

## THE TIME UTILIZATION OF THE HYDRAULIC EXCAVATORS AND FRONTAL LOADERS IN OPC ČIERNA NAD TISOU

## VREME ISKORIŠĆENJA HIDRAULIČKIH BAGERA I FRONTALNIH UTOVARAČA U OPC ČIERNA NA TISI

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**Abstract:** *Reloading centres are very important in railway transport of loose material. Within the scope of these centres it is very important to analyse the time utilization of all elements. This paper deals with the analyse of the time utilization of the hydraulic excavators and frontal loaders in OPC Čierna nad Tisou, which is one of the most important reloading and transit station in this region.*

**Key words:** *reloading and transit station, the time utilization, excavators and loaders*

**Apstrakt:** *Pretovarni centri su veoma važne karike u lancu železničkog transporta rasutog tereta. U okviru ovih centara veoma važno je da se postigne maksimalno moguće iskorišćenje svih elemenata. U ovom radu se analizira vreme iskorišćenja hidrauličkih bagera i frontalnih utovarača u OPC Čierna na Tisi, koja spada u najvažnije pretovarne i tranzitne stanice u regionu.*

**ključne reči:** *pretovarna i tranzitna stanica, vreme iskorišćenja, bageri i utovarači*

### 1 OPC ČIERNA NAD TISOU

Čierna nad Tisou as a reloading and transit station was established in 1947 and 55 years is the most important station in goods transport within the gauge and schedule (SMGS/CIM). **The Commercial-Reloading Centre Čierna nad Tisou** has been established as the independent ŽSR organisational unit since 1<sup>st</sup> June 1998, which provides trade and reloading activity, customer service related to transport and reloading goods and relations with public administration bodies within goods export and import through the railway junction Čierna nad Tisou - Čop (UZ). (Picture 1).

### 1 OPC ČIERNA NA TISI

Čierna na Tisi, kao pretovarna i tranzitna stanica, je osnovana 1947. godine i 55 godina je po svim standardima i planovima najvažnija stanica za transport robe. (SMGS/CIM). Trgovinski-pretovarni centar Čierna na Tisi je osnovana 1. juna 1998. godine kao nezavisna ŽSR organizaciona jedinica, koja obezbeđuje trgovinske i pretovarne delatnosti, usluge kupcima u vezi transporta i pretovara robe i veze sa javnim administrativnim telima u okviru izvoza i uvoza robe kroz železničku raskrnicu Čierna na Tisi - Čop (UZ) (slika1).



Figure 1 Location of OPC Čierna nad Tisou  
slika 1 Položaj OPC Čierna na Tisi

There are different types of machines and facilities in each reloading platform in according to type of reloading – the hoisting facilities, the hydraulic excavators, the motor trucks, the universal frontal loaders, the siphon complexes, etc.

This article is dealing with the time utilization of the hydraulic excavators and the universal frontal loaders in 2001, which performed the reloading of free-stored substratum.

## 2 THE HYDRAULIC EXCAVATORS AND THE UNIVERSAL FRONTAL LOADERS INSTALLED IN OPC ČIERNA NAD TISOU

At railway reloading centre the hydraulic excavators are used for reloading of all types of the iron ores and other ore free-stored substratum. For this purpose are the hydraulic excavators equipped by a claw working equipment. There are two types of reloading the ores by those excavators:

1. Reloading directly from a wide gauge wagon to normal gauge wagon;
2. Reloading of ores from halls to normal gauge wagons.

In 2001 there was 21 hydraulic excavators from two producers:

- 1) Producer: LIEBHERR FRANCE S.A., type R 934 LITRONIC. The number of the excavators: 4. Two of those excavators are on the wheel chassis and others are on belt chassis. The volume of claw of those excavators is between 0,8–1,2 m<sup>3</sup>. Horizontal range is up to 11 meters and vertical range is 10 m. The power of drive engine is 137 kW.
- 2) The Excavators produced in Uničov engineering works (UNEX a.s. Uničov) types DH 411, DH441, DH421 DH28.1. Total number of the excavators: 17. The comparison of basic parameters of DH 411 a DH 28.1 excavators are in the table 1. On the picture 2 there is an excavator at work.

Postoje različiti tipovi opreme na svakoj pretovarnoj platformi prema tipu pretovara - izvozna postrojenja; hidraulički bageri, kamioni, univerzalni frontalni utovarači, kompleksi kanala za trosku itd.

