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REDUCTION OF SPLATTERS IN INTERCELL WELDING OF A LEAD ACID BATTERY

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Abstract - *Splatters are the major losses in resistance welding process. Splatter or weld splash is the unwanted creation of small metal particles that are expelled from the welding area during the welding process. These small metal particles can be airborne in the form of "hot sparks" or can solidify as small "balls" or "filaments" that remain loosely attached to the welding area. Excessive weld splash can be an indicator of a weld joint filled with voids and cracks, which can propagate with vibration and temperature cycling to create a future, weld failure. In this paper, I am here to reduce the splatters by varying the electrode geometry. In order to reduce these losses, there was many people have studied and did many researches. The researches may be did by varying the weld parameters such as weld current, weld time, cool time, pressure and squeeze time. By playing all these parameters they might have reduced the splatters to some extent. But in fact the amount of heat generated during welding process plays a major role in production of splatters. Splatter losses are mainly due high heat generated during the welding. So I would like to concentrate on distribution of heat generated during welding and control the splatters by increasing the surface area of the electrodes.*

Key Words: Splatters, Resistance welding, Weld current, Weld time, cool time, pressure and squeeze time, Thermo electric process

1. INTRODUCTION

Resistance spot welding is a process in which coalescences produced at two faying surfaces by heat generated at the joint to form lap joint. Spot welding produces single spot like welds, which are called nuggets. The heat is generated by resistance to flow of current though the work piece. Electrodes are located on both sides of the work piece in which one is movable and other is fixed. The advantages of spot welding include cost efficiency, good dimensional accuracy and reliable production. Without large deformation, it can be used for joining of several metallic materials and sheets of different thicknesses together.

Heat generation in resistance welding is takes place by heating phenomenon. The heat generated depends upon the current, the time the current is passed and the resistance at the interface. The resistance is a function of the resistivity and surface condition of the parent material, the size, shape and material of the electrodes and the pressure applied by the electrodes.

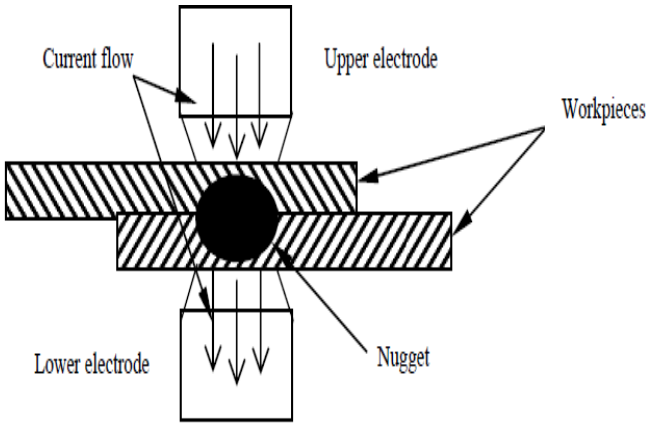


Fig.1 Illustration of resistance welding process

Generally, amount of heat generated during resistance welding process is given by the following formula:
Heat = I^2xRxT

Where

I - Weld current applied on work piece
R- Work piece electrical resistance in Ohms
T- Weld time in milli seconds

1.1 Literature Review

Literature review has been done for analyzing the process parameters and their effect on the response variables of the resistance welding. Gajanan S. Gaikwad[1], reviews on various effects of process parameters on response variables. Input parameters such as welding current, weld time, electrode force and electrode geometry effects on the response variables such as tensile strength, hardness, nugget size. He used ANOVA and Taguchi has been most efficient and powerful tool for optimization of resistance welding response parameters which produce high quality parts rapidly and low cost. A. G. Thakur, T. E. [2] says that the amount of resistance at the interface of the work piece depends on the heat transfer capabilities of the material, the material's electrical resistance, and the combined thickness of the materials at the weld joint.

M. Vural et al. [3] has done study on the fatigue strength of resistance spot welded galvanized steel sheets and AISI 304 sheets. The results show that galvanized steel sheet

combination has the highest fatigue limit. The sheet combination which has minimum fatigue limit is galvanized-AISI 304 sheet combination. D.S. Sahota [4]. The objective of this work is to study the effect of parameters on resistance spot weld of ASS316 material.

1.2 Inter cell Welding machine and operation

Two work pieces are joined together firmly by squeezing the electrodes with the help of hydraulic pressure. Weld start time and squeeze time plays a major role in welding process. Each connected joint cell gives 2V. There are totally 6 cells are there. So totally 12V will be the battery output.

