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To Understanding the Welding tip that was used on the Welding Machine during Spot Welding: A Review

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ABSTRACT

For securing body sheet parts, for many years, the automotive and aerospace industries have employed resistance spot welding extensively. Comparing resistance spot welding to other welding techniques like arc welding, it is rapid, easy to automate, and minimal maintenance. Accurate SRW electrode heat analysis could make it possible to pinpoint key design variables that prolong electrode life. Where connected, the process is challenging. Interactions occur between mechanical, thermal, and electrical processes. Interactions occur between mechanical, thermal, and electrical processes. The finite element approach, which is capable of complicated behavior's& intricate situations, gives the strong device for comprehending these exchanges & has emerged as by far most significant technique for resistance spot welding investigation. A 2-D finite element model has been used in this work. used a method to anticipate transient thermal behaviors of electrodes for spot welding. ANSYS-FLUENT may be used to analyses the Transient Response of RSW. The example considered the relationship between temperature, phase changes during melting and solidification, applied voltage analysis, and material properties affected by heat exchange analysis. Models were developed for the connections at the electrode-work interface and the faying surface with temperature-dependent contact resistances.

Keywords: Welding, RSW, ANSYS-FLUENT.

INTRODUCTION

Every resistance welding procedure is automated, thus all of the process variables are predetermined and maintained constant. The cycle is completed according to the predefined times after the welding process has started.[1] The spot-welding cycle consists of four stages: squeeze, welds, hold, and off. These step times have been pre-set for a certain metal and a variety of thicknesses. Each one of these processes is necessary for a weld to be successful and the required size.[6]The three main resistance spot welding variables are accepted to be electrode force, welding current, and current flow time [2]. To achieve good welds in the majority of metals, these elements must be managed within incredibly strict parameters [3].The weld nugget's size is determined by the interior heating rate energization. Weld current is therefore the most crucial element. For resistance welding to be successful, the welding current must be precisely controlled.[4]The right current density may be determined using the relationship: -J = 192 + kce-ts (2) [5] Where J is the current density in A/mm2, ts is the sheet thickness in mm, e is a constant of 2.718, and for mild steel, kc is a constant of 480 [12].Weld time refers to the duration of applying a welding current to the metal sheets. Use only the bare minimum of welding time [8]. To control how long electricity flows, timers might be mechanical, pneumatic, electronic, or manual. The weld duration may need to be adjusted if the welding apparatus doesn't fulfil the requirements for the electrode force and weld current, respectively [9].A primary The electrode force's objective is to compress metallic sheets that will become unified. In addition to bringing the work pieces close together, the electrode force also reduces the initial resistance to contact at interfaces and consolidates melting metal into solid join a nugget [7][9]. Applying the electrode force mechanically, magnetically, hydraulically, or pneumatically [13][14].Transient characteristics of resistance spot welding thermal analysis simulated using the D axisymmetric resion [15].Sheet with a 1 mm thickness used as the mode [16].The three versions listed below, which correlate to different electrode shapes:

1. A flat electrode with a 15 mm diameter [16].
2. A pointed electrode with a 120° angle and a 15 mm diameter [16].
3. A dome nose electrode with a 75 mm radius of curvature and a 15 mm diameter [16].

The mechanical system, electrical circuit, contactors, and timers are the essential components of the resistance spot welding apparatus[17]

Electrode Serves: 1. For purpose of carrying the work's welding current components.
2. To be able to to endure & transfer required force on the workpieces in order to achieve an acceptable weld.[17]
3. To diffuse some of heat generated by effort and avoid surface fusion[17].

LITERATURE REVIEW

Electrical, thermal, mechanical, and metallurgical science are all applied in the process of resistance spot welding. The work piece and electrode's surface roughness affects the contact resistance between the electrode-work piece interface and the faying surface. So, compared to an unlubricated sheet, a lubricated sheet has reduced contact resistance. In the study of homogeneous aluminum alloys, nugget formation can be constrained by increasing the local current density with either a little amount of weld force or a very high contact resistance. An analysis of how pressure and temperature impact the interfacial contact behaviors, which is essential for the formation of nuggets, may help us understand electrode pitting, according to a case study by Tip. Weld quality is also impacted by sheet deformation and weld residual stress.

The right electrode shape is crucial for achieving the necessary current density. There are three primary types of electrodes available commercially for this use [18].

Pure copper cannot be utilized as an electrode material since it is soft and quickly deforms under stress while having strong electrical and thermal conductivities [09]. Tellurium and nickel are added to the material to increase its strength [18].Three models were made, each one depicting a different electrode shape: 1. A flat, 15 mm-diameter electrodes [14]. 2. A pointed electrode with a 15 mm diameter and a 120° angle [14].The desired nugget diameter determines the diameter of the electrode tip. The thickness of the sheet being welded affects the nugget diameter. The nugget size is calculated using Unwin's formula D t e 6 and is thought to be about equivalent to the electrode tip size [12].De is the electrode tip's diameter, and t is the sheet's thickness in millimeters. The electrode won't be robust enough to sustain the pressure applied through it if its entire length is formed of the same cross-section. Additionally, overheating and high electric resistance will result from this. A truncated cone with an included angle of 120–140 degrees is used to create pointed electrodes, whereas a domed electrode has the right radius [19]. The simulation studies were completed with two different sulfur concentrations, i.e., 10 ppm and 64 ppm. The interfacial strain relationship shifts altogether around these two qualities [20]. Because of oddity in the joint arrangement and the base. Because of oddity in the joint arrangement and the base metal utilized (AA6068 aluminum combination), there is minimal in the writing about tracking down process boundaries. Beginning cycle boundaries for the interaction were chosen by the Aghajani Derazkola et al. [21] and Guan et. al. [22]. The FSW apparatus plunging and leave stages were ignored in this reenactment, and the temperature and speed fields were tackled accepting consistent state conduct. During the recreation, three-layered plastic stream is addressed by the force, energy, and plastic stream preservation. The force protection condition in list documentation, with I or j = 1, 2, and 3, which compare to the x, y, and z headings[23-25].

