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COMPARATIVE LABORATORY TESTS FOR WATER RESISTANCE OF CARRYING ROLLERS FOR BELT CONVEYORS

KOMPARATIVNA LABORATORIJSKA ISPITIVANJA OTPORNOSTI NA VODU NOSEĆIH VALJAKA TRANSPORTERA SA TRAKOM

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Abstract: *The present paper treats the carrying out of comparative laboratory tests of samples of the carrying rollers, produced by REMOTEKS, Radnevo town and INTRANSMASH, Sofia, with the purpose of partially determining and analyzing the performance characteristics in particular, their resistance against pervasion of water into the bearing boxes and the change of the rolling characteristics after the tests.*

Key words: *Rollers, Belt Conveyors, Water Resistance*

Apstrakt: *Ovaj rad se bavi izvođenjem komparativnih laboratorijskih ispitivanja uzoraka nosećih valjaka, od proizvođača REMOTEKS, iz Radneva i proizvođača INTRANSMASH, iz Sofije, u cilju delimičnog određivanja i analiziranja radnih performansi, naročito njihove otpornosti na prodiranje vode u kućišta ležaja i menjanja karakteristika valjaka nakon ispitivanja.*

Ključne reči: *valjci, transporteri sa trakama, otpornost na vodu*

1 INTRODUCTION

During the last decades, the coming in and the widening application of the belt conveyors in MINI MARITZA IZTOK EAD for transportation of coals and overburden is realized by the delivery and use of bulgarian and import conveyors.

The belt conveyors GLT – 1800 are among the wide used in the opencast mines of MINI MARITZA IZTOK EAD. They operate in the production sections and in the overburden sections as well, i. e. in the so called uncovering-transport and dump complexes (UTDC).

In the end of 2007, in the opencast mine TROYANOVO-1, the total number of the conveyors of the type is 24 (7 in the production section and 17in the different UTDC) and their total length reaches 23 058 m.

1. UVOD

Tokom poslednjih decenija, nastupajuća i rasprostranjena primena transportera sa trakom u rudniku MINI MARITZA IZTOK EAD za prevoz uglja i otkrivke obavlja se korišćenjem bugarskih i uvoznih transportera.

Transporteri sa trakom GLT – 1800 su u grupi najrasprostranjenijih u površinskim kopovima rudnika MINI MARITZA IZTOK EAD. Oni rade u proizvodnim odeljenjima ali i u odeljenjima za otkrivku, tj. u takozvanim kompleksima za nepokriven transport i deponovanje (UTDC).

Krajem 2007. godine, u površinskom kopu TROYANOVO-1, ukupan broj transportera ove vrste iznosi 24 (7 u proizvodnom odeljenju i 17 u različitim kompleksima UTDC) a njihova ukupna dužina dostiže 23.058 m.

At the available 32 belt conveyors operating in the opencast mine with belt width 1800 and 2250 mm, the total length of the conveyor lines reaches 35437 m. The share of the GLT – 1800 is respectively 65% of the available conveyors in the opencast nine and 75% of the total length of the belt conveyance. The conveyors are equipped with combined driving stations (bulgarian or german production, combining the functions driving, tightening, primary and secondary cleaning of the belt from stuck mine body) and linear part built from sections. Each of them is equipped with five string belt carriers and one supporting the underbelt.

The closed contour of the conveyor belt is normally built from pieces of belt 1800 mm in width, type GLT 1800 EP 2500/4+2, connected by vulcanization.

The drive of the conveyors is two-drum, three-motor, with total installed power 3x560 kW and a rheostat control of the starting process.

The conveyors of this type could be characterized with speed of the belt movement V 5,24 m/s, distance between the belt carriers supporting the loaded strand l'_p = 1,2 m and indicated volume output Q_I = 7200 m^3/h. For the conditions of MINI MARITZA IZTOK EAD, their operational volume output varies in the limits Q_{op}=3200÷3600 m^3/h.

The string belt carriers supporting the loaded strand of the belt consists of hinge connected carrying rollers. The diameter of their mantle is d = 159mm and width 600 mm or 670 mm, without a rubber or plastic lining. The hinge carrying rollers of the type A – 159x600 are built in the string belt carriers as middle and these of the type A – 159x670 as side rollers. The bodies of the both rollers types are connected to the immovable axes by radial rolling ball bearings No 6308 and No 6310.