2. PROBLEM IDENTIFICATION

2.1 Impact of the problem:

1. Low Productivity
2. Battery life reduced
3. Low quality
4. Increasing scrap percentage

3 ANALYSES

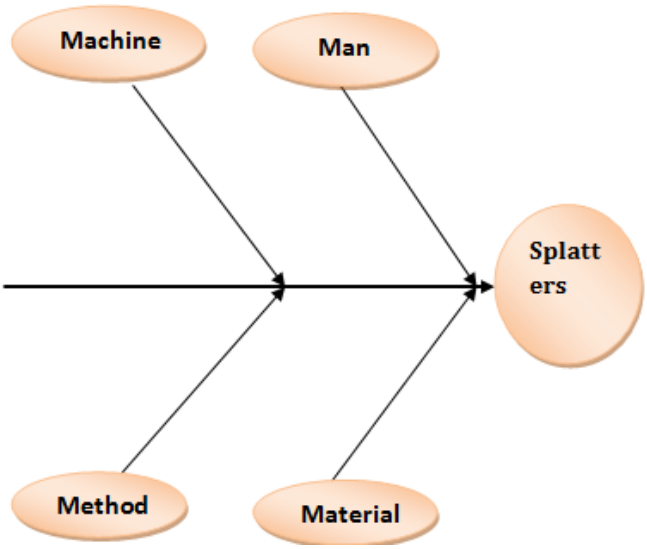
3.1 4W1H technique

- **WHAT**
  - Splatters in Inter cell welding operation
- **WHEN**
  - While welding operation
- **WHERE**
  - At weld nugget
- **WHO**
  - Quality and productivity
- **HOW**
  - By analyzing the problem and causes

3.2 Brain storming

- Hydraulic oil pressure
- Weld start time
- Weld cool time
- High weld current
- Squeeze length
- Electrode Contacting area less
- Electrode wear out
- Tip gap variation
- Improper alignment
- Operator awareness
- Material composition

3.3 Fish bone diagram



3.3.1 Machine

- Hydraulic pressure
- Weld start time
- Squeeze length
- Weld cool time
- Weld current
- Tip gap variation

3.3.2 Man

- Operator awareness
- Less trained
- Lack of skill and competency

3.3.3 Method

- Electrode contact area
- Insufficient cooling of electrodes
- Insufficient cooling of jaws

3.3.4 Material

- Material composition
- Electrode wear out
- Flag alignment disturbed

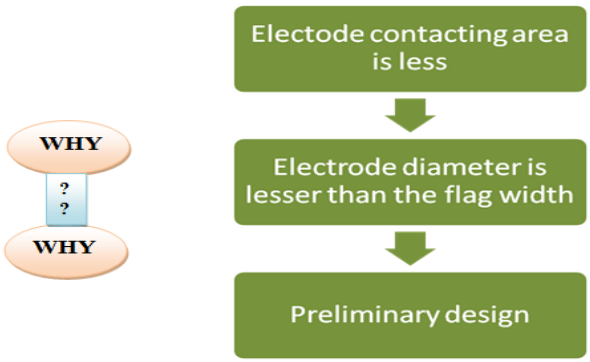
3.3.5 Majority causes

By using brainstorming technique we have identified the vital few causes.

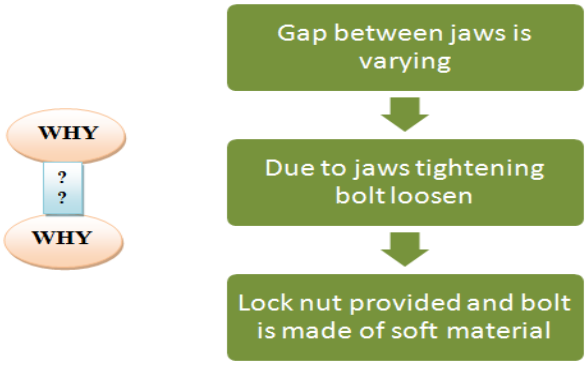
- Electrode Contacting area less
- Tip gap variation

3.4 WHY-WHY Analysis

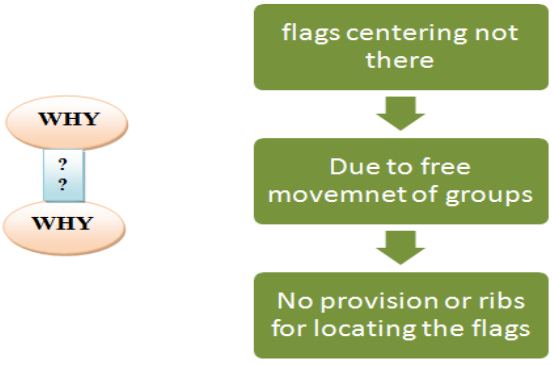
Cause: 1- Electrode contacting area less



Cause: 2- Tip gap variation



Cause: 3- Flag aligned disturbing



3.5 Developing solutions

Table-1: Solutions identified

S.No	Cause identified	Solution implemented
1	Electrode Diameter (contacting area) less than the flag width	Electrode outer diameter increased
2	Tip gap variation	Hardened bolt used & Lock nut provided

3.6 Comparison between Existing and proposed electrode

Existing electrode is having less contact with the work piece. So heat distribution is not uniform as less surface are of the electrode. Amount of heat dissipated will melt the joint at the time of welding leads to splatters. The proposed electrode is having very good contact with the work piece. So heat distribution is uniform and splatters are reduced at most extent.

4 RESULTS AND DISCUSSIONS

4.1 . Intangible benefits

- Increased productivity
- Learned an effective problem solving methodology & QC tools
- Ability to take up the new challenges
- Increased employee morale.

4.2 Tangible benefits

- Savings in terms of money.

5. CONCLUSIONS

As we have seen here there is gradual reduction of splatters from month to month. So it is concluded that proposed electrode can bare the amount of heat generated during welding process and that can reduce the splatters in major extent. And finally these proposed electrodes are amended in the engineering product drawing.

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