Ovaj rad govori o vremenu iskorišćenja hidrauličkih bagera i univerzalnih frontalnih utovarača u 2001. godini, koji su izvodili pretovar rovne rude.

## 2 HIDRAULIČKI BAGERI I UNIVERZALNI FRONTALNI UTOVARAČI INSTALIRANI U OPC ČIERNA NA TISI

U železničkom pretovarnom centru hidraulički bageri su korišćeni za pretovar svih tipova metalčnih i drugih ravnih ruda. Za ovu svrhu hidraulički bageri su opremljeni grabiličastom radnom opremom. Sa ovim bagerima se rade dva tipa pretovara rude:

1. Direktan pretovar iz širokih standardnih vagona u obične standardne vagone i
2. Pretovar ruda iz hala u obične standardne standardne vagone.

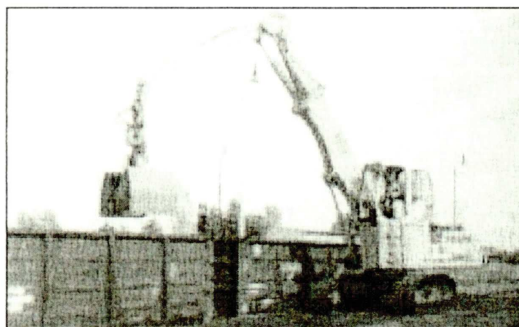
U 2001. godini postojao je 21 hidraulički bager od dva proizvođača:

- 1) Proizvođač: LIEBHERR FRANCE S. A. tip R 934 LITRONIC. Broj bagera je 4. Dva od ovih bagera su na postolju sa točkovima, a druga dva su na postolju sa gusenicama. Zapremina grabilice ovih bagera je između 0,8 - 1,2 m<sup>3</sup>. Horizontalni opseg je do 11 metara, a vertikalni opseg je 10 m. Snaga pogonskog motora je 137 kW.
- 2) Bageri proizvedeni u Uničov engineering works (UNEX a. s. Uničov) tipovi DH 411, DH 441, DH 421 i DH 28.1. Ukupan broj bagera je 17. U tabeli 1 je dato poređenje osnovnih parametara bagera DH 411 i DH 28.1. Na slici 2 prikazan je bager pri radu.

Table 1 The basic parameters of the excavators DH 411 a DH 28.1

Tabela 1 Osnovni parametri bagera DH 411 i Dh 28.1

Type of the excavator	DH 411	DH 28.1
The power of drive engine (kW)	132,4	130
Type of chassis	belt	belt
The volume of claw	0,8	1,0
Horizontal range (m)	8,32	9,75
Vertical range (m)	6,8	6,2

Figure 2 An excavator at work  
slika 2 Bager pri radu

The universal frontal loaders are used to reload free-stored charcoal by a closed shovel, by which are those facilities equipped. OPC has 5 frontal loaders – type of UNC – 060, which are installed in a light mechanisation area. The producer of those loaders was the Factory of Heavy Machinery in Detva, Slovakia.

Univerzalni frontalni utovarači se koriste za pretovar drvenog uglja sa zatvorenim lopaticama kojima je opremljen ovaj uređaj. OPC ima 5 frontalnih utovarača - tipa UNC-060, koji su instalisani u oblasti lake mehanizacije. Proizvođač ovih utovarača je fabrika teških mašina iz Detve, Slovačka.

### 3 THE TIME UTILIZATION OF THE HYDRAULIC EXCAVATORS

The number of real hours worked of machine or group of machines per specific time (month, year) can be evaluated by coefficient of time utilization ( $c_t$ ). This coefficient represents the percent rate of utilization of a calendar time fond for productivity, in our case for commodity reloading.

Coefficient can be calculated by the followed simple formula:

$$c_t = \frac{t_s}{t_f} \cdot 100 \quad [\%], \quad (1)$$

where:

$t_s$  – machine hours, time of working machine per monitoring period (h); i.e. time, when a machine was performing,

$t_f$  – the number of hours in monitoring period. Time, in which each machines were available.

### 3 VREME ISKORIŠĆENJA HIDRAULIČKIH BAGERA

Broj stvarnih radnih sati, mašine ili grupe mašina, po specifičnom vremenu (mesec, godina) može se izračunati preko koeficijenta vremena iskorišćenja ( $c_t$ ). Ovaj koeficijent predstavlja procentualni iznos iskorišćenja kalendarskog vremena produktivnosti, u našem slučaju za pretovar robe.

