Building up Mathematical Modeling Using Spot Welding Parameters and Prediction Weld Nugget by Minitab

İlhan Çekiç[1]* , Kadir Çavdar[2]

[1]Bursa Uludağ Üniversitesi, Mühendislik Fakültesi, Makine Mühendisliği Bölümü, 16059 Nilüfer Bursa.
[2]Bursa Uludağ Üniversitesi, Fen Bilimleri Enstitüsü, Makine Mühendisliği Anabilim Dalı, 16059 Nilüfer Bursa.

Abstract

In serial production, problems are constantly encountered in the selection of welding parameters due to the excess of welding parameters and variations. In order to compensate for these variations, mostly high energy flux is used. In this study, an approach developed in order to estimate weld nugget diameter in determining the welding parameters for sheets with a thickness of 0.6–3 mm is introduced. Sheet is an iron-based material that has been given certain mechanical and chemical properties in standards, turned into sheets from thick plates by rolling processes. Minitab statistical program was used to create experimental data and mathematical operations. First of all, 7 source parameters were selected and experimental study was carried out for 64 experiments using the ½ partition factorial method of disegn of experiments(DOE) in Minitab software. With the experiments, real weld nugget diameters were obtained. These results were transferred to the Minitab software and the mathematical model of the system was established. Weld nugget diameter estimation procedures were carried out using the datas of factorical disegn of experiments(DOE). Test and prediction data were transferred to Minitab software, regression graph was drawn and R-Sq and R-Sq (adj) values were calculated. In addition, samples were created with randomly selected data for verification and comparison was made by transferring them to Minitab. According to the results of this study, remarkable accuracy rates have been achieved in the weld nugget diameter estimation with Minitab.

Keywords: Resistance spot welding, weld nugget prediction, design of experiment, regression analysis, Minitab.

1. INTRODUCTION

Today, 7-12 thousand spot welding is used when a car is being produced. Electric Resistance Welding (ERW) is generally done by computer controlled robots. The quality of ERW is an extremely important issue in the automotive industry. The accuracy and consistency of parameter settings made with manual welding parameter calculations, operator experience and technician expertise may not be appropriate.

Welding parameter setting of each machine and point is a difficult process due to many sensitive factors. It takes a lot of trials with a large number of materials to find the optimum value of each spot to be spot welded, which cannot be done as it is very costly. In order to achieve the final standard welding quality, different sheet thicknesses such as electrodes etc. The process of adjusting the parameters in each different welding machine model by changing it is quite costly. Therefore, in the ERW spot welding process, it is important to be able to meet the weld quality improvement requirements with efficiency estimation and appropriate parameter

optimization.

When the literature is examined in general, it is seen that studies are carried out on a single sheet thickness by taking only the welding time, current and force. Different approaches can be seen for estimation methods.

In another method, welding current, electrode force and welding time other welding parameters can be kept constant. Welded joints can be subjected to tensile-shear tests to determine shear force and absorption energy values. In the study, parameter optimizations can be performed by using the surface methodology based on Box-Behnken design to generate a quadratic response model regression from Yue et al. [1].

There are also approaches to applying data mining techniques to estimate the weld nugget diameter in the ERW resource. With a relatively simple and straightforward approach, it can accurately estimate the diameter of a spot from easily measured signals during the welding process by Boersch et al. [2].

* Corresponding author
Email: i_cekic@hotmail.com

Mathematical Modeling With Minitab

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