The high linear density (833 pcs/km) of the string carriers at the conveyors in question determines the same density of the rollers of the type A – 159x600 and two times bigger (1666 pcs/km) for these of the type A – 159x670. This undoubtedly turns the rollers into the widest spread unit in the belt conveyor subjected to delivery, maintenance, replacement and repair, which design, movement characteristics, price, operation life, maintainability and energy consumption to a considerable extent determine not only the operating duty and the

Kod raspoloživa 32 transportera sa trakom koji rade u površinskom kopu, gde je traka širine 1.800 i 2.250 mm, ukupna dužina trasa transportera dostiže 35.437 m. Model GLT – 1800 učestvuje sa 65% u odnosu na broj raspoloživih transportera u površinskom kopu odnosno 75 % na ukupnu dužinu transportne trase. Transporteri su opremljeni kombinovanim pogonskim stanicama (bugarske i nemačke proizvodnje, koje imaju kombinaciju funkcija pogona, zatezanja, primarnog i sekundarnog čišćenja trake od zaglavljenog materijala) i linearnim delom izgrađenim od odeljaka. Svaki od njih je opremljen sa 5 žičanih nosača traka i jednim potpornim koji se nalazi ispod trake.

Zatvoreni krug trake transportera je obično sastavljen od delova trake 1800 mm širine, tipa GLT 1800 EP 2500/4+2, spojenih vulkanizacijom.

Pogon transportera se sastoji od dva doboša, tri motora, ukupne instalisane snage od 3x560 kW i uz kontrolu otpornika kod uključivanja.

Transportere ovog tipa može karakterisati brzina kretanja trake od V 5,24 m/s, razmak između nosača trake koji podupiru opterećenu stranu l'_p = 1,2 m i naznačena početna zapremina Q_I = 7200 m^3/h. Za uslove koji vladaju u rudniku MINI MARITZA IZTOK EAD, njihova operativna početna zapremina varira između Q_{op} = 3200÷3600 m^3/h.

Žičani nosači traka koji podupiru opterećenu stranu trake sastoje od zglobno spojenih nosećih valjaka. Prečnik njihovog omotača je d = 159 mm a širina 600 mm ili 670 mm, bez gumene ili plastične obloge. Zglobni noseći valjci tipa A – 159x600 su ugrađeni u žičane nosače trake kao središnji a valjci tipa A – 159x670 kao bočni valjci. Trupovi valjaka oba tipa su povezani sa nepokretnim osovinama radijalnim kugličnim ležajevima br. 6308 i br. 6310.

Velika linearna zbijenost (833 kom/km) žičanih nosača kod pomenutih transportera određuje istu zbijenost valjaka tipa A – 159x600 i dva puta veću (1666 pcs/km) za valjke tipa A – 159x670. Ovo nesumnjivo pretvara valjke u najrasprostranjeniju jedinicu u transporteru sa trakom koji zavisi od isporuke, održavanja, zamene i popravke, čiji nacrt, karakteristike kretanja, cena, vek upotrebe, mogućnost održavanja i potrošnja energije u značajnoj meri

durability of the belt but also the operation duty of the drive, the consumption of energy of the conveyance process and in the last–its efficiency.

2 LABORATORY TESTS FOR WATER RESISTANCE

The above mentioned indices characterizing the dimensions of the application of GLT – 1800 in opencast mine TROYANOVO-1, as well as those assigning to the position and the uniform distribution of the string belt carriers, consisting of rollers A – 159x600 and A – 159x670, along the conveyor, show that about 57000 rollers with diameter Ø159 are in simultaneous exploitation, respectively 19000 of the former and 38000 of the latter type. In order such a great number of rollers, subjected to the unfavorable influence of a series of factors (presence of moist, dust, as well as of dynamic loads of the conveyed material passing above the rollers) requires a well organized and strictly applied system for current engineering inspections of the rollers and the string carriers, for timely replacement and repairs.

Normally, in opencast mine TROYANOVO-1, as well as in the rest of the mines of MINI MARITZA IZTOK EAD, the inspections and replacement of the string carriers are made during the repair shifts. The repair works of the rollers and the string carriers are made in a mill (such mills are organized at all the opencast mines). Repaired and partially new rollers, of the respective type, are used for the replacement and compensation of the rejected rollers.

