on each abrasion trace in four perpendicular sections according to the standard

Bay Zoltán Alkalmazott Kutatási Közhasznú Nonprofit Kft. / Mérnöki Divízió
Bay Zoltán Nonprofit Ltd. For Applied Research / Engineering Division
www.bayzoltan.hu

Tribological examination of anodized Al-356 automotive alloy

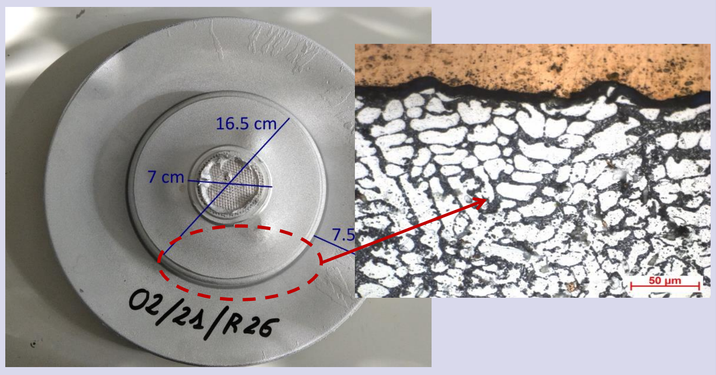
Noemi LASZLO[1], Nora TAKACS[2]
[1] Head of Laboratory [2] junior researcher

1. INTRODUCTION

The use of aluminum alloys in the automotive industry is becoming increasingly important due to its favorable properties (low density, mechanical strength, etc.) the properties of aluminum alloys can be improved by surface modification and treatment processes. In the present research, we made an attempt to improve the wear and corrosion resistance of Al 356 brake disc base material (Al-Si eutectic alloy) by oxalic acid anodizing surface treatment. in the case of the layers separated with different treatment parameters, their surface roughness and hardness were determined, and their tribological analyzes were analyzed with the help of ball-on disc arrangement. the results show that the parameters used during anodization significantly influence the wear resistance of aluminum alloys

2. LAYER CHARACTERISTICS

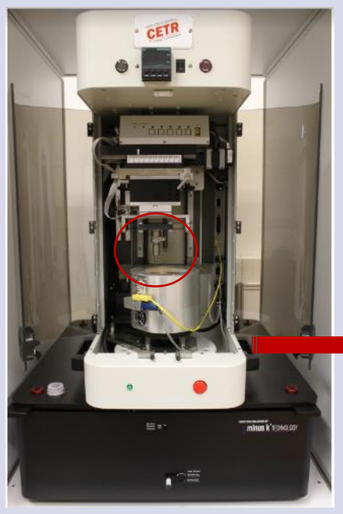
Parameters of anidizng	
Current density(A/dm^2)	2
Current (A)	1,4
$T_{treatment}$ (h)	2
C_{oxalic} (g/L)	70
T (°C)	10-15



Sample	*The identification mark of the examined layer*						
	t_ano_9_240	*t_ano_9_320*	*t_ano_10_500*	*t_ano_10_800*	*t_ano_11*	*t_ano_12*	*t_ano_13*
Thickness, d / mm	***23.1***	***22.9***	***35.6***	***41.4***	***27.9***	***47.8***	***45***
R_a / mm before anodizing	***1.5***	***1.6***	***5.1***	***4.2***	***1.1***	***0.9***	***1.02***
R_a / mm after anodizing	1.21	1.13	4.63	3.55	0.91	0.66	1.06
HV	371	258	379	409	608	506	510

3. TEST PARAMETERS

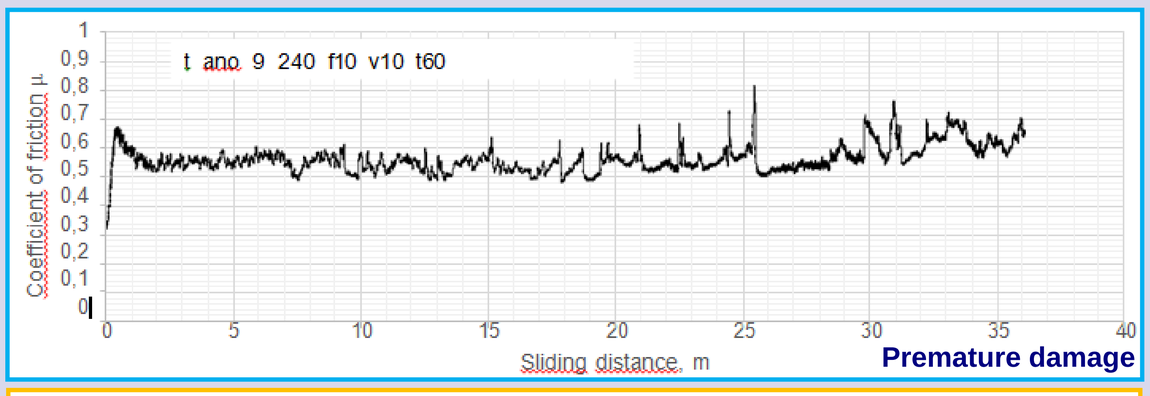
- Test speciment: UNMT-1 multifunctional modular micro-nano surface test system;
- Normal load: 10 N;
- Sliding speed: 10 mm/s;
- Sliding radius: 3 mm;
- Tribopair: ϕ5.96mm, ZrO_2 ball;
- Testing temperature: 29±2 °C;
- Medium: air;
- Frictional state: unlubricated..



