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EFFECT OF WELDING PROCESS PARAMETERS ON BEAD GEOMETRIC CHARACTERISTICS - A REVIEW

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ABSTRACT
This is a review paper of the effect of welding parameters on bead geometry characteristics of the submerged arc welding process besides its methods of manufacturing and characteristics of fluxes used. The main objective of this review is to ensure the quality of the weld joint and to improve the weld strength as there is an indication of impurities involves in the molten metal during the welding process and influences of welding parameters result in poor quality. The various welding parameters such as bead width, height, current setting, grove angles, and penetration are the major factors that influence the mechanical properties in the weld joint. To overcome the joint quality, series of research has been carried and identified the various parameters that influence bead geometry. Thus, the review paper will provide the summery of experiments and investigation by researchers on various welding parameters and preventive measure on the weld joint process.
KEYWORDS: Submerged arc welding, flux, weld bead geometry, weld strength and Influence

INTRODUCTION
The welding is a metal to metal joining process using electricity to create enough heat to melt metal and the melted metals solidify result in a binding of the metals. In this process of welding, the arc is formed between the actual work and an electrode (stick or wire) that is manually or mechanically guided along the joint. Most welding in the manufacture of steel products uses the second type of electrode. The electrode is coated by flux to reacts with the impurities in the molten weld metal to form a slag, which floats over the surface of weld metal. It deposits a layer of slag over the molten weld metal to increased protection of weld metal from atmospheric gas contamination and improved mechanical properties in a weld joint. Arc Welding is a high-quality welding process with a high deposition rate in the flat position. What so ever, it is noteworthy to choose correct filler material, shielding gas and welding parameters, which result in stable welding process without the appearance of welded joint failures and quality deviations. The paper is further arranged, section II contains a literature review, Second III contains Conclusion and section IV contains acknowledgment.

LITERATURE REVIEW
(V. Gunaraj& N. Murugan, 2000)[1] 'Prediction and Optimization of Weld Bead Volume for the Submerge Arc Process', It emphasized to use Submerged Arc Welding (SAW) as it is one of the chief metal-joining processes employed in most of the industry and the manufacture of steel pipes. In this mainly focused on the analysis of various process control variables and important of weld bead quality in SAW of pipes manufactured out of structural steel (IS: 2062). In this experimental on the weld bread, plates (IS 2062 carbon steel of 6mm thickness) has been taken with 3.15 mm diameter of steel electrode. The models were developed using the five-level factorial technique to relate the important process control variables like penetration, reinforcement, bead width, the total volume of the weld bead and dilution. Using this model, it determined the quantitative and graphically interaction effects of the process-control variables on bead geometry parameters.

(P. Kanjilal, et. al., 2007) [2]'Prediction of Element Transfer in Submerged Arc Welding' In this the authors studied the transfer of elements across the molten weld pool by developing quadratic models in terms of flux ingredients with the application of statistical experiments for mixture design. As a result, it has shown

some of the individual flux ingredients and their binary mixtures have a predominant effect on weld metal transfer of oxygen, manganese, silicon, and carbon contents. The analysis of experimental data indicates the transfer of oxygen is affected by several properties of flux ingredients such as oxygen potential, thermodynamic stability, and viscosity.

(S. Kumanan et. al., 2007)[3]'Determination of submerged arc welding process parameters using Taguchi method and regression analyses'. It works on the application of Taguchi technique and regression analysis to determine the optimal process parameters for submerged arc welding. They carried experiments on semiautomatic submerged arc welding machine and the signal-to-noise ratios to determine the optimum parameters. Analysis of variance (ANOVA) technique, multiple regression analysis (MRA), and the mathematical model to predict the bead geometry for any given welding conditions validate.

(ŠtefanijaKlarić et. al., 2008)[4] 'MAG WELDING PROCESS - ANALYSIS OF WELDING PARAMETER INFLUENCE ON JOINT GEOMETRY'. The authors 'objective is to determine the quality of the welded joint by metal active gas (MAG) in the welding process. In general welding process depends on external influences, like a type of metal, base thickness, groove type, welding position, etc., therefore a proper selection of welding parameters is considered as a key role. The analysis of weld bead geometry at MAG welding process has been carried, respect to welding parameters such as weld current, voltage, weld speed, and shielding gas flow.

(Deepak Kumar Choudhary et. al. (2011) [5]'Study the effect of welding parameters on weld bead geometry in SAW welding processes'. The authors' studies on the effect of welding parameters on bead geometry by mathematical models with using 2- a level half-factorial technique to predict the bead geometry within the range of control parameters for single wire submerged arc welding. The models were developed from the observed values, with the help of design matrix to employ easily in automatic or robotic welding through a program to ensure high quality of welds. In these, parameters involved such as current, open circuit voltage, welding speed and nozzle-to-plate distance with the condition to be variables constant. At the end of models, penetration increases significantly with current, decreases with welding speed and remains unaffected by open circuit voltage & nozzle to plate distance.

