WELDING AND WEAR TEST PERFORMANCE OF EN MATERIALS

A. Vignesh[1],G. Vijayakumar[2],S. B. Selvakumar[3],S. Ramesh[4]
UG Student, Department of Mechanical Engineering, Arjun College of Technology, Coimbatore
UG Student, Department of Mechanical Engineering, Arjun College of Technology, Coimbatore
UG Student, Department of Mechanical Engineering, Arjun College of Technology, Coimbatore
Assistant Professor, Department of Mechanical Engineering, Arjun College of Technology, Coimbatore

Abstract - *To analysis the wear test on the en materials like EN- 8, EN - 24 and EN - 31.We are taken in the three type of en materials and cutting the materials at particular dimensions for the purpose of welding. After finishing the welding process, the materials will be tested on the industrial laboratory***.** *Wear is the damaging, gradual removal or deformation of material at solid surfaces. Causes of wear can be mechanical (e.g., erosion) or chemical (e.g., corrosion). Electrical arc welding is the procedure used to join two metal parts, taking advantage of the heat developed by the electric arc that forms between an electrode (metal filler) and the material to be welded. . The arc welding is a fusion welding process in which the heat required to fuse the metal is obtained from an electric arc between the base metal and an electrode. The electric arc is produced when two conductors are touches together and then separated by a small gap of 2 to 4 mm, such that the current continues to flow, through the air. The temperature produced by the electric arc is about 4000°C to 6000°C.*

Key words: EN Materials, Electric arc welding and Wear test.

I. INTRODUCTION

Wear is the damaging, gradual removal or deformation of material at solid surfaces. Causes of wear can be mechanical (e.g., erosion) or chemical (e.g., corrosion).The study of wear and related processes is referred to as tribology. Wear of metals occurs by plastic displacement of surface and near-surface material and by detachment of particles that form wear debris. The particle size may be vary from millimeters to nanometers. The wear rate is affected by factors such as type of loading (e.g., impact, static, dynamic), type of motion (e.g., sliding, rolling), and temperature. First of all, metal pieces to be weld are thoroughly cleaned to remove the dust, dirt, grease, oil, etc. Then the work piece should be firmly held in suitable fixtures. Insert a suitable electrode in the electrode holder at an angle of 60 to 80° with the work piece. Select the proper current and polarity. The spot are marked by the arc at the places where welding is to be done. The welding is done by making contact of the electrode with the work and then separating the electrode to a proper distance to produce an arc. When the arc is obtained, intense heat so produced, melts the work below the arc, and forming a molten metal pool. A small depression is formed in the work and the molten metal is deposited around the edge of this depression. It is called arc creator. The slag is brushed off easily after the joint has cooled. After welding is over, the electrode holder should be taken out quickly to break the arc and the supply of current is switched off.

- En - 8 (080M40) medium strength steel that is suitable where good all- round performance is required.
- Much better quality compare than en-3, but with the drawback of machinability.
- En-24, also known as 817M40.It is also known as high strength alloy steel.
- EN - 31 is an unalloyed medium carbon steel. The hardness obtained after hot rolling or cold drawing, with a hardness normally within the range of 180 to 230HB.

II. METHODOLOGY

EN-8:

- En - 8 (080M40) medium strength steel that is suitable where good all- round performance is required.
- Much better quality compare than en-3, but with the drawback of machinability.

Common uses of EN-8 materials:

- Hydraulic rams (chromed).
- Key steel.
- Medium torqued shafts.
- Medium bending and compression loading applications. Good corrosion resistance.

Not suitable for:

- High shock loads as the material tends to shear under extreme conditions. High bending forces.

Chemical compositions of EN-8 steel:

Carbon - 0.36 to 0.44%

Silicon - 0.10 to 0.40%

Manganese - 0.60 to 1.00%

Sulphur - 0.050 max **Applications:**

- General purpose axles,
- Shafts,
- Gears,
- Automotive and general engineering components, ➢ Bolts and studs.

EN-24:

En-24, also known as 817M40.It is also known as high strength alloy steel.

Properties:

- Easy to heat treat and temper.
- Good combination of strength, ductility and wear resistance. Equivalent to AISI 4340.

Chemical composition:

Carbon - 0.36 - 044%

Magnesium - 0.45 - 0.70%

Silicon - 0.10 - 0.35%

Molybdenum - 0.20 - 0.35%

Chromium - 1.00 - 1.40% **Applications:**

- Aircraft and heavy vehicle crank shafts,
- Connecting rods and chain parts, ➢ Cam shafts and propeller shafts, ➢ Screws, studs and pinion.

EN - 31:

- EN - 31 is an unalloyed medium carbon steel.
- The hardness obtained after hot rolling or cold drawing, with a hardness normally within the range of 180 to 230HB.

Chemical compositions of EN-31 steel:

Carbon - 1.00%

Silicon - 0.20%

Manganese - 0.50 %

Chromium - 1.40% **Applications:**

- Ball and roller bearings,
- Punches and dies, ➢ Beading rolls, ➢ Spinning tools.

