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ANALYSIS THE OPERATING PARAMETERS OF БелАЗ TRUCK AT THE OPEN PITS OF THE BROWN COAL MINE "BANOVICI" BASED ON PROCESSOR DATA

Abstract

This work presents a methodology of data collecting and processing from the load and fuel control system СКЗиТ, installed on БелАЗ 75131 trucks, owned by the Brown Coal Mine "Banovici"in Banovici. There is also a methodology of display the achieved operating parameters. Transport of coal and overburden is performed by these trucks. Total of eleven trucks has processors. Conclusions about working time, length of crossed routes, quantity of transported load, achieved cycles, etc. can be presented by data processing.

Keywords: *open pit, БелАЗ, truck, Brown Coal Mine "Banovici", processor*

1 INTRODUCTION

Production (overburden and coal) at the open pits of the Brown Coal Mine "Banovici" in Banovici, is realized by discontinuous technology with the use of classical cyclic loading-transport complex shovel-truck.

The open pit mining system is a sequence of works on excavation, transport and dumping of overburden, production and other (auxiliary) processes, which provide the designed (planned) capacity of the open pit.

At the open pits of Brown Coal Mine "Banovici" ("Grivice" and "Turija"), a longitudinal one sided mining system is applied with deepening by overlying contact of ore body (coal seam) and transport of overburden on the external dump.

Production process of overburden and coal consists of the following working processes: drilling and blasting (preparation of rock digging and loading), digging and loading (excavation), transport, dumping of overburden and dumping of coal (if necessary).

After coal loading onto trucks, it is transported from the working area and unloading into the crusher. Transport of coal from the crusher to the reloading bunker at the railway station "Draganja" is carried out by conveyor belt system, and further by rail to the separation. At the open pit "Turija", transport of coal to the reloading bunker is carried out by trucks. Transport of overburden is carried out by trucks directly from the working area at the open pit to the dump.

Open pits are mutually connected by midfield transport roads used for crossing of trucks and other mechanization from one to the other open pit, and also to the service complex "Besin" due to the preventive maintenance and repair. Works on overburden is realized in a way that after drilling and blasting, the overburden is

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loaded by shovel onto trucks. Digging and loading of overburden is performed by shovels and hydraulic shovels with the previous blasting of rock mass above shovel level. At the open pits, the overburden from benches is transported to the dumping benches by trucks via transporting roads. At dump, truck goes on dump road to the dumping bench where dumping of overburden is done. All transport roads are constructed by overburden and covered with solid and persistent marls.

2 DATA OBTAINED FROM PROCESSOR ON БелАЗ TRUCKS

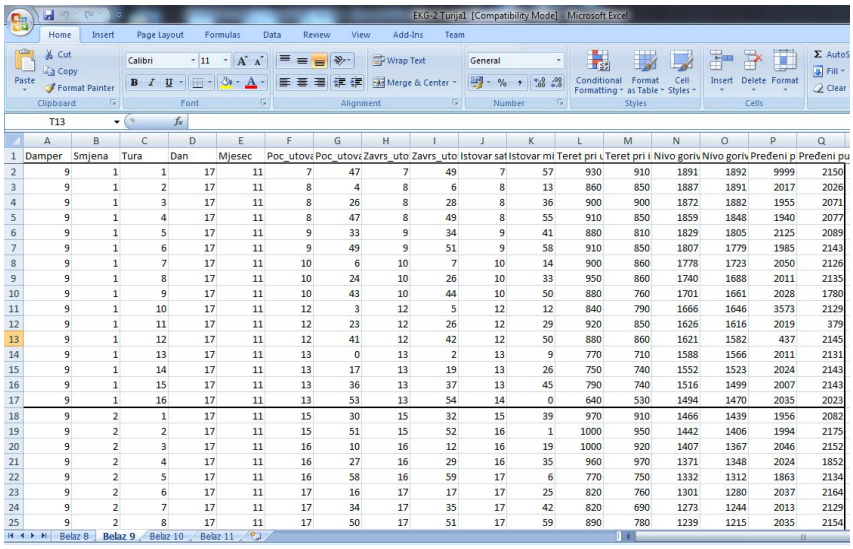
The Brown Coal Mine ”Banovici“ has eleven БелАЗ 75131 trucks with processors, respectively load and fuel control system СКЗиТ.

This system, except of monitoring transported load and fuel consumption, provides data on load and unload time as well as length of crossed routes for full and empty trucks.

Load and fuel control system СКЗиТ consists of the following elements: controller, panel management and indication, pressure sensors on shock absorbers, fuel level sensor in tank, inclinometer and signal of load quantity.

Figure 1 shows a module with the system panel СКЗиТ. Processor data on БелАЗ trucks are obtained in the form shown in Figure 2.

Figure 1 *Load module with the panel*



Damper	Smjena	Tura	Dan	Mjesec	Poc_utovi	Poc_utovi	Zavrs_uto	Zavrs_uto	Istovar sat	Istovar mi	Teret pri u	Teret pri i	Nivo goriv	Nivo goriv	Pređeni p	Pređeni pu
9	1	1	17	11	7	47	7	49	7	57	930	910	1891	1892	9999	2150
9	1	2	17	11	8	4	8	6	8	13	860	850	1887	1891	2017	2026
9	1	3	17	11	8	26	8	28	8	36	900	900	1872	1882	1955	2071
9	1	4	17	11	8	47	8	49	8	55	910	850	1859	1848	1940	2077
9	1	5	17	11	9	33	9	34	9	41	880	810	1829	1805	2125	2089
9	1	6	17	11	9	49	9	51	9	58	910	850	1807	1779	1985	2143
9	1	7	17	11	10	6	10	7	10	14	900	860	1778	1723	2050	2126
9	1	8	17	11	10	24	10	26	10	33	950	860	1740	1688	2011	2135
9	1	9	17	11	10	43	10	44	10	50	880	760	1701	1661	2028	1780
9	1	10	17	11	12	3	12	5	12	12	840	790	1666	1646	3573	2129
9	1	11	17	11	12	23	12	26	12	29	920	850	1626	1616	2019	379
9	1	12	17	11	12	41	12	42	12	50	880	860	1621	1582	437	2145
9	1	13	17	11	13	0	13	2	13	9	770	710	1588	1566	2011	2131
9	1	14	17	11	13	17	13	19	13	26	750	740	1552	1523	2024	2143
9	1	15	17	11	13	36	13	37	13	45	790	740	1516	1499	2007	2143
9	1	16	17	11	13	53	13	54	14	0	640	530	1494	1470	2035	2023
9	2	1	17	11	15	30	15	32	15	39	970	910	1466	1439	1956	2082
9	2	2	17	11	15	51	15	52	16	1	1000	950	1442	1406	1994	2175
9	2	3	17	11	16	10	16	12	16	19	1000	920	1407	1367	2046	2152
9	2	4	17	11	16	27	16	29	16	35	960	970	1371	1348	2024	1852
9	2	5	17	11	16	58	16	59	17	6	770	750	1332	1312	1863	2134
9	2	6	17	11	17	16	17	17	17	25	820	760	1301	1280	2037	2164
9	2	7	17	11	17	34	17	35	17	42	820	690	1273	1244	2013	2129
9	2	8	17	11	17	50	17	51	17	59	890	780	1239	1215	2035	2154

