

ASSESSMENT OF SPOT GEOMETRY AND MECHANICAL PROPERTIES OF RESISTANCE WELDING BY USING STATISTICAL ANALYSIS

Louriel Oliveira Vilarinho¹, Jose Enrique Vargas², Sadek Absi Alfaro²

¹ Federal University of Uberlandia

Laboratory for Welding Process Development (Laprosolda)

² University of Brasilia - Graco

vilarinho@mecanica.ufu.br

1. INTRODUCTION

The high productivity (more than 20 spots/minute) and good quality provided by the Resistance Spot Welding (RSW) make this process largely employed in the automotive industry. However, the introduction of galvanized steel has brought some complications in the production lines concerning the correct welding parameter adjustment. Thus, this work aims to present a detailed study of the influence of the main parameters (upslope, current and downslope times, electrode force and water flow) on the geometry and mechanical resistance of the spot in galvanized steel welded by AC machines by using statistical planning and analysis (Robust and Central Composite Design).

2. EXPERIMENTAL PROCEDURE

The experimental design is carried out from five different factors, namely upslope, current and downslope times, electrode force and water flow. The dependent variables (responses) are the spot diameter, the indentation and the ultimate strength of the joint. Two different designs were used: the Robust design (Taguchi) and the Central Composite Design (CCD). The final goal is to check if the robustness set of parameters provided by Robust design is correlated to the optimum set obtained from the CCD plus an optimization algorithm. It must be pointed out, that, different from other authors, the process energy is kept the same, it means that the current is recalculated for each condition.

3. RESULTS AND DISCUSSION

The Robust Design is capable of defining a robust set of parameters, where the significant welding parameters are the current time and the electrode force. Up to here, it is not possible to assert that this is an optimum region of working. This is done by coupling the CCD and an optimization algorithm. The CCD generates an empirical equation, which is the input for the optimization algorithm. Since, it is a polynomial equation, finding the optimum working point is not so complicated and it was done in few iterations. The confrontation between the Robust Design and the CCD plus optimization algorithm results that the set of parameters from those two approaches are very close and differ from each other in the order of the process uncertainty.

3. CONCLUSION

It is possible to conclude it can be possible to obtain a set of parameters which are at the same time robust and led to optimal responses for spot geometry and

mechanical resistance. The significant welding parameters are the current time and the electrode force. Thus, the methodology employed here (confrontation of two different experimental designs and an optimization algorithm) are capable of defining the work optimum region (operational envelope).

Keywords: Resistance Spot Welding, Robust Design, Central Composite Design.

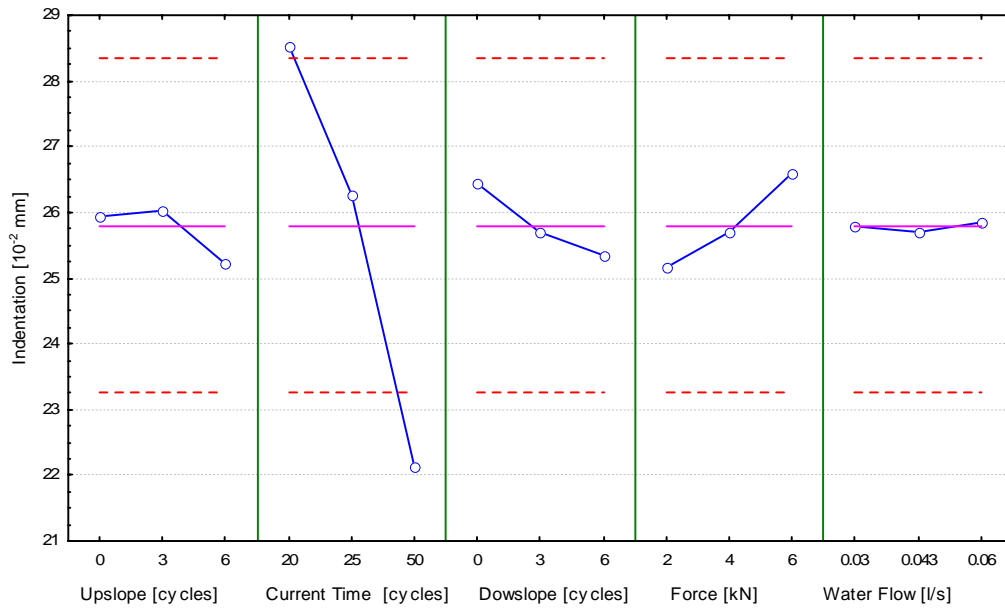


Figure 1. Example of Taguchi results for indentation.