In 2007, 6 000 new rollers of the type A–159x600 and 12 000 of the type A–159x670 have been delivered and distributed for the needs of MINI MARITZA IZTOK EAD. Annually, 20000÷30000 rollers of the two types are received for repair works in the mills of the opencast mines.

The analysis of the data, reflecting the annual movement of the received in the mill and liable to replacement and repair rollers shows that in the period about 21,52% of the A–159x600 rollers and 20,51% of the type A–159x670 operating in the opencast mine are subjected to repair. At the moment, the mechanical departments of MINI MARITZA IZTOK EAD do not have concrete data for the real operation time of the mentioned types of rollers and the conclusions drawn by the experts usually are considerably different.

određuju ne samo funkcionalnost i trajnost trake već i funkcionalnost pogona, potrošnju energije procesa transporta i na kraju – njenu efikasnost.

2 LABORATORIJSKA ISPITIVANJA OTPORNOSTI NA VODU

Prethodno pomenuti pokazatelji koji karakterišu obim primene GLT – 1800 u površinskom kopu TROYANOVO-1, kao i oni koji se pripisuju položaju i jednoobraznoj raspodeli žičanih nosača trake, koji se sastoje od valjaka tipa A – 159x600 i A – 159x670, duž transportera, potvrđuju da se oko 57000 valjaka prečnika Ø159 nalaze u istovremenoj upotrebi, od kojih 19000 prvog a 38000 drugog tipa. S obzirom na tako veliki broj valjaka, podložnih nepovoljnom uticaju niza faktora (prisustvo vlage, prašine, kao i dinamičkog opterećenja transportovanog materijala koji prolazi iznad valjaka) potreban je dobro organizovan i striktno primenjen sistem za tekuća tehnička ispitivanja valjaka i žičanih nosača, u cilju blagovremene zamene i popravke.

U površinskom kopu TROYANOVO-1, kao i u drugim rudnicima MINI MARITZA IZTOK EAD, kontrola i zamena žičanih nosača vrše se tokom smena zaduženih za popravke. Popravke valjaka i žičanih nosača se obavljaju u postrojenjima (ta postrojenja se postavljaju kod svih površinskih kopova). Popravljeni i delimično novi valjci, zavisno o kojem tipu se radi, koriste se za zamenu i kompenzaciju odbačenih valjaka.

Godine 2007. za potrebe MINI MARITZA IZTOK EAD isporučeno je i distribuirano 6000 novih valjaka tipa A–159x600 i 12.000 tipa A–159x670. Godišnje se u postrojenjima površinskih kopova primi za popravku 20000÷30000 valjaka oba tipa.

Analiza podataka, koji odražavaju godišnje kretanje valjaka, koja se u postrojenju prime za eventualnu zamenu i popravku, pokazuju da je oko 21,52% valjaka A–159x600 i 20,51% valjaka tipa A–159x670 koji su u tom periodu bili u upotrebi na površinskom kopu, bilo podložno popravci. Trenutno, mašinska odeljenja u MINI MARITZA IZTOK EAD nemaju konkretne podatke o realnom vremenu rada pomenutih tipova valjaka i zaključci koje su izvukli eksperti obično se razlikuju u značajnoj meri.

Up to now, a strict control of the movement and the real operation time of the each batch have not been established and the replacement of the rollers is made in case of failure.

The imposed by the real technical conditions trend rollers of the type A–159x600 and even of the type A-159x670 equipped with bearings of heavier series – 6310 instead of 6308 to be used is ascertained. This could be explained by the biggest per cent of the received, for repair works rollers with bearings 6308 – 43,69% of the type A–159x600 and 37% of the type A-159x670 (according to data of the opencast mine TROYANOVO - 3).

A traditional producer and deliverer of new carrying rollers of the types A–159x600 and A-159x670, for MINI MARITZA IZTOK EAD, is REMOTEKS (the ex CENTRAL REPAIR BASE), Radnevo town.

INTRANSMASH is another possible Bulgarian producer of new rollers of the mentioned types, which has the tool equipment needed and is able to produce and deliver rollers, with different of that of REMOTEKS sealing of the bearings, for tests in laboratory and opencast mine conditions.

The present paper treats the carrying out of comparative laboratory tests of samples of the carrying rollers of the mentioned types, produced by REMOTEKS, Radnevo town and INTRANSMASH, Sofia, with the purpose of partially determining and analyzing the performance characteristics in particular, their resistance against pervasion of water into the bearing boxes and the change of the rolling characteristics after the tests.