Figure 2

For one shift, about 255 data is got, which can be used for individual transformations, and later for analyses. Data from the truck processor are needed for previously preparation for analysis. Data are in such form that is necessary to do the transformation of data for time because of classification by hours and minutes in the columns (Figure 2). To present in a diagram, these data are needed to transform in the form of data TIME (0:00:00). In Microsoft Excel, it is necessary to add some new columns to get data in a form TIME (0:00:00) and time expressed in seconds. In displayed file with processors, it can be observed that the time, which shows seconds, is not recorded, in contrast with data which could be got on the basis of truck monitoring with built-in GPS receiver. Registered data are in two separate columns about mass of the load immediately after loading and at unloading, increased ten times. Mainly, the mass data of the load, immediately at the end of loading, show considerable differences in comparison with registered data at unloading. These two values are different because the sensor, when loading, registers higher value of load, because the load is unevenly distributed in the truck box. During the transport from the load place to the unload place, it occurs to more balanced distribution of load and then the registered load mass at the unloading is authoritative for further analysis. Data about driving time of full damper can be obtained from the subtraction registered unloading time and finished loading time. Values of crossed routes of full truck and empty truck are there in the file. If the values of length of crossed routes are divided with driving time of full truck, a driving speed of full truck can be obtained. If the difference between registered time of load beginning and time of previous unloading is defined, a driving time of empty truck can be obtained, that is longer than driving time of full truck, so it can be concluded that the speed of empty truck is low in comparison with the speed of full truck. Length of crossed routes of empty truck also have in itself the length for load maneuvering, so they are not adequate for determining the driving time of the same.

3 THE ACHIEVED OPERATING PARAMETERS OF THE TRUCKS БелАЗ 8, БелАЗ 9, AND БелАЗ 10

By data analyzing with processor, it is possible to show the achieved results of truck operation for each shift. Daily reports on operation of three trucks are shown in the next text.

Open pit Turija
Shovel ЭКГ 8И (2)
Truck БелАЗ 75131 (8)
Dump of the open pit Turija

Daily report

Total of transported load 3726 t

Average values of transported load 81 t per cycle

Total duration of loading (without truck changing time) 4650 s

Average duration of loading (without truck changing time) 99.13 s

Total fuel consumption 1408 l

Number of cycles (tours) 46

Total of crossed route of full truck 91720 m

Average crossed route of full truck (semi cycle full truck) 1 993.91 m

Total of crossed route of empty truck 101196 m – with coming under the shovel at the beginning of shift and coming under the shovel at the end of shift

Average crossed route of empty truck (semi cycle empty truck) 2026.6 m

Total driving time of full truck 19920 s

Average driving time of full truck (semi cycle full truck) 433.04 s

Average driving speed of full truck 4.60 m/s

***Presentation of information in the form of graphs - truck* БелАЗ 8**

Figure 3 shows a graph of duration the loading and Figure 4 mass of load transported during one cycle. Figure 5 shows a graph of crossed routes in driving of full and empty truck and Figure 6 registered speeds.

Figures 7 and 8 show a graph on changes the level of fuel during loading and unloading of truck.

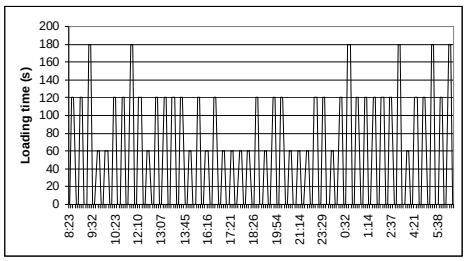


Figure 3

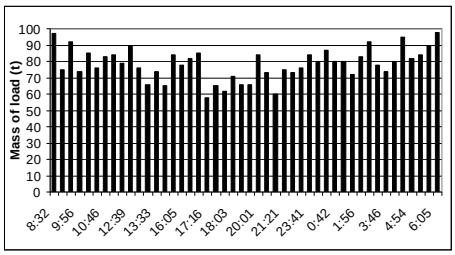


Figure 4

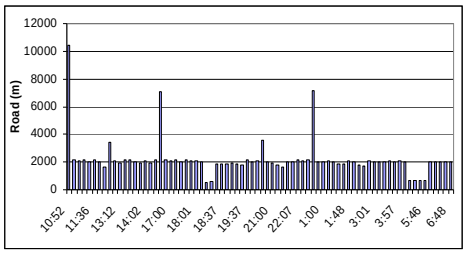


Figure 5

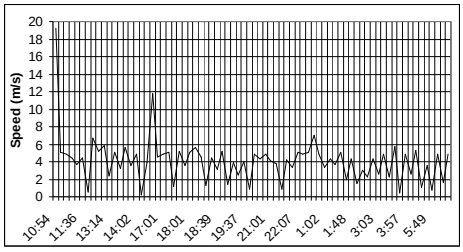


Figure 6

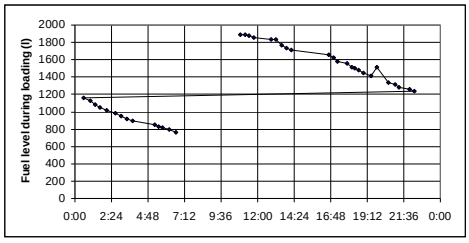


Figure 7

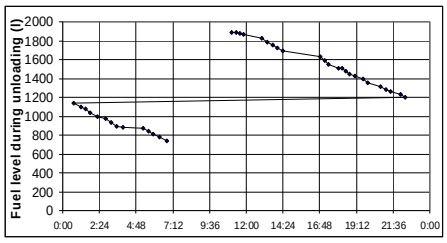


Figure 8

Open pit Turija
Shovel ЭКГ 8И (2)
Truck БелАЗ 75131 (9)
Dump of the open pit Turija

Daily report

Total of transported load 3612 t
Average values of transported load 7852 t per cycle
Total duration of loading (without truck changing time) 4980 s
Average duration of loading (without truck changing time) 108.26 s
Total fuel consumption 1454 l
Number of cycles (tours) 46
Total of crossed route of full truck 91885 m
Average crossed route of full truck (semi cycle full truck) 1997.50 m
Total of crossed route of empty truck 113481 m – with coming under the shovel at the beginning of shift and coming under the shovel at the end of shift
Average crossed route of empty truck (semi cycle empty truck) 2074.21 m
Total driving time of full truck 19860 s
Average driving time of full truck (semi cycle full truck) 431.74 s
Average driving speed of full truck 4.63 m/s

***Presentation of information in the form of graphs - truck* БелАЗ 9**

Figure 9 shows a graph of duration of loading and Figure 10 mass of load transported during one cycle. Figure 11 shows a graph of crossed routes in driving of full and empty truck and Figure 12 registered speeds.

Figures 13 and 14 show a graph on changes the level of fuel during loading and unloading of truck.

