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INVESTIGATION FOR DEFECTS IN HARDFACING OPERATION AS A PART OF DUAL PLATE CHECK VALVE MANUFACTURING –A REVIEW

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Abstract

The non-return valves specially dual plate check valves are used in many application such as in petrochemical industries, refinery, oil & gas petroleum and cooling water application. It is applicable in downward stream of pump preventing flow reverse, in wellhead injection lines, for oil rings and platforms, in gas and oil processing plants and refinery on delivery/discharge side of pumps, for LNG & chemical storage tank, use on discharge side of pump to prevent the backflow. However since the weld bead geometry necessary for the valve plates & seats to reduce the cost of material because, by this mean the base metal with low cost is used with the sufficient accuracy & life of overlapping surfaces. Hence the geometric accuracy of weld is necessary & expansive process the correct grouping of parameters with counter to weld bead geometry is required. By analysis of different parameters & their control on hardfacing process we can build up new improved & economical process. By which we can get optimum weld bead geometry as well as surface finish with grinding allowance. We are going to take Welding

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voltage, Welding Current and wire feed rate for analysis. Deep study of these parameters will give us idea about its influence on process.

Keywords– *GMAW, PAW, SAW, Valve plates, Valve seats, Weld bead geometry, pinhole*

1. Introduction

Wear is the predominant factor that controls the life of any machine part. Metal parts often fail their intended use not because they fracture, but because they wear, which causes them to lose dimension and functionality. Different categories of wear exist, but the most typical modes are – Abrasion, Impact, Metallic (metal to metal), Heat, Corrosion etc. Most worn parts don't fail from a single mode of wear, such as impact, but from a combination of modes, such as abrasion and impact etc. Research is going on over years to reduce the wear either in the form of using a new wear resistant material or by improving the wear resistance of the existing material by addition of any wear resistant alloying element etc. Many methods are in practice. In the last years hardfacing became an issue of intense improvement related to wear resistant applications [1].

The agricultural machinery parts soil assets are subject to pronounced wear that can cause damage and failure in operation for its intended objectives. Friction processes involved in the processing of the soil are complex processes that depend on the nature of the materials used, the soil composition and operating manner [2].

Bead geometry in the arc welding process is an important factor in determining the mechanical characteristics of the weld. Bead geometry variables, such as bead width, bead height, and penetration depth, are greatly influenced by welding process parameters including welding current, welding voltage, shielding gas, and contact tube-to-work distance (CTWD). The selection of the appropriate welding process parameters is required in order to obtain the desired weld bead geometry, which greatly influences weld quality. However, costly and time-consuming experiments are required in order to determine the optimum welding process parameters due to the complex and nonlinear nature of the welding process. Therefore, a more efficient method is needed to determine the optimum welding parameters [3].

Automatic weld surfacing is being employed increasingly in the process, mining and power industries. Gas metal arc welding has become a natural choice for automatic surfacing due to its important properties. These include: high reliability, all positions capabilities, ease of use, low cost and high productivity. With growing use of gas metal arc welding in its automatic mode, the use of mathematical models to predict the dimensions of the weld bead has become compulsory [4].

Weld deposition of hardfacing alloys is commonly employed to enhance the tribological life of Engineering components subjected to hostile environments. The reclamation of worn out metal parts is demanded worldwide and for this demand PTA hardfacing of hard, wear resistant thin surface layer of metals and alloys on suitable substrates is one of the proven surfacing techniques [5].

1.1. Welding Processes

Hardfacing can be applied by a number of welding processes. Selection of the most suitable welding process will depend on following factors like: Nature of Work to be Hardfaced, Function of the component, Base metal composition, Size and shape of component, Accessibility of Weld equipment, Number of same or similar items to be hardfaced etc [1]. Generally in most cases hardfacing is done by GMAW (Gas Metal Arc Welding) and SAW (Submerged Arc Welding).

Other welding processes such as shielded metal arc welding (SMAW), gas tungsten arc welding (GTAW), and flux cored arc welding (FCAW) are used only for small areas or for repairs to overlays made using GMAW and SAW. The quality of SMAW and FCAW overlays is generally poorer than that of GMAW or SAW overlays.

1.1.1. Gas Metal Arc Welding

Manual MIG welding is usually carried out in the lower power levels (< 400 A) because of the weld pool size, arc radiation and the heat developed. At higher power levels, fully mechanised or automatic equipment is employed [6].