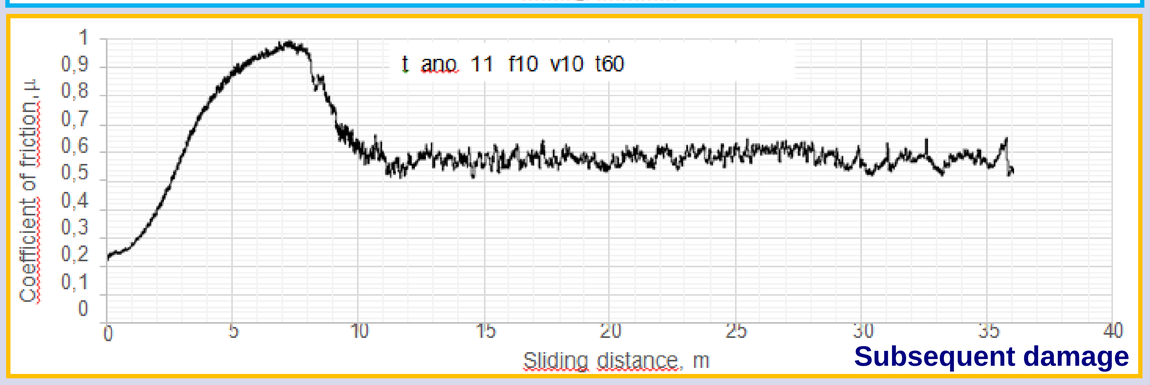
4. WEAR BEHAVIOR OF ANODIZED SAMPLES

Table 1. Categorization og tested coatings according to wear behavior

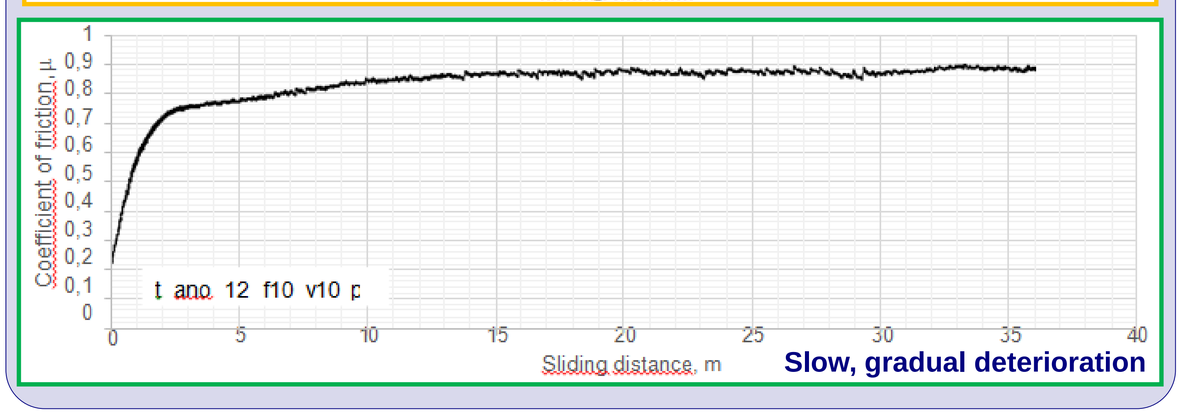
Category of wear	Identification of the tested coating						
	t_ano_9_240	*t_ano_9_320*	*t_ano_10_500*	*t_ano_10_800*	*t_ano_11*	*t_ano_12*	*t_ano_13*
	Wear track						
	p1 p2	p1 p2	p1 p2	p1 p2	p1 p2	p1 p2 p3	p5 p1 p2 p3
A	■		■	■			
B		■			■		
C						■	■