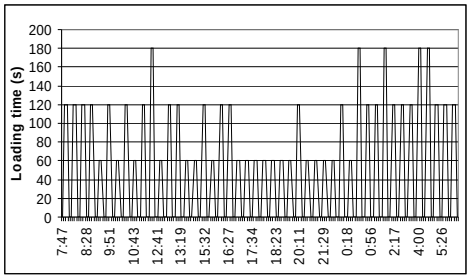


Figure 9

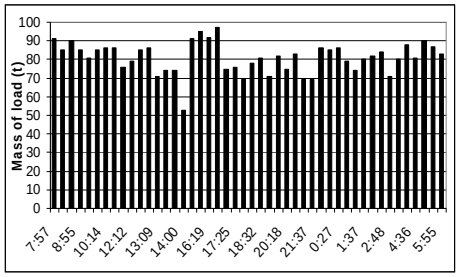


Figure 10

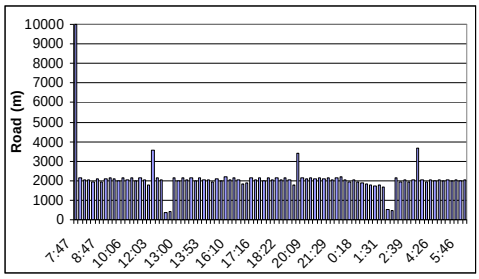


Figure 11

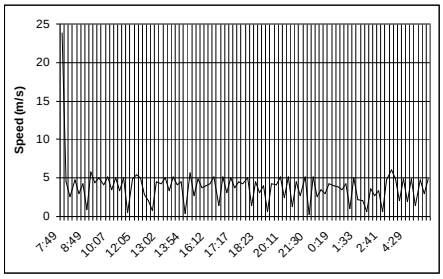


Figure 12

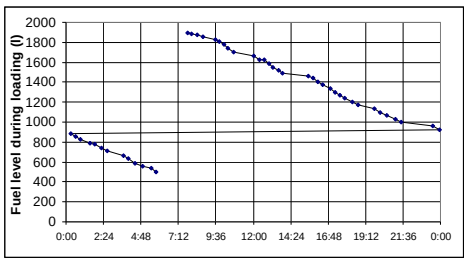


Figure 13

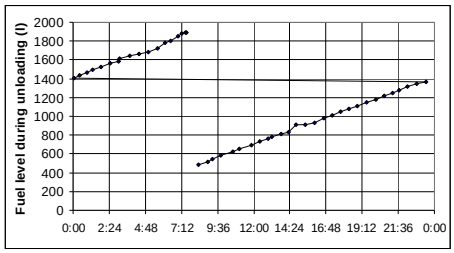


Figure 14

Open pit Turija
Shovel ЭКГ 8И (2)
Truck БелАЗ 75131 (10)
Dump of open pit Turija

Daily report

Total of transported load 2944 t
Average values of transported load 77.47 t per cycle
Total duration of loading (without truck changing time) 4200 s
Average duration of loading (without truck changing time) 110.53 s
Total fuel consumption 1155 l
Number of cycles (tours) 38
Total of crossed route of full truck 73037 m
Average crossed route of full truck (semi-cycle full truck) 1922.03 m
Total of crossed route of empty truck 92923 m – with coming under the shovel at the beginning of shift and coming under the shovel at the end of shift
Average crossed route of empty truck (semi-cycle empty truck) 1950.34 m
Total driving time of full truck 15600 s
Average driving time of full truck (semi-cycle full truck) 410.53 s
Average driving speed of full truck 4.68 m/s

***Presentation of information in the form of graphics-truck* БелАЗ 10**

In Figure 15, the graph shows duration of loading and in Figure 16 mass of load transported during one cycle. In Figure 17, there is a graph of crossed routes in driving of full and empty truck and in Figure18 registered speeds.

In Figures 19 & 20, there is a graph about changes in the level of fuel during loading and unloading of truck.

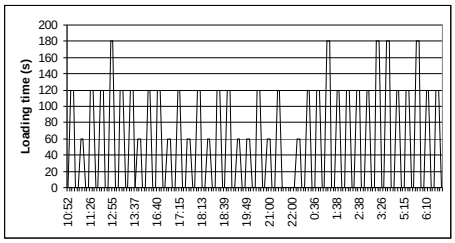


Figure 15

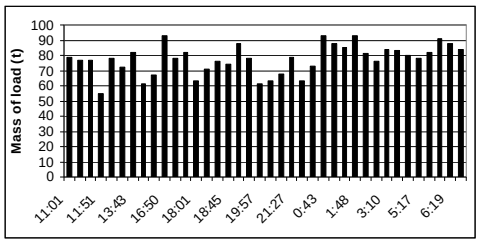


Figure 16

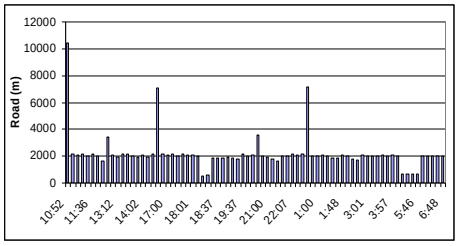


Figure 17

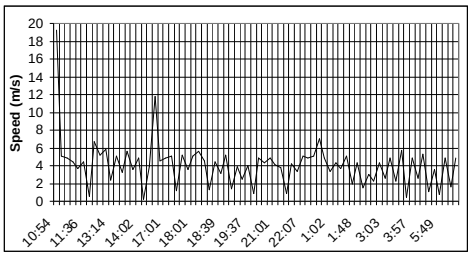


Figure 18

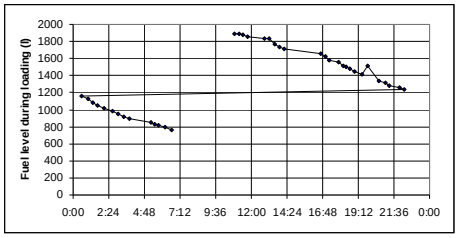


Figure 19

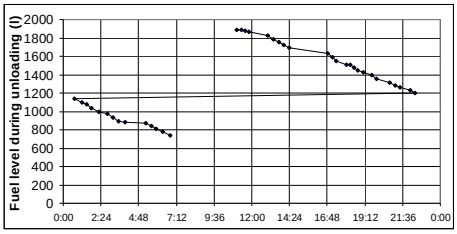


Figure 20

4 DISCUSSION

Analyzing the processor data of all three trucks БелАЗ in one day, it can be concluded that truck БелАЗ 8, in total 46 working cycles, achieved the biggest capacity (output), but truck БелАЗ 10 the smallest. In the observed day during the first shift, truck БелАЗ 10 was in service according to the reports of operational technical preparation service, and it achieved only 38 working cycles.

Although all three trucks served the same shovel, there is a significant difference in length of crossed route and duration of loading. According to the records about length of crossed routes of empty truck at the beginning of shifts, the truck БелАЗ 9 was the only truck at the beginning of first shift that came from the turn-over place Besin, and at the beginning of the second and third shift the turn-over performed at the shovel, it is different between the truck БелАЗ 8 and БелАЗ 10 on the other side which moved from the turn-over place Besin at the beginning of all three shifts. Figure 21 presents the shortest time of loading for БелАЗ 10, it

is logical, because of this truck during the three shifts achieved 8 cycles fewer from the other two trucks. Minimum average time of loading was achieved for truck БелАЗ 8, and also minimum average moving speed.

