



PROSPECT OF ARTICULATED DUMP TRUCKS APPLICATION IN CONDITIONS OF MIRNY GOK ALROSA CO. LTD.

PERSPEKTIVE PRIMENE ZGLOBNIH KIPERA U USLOVIMA RUDNIKA MIRNI GOK ALROSA CO. LTD

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Abstract: As a basis design decision for development of gravel deposits of Mirny GOK, ALROSA Co. LTD., BELAZ-75473 model has been provided for moving on surfaced roads. Technological roads are dumped only by the rocks mined in situ – bedrock and overburden, during preparation of dredge proving ground and in order to avoid dilution. In connection with low mechanical properties of dumped rocks the overall structure has the best hardness index only during summer or winter seasons. Thereby there is a seasonal organization of mining and transportation operations during the preparation of dredge proving ground. For transportation of rocks over roadways that are reducing load-carrying capacity in the case of watering articulated dump trucks (ADT) should be used. It will allow to provide steady usage of vehicles during year months. Implemented calculations have shown that ADT shift production is 18% higher but traffic handling cost – 2% lower than BELAZ efficiency.

Resulted from calculations efficiency of ADT became one of the arguments for their purchasing and two vehicles of Volvo A40E have been used since quarter IV of year 2008.

Key words: dump trucks, articulated dump trucks, life time, production rate, prime cost, technological roadways, efficiency.

Apstrakt: Kao osnovna konstrukcionalna odluka da se eksploratiše ležište šljunka rudnika Mirni GOK, ALROSA Co. LTD., za kretanje po površinskim putevima predviđen je model BELAZ-75473. Tehnološki putevi se posipaju samo kamenjem iskopanim na licu mesta – stenovito tlo i jalovina, tokom pripremanja zemlje za bager i kako bi se izbeglo razređivanje. U pogledu slabih mehaničkih osobina odloženih stena ukupna struktura ima najbolji indeks čvrstoće samo tokom letnjih ili zimskih meseci. Na taj način postoji sezonska organizacija rudarskih i transportnih aktivnosti tokom pripremanja zemlje za iskopavanje bagerom. Za transport stena putevima koji smanjuju kapacitet nosivosti tereta u slučaju da treba da se koriste zglobni kiperi za zalivanje (ADT). To će omogućiti ravnometno korišćenje vozila tokom godine. Izračunavanja koja su primenjena pokazala su da je proizvodnja ovih kipera po smeni veća za 18% ali da su troškovi održavanja prometa za 2% niži od produktivnosti BELAZ-ovih modela.

Na osnovu obračuna, produktivnost zglobnih kipera je postala jedan od argumenata za njihovu kupovinu i korišćenja su dva vozila Volvo A40E od IV kvartala 2008. godine.

Ključne reči: kiperi, zglobni kiperi, vek trajanja, stopa proizvodnje, cena koštanja, tehnološki putevi, efikasnost.

1 INTRODUCTION

The raw-material base of diamond-mining joint-stock company "АЛРОСА" is represented by a number of kimberlite deposits, a part of which has already been mined, a part has been in operation or rehabilitation. The deposits are mainly located in north-western region of Republic Sakha (Yakutia) on vast territory, significantly separated (500-1300 km) from each other.

In recent years mining conditions of developing primary diamondiferous deposits of Yakutia essentially changed.

Boundary lines of open mining operations have considerably extended. In many design solutions the maximum depth of effective open-pit excavation has been determined as 500-600 m and the haulage distance – up to 10 km.

Average weighted lift of mined rock today constitutes 600 m with simultaneous development of up to 10 benches. The value of average weighed inclination of ramp in the pits makes 71-75% and at lower levels it reaches 80-100 %, which allows drastically decrease the volumes of stripping within the pit and involve additional volumes of ore into development.

Operation of open-pit dump trucks in ALROSA Co. Ltd. is exercised in severe climatic and mining conditions.

Average annual temperature is within the limits of -7°C to -14°C. The range of outdoor temperature changes is from +35°C to -65°C. Wind velocity is from 1.5 to 3.5 m/s. However, despite of complexities and deterioration of conditions efficiency of the Company technological motor transport tends to grow.