The tests for determination the rolling characteristics of the rollers including the static W_{1s}, and dynamic W_{1dyn} resistance have been carried out preliminary in laboratory conditions. Thoroughly the methodology, test stand and the test results are described in an official report approved by the expert council of MINI MARITZA IZTOK EAD. An extract of the results is presented in Table 1, columns 3, 4, 5, 6, 7 and 8 (Primary tests).

The testing methodology of the water resistance of the rollers has been developed after studying of a series of standards and DIN 22112-3 and PN-91/M-46606 are used as a basis. According to it a consecutive tests of three preliminary weigh out rollers of one type (with similar design,

Do danas nije uspostavljena stroga kontrola kretanja i realno vreme rada svake serije a zamena valjaka se vrši u slučaju kvara.

Trend koji su nametnuli realni tehnički uslovi sastoji se u tome da treba da se koriste valjkovi tipa A–159x600 i čak tipa A-159x670 opremljeni ležajevima teže serije – 6310 umesto 6308. Ovo se može objasniti većim procentom valjaka sa ležajevima, primljenih na popravku, 6308 – 43,69% tipa A–159x600 i 37% tipa A-159x670 (prema podacima površinskog kopa TROYANOVO - 3).

Dugogodišnji proizvođač i isporučilac novih nosećih valjaka tipa A–159x600 i tipa A-159x670, za MINI MARITZA IZTOK EAD, je REMOTEKS (ranije pod nazivom CENTRAL REPAIR BASE), iz mesta Radnevo.

INTRANSMASH je drugi mogući bugarski proizvođač novih valjaka navedenih tipova, koji ima potrebne mašine i opremu koji mogu da proizvedu i isporuče valjke, osim zaptivnog elementa ležajeva firme REMOTEKS, za ispitivanja u laboratoriji i uslovima koji vladaju u površinskom kopu.

Ovaj rad se bavi izvođenjem komparativnih laboratorijskih ispitivanja uzoraka nosećih valjaka navedenih tipova, proizvedenih od strane REMOTEKS-a iz Radneva i INTRANSMASH –a iz Sofije, u cilju određivanja i analiziranja performansi a naročito njhove otpornosti na prodiranje vode u kućišta ležajeva i menjanja valjnih karakteristika nakon ispitivanja.

Ispitivanja u cilju određivanja valjnih karakteristika valjaka uključujući statičku W_{1s} i dinamičku W_{1dyn} otpornost izvršena su preliminarno u laboratorijskim uslovima. Metodologija, testno postolje i rezultati ispitivanja detaljno su opisani u zvaničnom izveštaju koji je odobrio stručni savet rudnika MINI MARITZA IZTOK EAD. Deo tih rezultata prikazan je u Tabeli 1, u kolonama 3, 4, 5, 6, 7 i 8 (osnovna ispitivanja).

Metodologija ispitivanja otpornosti na vodu kod valjaka izrađena je nakon proučavanja niza standarda i kao osnova korišćeni su DIN 22112-3 i PN-91/M-46606. Po toj metodologiji, treba da se izvrše uzastopna ispitivanja tri preliminarne mere kod valjaka jednog tipa (koji imaju

external diameter of the mantle, number of the rolling bearings, type and dimensions of the bearing units sealing) have to be carried out.

približno isti dizajn, spoljašnji prečnik omotača, broj valjnih ležaja, tip i veličinu zaptivke kod ležaja).

Table 1 Methodology, test stand and the test results
Tabela 1 Metodologija, testno postolje i rezultati ispitivanja

N_0	Producer, type	Mass, kg		Primary tests				Water resistance tests			
				Static	Dynamic			Static	Dynamic		
		m nominal	M real	M_{1s}, Nm	P_1, kW	M_{1dyn}, Nm	W_{1dyn}, N	M_{2s}, Nm	P_2, kW	M_{2dyn}, Nm	W_{2dyn}, N
1	2	3	4	5	6	7	8	9	10	11	12
1	Intransmash (159/600/6308)	21,96	23,74	0,066	0,286	4,126	0,0042	0,0752	0,2466	3,552	0,0036
2	Remoteks (159/600/6310)	22,37	22,37	0,137	0,297	4,278	0,0044	0,0763	0,2528	3,642	0,0037
3	Intransmash (159/670/6308)	23,96	25,67	0,042	0,284	4,094	0,0042	0,1021	0,2027	2,920	0,0030
		23,96	25,79	0,586	0,259	3,735	0,0038	0,265	0,2602	3,748	0,0038
4	Remoteks (159/670)	24,4	25,45	0,097	0,297	4,274	0,0044	0,0719	0,2763	3,980	0,0041
		24,4	25,82	0,081	0,306	4,402	0,0045	0,0795	0,2576	3,710	0,0038

