Abrasive resistance of filler metals in laboratory conditions

Oteruvzdornosť prídavných materiálov v laboratórnych podmienkach

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Abstract

Wear of selected surfacing welded materials at the tribological test in laboratory conditions is deal with in this contribution. Filler metal is evaluated according to its weight loss, relative wear resistance and hardness. Tested materials show higher abrasive resistance and they are suitable into the conditions with intensive wear.

Keywords: tribo-test, filler metal, hardness, wear

Abstrakt

V príspevku sa zaoberáme opotrebením vybraných návarových materiálov pri tribologickej skúške v laboratórnych podmienkach. Prídavný materiál sme vyhodnotili na základe úbytku hmotnosti, pomernej odolnosti proti opotrebeniu a tvrdosti. Testované materiály vykazujú zvýšenú oteruvzdornosť a sú vhodné do podmienok intenzívneho opotrebenia.

Kľúčové slová: laboratórne testy, návarový materiál, opotrebenie, tribologická skúška, tvrdosť

Detailný abstrakt

Cieľom príspevku bolo stanoviť odolnosť prídavných materiálov v laboratórnych podmienkach. Prídavný materiál sme testovali na normalizovanej skúške pri definovaní pomernej odolnosti proti opotrebeniu.

Na overenie odolnosti sme použili štyri prídavné materiály typového označenia Kasamas, ktoré majú vyšší obsah chrómu, mangánu a volfrámkarbidických častíc. Vytvorené návary sú odporúčané do prevádzkových podmienok, kde prevláda abrazívne opotrebenie.

Návary vykazujú zvýšenú pomernú odolnosť proti opotrebeniu a tým zníženú veľkosť opotrebenia. Avšak sa nám nepotvrdila teória, že so zvýšenou tvrdosťou stúpa aj odolnosť proti opotrebeniu. Pri vytvorení návaru s podielom volfrámkarbidických častíc sme dosiahli až 9-násobné vyššiu hodnotu pomernej odolnosti pri nameranej najnižšej tvrdosti. Môže to byť spôsobené vhodnejším usporiadaním karbidických častíc v základnej matrici.

Všetky testované návary na základe laboratórnych skúšok potvrdili vhodnosť použitia do prevádzky za účelom vytvorenie oteruvzdorných vrstiev pre zvýšenie životnosti časti strojov.

Introduction

If we want to define unequivocally which filling surfacing material is wear resistant we have to test the materials in specific operating conditions or in laboratory conditions. There can be created similar conditions for defining the material resistance in laboratory as in operation or conditions that are specified in the standards with the exact parameters (Kotus-Drahoš, 2010; Kotus-Gyurica, 2010).

The welds have to fulfil particular material requirements related to the function of the surface layers. Properties of weld deposits may be influenced by surfacing technology and technological parameters of surfacing. The size of immixture between welds and base material significantly affects changes of the weld properties (Čičo-Bujna, 2009; Górka et al., 2013; Kováč-Tolnai, 2009).

The object of this paper is to define abrasive resistance of filler metals according to the relative wear resistance at tribological test on abrasive cloth in laboratory conditions. Material which is suitable into the operating conditions with predominant abrasive wear can be determined according to the material resistance.

Materials and Methods

Test of abrasive wear on the laboratory device is based on the wear of tested element within exactly defined conditions on the device with abrasive cloth at the conditions determined by standard STN 01 5084 Determination of metal material resistance against wear by abrasive cloth.

Purpose of the test is determination of the relative abrasive wear resistance of metal materials ($\psi_{abr.}$) which is the basic criterion for evaluation of materials in laboratory conditions. Wear resistance are calculated according to the ratio of average weight losses of etalon samples to losses of individual filler metals.

Testing device is showed in the figure 1 and its parameters are of a piece with the named standard. Filling surfacing material sample preparation and methodological procedure is also defined by the standard and fulfilled at the test.

Steel of class 12 050, defined by national standard STN 41 2050, was used as a basic material on which was applied abrasive resistant filler metals. Comparative testing bodies are made of the steel 12 014.20, defined by standard STN 41 2014.

Filling surfacing materials with typal marking Kasamas 511, Kasamas 519, Kasamas 523 and Kasamas 530 have their chemical composition initiated in table 1.