Koeficijent se može izračunati po sledećoj prostoformuli:

$$c_t = \frac{t_s}{t_f} \cdot 100 \quad [\%], \quad (1)$$

gde je:

$t_s$  - sati rada mašine, vreme rada mašine po periodu monitoringa (h), tj. vreme koje je mašina odradila,

$t_f$  - broj sati u periodu monitoringa, odnosno vreme u kojem je svaka mašina bila upotrebljavana.

The coefficient of time utilization of a fleet of machines (n – the number of machines) can be calculated similarly

$$k_{\tilde{c}_n} = \frac{\sum_{i=1}^n t_{s_i}}{t_f \cdot n} \cdot 100 \quad [\%]. \quad (2)$$

Koeficijent vremena iskorišćenja brzih mašina (n – broj mašina) može biti slično izračunat:

$$k_{\tilde{c}_n} = \frac{\sum_{i=1}^n t_{s_i}}{t_f \cdot n} \cdot 100 \quad [\%]. \quad (2)$$

### 3.1 The time utilization of hydraulic excavators

As it has been already mentioned in chapter 2, OPC had in 2001 available 21 excavators. The number of each type of excavators and their performance during 2002 is showed in the table 2.

### 3.1 Vreme iskorišćenja hidrauličkih bagera

Kao što je već pomenuto u poglavlju 2, OPC je u 2001. godini imao na raspolaganju 21 bager. Broj svakog tipa bagera i njihovog rada u 2002. godini je prikazan u tabeli 2.

Table 2 Dividing of the excavators in according to type  
Tabela 2 Podela bagera po tipu

Type of the excavator	The number of the excavators	Performance in 2001
DH 411	8	- The majority of excavators performed the reloading during 2002/Većina bagera radila je na pretovaru u 2002. - Since 31 <sup>st</sup> December 2001 3 excavators have been laid up./Od 31. decembra 3 bagera su demontirana.
DH 441	4	- 3 excavators work during the whole year./3 bagera su radila preko cele godine
DH 428.1	2	- Both of the excavators work during the whole year./Oba bagera su radila tokom cele godine
DH 421	3	- 1 excavator works till October, then it has been laid up./1 bager je radio do oktobra, zatim je demontiran, - Next 2 excavators did not work and since August they have been laid up./Sledeća 2 bagera nisu radila, a od avgusta su demontirani
LIEBHERR Litronic R 934	4	- 3 excavators works during whole year./3 bagera su radila preko cele godine - 1 has started to work since October./1 je počeo da radi u oktobru.

There is the list of working hours in 2001 for each excavator in according to OPC – reloading centre in the table 3.

U tabeli 3 je data lista radnih sati u 2001. godini za svaki bager, prema OPC - pretovarnom centru.

From those values, the coefficients of the time utilization of each excavator have been calculated in 2001 (in according to formula (1)). Reloading of commodities is continual activity, so parameter  $t_f$  is:  $t_f = 365 \times 24 \text{ hours} = 8760 \text{ hours}$ .

Iz ovih vrednosti izračunat je koeficijent iskorišćenja svakog bagera u 2001. godini (prema formuli (1)). Pretovar robe je kontinualna aktivnost, tako da je parametar  $t_f = 365 \times 24 \text{ sata} = 8760 \text{ sati}$ .

Table 3 Working hours of the excavators and the loaders in 2001

Tabela 3 Radni sati bagera i utovarača u 2001. godini

Type of excavator	Number	Working hours in 2001	Coefficient of time utilization [%]
DH411	1	3042	34,73
	2	1620	18,49
	3	2805,5	32,03
	4	1327	15,14
	5	1653,5	18,87
	6	1747,5	19,94
	7	1601,5	18,28
	8	1858	21,21
DH 441	1	1207	13,78
	2	3751	42,81
	3	2147	24,5
	4	1475	16,83
DH428.1	1	3009,5	34,35
	2	3128,3	35,71
DH421	1	1708,5	19,5
	2	0	0
	3	0	0
Liebherr	1	2336	26,66
	2	3053,1	34,27
	3	3002,6	34,27
	4	632,5	28,64
UNC 060	1	1352	15,43
	2	2074	23,67
	3	192	2,2
	4	1885	21,52
	5	2470,5	28,2

There is represented the time utilization of the hydraulic excavators DH 411, DH 441 a DH28.1 on the picture 3 and Liebherr excavators on the picture 4, in monitored year.