Premature damage



Subsequent damage



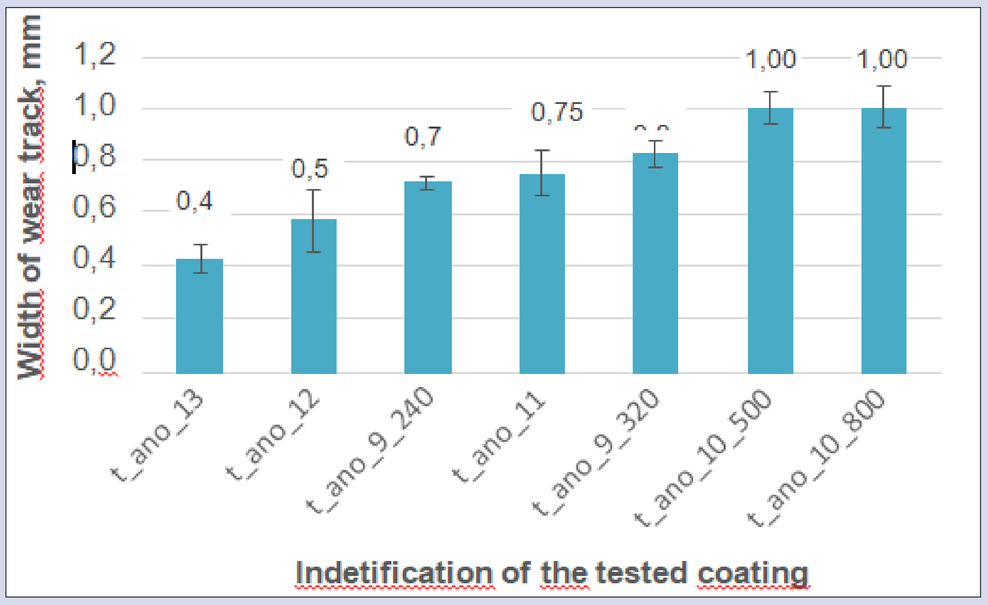
Slow, gradual deterioration

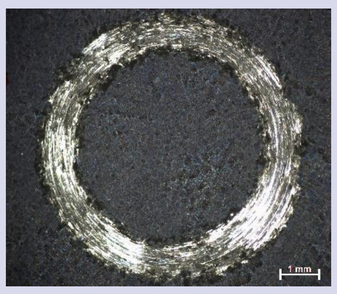
5. Determination of wear track width

The width of the wear track was measured on each abrasion trace in four perpendicular sections according to the standard.

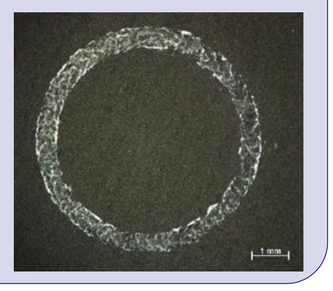
Table 2. Width of wear tracks

Width of wear track	Identification of the tested coating						
	t_ano_9_240	*t_ano_9_320*	*t_ano_10_500*	*t_ano_10_800*	*t_ano_11*	*t_ano_12*	*t_ano_13*
Average, mm	0,72	0,82	1,00	1,00	0,75	0,57	0,43
Pointing error, mm	0,02	0,05	0,06	0,08	0,08	0,12	0,05
Variance cof., %	3,3	6,3	6,1	7,5	10,9	20,4	12,6





The wear pattern of the coating **t_ano_10_500** clearly shows that the coating is completely detached during abrasion, and that a distinctive form of abrasive wear, the so-called abrasive wear, is applied to the soft, metallic substrate. traces of microfabrication wear [2] are visible



In contrast, the abrasion mark on the **t_ano_13** coating shows only partial damage to the coating layer;

The coating t_ano_10_500 is more than 20% thinner than the t_ano_13 coating, and the average roughness of the surface is more than four times lower in case of less favorable behavior

6. CONCLUSION

Based on ball-on-disc comparative abrasion tests on Si and Mg aluminum alloys, friction coefficient-abrasion path length diagrams, as well as analysis of the morphological features of abrasion traces, as well as in short - they can be summarized below.

- The coating that performs best in the selected tribo system, that is, most resistant to abrasion under the given loading conditions, is the coating t_ano_13;
- under the present test conditions, t_ano_13 resp. with the exception of the t_ano_12 samples, complete abrasion of the coating is observed;
- In terms of wear resistance, the t_ano 500 and 800 layers are considered to be the weakest

References

- [B. C. Mutsuddy, R. G. Ford (1995): *Ceramic Injection Molding*. Chapman&Hall, London.
- M. Trunec, J. Cihlar, Thermal removal of multicomponent binder from ceramic injection mouldings. *Journal of the European Ceramic Society*, 2002/22.
- US5135977 Injection molding composition, M. Achikita, A. Ohtsuka, Sumito Metal Mining Co. (Tokyo). 1990.

Cím/address: H-1116 Budapest, Fehérvári út 130.
Levelezési cím: H-1509 Budapest Pf.: 53.
Mailing address: H-1509 Budapest P.O.Box 53.

Telefon/phone: +36-1/463-0545
Fax: +36-1/463-0529
E-mail: bay-ati@bayzoltan.hu
Web: www.bayzoltan.hu