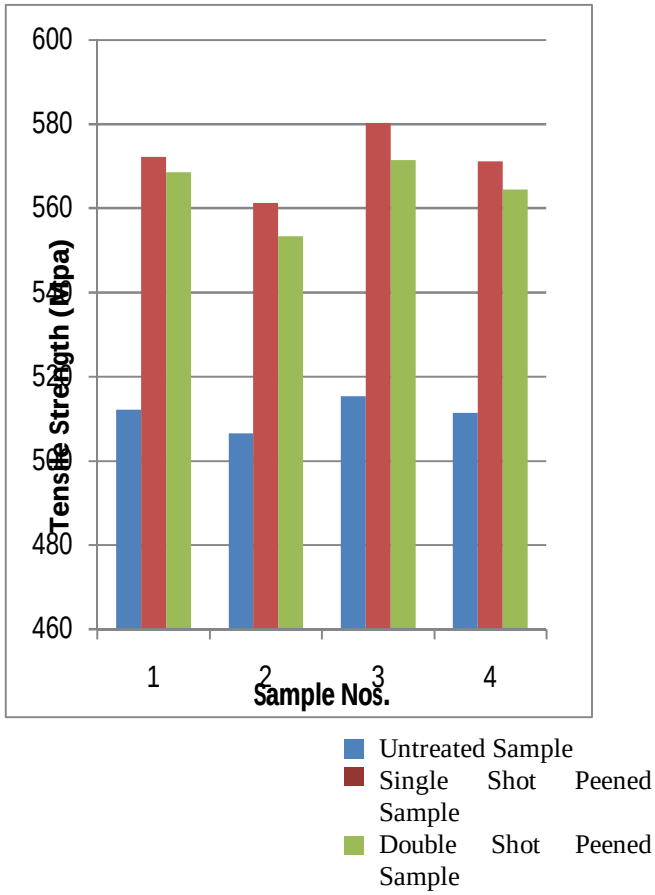

Fig.6: Tensile strength for different samples

B. Surface Roughness

The surface of a part was its exterior boundary and the surface irregularities consist of numerous wedges and valleys that deviate from a hypothetical nominal surface. Average samples were found to be less as compared with the shot peened samples (table 3).

TABLE 3: SURFACE ROUGHNESS VARIATION

S.No.	Average surface roughness (um)	
	Primary shot peening (6A)	Double shot peening (1A)
1	4.29	3.61
2	4.34	3.86
3	4.37	3.78
4 (mean)	4.33	3.75

It was found that the improvement in surface finish of shot peened samples increases the fatigues life. Surface roughness was reduced by double shot peening. In double shot peening, primary shot peening (6A) is followed by micro-ball shot peening of intensity 1A. For double shot peening zirconium shots of 1-6 microns were used. Double shot peening reduced the surface roughness by approximately 0.6 to 0.7 microns. The improvement in surface finish after double shot peening further helps in improving the fatigue strength.

4. CONCLUSION

In this present paper work welding of 304 Stainless Steel is done. The specimens made are as per ASME standard A370, as per this standard tensile test specimens were prepared for tensile test. Arc welding is used for welding; a special electrode made of EASB used for Stainless Steel 304 is used. The electrode is coded with SS 308 and having no. 10, means it is used for welding Stainless Steel upto 308 grades. The specimens made were single shot peened. The tensile strength is improved after shot peened.

The paper has accomplished the following for welded austenitic stainless steel-304:

1. Shot peening improves the tensile strength of the welding joint.
2. Shot peening improves the surface finish of the welded joint.
3. It was also found double shot peening does not much effect on the tensile strength but it improves the surface finish of the specimen.
4. Double shot peening reduces the surface roughness without significant change in residual stress.

REFERENCES

1. M.Mitsubayashi., T. Miyata And H. Aihara. **Prediction of improvement in fatigue strength by shot peening and selection of most effective peening condition,** *Trans. Jpn Soc. Mech. Eng. Ser A*, Vol. 61, pp 1172-1178, 1995.
2. B. A Shaw, C.Aylott, P.O.Hara and K.Brimble.**The role of residual stress on the fatigue strength of high performance gearing,** *International Journal of Fatigue*, Vol. 25, 2003, pp 1279-1283.
3. M.L Aggarwal, R.A.Khan and V.P.Agrawal. **A stress approach model for predicting fatigue life of EN45A spring steel**, *International Journal of Fatigue*, Elsevier Publication 28 (12), 2006, pp1845-1853.
4. M.L. Aggarwal, R.A. Khan and V.P Agrawal. **Effect of surface roughness on fretting fatigue behaviour of EN-45A spring steel leaf springs**, *Journal of Engineering Manufacture*, Institution of Mechnical Engineers UK, Vol.220(8), 2006, pp1325-1333. (www.pepublishing.com).
5. M.L. Aggarwal. **Shot peened high nitrogen austenitic stainless steel: an alternate to Ni rich austenitic steel for medical applications**, *International Journal of Materials and Product Technology* (Accepted), 2008.
6. V.S. Nandkarni, M.C. Sharma. **Behaviour of shot peened electron beam welded stainless steel plate samples under combined reverse torsional and bending cyclic stress**, *7th international conference on shot peening*, Poland, pp 161-166.