III. EXPERIMENTAL SETUP

Welding of EN material by using Electric arc welding:

The welding machine used can be A.C. or D.C. welding machine. The A.C. welding machine has a step-down transformer to reduce the input voltage of 220- 440V to 80-100V. The D.C. welding machine consists of an A.C. motor-generator set or diesel/petrol engine-generator set or a transformer-rectifier welding set. A.C. machine usually works with 50 hertz or 60 hertz power supply. The efficiency of A.C. welding transformer varies from 80% to 85%. The energy consumed per Kg. of deposited metal is 3 to 4 kWh for A.C. welding while 6 to 10 kWh for D.C. welding. A.C. welding machine usually work with low power factor of 0.3 to 0.4, while motor in D.C. welding has a power factor of 0.6 to 0.7. The following table shows the voltage and current used for welding machine.

Table 1-Voltage and current for welding machine

Current (Amp.)	Voltage (volts)
50 to 100	15
100 to 250	20
200 to 250	25
250 to 350	30
350 to 450	35

Arc Welding with a Coated Electrode

A metal electrode is used which supplies the filler metal. The electrode may be flux coated or bare. In case of bare electrode, extra flux material is supplied. Both direct current (D.C.) and alternating current (A.C.) are used for arc welding. The alternating current for arc is obtained from a step down transformer. The transformer receives current from the main supply at 220 to 440 volts and step down to required voltage i.e., 80 to 100 volts. The direct current for arc is usually obtained from a generator driven by either an electric motor, or patrol or diesel engine. An open circuit voltage (for striking of arc) in case of D.C. welding is 60 to 80 volts while a closed circuit voltage (for maintaining the arc) is 15 to 25 volts.

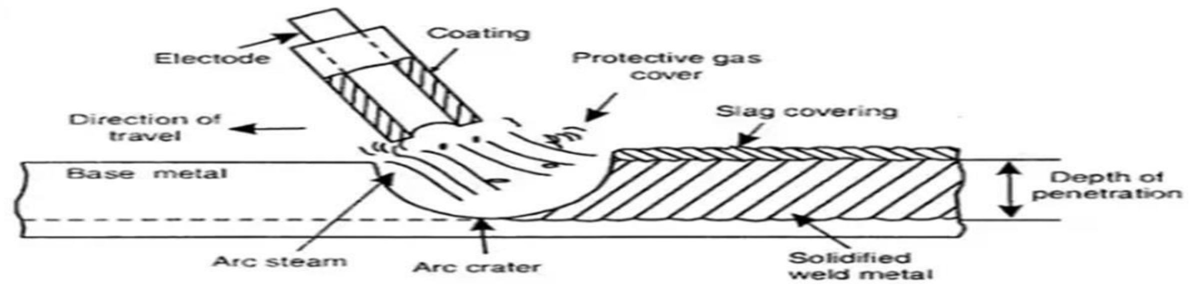

Fig.1 Arc welding with a coated electrode

Wear analysis:

Wear is a process of removal of material from one or both of two solid surfaces in solid state contact. As the wear is a surface removal phenomenon and occurs mostly at outer surfaces, it is more appropriate and economical to make surface modification of existing alloys than using the wear resistant alloys.

Three levels of wear testing:

- Laboratory test,
- Component simulation test, In - service test.

PIN-ON-DISC TEST

Initially, pin surface was made flat such that it will support the load over its entire cross-section called first stage. This was achieved by the surfaces of the pin sample ground using emery paper (80 grit size) prior to testing Run-in-wear was performed in the next stage/ second stage. This stage avoids initial turbulent period associated with friction and wear curves Final stage/ third stage is the actual testing called constant/ steady state wear. This stage is the dynamic competition between material transfer processes (transfer of material from pin onto the disc and formation of wear debris and their subsequent removal). Before the test, both the pin and disc were cleaned with ethanol soaked cotton (Surappa et al 2007) 87. Before the start of each experiment, precautionary steps were taken to make sure that the load was applied in normal direction.