High-performance electrode Kasamas 511 with an extract of 170% is designated for a hard rustproof hard-facing, high abrasive wear resistant while wet. Kasamas 519 is suitable for creation of hard, resilient layers that are abrasive resistant. Kasamas 530 is a special electrode for the layers that are extremely resistant to impact and pressure. The last material is a tube Kasamas 523 which consists of the wolfram carbides in the metal matrix.

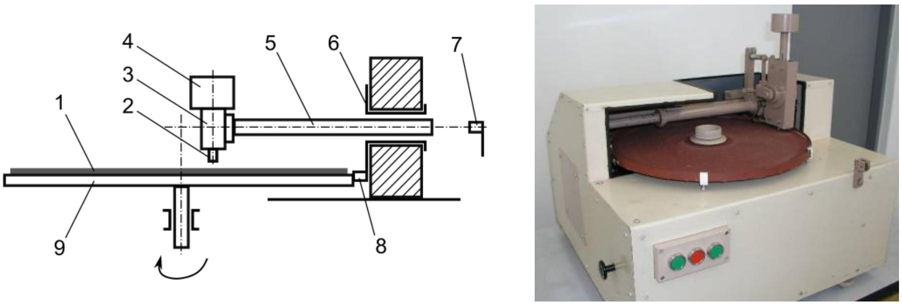

Figure 1 Schematic and real construction of a testing device for determination of metal material resistance to abrasive wear on abrasive cloth: 1 – abrasive cloth, 2 – sample, 3 – holder, 4 – weight unit, 5 – motion screw, 6 – rotary matrix, 7 – terminal switch, 8 – tripping dog, 9 – rotary horizontal panel

Obrázok 1 Schematické a reálne zobrazenie skúšobného zariadenie pre stanovenie odolnosti kovových materiálov proti abrazívnemu opotrebeniu na brúsnom plátne: 1 – brúsne plátno, 2 – vzorka, 3 – držiak, 4 – závažie, 5 – pohybová skrutka, 6 – otočná matica, 7 – koncový vypínač, 8 – narážka, 9 – otáčajúca sa vodorovná doska

Adjusted parameters of the testing device are following:

- friction speed – 0.15÷0.48 m*s^{-1}
- transverse shift on rev – 3 mm
- average of friction track – 480 mm
- length of friction track – 50 m
- amount of pressure – 0.32 MPa
- abrasive cloth v Globus 100

Table 1 Initial chemical composition of filler metals

Tabuľka 1 Smerné chemické zloženie prídavných materiálov

Filler metal	Contents of elements, [%]			
	C	Mn	Cr	Si
Kasamas 511	4.5	–	34	–
Kasamas 519	0.45	0.4	9	1.75
Kasamas 523	Fe 40 %		WSC 60 %	
Kasamas 530	0.6	17	14	0.5

Results and Discussion

Graphical representation of the relative wear resistance on abrasive cloth for the filler metals is showed in the figure 2. Calculated average value of the relative resistance is mentioned for four samples of each material. Reached hardness of Vickers (HV10) is graphically represented in the figure 3.