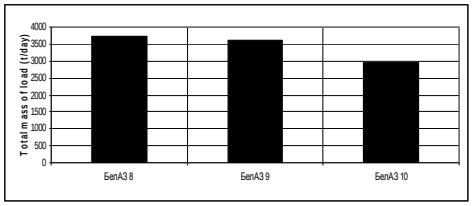


Figure 21

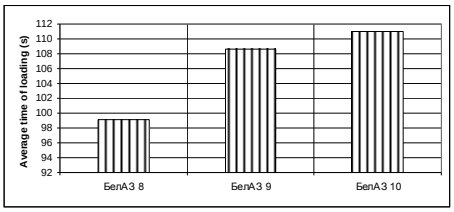


Figure 22

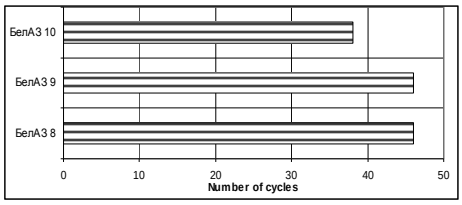


Figure 23

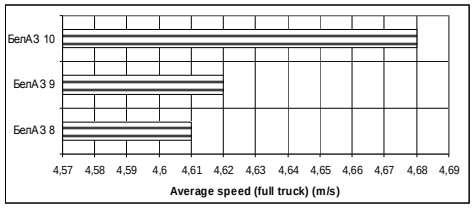


Figure 24

According to the processor data, the truck БелАЗ 11 crossed between 500 and 600 km, while the truck БелАЗ 8 crossed about 170 km (the same shovel and the same dump). The processor is broken on the truck БелАЗ 11, so the data from this truck cannot be used for further analysis until solving the problem.

According to the processor data, maximum amount of fuel is 1892 (l) that is registered on trucks БелАЗ, while in the tank can fit 1900 (l), but the average fuel consumption is shown in the next chart.

Table 1.

Shovel – dump	**Truck**		
	БелАЗ 8	**БелАЗ 9**	**БелАЗ 10**
Shovel ЭКГ 8И (2) – dump of the open pit Turija			
Average fuel consumption (l/km)	6.76	7.19	6.9
Average quantity of fuel for refueling in tank (l)	1448	1411	1154
Hydraulic shovel Terex RH 120E (1) – dump of the open pit Turija			
Average fuel consumption (l/km))	7.48	7.35	7.50
Average quantity of fuel for refueling in tank (l)	1844	1138	1437
Shovel Marion M 201 – dump of the open pit Grivice			
Average fuel consumption (l/km)	7.28	7.33	7.18
Average quantity of fuel for refueling in tank (l)	1494	1471	1508

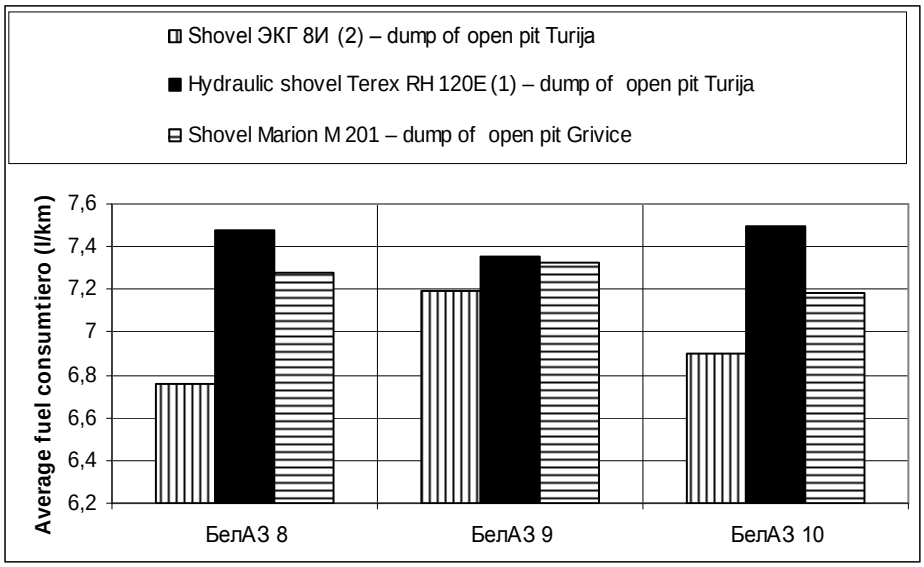


Figure 25

5 CONCLUSION

Total 11 trucks have processors; the processors are correct on the trucks БелАЗ 8, БелАЗ 9 and БелАЗ 10 and data from these processors can be used for analyses. The other trucks processors must be repaired because of using the data for analyses.

Five trucks Terex 3600 B and two trucks Mark 36 have not this kind of processors, so the data about working and slowdowns/cancellations cannot be analyzed in this way.

Data from the truck processors can be used for defining each working parameter of truck transport. By installation the Global Positioning System (GPS) receivers on the equipment in the Black Coal Mine „Banovici“, a new possibility of getting real and timing and spatial working insight is opened and also forming the Center for dispatchers in the Mine.

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ANALIZA PARAMETARA RADA KAMIONA БелАЗ NA POVRŠINSKIM KOPOVIMA RMU "BANOVIĆI" NA OSNOVU PODATAKA SA PROCESORA

Izvod

U radu je data metodologija prikupljanja i obrade podataka iz sistema za kontrolu tereta i goriva СКЗиТ, a koji se nalaze na kamionima БелАЗ 75131 koje posjeduje Rudnik mrkog uglja (RMU) „Banovići" u Banovićima. Takođe, predstavljena je i metodologija prikaza ostvarenih parametara rada.

Ovim kamionima vrši se transportovanje i uglja i otkrivke (jalovine) na površinskim kopovima navedenog rudnika. Ukupno jedanaest kamiona posjeduju procesore. Obradom podataka mogu se izvesti zaključci o vremenima rada, dužinama pređenih puteva, količini prevezenog tereta, ostvarenim ciklusima itd.

Ključne riječi: *površinski kop, kamion, БелАЗ, RMU „Banovići", procesor*

1. UVOD

Proizvodnja (otkrivka i dobivanje uglja) na površinskim kopovima Rudnika mrkog uglja „Banovići" d.d. Banovići ostvaruje se diskontinuiranom tehnologijom sa primjenom klasičnog cikličnog utovarno-transportnog kompleksa bager-kamion.

Sistem površinske eksploatacije je redoslijed izvođenja radova na otkopavanju, transportu i odlaganju otkrivke, dobivanju i drugim (pomoćnim) procesima, kojim se obezbjeđuje projektovani (planirani) kapacitet površinskog kopa. Na površinskim kopovima RMU „Banovići" („Grivice" i „Turija") primjenjuje se uzdužni jednokrilni sistem eksploatacije sa produbljavanjem po krovinskom kontaktu rudnog tijela (ugljenog sloja) i transportom otkrivke na vanjska odlagališta.

Proizvodni proces otkrivke i uglja sastoji se od slijedećih radnih procesa: bušenje i miniranje (priprema stijene za kopanje i utovar), kopanje i utovar (bagerovanje), transport, odlaganje otkrivke i deponovanje uglja (po potrebi).

Nakon utovara uglja u kamione vrši se transport istog sa etaže i istovar u drobilično postrojenje. Transport uglja od drobiličnog postrojenja do pretovarnog bunkera na željezničkoj stanici „Draganja" vrši se sistemom transportera sa gumenom trakom, a dalje željeznicom do separacije, dok se na površinskom kopu „Turija" transport uglja u pretovarni bunker vrši kamionima. Transport otkrivke obavlja se direktnim prevozom kamionima sa etaže na površinskom kopu do etaže na odlagalištu.