A schematic of the GMAW process is illustrated in Figure-1. This process typically operates at current in the range of 110 –450 amperes. The speed of the wire from the torch is controlled by an automatic wire feeder. An auxiliary shielding gas is used to protect the molten weld pool.

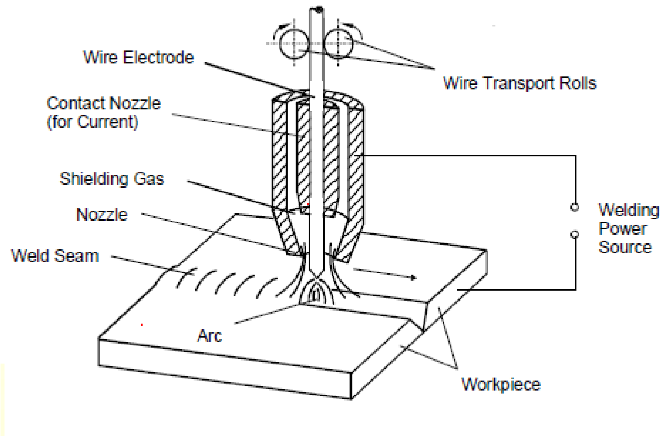

Figure-1 GMAW process [6].

The continuously fed electrode of the GMAW process produces deposition rates which are typically higher than the non-consumable processes. In the non-consumable processes, much of the heat generated at the electrode is carried away by the cooling water which flows through the torch. This loss of energy represents an inefficiency of energy transfer to the base metal. With the consumable electrode processes, the heat generated at the electrode is transferred directly to the base metal when the electrode is deposited as weld metal. In addition, the continuously fed electrode permits the use of higher currents.

1.1.2. Submerged Arc Welding

In this technique granular flux and copper coated electrode is used. Arc between the electrode and job is the heat source and residues buried under the flux. The flux serves as a shield and protects the molten weld pool from atmospheric corruption. This process may be automatic or semi-automatic [7].

1.1.3. Plasma Arc welding

It is an process wherein coalescence is produced by the heat obtained from a constricted arc set up between a tungsten electrode and the job(non-transferred arc) or between a tungsten electrode and the job(transferred arc). The process employs two inert gases; one forms the arc plasma and the second shield the arc plasma. Filler metal may or may not be added and pressure not employed normally [7].

1.2. Weld Bead Geometry

1.2.1. Reinforcement(R)

As shown in figure-2 the reinforcement is well-defined as the maximum distance between the base metal level and the top point of the deposited metal.

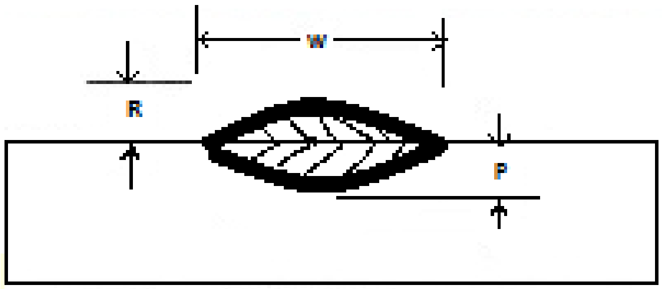

Figure-2 Weld Bead Geometry

1.2.2. Penetration (P)

As shown in figure-2 the distance between the base metal plate top surface and depth to which the fusion takes place.

1.2.3. Weld bead width (W)

As shown in figure-2 maximum width of filler metal deposited.

1.3. Effort Variables

Effort variables are the welding process parameters, whose effects upon the performance measures are tested in the experiments to be directed. In every process, there are some inputs which may be renewed into desired outputs or response by funds of some process through control factors [8].

1.4. Response Variables

Response variables are the performance events, which can also be termed as output variables or output parameters [8].

2. Literature Review

Hard facing history began ninety years ago when two brothers in a small California shop were experimenting with a new weld overlay process at a time no one else had even heard of the concept. Ninety years ago, no one had even heard of the concept. But in a small shop in Whittier, CA, two brothers were experimenting with a new weld overlay process. The result hard facing history began. The basic aim of hardfacing is to improve or extend the life of various components used across the industry owing to the high cost of replacement of original part. Most of the work was carried out on wear, because hardfacing is mainly done for wear resistance of parts. [Bell et al. (1972)] Gas welding is often a convenient and relatively inexpensive method of applying wear-resistant surface coatings.