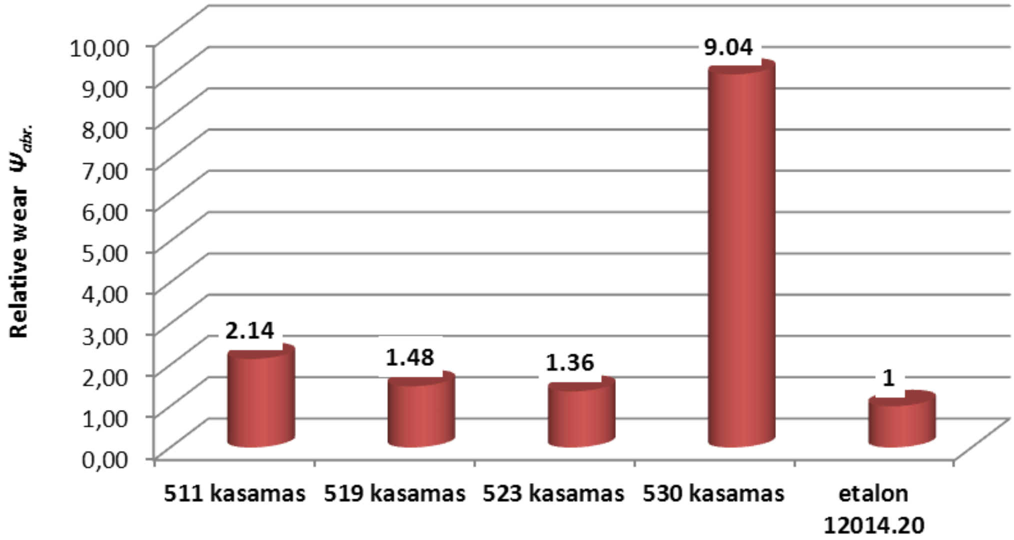

Figure 2 Relative wear resistances of materials on abrasive cloth

Obrázok 2 Pomerná odolnosť proti opotrebeniu materiálov na brúsnom plátne

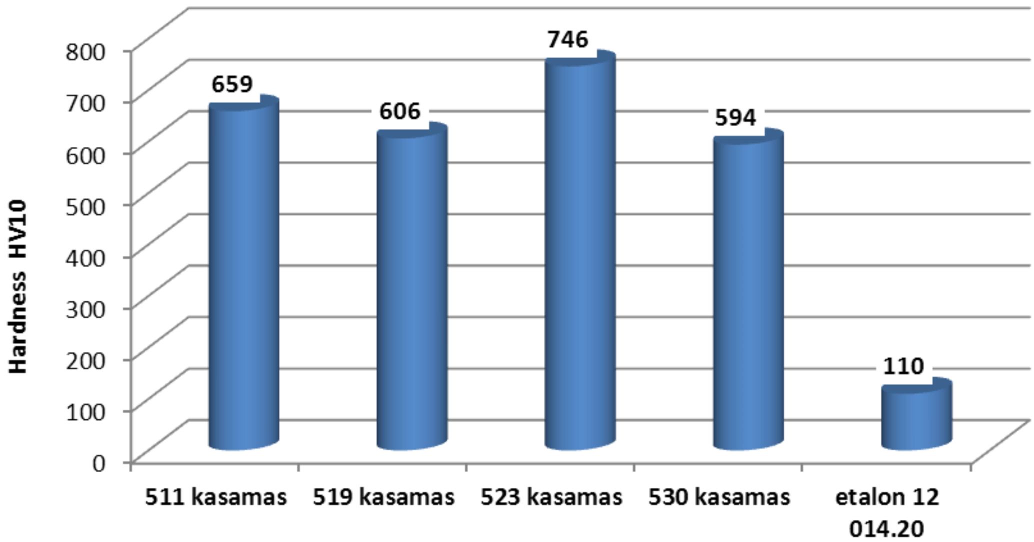

Figure 3 Measured values of hardness HV 10 of materials

Obrázok 3 Namerané hodnoty tvrdosti HV 10 materiálov

Achieved results show that the highest relative wear resistance and so the lowest weight loss was detected for material Kasamas 530. But it is important to say that the lowest hardness HV10 was detected for that same material. Kasamas 530 had the highest content of the manganese comparing to other filler metals. The manganese in higher amount that the amount of an accompanying element caused the higher harden-ability and improved some of the mechanical attributes (f. e. increases the wear resistance). Higher level caused the creation of an austenitic structure and a coincident addition of chrome improved the resistance to corrosion noticeably.

The highest hardness was reached for the material Kasamas 523 that was caused by presence of the wolfram carbidic elements in metal matrix. We also state the highest weight loss for that surfacing weld.

The second highest hardness and also the highest value of relative resistance were detected for the surfacing weld Kasamas 511. This surfacing weld was created by the carbides of chrome at the higher level of carbon which increased the resistance to abrasive and corrosion.

Surfacing welds made by material Kasamas 519 reached the third highest hardness and relative resistance of all tested filler metals. This material had the highest content of silicon which does not create carbides but dissolves in ferrite and therefore it increased hardness and solidity.

Conclusions

Tribological tests are often operated in laboratory conditions because of economic and time difficulties of the operating test conditions. Results from laboratory measurements (within precisely defined conditions) can be used for definition of the material suitability into the specific operating conditions. (Kotus, 2009; Špendel et al. 2011)

Creation of surfacing welds with higher values of material mechanical attributes such as a basic material could lead to increment of the wear resistance. Higher abrasive resistance could prolong the lifetime of machine components with a conservation of functions. (Viňáš 2008, 2011)

Filler metals of Kasamas group which were tested by tribological test according to the standard STN 01 5084 showed the higher wear resistance. All studied surfacing welds are suitable into conditions where it is necessary to reach the higher abrasive resistant attributes.

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