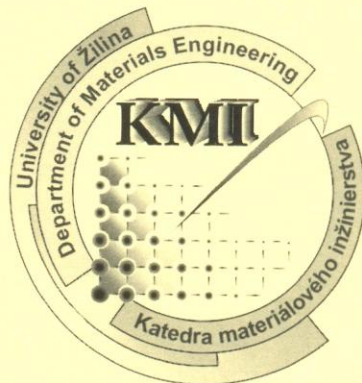


ŽILINSKÁ UNIVERZITA V ŽILINE
STROJNÍCKA FAKULTA
KATEDRA MATERIÁLOVÉHO INŽINIERSTVA



DEGRADÁCIA KONŠTRUKČNÝCH MATERIÁLOV 2013

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konaná pod záštitou dekana Strojníckej fakulty Žilinskej univerzity v Žiline
prof. Dr. Ing. Milana Ságu

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DETERMINATION AND ANALYSIS OF CAUSES FOR A CATASTROPHIC FAILURE OF A RESPONSIBLE MACHINE PART

Vukić Lazić¹, Srbislav Aleksandrović¹, Ružica R. Nikolić^{1,2}

Petar Marinković³, Dušan Arsić¹, Milan Djordjević¹, Božidar Krstić¹

¹ University of Kragujevac, Faculty of Engineering, Sestre Janjić 6, 34000 Kragujevac, Serbia

² University of Žilina, Faculty of Civil Engineering, Univerzitna 1, 01026 Žilina, Slovakia

³ Zastava automobiles, Trg Topolivaca 4, 34000 Kragujevac, Serbia

1. Introduction

In this paper is analyzed a breakdown of a very responsible machine part, which was subjected to high pressures and impact loading. In manufacturing new parts, due to lack of material which was originally used – steel that was tested in exploitation several times, the steel was used that had similar properties. The renowned European steel manufacturer was selected, which delivered two massive steel blocks, accompanied by necessary certificates on the material's quality. The user had also performed adequate control of the delivered forged pieces, conducted necessary input, process and additional control, of the mechanically and thermally treated part. In exploitation, the finally machined piece has broken into several pieces during the very first test run. This paper deals with discovering the causes of that fracture and points to the reasons why it occurred despite the rigorously conducted control procedures, both by the manufacturer and the final user. Thanks to regulations that the first tests of this class of parts must be conducted without human presence, there were no casualties, just the very costly material losses resulted. Here are presented properties of original material, as well as properties of the alternative material that served as substitution, since the original one was not available. Finally, here are analyzed results of tests performed on the broken part and the possible causes of its failure during the test run are discussed. Results of this paper can be useful to all those dealing with material selection for the responsible machine parts, as an important instruction that besides the standard tests a special control has to be performed for possible presence of non-metallic inclusions.

In papers [1-5] are described, in details, all the causes of damages of various machine parts. Methods for detection of the causes of damages, applied in those investigations, served to authors of this paper in the attempt to discover and explain cause of fracture of the part described here.

2. The most important properties of the original material of the working piece

Material of the original working piece, which proved to be very reliable in exploitation, was the special tool steel, Table 1. This steel belongs into a group of high quality noble tool steels for tempering (P, S <0.012%). Steels of this type are being produced only by special order,