Površinski kopovi su međusobno povezani veznim transportnim putevima koji služe za prelazak kamiona i druge mehanizacije sa jednog na drugi površinski kop, kao i do servisnog kompleksa „Bešin" radi preventivnog održavanja i opravki. Radovi na otkrivci se izvode tako što se nakon bušenja i miniranja otkrivka bagerima utovara u

**RGGF Tuzla BiH*

kamione. Kopanje i utovar otkrivke vrši se bagerima kašikarima i hidrauličnim bagerima uz prethodno miniranje stijenske mase iznad bagerskog nivoa. Kamionima se otkrivka sa etaže na površinskom kopu transportnim putevima prevozi do etaže na odlagalištu. Na odlagalištu kamion odlagališnim putem odlazi do odlagališne etaže na kojoj vrši odlaganje otkrivke. Svi transportni putevi su izrađeni od otkrivke i nasuti čvrstim i postojanim laporcima.

2. PODACI DOBIVENI SA PROCESORA NA KAMIONIMA БелАЗ

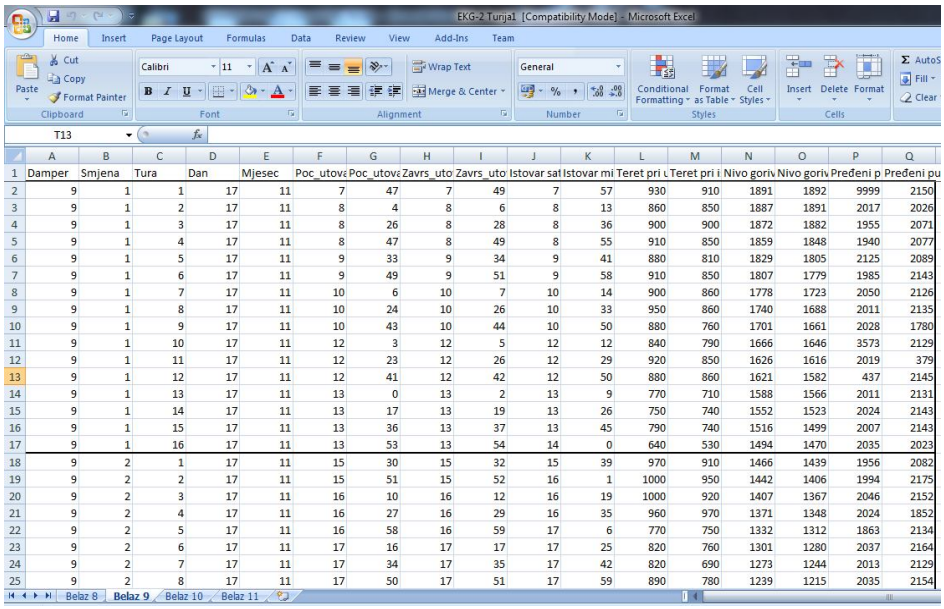
RMU „Banovići“ posjeduje 11 kamiona БелАЗ 75131 na kojima se nalaze procesori odnosno sistem za kontrolu tereta i goriva СКЗиТ.

Ovaj sistem pored praćenja prevezenog tereta i potrošnje goriva daje podatke i o vremenima utovara i istovara kao i dužinama pređenih puteva punih i praznih kamiona.

Sistem kontrole tereta i goriva СКЗиТ čine slijedeći elementi: kontroler, panel upravljanja i indikacije, davači pritiska na amortizerima, senzor nivoa goriva u rezervoaru, inklinometar i semafor za signalizaciju količine tereta.

Na slici 1 prikazan je modul sa panelom sistema СКЗиТ. Podaci sa procesora na kamionima БелАЗ dobijaju se u formi prikazanoj na slici 2.

Sl. 1. *Modul tereta sa panelom*



Damper	Smjena	Tura	Dan	Mjesec	Poc_utova	Poc_utova	Zavrs_uto	Zavrs_uto	Istovar sat	Istovar mi	Teret pri u	Teret pri i	Nivo goriv	Nivo goriv	Pređeni p	Pređeni pu
9	1	1	17	11	7	47	7	49	7	57	930	910	1891	1892	9999	2150
9	1	2	17	11	8	4	8	6	8	13	860	850	1887	1891	2017	2026
9	1	3	17	11	8	26	8	28	8	36	900	900	1872	1882	1955	2071
9	1	4	17	11	8	47	8	49	8	55	910	850	1859	1848	1940	2077
9	1	5	17	11	9	33	9	34	9	41	880	810	1829	1805	2125	2089
9	1	6	17	11	9	49	9	51	9	58	910	850	1807	1779	1985	2143
9	1	7	17	11	10	6	10	7	10	14	900	860	1778	1723	2050	2126
9	1	8	17	11	10	24	10	26	10	33	950	860	1740	1688	2011	2135
9	1	9	17	11	10	43	10	44	10	50	880	760	1701	1661	2028	1780
9	1	10	17	11	12	3	12	5	12	12	840	790	1666	1646	3573	2129
9	1	11	17	11	12	23	12	26	12	29	920	850	1626	1616	2019	379
9	1	12	17	11	12	41	12	42	12	50	880	860	1621	1582	437	2145
9	1	13	17	11	13	0	13	2	13	9	770	710	1588	1566	2011	2131
9	1	14	17	11	13	17	13	19	13	26	750	740	1552	1523	2024	2143
9	1	15	17	11	13	36	13	37	13	45	790	740	1516	1499	2007	2143
9	1	16	17	11	13	53	13	54	14	0	640	530	1494	1470	2035	2023
9	2	1	17	11	15	30	15	32	15	39	970	910	1466	1439	1956	2082
9	2	2	17	11	15	51	15	52	16	1	1000	950	1442	1406	1994	2175
9	2	3	17	11	16	10	16	12	16	19	1000	920	1407	1367	2046	2152
9	2	4	17	11	16	27	16	29	16	35	960	970	1371	1348	2024	1852
9	2	5	17	11	16	58	16	59	17	6	770	750	1332	1312	1863	2134
9	2	6	17	11	17	16	17	17	17	25	820	760	1301	1280	2037	2164
9	2	7	17	11	17	34	17	35	17	42	820	690	1273	1244	2013	2129
9	2	8	17	11	17	50	17	51	17	59	890	780	1239	1215	2035	2154

Sl. 2.

Za jednu smjenu dobije se oko 255 podataka koji se mogu iskoristiti za pojedine transformacije, a kasnije za analize. Podatke sa procesora kamiona neophodno je prethodno pripremiti za analizu. Podaci su u takvom obliku da je potrebno izvršiti transformaciju podataka za vrijeme jer su po kolonama razvrstani po satima i minutama (slika 2). Ove podatke da bi se dijagramski predstavili neophodno je transformisati u podatke oblika TIME (0:00:00). U Microsoft Excel-u potrebno je izvršiti ubacivanje novih kolona da bi se dobili podaci oblika TIME (0:00:00) i vrijeme izraženo u sekundama. U prikazanoj datoteci sa procesora može se primjetiti da se ne evidentira vrijeme koje pokazuje i sekunde, za razliku od podataka koji bi se dobili na osnovu praćenja kamiona koji bi imali ugrađene GPS prijemnike. U dvije zasebne kolone dati su registrovani podaci o masi tereta neposredno poslije utovara i pri istovaru uvećane 10 puta. Uglavnom, podaci o masi tereta neposredno po završetku utovara pokazuju znatne razlike u odnosu na registrovane podatke pri istovaru. Ove dvije vrijednosti se razlikuju zbog toga što senzor prilikom utovara registruje veću vrijednost tereta, jer je teret neravnomjerno raspoređen u sanduku kamiona. Prilikom transporta od mjesta utovara do mjesta istovara dolazi do ravnomjernije raspodjele tereta i pri tome registrovana masa tereta pri istovaru je mjerodavna za dalju analizu. Podaci o vremenima vožnje opterećenog kamiona (pun kamion) mogu se dobiti iz razlike registrovanog vremena istovara i vremena završetka utovara. U datoteci su prikazane vrijednosti pređenih puteva opterećenog (pun) i neopterećenog (prazan) kamiona. Dijeleći vrijednosti dužina pređenih puteva sa vremenima vožnje opterećenog (punog) kamiona mogu se dobiti brzine vožnje opterećenog (punog) kamiona. Ako odredimo razliku registrovanih vremena početka utovara i vremena prethodnog istovara dobijaju se vremena vožnje praznog (neopterećenog) kamiona koja su puno veća od vremena vožnje punog kamiona, te su dobijene brzine vožnje praznog kamiona male u odnosu na brzine punog kamiona. Dužine pređenih puteva neopterećenog

(praznog) kamiona u sebi sadržavaju i dužine vezane za manevrisanje pri utovaru, tako da nisu adekvatne za određivanje brzina vožnje istog.