2. TRANSPORT WITH ARTICULATED DUMP TRUCKS IN MINE MIRNY

Besides primary diamond deposits ALROSA intensively develops diamondiferous placers located on Mirny site. In this connection there is a great variety of mining and preparatory works the number of which amounts to 5 only at one deposit, and in total several placer deposits are in development simultaneously. Those works include: preparation of grounds (clearing from

1 UVOD

Osnovna sirovina akcionarskog društva za iskopavanje dijamanata "АЛРОСА" predstavljena je određenim brojem ležišta kimerlita, čiji je jedan deo već eksplorisan, a jedan deo je u procesu rada ili sanacije. Ležišta se uglavnom nalaze u severozapadnoj oblasti Republike Saka (Jakutija) na prostranoj teritoriji, znatno udaljena jedna od drugih (500-1300 km).

Poslednjih godina eksploracioni uslovi razvijanja primarnih dijamantonosnih ležišta u Jakutiji bitno su se promenili.

Granice aktivnosti površinskih kopova značajno su se proširile. U mnogim projektnim rešenjima maksimalna dubina stvarnog otkopavanja površinskog kopa određena je kao 500-600 m a transportna razdaljina – do 10 km.

Prosečan ponderisan hod iskopine danas čini 600 m uz istovremenu eksploraciju do 10 otkopa. Vrednost prosečnog ponderisanog nagiba kosine u otkopima čini 71-75% a na nižim nivoima dostiže 80-100%, što omogućava drastično smanjenje obima urušavanja na otkopu i uključuje dodatne količine rude prilikom otkopavanja.

Rad površinskih kipera u kompaniji ALROSA Co. Ltd. obavlja se u oštrim klimatskim i rudarskim uslovima.

Prosečna godišnja temperatura kreće se od -7°C do -14°C. Raspon promena spoljne temperature je od +35°C do -65°C. Brzina veta je od 1,5 do 3,5 m/s. Međutim, uprkos kompleksnosti i pogoršanja uslova, efikasnost tehnološkog motornog transporta Preduzeća ima tendenciju rasta.

2. TRANSPORT ZGLOBNIM KIPERIMA U USLOVIMA RUDNIKA MIRNI

Pored primarnih ležišta dijamanata ALROSA intezivno radi na nalazištima dijamanata smeštenim u Mirni. S tim u vezi, postoji širok spektar eksploracionih i pripremnih radova, čiji broj dostiže 5 samo u jednom ležištu, a ukupno se eksplorise nekoliko nalazišta istovremeno. Ovi radovi uključuju: pripremanje zemljišta (krčenje terena od snega

snow and trees), mining-preparatory works, haulage of bedrock, sands, and turf to a dumping place or to erection of dams and other facilities, and total number of repartitions of mining and other works in Mirny GOK amounts to 40.

Several diamond placer deposits have been under development on the Irelyakh river simultaneously: deposit "Gornoje" – by dredge, "Irelyakh Placer" – by dredge and open cast method, "Vodorazdel'nyey Galechniky" (watershed pebbles) – by open cast method.

According to the design solution model BelAZ-75473 truck has been used as the basic one for the development of placer deposits (Figure 1).

i drveća), rudarsko-pripremni radovi, transport stenovite zemlje, peska, treseta do odlagališta ili do mesta gradnje brana i drugih objekata, i ukupan broj rudarskih i drugih radova u rudniku Mirni GOK iznosi 40.

Nekoliko nalazišta dijamanata su istovremeno eksploatisana na reci Irelijak: ležište „Gornoje“ – putem bagera, „Nalazište Irelijak“ – bagerom i metodom površinskog otkopavanja, „Vodorazdelnijev Galečnici“ (ispran šljunak) – metodom površinskog otkopavanja.

Po svom projektnom rešenju, model kamiona BelAZ-75473 se koristi kao osnovni za otkopavanje nalazišta (slika 1).



*Figure 1 BelAZ-75473 truck on deposit "Gornoje" of Mirny GOK
slika 1 BelAZ-75473 kamion na ležištu "Gornoje" u rudniku Mirni GOK*

All trucking during placers development and preparation of dredge proving grounds is performed all year round, except for the period of spring flood (in May), however, during preparation of dredge grounds there is seasonal arrangement of mining-transport works. Irregular work of the trucks during a year is stipulated by conditions of technological roads to construct which only overburden and bedrock having low strength properties can be used to avoid dilution.

The basic volume of mining-transport operations is planned and performed both in summer and in winter months. Distribution of trucking and freight turnover by months (at the example of year 2007) shown in Figure 2 is typical common during placers development for the period of last few years.

As a rule, operation of trucks interrupts in decades II-III of April, resumes in June-July; in summer during long period of rains motor transport does not work either.

