

## USE OF RESPONSE SURFACE METHODOLOGY TO INVESTIGATE THE EFFECT OF SOME CHEMICAL ELEMENTS ON THE TENSILE STRENGTH OF THIN SHEET METAL

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**Abstract:** *The chemical composition influences the mechanical properties of the metal thin sheet that will be subject to plastic deformation. The carbon (C), manganese (Mn) and phosphor (P), are the most important alloying elements of the metal sheet that influence the tensile strength ( $R_m$ ) of the thin sheet form temper steel. In the present study, the optimized proportions of these chemical elements were determined by applying the response surface method to achieve the maximum tensile strength. Results revealed that the best chemical composition occurs at 0.08% C, 0.5% Mn and 0.028% P. From the experimental results, it was found that the combination of 0.08% C, 0.5% Mn and 0.028% P significantly increases tensile strength at the value of 369.80 N/mm<sup>2</sup>.*

**Keywords:** *thin sheet metal, mechanical properties, optimization*

### 1. Introduction

Formability proprieties of the steel sheet are influenced by the material's proprieties. One of these important proprieties that characterize the mechanical behaviour of the material is the tensile strength ( $R_m$ ) which is influenced by the chemical composition of the metal thin sheet. Alloying elements influence the mechanical characteristics and technological properties of the material [2, 4, 9]. The chemical composition affects the tensile behaviour and the microstructure of the material [3, 10]. Some studies [5, 6] reveal that among all alloying elements of the thin sheets form temper steel, carbon (C), manganese (Mn) and phosphor (P) are the most important elements that influenced mechanical properties of the thin sheet. The increased concentration of C, Mn a P in the chemical composition of thin sheet metal used in drawing, will lead to an increase in tensile resistance. When compared to C and P, Mn is the chemical element with the highest degree of influence on the tensile strength [2]. The studies which have investigated the correlation between these elements show that significant

correlations have been obtained between C and Mn and between Mn and P [6].

The statistical design of experiments is used extensively in various investigations and comprises the process of planning the experiment so that the appropriate data can be analysed by statistical methods, resulting in valid and objective conclusions [7]. The method, such as response surface methodology (RSM) is more suitable for developing, improving and optimizing processes [8]. In addition, this methodology is not laborious and time consuming, because it decreases the number of factorial experiments from a large number of parameter combinations to a far smaller number without losing any information. This study was undertaken with the objective of using the response surface methodology to investigate the influence of some alloying elements on the tensile strength of thin sheets.

The aim of the presented study was to analyse the dependency of the tensile strength of thin sheets on three chemical elements from these composition (C, Mn and P). The response surface method (RSM) based on the