3. OSTVARENI PARAMETRI RADA KAMIONA БелАЗ 8, БелАЗ 9 i БелАЗ 10

Analizom podataka sa procesora moguće je prikazati ostvarene rezultata rada kamiona za svaku smjenu pojedinačno. Dnevni izvještaji o radu tri kamiona koji su razmatrani prikazani su u narednom tekstu.

Površinski kop Turija

Bager kašikar ЭКГ 8И (2)

Kamion БелАЗ 75131 (8)

Odlagalište površinskog kopa Turija

Dnevni izvještaj

Ukupno prevezeno tereta 3.726 (t)

Prosječna vrijednost prevezenog tereta 81 (t) po ciklusu.

Ukupno vrijeme trajanja utovara (bez vremena zamjene kamiona) 4.560 (s).

Prosječno vrijeme trajanja utovara (bez vremena zamjene kamiona) 99,13 (s).

Ukupna potrošnja goriva 1.408 (l).

Broj ciklusa (tura) 46.

Ukupno pređeni put kamiona pod teretom (pun kamion) 91.720 (m).

Prosječno pređeni put kamiona pod teretom - (poluciklus pun kamion) 1.993,91 (m)

Ukupno pređeni put kamiona bez tereta (prazan kamion) 101.196 (m) - sa dolaskom pod bager na početku smjene i dolaskom pod bager na kraju smjene.

Prosječno pređeni put kamiona bez tereta - (poluciklus prazan kamion) 2.026,6 (m).

Ukupno vrijeme vožnje kamiona pod teretom (pun kamion) 19.920 (s).

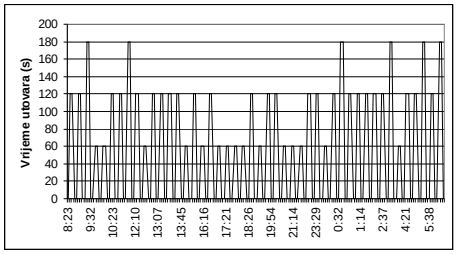
Prosječno vrijeme vožnje kamiona pod teretom (poluciklus pun kamion) 433,04 (s).

Prosječna brzina vožnje kamiona pod teretom (pun kamion) 4,60 (m/s).

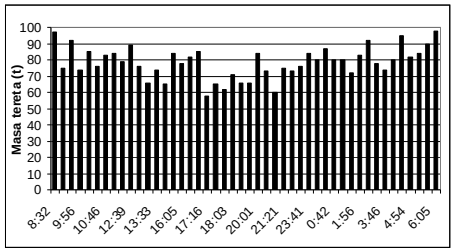
Predstavljanje informacija u vidu grafika - kamion БелАЗ 8

Na slici 3 dat je prikaz vremena trajanja utovara, a na slici 4 masa tereta prevezena u toku jednog ciklusa. Na slici 5 dat je prikaz pređenih puteva pri kretanju punog i praznog kamiona, a na slici 6 registrovane brzine.

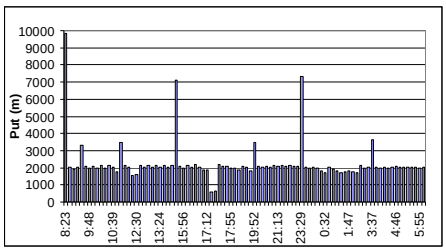
Na slici 7 i 8 dat je prikaz promjene nivoa goriva pri utovaru i istovaru kamiona.



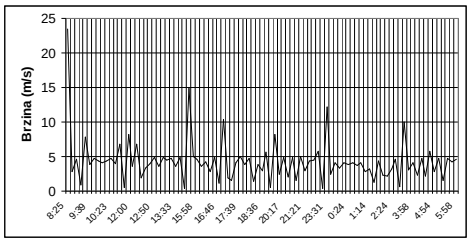
Sl. 3.



Sl. 4.



Sl. 5.



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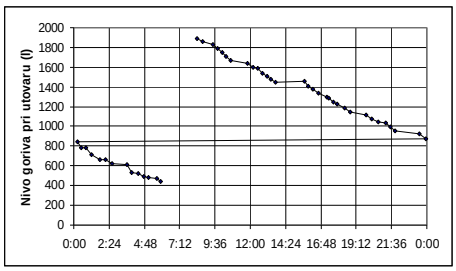

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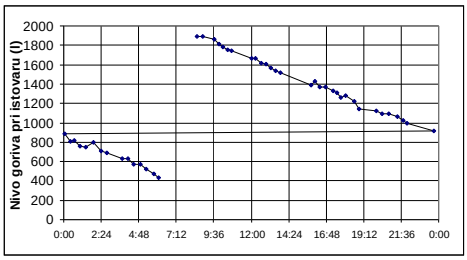


Sl. 8.

Površinski kop Turija
Bager kašikar ЭКГ 8И (2)
Kamion БелАЗ 75131 (9)
Odlagalište površinskog kopa Turija

Dnevni izvještaj

Ukupno prevezeno tereta 3.612 (t).

Prosječna vrijednost prevezenog tereta 78,52 (t) po ciklusu.

Ukupno vrijeme trajanja utovara (bez vremena zamjene kamiona) 4.980 (s).

Prosječno vrijeme trajanja utovara (bez vremena zamjene kamiona) 108,26 (s).

Ukupna potrošnja goriva 1.454 (l).

Broj ciklusa (tura) 46.

Ukupno pređeni put kamiona pod teretom (pun kamion) 91.885 (m).

Prosječno pređeni put kamiona pod teretom-(poluciklus pun kamion) 1997,50 (m)

Ukupno pređeni put kamiona bez tereta (prazan kamion) 113481 (m) - sa dolaskom pod bager na početku smjene i dolaskom pod bager na kraju smjene.

Prosječno pređeni put kamiona bez tereta - (poluciklus prazan kamion) 2.074,209 (m).