The tested roller is mounted horizontally and its axis is fixed, while the body is set to rotary motion, with a determined constant frequency, by an electric motor and belt transmission.

Testirani valjak se horizontalno postavlja i njegova osovina se učvršćuje, a trup se stavlja u poziciju za rotaciono kretanje, gde je određena konstatna frekvencija, a kretanje se vrši putem elektro-motora i remenskim prenosom.

For the tests is used drinking water, simultaneously injected to the two front walls of the roller body by two identical nozzles connected to two water pumps with flow 8 l/min, operating in a closed contour.

Kod testiranja je korišćena pijaća voda, koja je ubrizgana istovremeno na dve prednje strane trupa valjka putem dve identične mlaznice povezane na dve pumpe za vodu, protoka 8 l/min, koje rade u zatvorenom krugu.

The test has been carried out under the following conditions:

Ispitivanje je izvršeno u sledećim uslovima:

- Temperature of the air environment $t = 20 \pm 2°$ C;
- Pressure on the tested roll - 250 N;
- Total duration of the test – 36 h, 24 of which the rollers rotate with frequency 650 min^{-1}, and 12 h they are immovable, under the action of the nozzles and after every 3 hours they are one-way turned to 90°.

- Temperatura vazduha u datoj sredini $t = 20 \pm 2°$ C;
- Pritisak na ispitivani valjak - 250 N;
- Ukupno trajanje ispitivanja – 36 h, od kojih tokom 24 sata valjci se okreću frekvencijom od 650 min^{-1}, a 12 h su nepokretni pod dejstvom mlaznica, i svaka 3 sata okrenu se za 90°.

As a criteria for the water resistance of the tested roller are taken the change in its weight and dynamic resistance (W_{dyn}). In order they to be determined, after the test, the roller is subjected to a repeat weigh out and determination of the rolling characteristics according to the above mentioned preliminary developed methodology.

Za otpornost na vodu ispitivanog valjka kao kriterijum je korišćena promena njegove težine i dinamičke otpornosti (W_{dyn}). Da bi se odredile ove vrednosti, nakon testiranja se na valjku vrši ponovno merenje i određivanje valjnih karakteristika prema navedenoj prethodno izrađenoj metodologiji.

The general view of the stand designed for the water resistance tests is shown in Figure 1.

Izgled postolja namenjenog za ispitivanja otpornosti na vodu prikazan je na slici 1.

The adjustable drive of the stand (Figure 2) consists of an induction motor (N= 3kW and n =1440 min^{-1}), inverter type DRIVE MX pro and a belt transmission and transmission ratio μ = 1,52. The roller body is the driven part of the transmission.

The motor is mounted to a steel plate with guides. By the transmission belts it is mechanically connected to the middle frame and the tested roller.

The motor weight is used for tightening of the belt transmission. Additional weights are suspended to the steel plate, in order the prescribed in the methodology pressure of 250 N to be achieved.

The inverter DRIVE MX pro is used for measuring of the controlled values (P_2, n and I). The registration and processing of the data obtained is realized by a PC and specialized software. Figure 3.a, show the graphics obtained for the rollers produced by INTRANSMASH, Sofia and Figures 3b for those, produced by REMOTEKS, Radnevo town.

Podesivi pogon postolja (slika 2) sastoji se od indukcionog motora (N= 3kW i n =1440 min^{-1}), izmenjivačkog uređaja tipa DRIVE MX pro i remenskog prenosa i prenosnog odnosa μ = 1,52. Trup valjka je pogonski deo prenosa.

Motor se postavlja na čeličnu ploču sa vođicama. Putem prenosnih traka mehanički je povezan sa srednjim okvirom i valjkom koji se ispituje.