Svaka vožnja kamiona tokom otkopavanja nalazišta i pripreme za bagersko iskopavanje zemlje vrši se tokom cele godine, osim u periodu prolećnih poplava (u maju), ali, tokom priprema zemlje tu je sezonsko raspoređivanje rudarsko-transportnih radova. Neredovan rad kamiona tokom godine zavisi od uslova tehnoloških puteva koje treba izgraditi, a koje samo jalovina i stena slabe snage mogu koristiti kako bi se izbeglo razblaživanje.

Osnovni obim rudarsko-transportnih aktivnosti planira se i obavlja kako u letnjim tako i u zimskim mesecima. Distribucija prevoznog prometa po mesecima (na primeru 2007. godine) prikazana na slici 2 je tipična tokom otkopavanja nalazišta u periodu prethodnih nekoliko godina.

Po pravilu, rad kamiona prekida se u 2. i 3. dekadi aprila, nastavlja u junu i julu; leti, tokom dugog kišnog perioda motorni transport takođe ne funkcioniše.

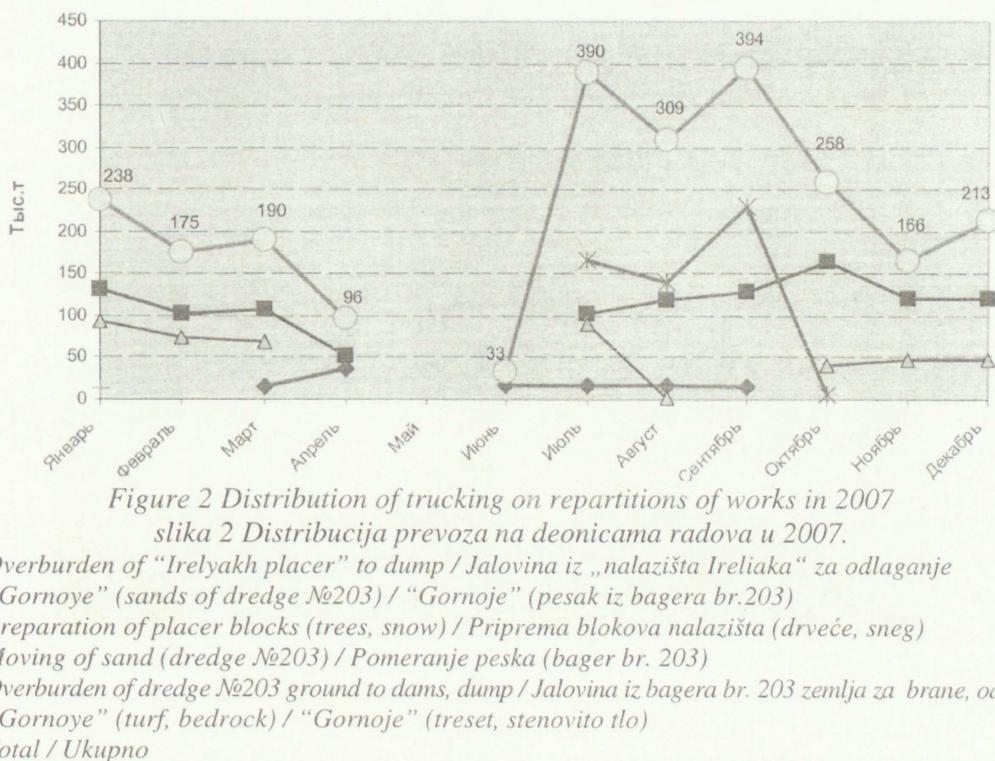


Figure 2 Distribution of trucking on repartitions of works in 2007

slika 2 Distribucija prevoza na deonicama radova u 2007.

- Overburden of "Irelyakh placer" to dump / Jalovina iz „nalazišta Ireliaka“ za odlaganje
- ▲— "Gornoje" (sands of dredge №203) / "Gornoje" (pesak iz bagera br.203)
- ×— Preparation of placer blocks (trees, snow) / Priprema blokova nalazišta (drveće, sneg)
- Moving of sand (dredge №203) / Pomeranje peska (bager br. 203)
- Overburden of dredge №203 ground to dams, dump / Jalovina iz bagera br. 203 zemlja za brane, odlagalište "Gornoje" (turf, bedrock) / "Gornoje" (treset, stenovito tlo)
- Total / Ukupno

Articulated dump trucks (ADT), Volvo A40E, for example, possess technical abilities for carrying loads in lack of roads conditions and in their complete absence. Application of ADT during the development of Irelyakh river placer deposits will allow perform all transport work regularly for the year periods (except May).

