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SELECTION OF THE MOST APPROPRIATE WELDING TECHNOLOGY FOR HARD FACING OF BUCKET TEETH

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Abstract: The aim of this paper is to analyze the possibility of extending the service life of working parts on construction machinery. Particular attention is given to the production of hard facing of loader bucket teeth. The theoretic part of this paper analyzes the tribological processes that occur while machinery is in operation. Worn excavator parts are made from conditionally weldable cast steel that requires special hard facing technology, so numerous model investigations have been performed in order to choose the most appropriate one. The experimental part of the paper discusses selection of the optimal hard facing technology for bucket teeth and the procedure of manual arc hard facing. Model samples were first hard faced using different techniques and technologies, and then the microstructure and micro hardness of characteristic hard faced layers were studied. Specially prepared block-samples were used for tribological investigations. The results obtained in the model investigations enabled the selection of the most suitable hard facing technology and its application to real parts. The bucket teeth, with their hard faced layers applied vertically, horizontally or in a honeycomb pattern, were mounted on the loader bucket alternately with the new non-hard faced teeth. Their performance was monitored regularly under real operating conditions. After a certain period of time, the degree of wear for non-hard faced and differently hard faced teeth was measured. Taking into account both technical and economic factors, the most suitable hard facing technology was determined.

Key words: Hard facing, Wear, Loader bucket teeth, Hardness, Microstructure, Friction coefficient

1. INTRODUCTION

Whilst in operation, some parts of road construction machinery are exposed to different abrasive materials that causes wear. Most of the damage to the parts that come into direct contact with stone aggregate is caused by abrasive wear. Hard and edged-shaped particles, found in stone materials, are highly abrasive and they damage the working parts of bucket teeth.

Working parts exposed to abrasive wear with occasional medium impact loads include: bucket teeth of loaders, trenchers and excavators, blades of concrete and asphalt cutting devices, blades and rippers of bulldozers and graders, leading rings and blades of rock drills bits, spindles of screw conveyors, etc. However, the greatest abrasive wear is observed in bucket teeth. For that reason, our experimental investigations were conducted on the loader bucket teeth.

The study of common causes of damage to some parts of machines and devices has revealed that in more than 50% of the cases the damage was the result of tribological processes taking place under more or less regular operating conditions[1-6]. The damaged parts can be either replaced with new ones or, in most cases, they can be hard faced. Both reparatory and production hard facing reduce downtime and costs because new parts are expensive. Hard facing is especially economically justified for large-size parts or in cases when there are many identical parts. However, there are occasions when reparatory hard facing has to be performed regardless of costs, for example, when unique machines and devices have to be repaired or when there are no spare parts available[7-11].

2. DAMAGE DUE TO TRIBOLOGICAL CAUSES

Wear is generally considered to be the result of a friction action or combined actions of friction, thermal, chemical, electrochemical and other factors on elements of a tribo-mechanical system. When studying friction, one has to consider the factors dominant in each particular case, such as: material, working surface properties, contact surfaces` quality and properties, properties of the medium between the contact surfaces, characteristics of relative motion between the working surfaces, load, temperature, quantity and properties of the particles produced by wear etc.[1-6].

During the surface contact between the two tribo elements, a stress state is formed in the surface layers, i.e. elastic and plastic deformations occur. They depend on the load intensity, friction conditions, material mechanical properties and micro geometry of the contact surfaces. When the two rough surfaces interact, a momentary loss of contact may occur due to micro roughness, i.e. due to heir elastic and plastic deformations. The process of micro wear involves plurality of such micro deformations and destruction of the surface roughness peaks. Experimental investigations[1-6] have shown that the process of final wear is, in fact, the process of fatigue. Different authors have given different classifications of wear, but all of them are based on the way the contact between two bodies is realized. Therefore, the following types of wear can be distinguished: adhesive, abrasive, erosive, fatigue, cavitation, vibrational and corrosive wear. Since the aim of this paper was to study and estimate among other things the filler materials used for hard facing of parts exposed to abrasive wear, it is the abrasive wear under moderate to medium impact loads that was considered here.

According to several authors[1-6], abrasive wear accounts for approximately half of all types of wear. The most exposed to abrasive wear are the parts of construction, mining and agricultural machinery, elements of transport devices, working parts of equipment in metallurgy, some parts of tool machines, parts of railway and tram equipment, impellers of hydraulic and gas turbines, oil well drilling bits, and parts of equipment for sandblasting.

Experimental investigations have shown that resistance to abrasive wear is linearly dependent on the mechanical properties of a metal[1,4]. Therefore, wear behavior of a metal can be predicted based on its mechanical properties, primarily hardness. Penetration depth of foreign particles into the coupled machine elements is inversely proportional to