Težina motora se koristi za zatezanje remenskog prenosa. Na čeličnu ploču se stavlja dodatni teret kako bi se postigao pritisak od 250 N, predviđen pomenutom metodologijom.

Izmenjivački uređaj DRIVE MX pro koristi se za merenje kontrolisanih vrednosti (P_2, n i I). Unos i obrada dobijenih podataka se vrše putem računara i specijalizovanog softvera. Slika 3.a predstavlja grafikon za valjke koje proizvodi INTRANSMASH iz Sofije a slika 3b za one proizvedene u REMOTEKS-u, iz Radneva.

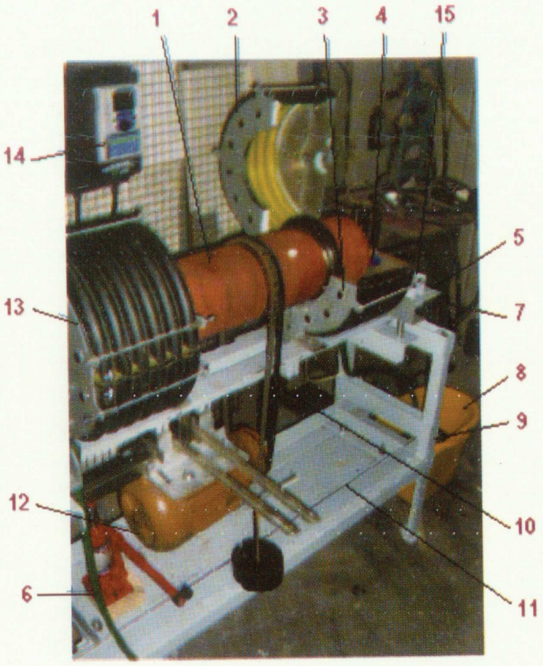


Figure 1 / slika 1

1 – roller subjected to test; 2 and 3 – upper and lower half body of the right water chamber; 4 – nozzle; 5 and 15 – middle and basic frame of the stand; 7 and 6 – pressure water-supply and outlet water pipe; 8 – tank for circulating water; 9 – water pump; 10 – transmission belts; 12 – electric motor; 13 – left water chamber; 14 – inverter; 15 – movable support.

1 – valjak podvrgnut ispitivanju; 2 i 3 – gornja i donja polovina trupa desne komore za vodu; 4 – mlaznica; 5 i 15 – srednji i osnovni okvir postolja; 7 i 6 – dovod vode pod pritiskom i izlazna cev za vodu; 8 – rezervoar za vodu koja kruži; 9 – pumpa za vodu; 10 – pogonski remeni; 12 – elektro-motor; 13 – leva komora za vodu; 14 – Izmenjivački uređaj; 15 – pokretna potpora.