(Chandel, Yang, and Bibby, 2013)[6] 'The Effects of Process Variables on the Bead Height of Submerged-Arc Weld Deposits' it was to determine the effect on bead width by other parameters like electrode polarity, electrode diameter, and electrode extension, welding current, welding voltage, and welding speed. With the conditions, the power source (constant voltage or current) does not affect much to the bead width as an acidic fused flux used. In other cases, the varying power sources (constant voltage or constant current) and fluxes (acidic or basic) depends on the depth of bead. To investigate the experiment it used regression equations to present computing bead height from the welding parameters, using both linear and curvilinear multiple regression analysis techniques.

(P. F. Mendez et. al., 2015) [7]'High Speed Video of Metal Transfer in Submerged arc welding' In this paper, it mainly on metal transfer in submerged arc welding (SAW). It has been captured in a video at a rate of 10,000 frames per second by inserting a thin gauge steel tunnel along the welding path. Analysis of the videos shows that at 500 A, a very chaotic, non-axial a globular metal transfer involving frequent explosions and bursts is present in both AC and DC polarities. The spectrometry instrument was used to determine the arc in the weld cavity and no obvious signs of external gas entrainment were detected. The technique presented opens range even for high-speed video analysis of metal transfer and the design of complex waveforms in SAW.

(Harish K. Arya et. al., 2015)[8] 'Effect of Welding Parameters on Penetration and Bead Width for Variable Plate Thickness in Submerged Arc Welding'. It states that the heat flow in weldment changes its

nature from 2D to 3D with the increase in plate thickness. Example as welding on thicker plates, there will be a heat loss in thickness direction increases the cooling rate of the plate, which affect the various bead parameters like bead penetration; bead height and it affected bead width. This experiment also l incorporates the effect of variable plate thickness on penetration and bead width as the penetration reduces with increase in plate thickness.

(Rakesh Ranjan et. al., 2016)[9] 'Effect of welding parameters on bead geometry of weld by GMAW process', it is to determine the effect of various welding parameters on bead geometry of mild steel specimen of 5.5mm thick welded by Gas Metal Arc welding process. The tests were conducted using CO2 for both (MAG welding) and (MIG welding) as shielding gas with a variable parameter such as the current, voltage and welding speed. The bead height and depth of penetration of individual specimen were recorded, after the welding operation. In this experiment, it was found that the joint strength in MAG welding was not very strong, and the depth of penetration increases linearly with an increase in welding current. Moreover, the maximum value of tensile strength and peak load was found to be 205.67 MPa and 63.8 KN respectively.

(G. GÖTT et. al., 2016) [10]'Optical and Spectroscopic Study of a Submerged Arc Welding Caven', it is to study on the combination of high speed and spatially resolved spectroscopy at 5000 fps on a submerged arc welding process. It used a thin gauge steel tunnel into the flux aligning to diagnostics accordingly. In this, four processes were observed; both direct current electrode positive (DCEP) and direct current electrode negative (DCEN), as well as alternating current (AC) at 600 A and DCEP with a higher current at 1000 A. It was found that a slight change in chemical composition of alloying elements for solidified weld joint when the oxygen content varied significantly in the droplet stage. Especially during the AC process, it observed, a fluctuating emission in Mn lines, which correlated with the frequency of the shifting polarity.

(Uma Gautam, 2017)[11] 'Effect of Process Parameter in Submerged Arc Welding- A Review'. The authors considered that welding is important for metal joining process since most of these welding methods like shield metal arc welding (SMAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and submerged arc welding (SAW) are used in most organizations and industries. It preferred in most of the production and manufacturing industries due to high production rate, high melting efficiency, ease of automation and low operator skill requirement. The author observed that welding parameters are the key role to affect all the methods of welding process in its weld chemistry and failure to ensure quality.

CONCLUSION

In most of the industries and manufacturing companies, there are concern and challenges in ensuring the quality of the weld joint. Much of the study and research were undertaken using different methods which includes software and other practical experiments as an approach to overcome the challenges. Looking at different sources, much of the research study results on 'the effects of various welding process variables on bead geometric' shows improper use of welding parameters as a cause leading to geometry imperfections of a weld and poor quality of weld strength. The welding parameters such as lack of penetration, high fusion width, excess bead height and types of metal result in poor load-bearing capacity. It is also learned that improper use of welding parameters lead to weld crack propagation.

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