METHOD

RSW is one of the connecting methods that businesses use the most these days. Due to its ease of automation, it is a versatile and adaptable technique of component manufacture. Therefore, in order to improve the weld quality and electrode life, researchers must constantly alter the pertinent parameters. It should be noted that the type of welding used has an impact on how much the material ultimately costs to produce. To reach this cost optimum, a variety of engineers and scientists have analyzed and modelled RSW using a variety of technologies. Nugget formation and heat-affected zones were two of these subjects that underwent much examination. These were supported by experiments. In addition to FEM, weld growth curves, graphic lobe curves, and statistical methods were also used. The Transient Response of RSW, which was first captured utilizingthermal vision Currently, High Speed Cinematography &examined employing CFD software such as ANSYS-FLUENT. Consequently, we may infer that as technology advances, spot weld analysis will become more and more useful, occasionally improving the quality of the weld [17-18].

We'll engage in the following activity during this case study time:

1. Pareto Chart
2. Why-Why Analysis

3. Brain Storming
4. Kaizen
5. Effectiveness
6. Engineering Drawing

A study that uses experimentation to illustrate the analysis of existing electrodes. Through this examination, we learned that several problems with the existing electrode surfaced throughout manufacturing.

1. Shunting: When part shunting started after a while, the spot welding tip height was damaged by around 8.0 mm.
2. At 142 rupees per tip, the price of the gratuity is excessive.
3. There is More Material Waste

We alter the tip drawing following tip analysis. This time, a Shank and a Tip were formed by Tip. The tip now has a female hollow shank and a 10 mm diameter. We learn that the tip bends during manufacturing after 500 Nos. This trial's efficacy fell short of expectations. We now need a full investigation.

After a second fresh tip test, we changed the tip and Shank designs. This time, the blind shank and 12.00 mm tip diameter are closed. The electrode quickly heated up during this experiment since the tip did not make immediate contact with it. These lead to rushed Tip Finished times. This endeavour also fell short of expectations. We now require an in-depth investigation.

Following the third fresh tip examination, we make changes to the tip and Shank designs. This time, we design an open side with an 11.0 mm shank diameter, an 11.0 mm inner tip diameter, a long height, and a substantial depth. We found that the tip was in direct contact with the water during this experiment and did not heat up. This time, the output was really high without any tip damage. Figure exemplifies this advice.

RESEARCHGAP

Numerous scholars have researched both theoretical and practical aspects of resistance spot welding. The main materials utilised to represent the outcomes were steel, aluminium, and their alloys. A variety of software programmes, including MINITAB17, COMSOL Multiphysics, CFE utilising the ABAQUS code, SORPAS, ANSYS, SYSWELD (FEM), etc., were utilised by researchers to analyse SRW.

It was found that the SRW study had research gaps in areas where the reference researchers had either less information or none at all. These reasons are as follows: In general, The electrodes were made of copper and tungsten alloys. electrode deflection or bending brought on by pressure and current.

- There was no study employing silver electrodes.
- The workpiece material was the subject of scant investigation (mostly stainless steel and aluminium were used).
- Additional investigation was needed to understand the welding HAZ, and due to the CFD tool's huge potential, more study will be done in the future to estimate the cap depth and water flow rate.

CONCLUSION

RSW is connecting methods used in business current most often. Since is easy to automate, it is a flexible and adaptable approach of component manufacturing. It is imperative for researchers to consistently change the pertinent parameters in order to enhance welding quality & electrode life. The kind of welding employed should be stated has an impact on how much the material ultimately costs to produce. To reach this cost-effectiveness, several engineers and scientists have studied and modelled RSW using a variety of technologies. Nugget formation and heat-affected zones were two of these subjects that underwent much examination. These were supported by experiments. Besides FEM, the following approaches were also used: Examples of statistical techniques are graphical lobe curves and weld growth curves. Today, CFD tools like ANSYS-FLUENT may be used to analyze the Transient Response of RSW, which was originally recorded utilizing thermo vision and high-speed cinematography. as a result, may infer that as technology advances, spot weld analysis will become more and more useful, occasionally improving the quality of the weld. We looked at the flat, pointed, and dome nose electrode form kinds. The Each electrode shape's temperature distribution was calculated using Finite elements method. The format electrode reached a greater temperature of 2876 C after only 0.2 sec. of weld. The electrode uses the least amount of electricity because it requires the least amount of welding over the course of all electrode time forms to produce the specified nugget length. There is a predicted nugget on each electrode form. The outcomes of the finite element analysis and the collected experimental data were in good agreement.

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