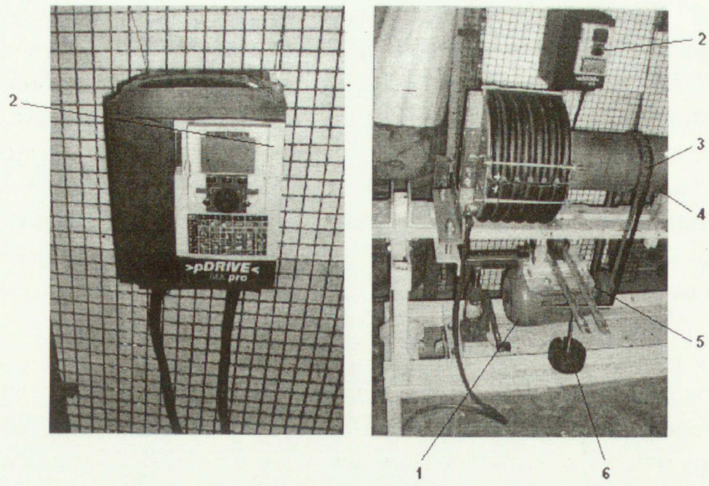
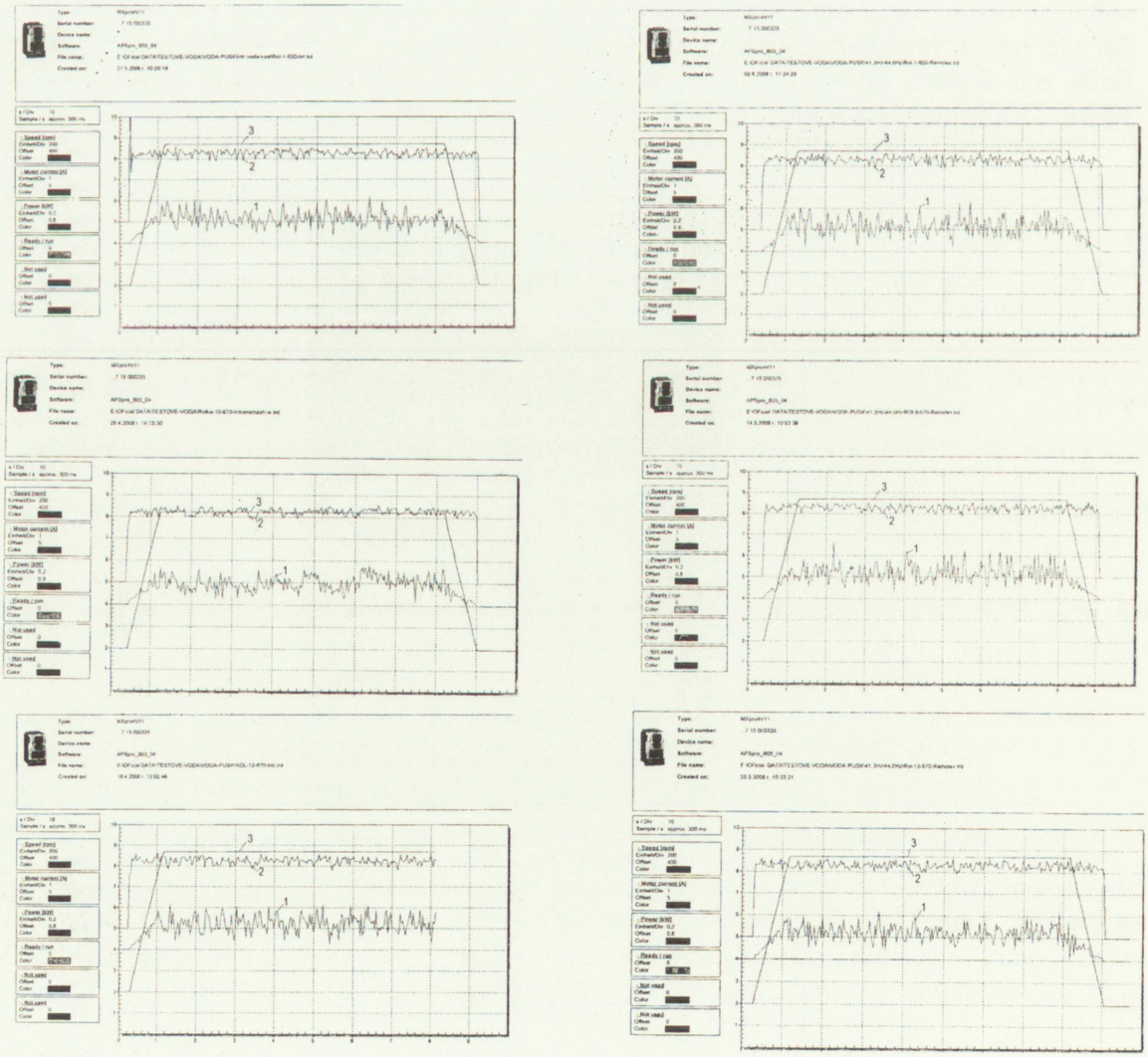


Figure 2 / slika 2
1 – induction motor; 2 - inverter type DRIVE MX pro; 3 – transmission belts; 4 – roller; 5 – steel plate; 6 - additional weights
1 – indukcioni motor; 2 – izmenjivač tipa DRIVE MX pro; 3 – pogonski remeni; 4 – valjak; 5 – čelična ploča; 6 – dodatni teret.



a) *b)*

Figure 3 - 1 – active power P_2; 2 - current; 3 – speed
slika 3 - 1 – aktivna snaga P_2; 2 - struja; 3 - brzina

The data obtained after the processing of the graphics, reflecting the alteration of the tested rollers are presented in Table 1, columns 10, 11 and 12 (Water resistance tests). As it is mentioned above, the alteration of the weight and the dynamic resistance W_{2dyn} are taken as a criteria for the water resistance of the tested rollers. A repeated measurement of the rollers weight is made after the end of the tests, but no differences are found.