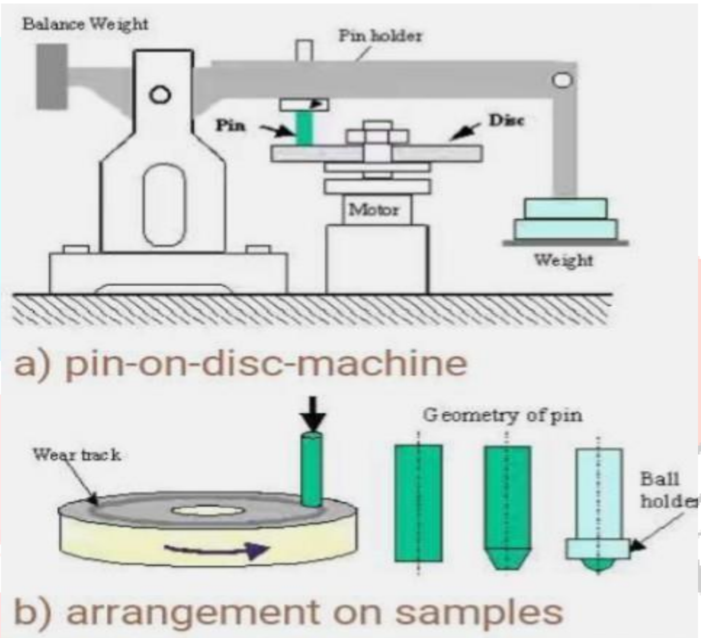

Fig.2 Pin on Disc Machine

Wear measurement/Quantification:

Wear measurement is carried out to determine the amount of materials removed after a wear test.

- Mass loss
- Volume loss
- Linear dimension loss

Mass loss:

Mass loss measurement by a precision balance is a convenient method for wear measurement, especially when the worm surface is irregular and unsymmetrical in shape. Sample to be measured is carefully cleaned, and the weight is measured before and after a wear test. The difference in weight before and after test represents the weight loss caused by wear. The unit can be gram (g) and milligram.

Volume loss:

Wear volume is normally calculated from the wear track depth, length, width and/or scar profile according to the geometry of the wear track/scar. A surface profilometer, e.g. a stylus type, or sometimes a microscope with scale is used for the measurement. The reporting unit of wear volume loss is mm3.In this case, the volume loss is calculated if the materials is uniform and its density is known.

Linear dimension loss:

Measuring wear by linear dimension change is very useful in many engineering situations, where certain dimensions such as length, thickness or diameter is more critical to the normal function of the system. A surface profile meter, e.g. a stylus type, a micrometer or a microscope can be used. The unit of linear dimension loss can be mm.

Wear rate calculation:

Wear rates are calculated results reflecting wear mass loss, volume loss or linear dimension change under unit applied normal force and/or until sliding distance. Wear rate can be expressed in many different ways.

FORMULA

Wear rate = volume/load* sliding distance

Example calculation:

Wear rate = volume/load* sliding distance

Volume = length*breadth*height

Volume = 6*5*24

=720mm3

Wear rate = 720/ (50*810.1)

=0.01777mm3/N-m

IV. CONCLUSION

WEAR ANALSIS OF WELDED FERROUS MATERIAL

WEAR ANALYSIS ON EN8

SI NO	TIME (sec)	WEAR(µm)	FRICTION FORCE (N)	COEFFICIENT OF FRICTION
1.	0	-14.67	2.08	0.63
2.	60	10.78	36.57	0.62
3.	120	41.39	40.03	0.63

WEAR ANALYSIS ON EN24

SI NO	TIME (sec)	WEAR(µm)	FRICTION FORCE (N)	COEFFICIENT OF FRICTION
1.	0	0.38	3.45	0.53
2.	60	102.34	41.98	0.53
3.	120	142.34	34.89	0.54

WEAR ANALYSIS ON EN31

SI NO	TIME (sec)	WEAR(µm)	FRICTION FORCE (N)	COEFFICIENT OF FRICTION

1.	0	-17.36	10.09	0.41
2.	60	10.78	51.36	0.41
3.	120	41.39	48.65	0.42

V. REFERENCES

1. Chattopadhyay, R. (2001). Surface Wear - Analysis, Treatment, and Prevention. OH, USA: ASM-International. ISBN 0-87170-702-0.
2. Akchurin, Aydar; Bosman, Rob; Lugt, Piet M.; Drogen, Mark van (2016-0616). "Analysis of Wear Particles Formed in Boundary-Lubricated Sliding Contacts". Tribology Letters. 63 (2): 16. doi:10.1007/s11249-016-0701-z. ISSN 1023-8883.
3. Davis, J.R., ed. (1998). Metals Handbook: Desk Edition. ASM International.
4. Varenberg, M. (2013). "Towards a unified classification of wear". Friction. 1 (4): 333–340. doi:10.1007/s40544-013-0027-x.
5. Williams, J. A. (2005). "Wear and wear particles - Some fundamentals." Tribology International 38(10): 863-870
6. Rabinowicz, E. (1995). Friction and Wear of Materials. New York, John Wiley and Sons.
7. Cary, Howard B; Helzer, Scott C. (2005). Modern Welding Technology. Upper Saddle River, New Jersey: Pearson Education. ISBN 0-13-113029-3.
8. Kalpakjian, Serope; Steven R. Schmid (2001). Manufacturing Engineering and Technology. Prentice Hall. ISBN 0-201-36131-0.
9. Lincoln Electric (1994). The Procedure Handbook of Arc Welding. Cleveland: Lincoln Electric. ISBN 99949-25-82-2.
10. Weman, Klas (2003). Welding processes handbook. New York, NY: CRC Press LLC. ISBN 0-8493-1773-8.