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Effect of Bismuth and Sulfur addition in Mechanical properties, structure and Machinability of 1045 steel

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Abstract – The aim of this study is to investigate the effects of the addition of bismuth and sulfur in 1045 steel to improve the machinability and also its influence on mechanical properties. Therefore, it is proposed to replace the use of lead as an element used to gain in machinability while maintaining the mechanical characteristics of steel in 1045.

Machinability is the term most often used to denote the performance of machining of a material, can be defined by the material's ability to be slashed or machined by a suitable tool [1]. Due to the various process parameters and properties of materials that can affect the machinability of tool-pair piece, determining the index of machinability becomes complex and its use must be careful - as a material which has a higher index of machinability according to certain criteria may submit a completely different behavior when another criterion is considered [2]. The carbon steels have a wide range of plants, depending on their mechanical properties .Therefore should take into account the chemical composition, heat treatment, type and quantity of inclusions before setting a material to be used for machining, as these characteristics of the material together with the kind of tools and machining operation to be performed determine the cost manufacturing. Lead and bismuth are elements with physicochemical characteristics that are very similar metallic inclusions in steel, which have the machining mechanism of action similar to the inclusions of manganese sulphide [3]. For this reason it would like to show that the lead can be replaced by bismuth as microalloying, and the bismuth does not present the same environmental problems of the lead, this will be a good contribution to the preservation of the environment and quality of life involved with the manufacturing process of 1045 steel.

The raw material was melted in a vacuum furnace at 1560°C temperature and the alloying elements addition take place in steel 1045 compared as the usual reference steel. To determine the machinability of each material, including the reference material, were machined specimens with dimensions in accordance with ISO 3685, 1993 and the end of toll life was the criteria used to evaluating the machinability in accordance with the same international standard.

Table 1: Mechanical Properties

STEEL	TENSILE STRESS (N/mm²)	FLOW STRESS N/mm²	ELONGATION (%)	AREA REDUCTION (%)	IMPACT TEST (J)
1045	580,2	277,8	19,8	23,7	**17,6**
1045 + S	568,5	293,2	12,3	12,3	**8,0**
1045 + Bi + S	614,9	326,3	7,6	7,5	**6,2**

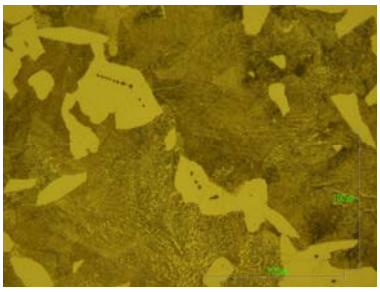

Figure 1: Optical metallography of 1045 steel with the addition of bismuth and sulfur

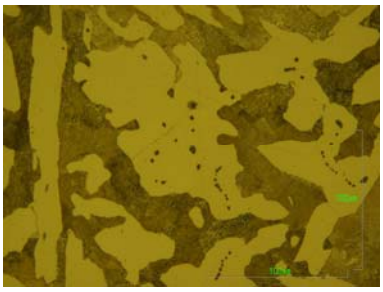

Figure 2: Optical metallography of 1045 steel with the addition of sulfur.

References

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