Ukupno vrijeme vožnje kamiona pod teretom (pun kamion) 19.860 (s)

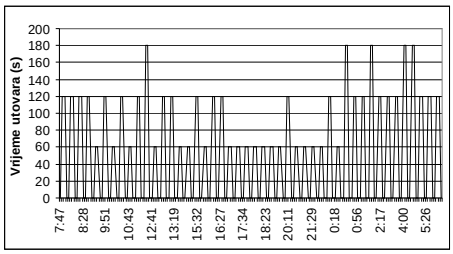
Prosječno vrijeme vožnje kamiona pod teretom (poluciklus pun kamion) 431,74 (s)

Prosječna brzina vožnje kamiona pod teretom (pun kamion) 4,63 (m/s)

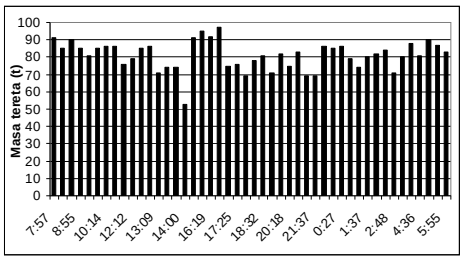
Predstavljanje informacija u vidu grafika-kamion БелАЗ 9

Na slici 9 dat je prikaz vremena trajanja utovara, a na slici 10 masa tereta prevezena u toku jednog ciklusa. Na slici 11 dat je prikaz pređenih puteva pri kretanju punog i praznog kamiona, a na slici 12 registrovane brzine.

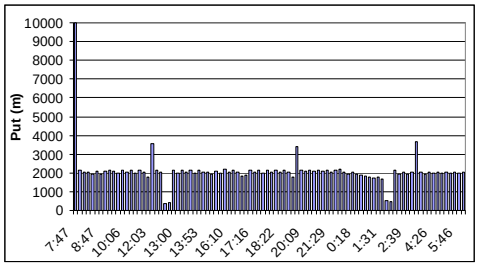
Na slici 13 i 14 dat je prikaz promjene nivoa goriva pri utovaru i istovaru kamiona.



Sl. 9.



Sl. 10.



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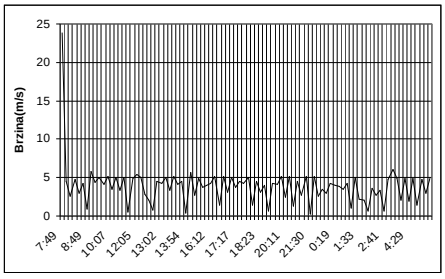

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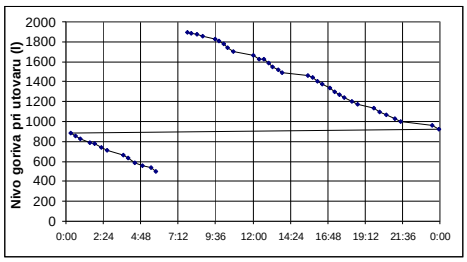
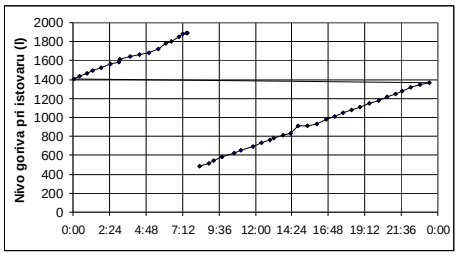


Sl. 13.



Sl. 14.

Površinski kop Turija
Bager kašikar ЭКГ 8И (2)
Kamion БелАЗ 75131 (10)
Odlagalište površinskog kopa Turija

Dnevni izvještaj

Ukupno prevezeno tereta 2.944 (t).

Prosječna vrijednost prevezenog tereta 77,47 (t) po ciklusu.

Ukupno vrijeme trajanja utovara (bez vremena zamjene kamiona) 4.200 (s).

Prosječno vrijeme trajanja utovara (bez vremena zamjene kamiona) 110,53 (s).

Ukupna potrošnja goriva 1.155 (l).

Broj ciklusa (tura) 38.

Ukupno pređeni put kamiona pod teretom (pun kamion) 73.037 (m).

Prosječno pređeni put kamiona pod teretom - (poluciklus pun kamion) 1922,03 (m)

Ukupno pređeni put kamiona bez tereta (prazan kamion) 92.923 (m) - sa dolaskom pod bager na početku smjene i dolaskom pod bager na kraju smjene.

Prosječno pređeni put kamiona bez tere-ta - (poluciklus prazan kamion) 1.950,34 (m).

Ukupno vrijeme vožnje kamiona pod teretom (pun kamion) 15.600 (s).

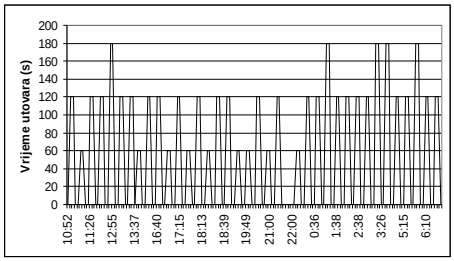
Prosječno vrijeme vožnje kamiona pod teretom (poluciklus pun kamion) 410,53 (s).

Prosječna brzina vožnje kamiona pod teretom (pun kamion) 4,68 (m/s).

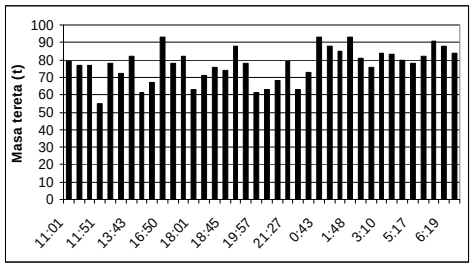
Predstavljanje informacija u vidu grafika-kamion БелАЗ 10

Na slici 15 dat je prikaz vremena trajanja utovara, a na slici 16 masa tereta prevezena u toku jednog ciklusa. Na slici 17 dat je prikaz pređenih puteva pri kretanju punog i praznog kamiona, a na slici 18 registrovane brzine.

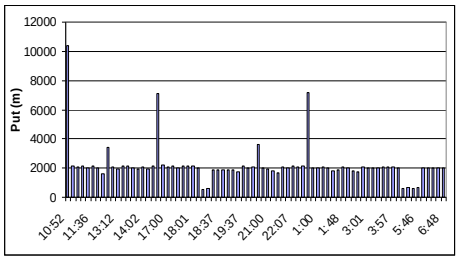
Na slici 19 i 20 dat je prikaz promjene nivoa goriva pri utovaru i istovaru kamiona.



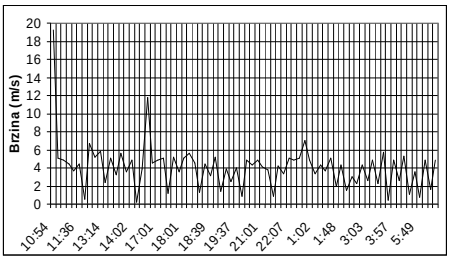
Sl. 15.



Sl. 16.



Sl. 17.



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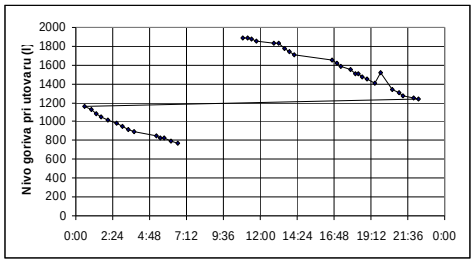

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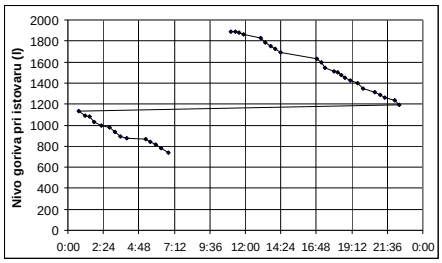


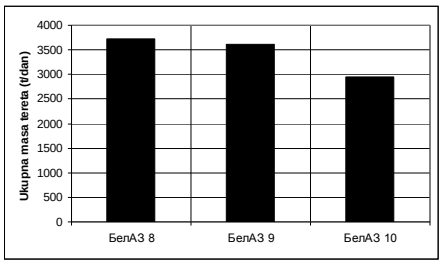
Sl. 20.