[D. KIM et al., 2005] This study proposes a method for determining the near-optimal settings of welding process parameters using a controlled random search (CRS) wherein the near-optimal settings of the welding process parameters are determined through experiments. The method suggested in this study is used to determine the welding process parameters by which the desired weld bead geometry is formed in gas metal arc (GMA) welding.

[S. Selvi et al.(2008)] investigated the hard facing of valve seat ring is done by manual metal arc welding (MMAW) process. The main aim of the hard facing is chosen here as a method of repairing or improving or extending the service life of the valve seat ring economically is to provide excellent wear resistance, increasing hardness and better corrosion resistance.

[P K Palani et al. (2009)]The DOE using Taguchi approach can significantly reduce time required for experimental investigations. In this investigation, in the first stage, Taguchi's orthogonal arrays were used to conduct the experiments to find the contributions of each factor and to optimize the parameter settings. [K. Siva et al. (2009)] aims to Modelling, analysis and optimization of weld bead parameters of nickel based overlay deposited by plasma transferred arc surfacing. The shape of weld bead geometry affected by the PTA Welding process parameters is an indication of the quality of the weld. The experiments were conducted based on a five factor, five level central composite rotatable design and a mathematical model was developed using multiple regression technique. The direct and interaction effects of input process parameters of PTA Hardfacing on weld bead geometry are discussed. [R. Chotěborský et al(2011)]aims to Effects of MIG process parameters on the geometry and dilution of the bead in the automatic surfacing. The development of mathematical equations using a four factor central factorial technique to predict the geometry of the weld bead in the deposition of OK Tubrodur 15.43 electrode onto structural steel S235JR is discussed. [Farhad Kolahan et al., 2011]By minimizing such a function, the process parameters can be determined so as the resultant bead geometry has the least deviation from its desired value. [K. Abbasi et al.(2012)]aims at the evaluation of depth of penetration and weld width by employing different MIG welding parameters.

When welding speed is taken as variable parameters, penetration depth increases with increase in speed up to an optimum value, and if the heat input is taken into consideration the depth of penetration increases with increase in heat input, and also welding speed increases the penetration depth increases until optimum value is reached, at which penetration depth and shape factor are optimum. Beyond that speed penetration depth and shape factor start decreasing [9].In this study, the effects of cutting edge geometry, work-piece hardness, feed rate and cutting speed on surface roughness and resultant forces in the finish hard turning of AISI H13 steel were experimentally investigated. Four-factor (hardness, edge geometry, feed rate and cutting speed) two-level fractional experiments were conducted and statistical analysis of variance was performed. During hard turning experiments, three components of tool forces and roughness of the machined surface were measured. This study shows that the effects of work-piece hardness, cutting edge geometry, feed rate and cutting speed on surface roughness are statistically significant. Especially honed edge geometry and lower workpiece surface hardness resulted in better surface roughness. Cutting-edge geometry, workpiece hardness and cutting speed are found to be affecting force components [2].

3. Problem Formulation

They are hardfacing on the valve seats and plates (figure-3 and figure-4), which are together in contact with each other for corrosion resistance and wear resistance purpose. After the investigation of whole process some problems are found as follows:

- Pinhole(figure-6)
- Poor surface finish
- Higher consumption of material
- Irregular weld bead geometry
- Lengthy process

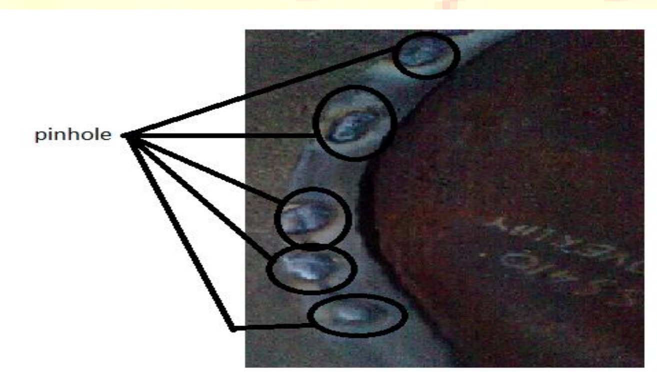

Figure-6 Welded plate

4. Conclusion

The conclusion of this research paper as a future goals of my proposed dissertation work are as follows:

- To optimize the parameters the taguchi method can be used.
- By optimization and selection of proper parameters, above mentioned defects can be improved without or negligible affecting properties of weld.
- To optimize the welding parameters and weld bead geometry
- To reduce the number of passes required
- To reduce the pinhole
- To reduce the filler metal consumption
- To increase the Productivity
- To reduce the cost of Operation

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