Na slici 3 je predstavljeno vreme iskorišćenja hidrauličkih bagera DH 411, DH 441 i DH 28.1, i na slici 4 bagera Liebherr u godini monitorniga.

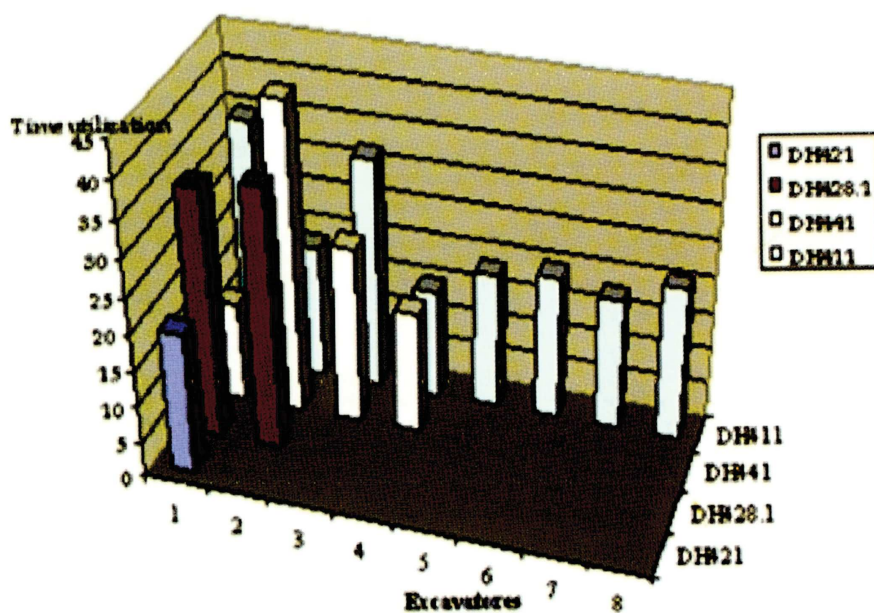


Figure 3 Coefficient of the time utilization of excavators  
slika 3 Koeficijent iskorišćenja bagera

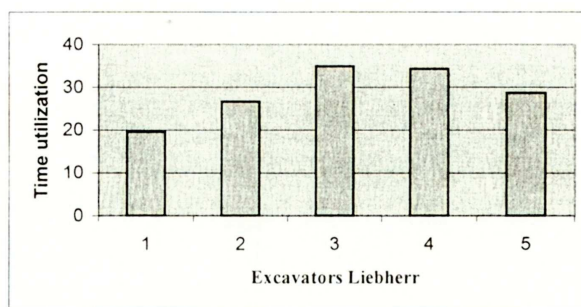


Figure 4 Coefficient of the time utilization of excavators  
slika 4 Koeficijent iskorišćenja bagera

From the pictures 3 and 4 can be seen, that the time utilization of each excavator is relatively small in 2001. It is caused by various factors.

Although the reloading is non-stop activity, each excavator has specified daily inspections – daily maintenance, cyclic reparations, which are executed directly on a platform or in workshops for this purpose. Besides those specified reparations, there are also non-planned reparations caused by accidents and unexpected circumstances, which influence the time utilization of the excavators. The performance of the excavators is influenced by a consistency of commodities, which are specified to be reloaded – although the reloading is non-stop activity, excavators are putting to work only if there is an appropriated commodity.

The time utilization is also influenced by movements of the excavators among platforms, especially those, which are used for reloading iron ores from heaps to normal gauge wagons, and for adjustment of cargoes of normal gauge wagonload at weighting on a track weight-bridge.

There are displayed the coefficients of the time utilization of all fleet of machines in 2001 on the picture 5. It is calculated in according to formula (2). In the first case there is consideration of all 21 excavators, and in the second case there is consideration without excavators DH421, which have been laid up during the year.

Sa slika 3 i 4 se može videti da je vreme iskorišćenja svakog bagera relativno malo u 2001. godini. To je prouzrokovano različitim faktorima.

