UDK 621.791.92:539.375.6:539.92
Professional article/Strokovni članek

ISSN 1580-2949
MTAEC9, 49(1)165(2015)

SELECTION OF THE MOST APPROPRIATE WELDING TECHNOLOGY FOR HARDFACING OF BUCKET TEETH

IZBIRA NAJBOLJ PRIMERNE TEHNOLOGIJE TRDEGA NAVARJANJA ZOBA ZAJEMALKE

Vukić Lazić[1], Aleksandar Sedmak[2], Ružica R. Nikolić[1], Milan Mutavdžić[3], Srbislav Aleksandrović[1], Božidar Krstić[1], Dragan Milosavljević[1]

[1]University of Kragujevac, Faculty of Engineering, Sestre Janjić 6, 34000 Kragujevac, Serbia
[2]University of Belgrade, Faculty of Mechanical Engineering, Kraljice Marije 16, 11000 Belgrade, Serbia
[3]Company for Road Construction Kragujevac, Tanaska Rajića 16, 34000 Kragujevac, Serbia
vlazic@kg.ac.rs

Prejem rokopisa – received: 2014-01-02; sprejem za objavo – accepted for publication: 2014-01-15

A possibility of extending the service life of the working parts of construction machinery with particular attention to hardfacing of loader bucket teeth was investigated. In the first part of this paper the tribological processes typical for this machinery is analysed. Worn excavator parts are made of conditionally weldable cast steel that requires a special hardfacing technology, so numerous investigations were performed to obtain the most appropriate technology. In the experimental part of the paper, the selection of the optimum hardfacing technology for bucket teeth and the procedure of the manual arc hardfacing are presented. The samples were first hardfaced using different techniques and technologies and then the microstructure and microhardness of characteristic hardfaced layers were studied. Specially prepared samples were used for tribological investigations. The results of experimental investigations enabled the selection of the most suitable hardfacing technology and its application to real parts. The bucket teeth, with their hardfaced layers applied vertically, horizontally or in a honeycomb pattern were mounted onto a loader bucket, alternated with the new non-hardfaced teeth and their performance during the operation was regularly monitored. After a certain period, the degrees of the wear for the non-hardfaced and differently hardfaced teeth were measured. Taking into account both technical and economic factors, the most suitable hardfacing technology was determined.

Keywords: hardfacing, wear, loader bucket teeth, hardness, microstructure, friction coefficient

Izvršena je bila analiza podaljšanja zdržljivosti delov na gradbenih strojih s posebno pozornostjo na trdem navarjanju na zobeh zajemalke. V prvem delu tega članka so analizirani tribološki procesi, ki se pojavijo pri teh strojih. Pri kopačih so deli, ki se obrabljajo, izdelani iz pogojno varivega litega železa, ki zahteva posebno tehnologijo nanašanja, zato so bile izvršene številne raziskave, da bi dobili najprimernejšo tehnologijo. V eksperimentalnem delu članka je predstavljena optimalna tehnologija nanašanja trdih slojev na zobe zajemalke in predstavljen je postopek za ročno varjenje. Na vzorce so bili naneseni različni trdi sloji z različnimi tehnikami in tehnologijami in preučevane so bile mikrostrukture in mikrotrdote trdih nanosov. Preiskani so bili posebno pripravljeni vzorci za tribološke preizkuse. Rezultati eksperimentov so omogočili izbiro najprimernejše tehnologije nanašanja trdega sloja in njeno uporabo na realnih delih. Zobje zajemalke z vertikalnim, horizontalnim ali satastim nanosom trdega sloja so bili nameščeni skupaj z novimi, neobdelanimi zobmi na nakladalnik in redno je bilo spremljano njihovo vedenje med delom. Po določenem času je bila izmerjena obraba zob z različnimi nanosi in obraba neobdelanih zob. Z upoštevanjem tehničnih in ekonomskih faktorjev je bila določena najprimernejša tehnologija nanašanja trdih plasti.

Ključne besede: trdo navarjanje, obraba, zobje zajemalke nakladalnika, trdota, mikrostruktura, koeficient trenja

1 INTRODUCTION

During operation, certain parts of the road-construction machinery are exposed to different abrasive materials that cause most of the damage of the parts in direct contact with the stone aggregate causing abrasive wear. Hard and sharp-edged particles of stone materials are highly abrasive and they damage the working parts of bucket teeth.

The working parts exposed to the abrasive wear due to occasional medium-impact loads include: the bucket teeth of loaders, trenchers and excavators, the blades of concrete- and asphalt-cutting devices, the blades and rippers of bulldozers and graders, the leading rings and blades of rock-drill bits, the spindles of screw conveyors, etc. The greatest abrasive wear occurs on bucket teeth. For that reason, our experimental investigations were conducted on the loader bucket teeth.

The studies of the causes for the damage of some parts of machines and devices revealed that in more than 50 % of the cases the damage was the result of tribological processes 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 hardfaced. Both reparatory and production hardfacing reduce downtime and costs because new parts are expensive. Hardfacing is economically justified especially in the cases of large-sized parts or when there are many equal parts. However, there are occasions when reparatory hardfacing has to be performed regardless of the costs, for example, when unique machines and devices have to be repaired or no spare parts are available[7–11].

2 DAMAGE DUE TO TRIBOLOGICAL CAUSES

Wear is generally considered to be the result of friction or a combination of friction, thermal, chemical, electrochemical and other factors on the elements of a tribo-mechanical system. When studying friction, one