4. DISKUSIJA

Analizirajući podatke sa procesora sva tri kamiona БелАЗ 75131 za jedan dan može se zaključiti da je kamion БелАЗ 8 u ukupno 46 ciklusa rada ostvario najveći kapacitet, a kamion БелАЗ 10 najmanji. Kamion БелАЗ 10 posmatranog dana u toku prve smjene nalazio se na servisu prema evidenciji službe operativno tehničke pripreme, te je ostvario samo 38 ciklusa rada. Iako su sva tri kamiona opsluživala isti bager evidentna je razlika u dužinama pređenih puteva i vremenu trajanja utovara. Prema evidenciji o dužinama pređenih puteva praznog kamiona na početku smjena, kamion БелАЗ 9 je samo na početku prve smjene imao dolazak sa primopredajnog mjesta Bešin, a na početku druge i treće smjene primopredaja je izvršena kod bagera, za razliku od kamiona БелАЗ 8 i БелАЗ 10 koji su na početku sve tri smjene dolazili sa primopredajnog mjesta Bešin.

Sa slike 21 može se uočiti da je ukupno vrijeme utovara najmanje za БелАЗ 10, što je i logično, jer je ovaj kamion u toku tri smjene ostvario 8 ciklusa manje

od ostala dva kamiona. Najmanje prosječno vrijeme utovara je ostvareno za kamion БелАЗ 8, kao i najmanja prosječna brzina kretanja.



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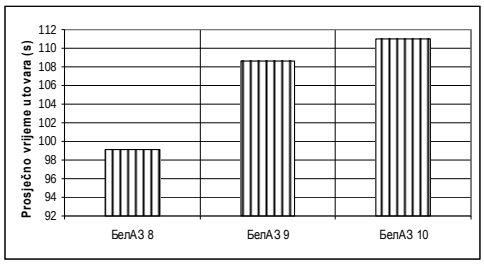

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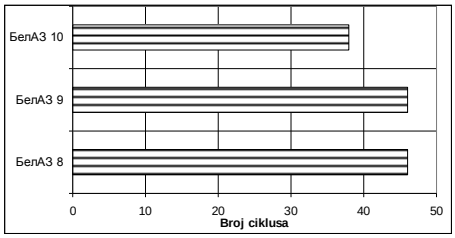

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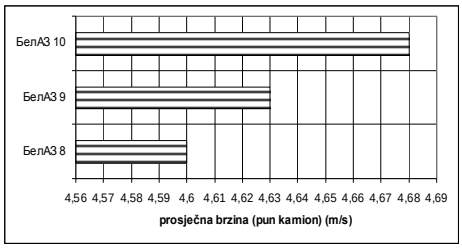


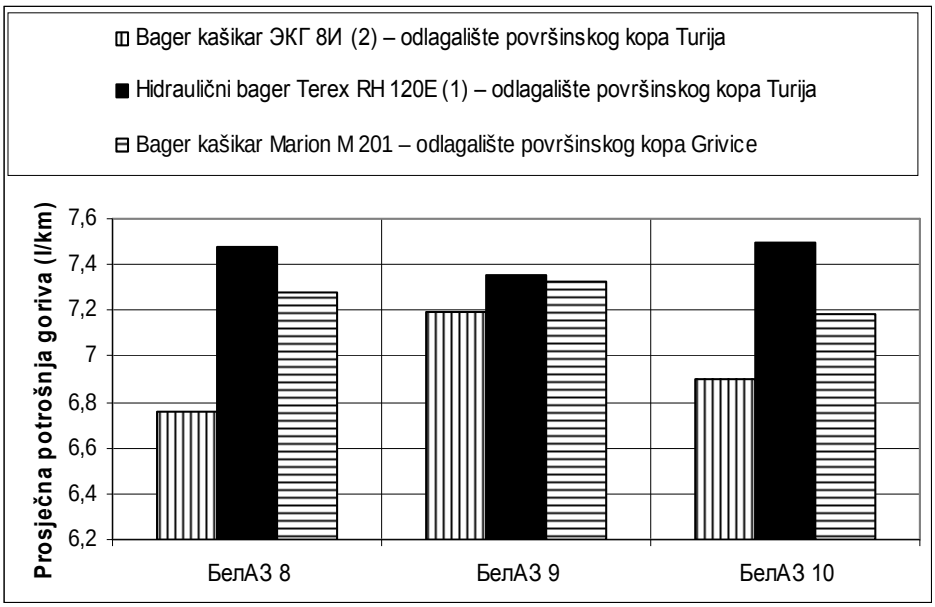
Sl. 24.

Prema podacima sa procesora kamiona БелАЗ 11 u toku dana on pređe 500 do 600 km, dok БелАЗ 8 pređe oko 170 km (isti bager isto odlagalište). Na kamionu БелАЗ 11 procesor nije ispravan tako da se podaci sa ovog kamiona ne mogu iskoristiti za dalju analizu dok se ne otkloni kvar.

Prema podacima sa procesora maksimalna količina goriva koja se registruje u kamionima БелАЗ je 1.892 (l) dok u rezervoar može stati 1.900 (l), a prosječna potrošnja goriva prikazana je u sljedećem grafikonu.

Tabela 1.

Bager – odlagalište	Kamion		
	БелАЗ 8	**БелАЗ 9**	**БелАЗ 10**
Bager kašikar ЭКГ 8И (2) – odlagalište površinskog kopa Turija			
Prosječna potrošnja goriva (l/km)	6,76	7,19	6,9
Prosječna količina goriva koja se dopunjava u rezervoar (l)	1448	1411	1154
Hidraulični bager Terex RH 120E (1) – odlagalište površinskog kopa Turija			
Prosječna potrošnja goriva (l/km)	7,48	7,35	7,50
Prosječna količina goriva koja se dopunjava u rezervoar (l)	1844	1138	1437
Bager kašikar Marion M 201 – odlagalište površinskog kopa Grivice			
Prosječna potrošnja goriva (l/km)	7,28	7,33	7,18
Prosječna količina goriva koja se dopunjava u rezervoar (l)	1494	1471	1508



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5. ZAKLJUČAK

Ukupno jedanaest kamiona posjeduje procesore, od kojih su na kamionima БелАЗ 8, БелАЗ 9 i БелАЗ 10 procesori u ispravnom stanju, te se podaci sa ovih procesora mogu koristiti za analize. Kod ostalih kamiona potrebno je izvršiti popravku procesora da bi podaci o radu bili dostupni za analize.

Pet kamiona Terex 3600 B i dva kamiona tipa Mark 36 ne posjeduju ovakve procesore, te se podaci o radu i zastojima /otkazima ne mogu analizirati na ovaj način.

Podaci sa procesora kamiona mogu se iskoristiti za određivanje pojedinih parametara rada kamionskog transporta. Ugradnjom Global Positioning System (GPS) prijemnika na opremu kojom raspolaže RMU „Banovići“ otvara se mogućnost dobijanja stvarne i vremenske i prostorne slika rada, kao i formiranje dispečerskog centra u rudniku.

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