Iako je pretovar neprekidna aktivnost, svaki bager ima određene dnevne inspekcije - dnevno održavanje, periodične popravke, koje se vrše direktno na platformi ili u radionicama za ovu svrhu. Pored ovih popravki, rade se takođe i neplanirane popravke koje su prouzrokovane nesrećama i neočekivanim okolnostima, koje utiču na vreme iskorišćenja. Na rad bagera utiče i konzistentnost robe koja treba da se pretovari - iako je pretovar neprekidna aktivnost, bageri se stavljaju u rad samo kada postoji odgovarajuća roba.

Na vreme iskorišćenja, takođe, utiče i pomeranje bagera između platformi, pogotovo onih koji se koriste za pretovar metalčnih ruda sa gomila u obične standardne vagone, i za prilagođavanje tovara običnim vagonima pri merenju na mostnoj vagi.

Na slici 5 su prikazani koeficijenti iskorišćenja svih brzih mašina u 2001. godini i izračunati su prema formuli (2). U prvom slučaju uzeti su u obzir svi bageri, 21 bager, a u drugom slučaju su uzeti u obzir svi bageri izuzev bagera DH 421, koji je demontiran preko godine.

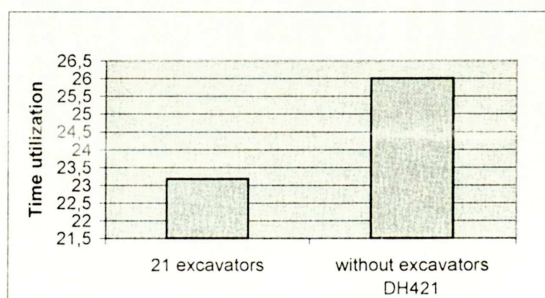


Figure 5 Coefficient of the time utilization of all fleet of machines in 2001  
slika 5 Koeficijent vremena iskorišćenja svih brzih mašina u 2001. godini

### 3.2 The time utilization of the frontal loaders UNC 060.

There is the list of working hours of the universal frontal loaders in 2001 in the table 3. The list was provided by the reloading centre.

The coefficients of the time utilization were calculated by similar way as in the case of the hydraulic excavators (formula 1 and 2).

From the table 3 and from the picture 6 can be seen, that the loaders are used in production very seldom. It could be said that the most important reason of this status is lack of given commodities for reloading.

### 3.2 Vreme iskorišćenja frontalnih utovarača UNC 060

U tabeli 3 je dat pregled radnih časova univerzalnih frontalnih utovarača u 2001. godini. Lista je urađena u pretovarnom centru.

Koeficijent vremena iskorišćenja je izračunat na sličan način kao kod hidrauličkih bagera (formula 1 i 2).

Iz tabele 3 i sa slike 6 se može videti, da su utovarači vrlo retko korišćeni. Može se reći da je najvažniji razlog tome nedostatak robe za pretovar.

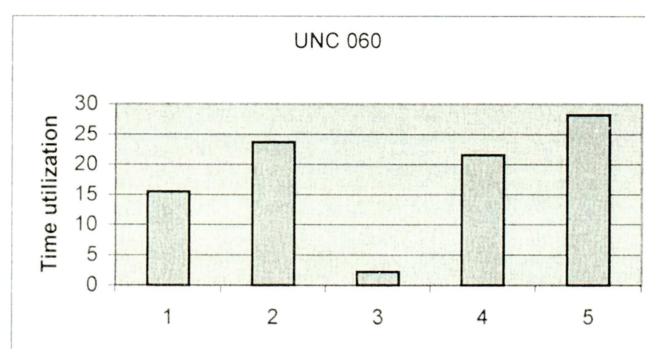


Figure 6 Coefficient of the time utilization of the loaders  
slika 6 Koeficijent vremena iskorišćenja utovarača

## 4 CONCLUSION

From the results of the time utilization of the hydraulic excavators and frontal loaders, we can say that reloading centre disposes with sufficient number of reloading facilities of this type. Increasing of the time utilization in the future could be provided for better organisation of work on the each platform and for enlarge the range of commodities, which could be reloaded by those facilities.

## 4 ZAKLJUČAK

Iz rezultata vremena iskorišćenja hidrauličkih bagera i frontalnih utovarača, može se reći da pretovarni centar raspolaže dovoljnim brojem opreme ovoga tipa za pretovar. Povećanje vremena iskorišćenja u budućnosti može dovesti do bolje organizacije rada na svakoj platformi, i za uvećanje klasa robe, koja se može pretovariti ovom opremom.

## REFERENCES / LITERATURA

- [1] OPC materials.