The values of the dynamic resistance W_{2dyn}, calculated on the basis of the obtained graphics of the active power P_2, are presented in Table 1, column 12.

3 CONCLUSION

It has to be had in mind that both the producers have delivered rollers with bearing supports of different series for the tests, so a direct comparison of the obtained results would not be correct. Under the circumstances, after studying the design documentation and the end of the tests the following inferences could be made:

1. The modern trends in design and sealing of bearing supports are reflected by the designs of the both versions of the roller carriers A 159 (produced by REMOTEKS, Radnevo town and INTRANSMASH, Sofia).
2. In the design of the rollers of the both producers double measures against water entering in the bearings are taken, which provide the protection needed.
3. The alteration of the dynamic resistance after the laboratory tests, shows a trend to decrease typical of the rollers of the both producers, which speaks for continuation of the running-in process and in no way for manifestation of design defects after the intensive treatment with water directly injected on the bearing sealing.

From this, it could be concluded that, according to the results of the laboratory test for resistance against water entering, the rollers produced by INTRANSMASH, Sofia could also operate in the conditions of the opencast mines of MINI MARITZA IZTOK EAD. However, a final statement could be expressed no sooner than the analysis of the results of the forthcoming laboratory tests for resistance against dust entering and the performance tests.

Podaci dobijeni nakon obrade grafikona, koji odražavaju smenjivanje ispitanih valjaka, prikazani su u Tabeli 1, kolone 10, 11 i 12 (ispitivanja otpornosti na vodu).Kao što je prethodno pomenuto, težina i dinamička otpornost $W_{2dyn,}$ naizmenično, uzeti su kao kriterijumi za otpornost na vodu ispitivanih valjaka. Ponovno merenje težine valjaka je izvršeno nakon završetka ispitivanja, ali nisu pronađene nikakve razlike.

Vrednosti dinamičke otpornosti W_{2dyn}, izračunate na osnovu dobijenih grafikona aktivne snage P_2, prikazane su u Tabeli 1, kolona 12.

3 ZAKLJUČAK

Treba imati na umu da su oba proizvođača dostavili valjke sa ležišnim nosačima iz različitih serija, u svrhu ispitivanja, tako da direktno poređenje dobijenih rezultata ne bi bilo tačno. U tim okolnostima, nakon proučavanja projektne dokumentacije i rezultata ispitivanja mogu se izvesti sledeći zaključci:

1. Savremeni trendovi u projektovanju i zaptivanju ležišnih potpora odražavaju se u dizajnu obe verzije nosača valjaka A 159 (koje je proizveo REMOTEKS, iz Radneva i INTRANSMASH iz Sofije).
2. Oba proizvođača su preduzela velike mere opreza u projektovanju valjaka u pogledu prodiranja vode u ležajeve, što je pružilo potrebnu zaštitu.
3. Menjanje dinamičke otpornosti nakon laboratorijskih ispitivanja pokazuje tendenciju kod oba proizvođača da se smanji otpornost koja je tipična za valjke, što govori o nastavljanju vršenja procesa a nikako o tome da su se pojavile mane u projektovanju nakon intezivnog tretiranja vodom koja je direktno ubrizgana na zaptivku ležaja.

Iz navednog se može zaključiti da, prema rezultatima laboratorijskog ispitivanja u pogledu prodiranja vode, valjci proizvedeni u INTRANSMASH-u iz Sofije bi takođe mogli da funkcionišu u uslovima koji vladaju u površinskim kopovima MINI MARITZA IZTOK EAD. Ipak, konačni sud bi se mogao doneti tek nakon analize rezultata narednih laboratorijskih ispitivanja u pogledu otpornosti na prodiranje prašine i ispitivanja radnih performansi.

The present research is the first step to the establishment of laboratory for incoming control and control after the repair works, which could serve not only MINI MARITZA IZTOK EAD but other mining enterprises as well.

Ovo istraživanje je prvi korak ka uspostavljanju laboratorijske kontrole prilikom prijema i nakon popravke, što bi moglo biti od koristi ne samo za MINI MARITZA IZTOK EAD već i za druga rudarska preduzeća.

REFERENCES / LITERATURA

[1] Standard DIN 22112-3
[2] Standard PN-91/M-46606

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