It should be noted that there are not many enterprises in Russia where ADT are employed. "Severalmaz" Co. is referred to such enterprises, where at present pipe "Arkhangelskaya" has been mined, being one of 6 pipes representing Lomonosov GOK. Lomonosov diamond deposit is characterized by less severe climatic conditions in comparison with diamondiferous deposits of Yakutia, but is located in swampy area where sources of several rivers are situated. ADT in Lomonosov GOK are represented by Volvo A40D and Terex TA-35C with load capacities 37 and 32 t respectively (Figure 3).

Subject to experience of ADT operation in conditions of Lomonosov GOK (during estimation Volvo F40D model was used for analog) and specific character of the Irelyakh river placer deposits' development the calculated efficiency of ADT operation in conditions of Mirny GOK was determined. Throughput and production cost of transport work were accepted as criteria of efficiency.

Zglobni kiper (ADT), Volvo A40E, na primer, ima tehničke sposobnosti za nošenje tereta, u nepovoljnim drumskim uslovima, ili čak u potpunom nedostatku puteva. Upotreba zglobnih kipera tokom eksploracije nalazišta reke Ireljak omogućava redovno obavljanje transporta u svim periodima godine (osim maja).

Napominjemo da u Rusiji nema puno preduzeća u kojima se upotrebljavaju ovi kiperi. "Severalmaz" Co. je takvo preduzeće, koje se eksploratiše u sadašnjem cevovodu "Arkhangelskaya", pri čemu je jedan od 6 cevovoda koji predstavljaju rudnik Lomonosov GOK. Rudnik dijamantnata Lomonosov karakterišu manje oštri klimatski uslovi u poređenju sa nalazištima dijamantnata Jakutije, ali je smešten u močvarnoj oblasti gde se nalaze izvori nekoliko reka. Zglobni kiperi su u rudniku Lomonosov GOK zastupljeni modelima Volvo A40D i Terex TA-35C sa kapacitetom opteretanja 37 odnosno 32 t (slika 3).

Zavisno od iskustva rada sa zglobnim kiperima u uslovima rudnika Lomonosov GOK (tokom procene bio je korišćen model Volvo F40D radi poređenja) a bio je utvrđen određeni karakter eksploracije nalazišta kod reke Ireljak, izračunata efikasnost rada zglobnih kipera u uslovima rudnika Mirni GOK. Propusna moć i proizvodni troškovi transportnog rada prihvaćeni su kao kriterijumi za efikasnost.



*Figure 3 Volvo F40D on pipe "Arkhangelskaya" "Severalmaz" Co.
slika 3 Volvo F40D na cevi "Arkhangelskaya" "Severalmaz" Co.*

Throughput was determined by use factor of bearing capacity (КИГ), average schedule speed, and operating regime of a driver.

When defining КИГ it was taken into account that specific weight of transported ground mass during placer deposits' mining and preparation of dredge grounds in conditions of Mirny GOK changes from 1.65 t/m^3 (turf) to 1.9 t/m^3 (sand). With 26 m^3 (with a "cap") holding capacity of the BelAZ truck platform the volume of transported in one trip ground mass changes from 29 t (stripping) to 31 t (sand) and constitutes 30 t on average, and the use factor of bearing capacity equals 0.67.

Taking into account the fact that holding capacity of ADT is 24 m^3 the volume of transported in one trip load will change from 27 t (stripping) to 28 t (sand) and will make 27.5 t on average, and the use factor of bearing capacity – 0.71.

When defining average schedule speed it was assumed that in conditions of Lomonosov GOK average schedule speed of ADT on horizontal length of 2.5 km, determined by experimental way, constituted 25 km/h.

Indicators of output rates per shift for drivers of compared trucks in trips, tons and tonne-kilometers are given in Table 1.

Propusna moć je određena korišćenjem faktora nosećeg kapaciteta (KIG), prosečne predviđene brzine i radnog režima vozača.

Kada se određuje KIG, uzima se u obzir specifična težina transportovane zemljane mase tokom otkopavanja nalazišta i pripreme zemlje za bagersko otkopavanje u uslovima rudnika Mirni GOK menja se od $1,65 \text{ t/m}^3$ (treset) do $1,9 \text{ t/m}^3$ (pesak). Sa 26 m^3 (sa „poklopcem“) nosivosti kamionske platforme BelAZ-a transportovane u jednoj zemljanoj masi menja se sa 29 t (ogoljavanje) do 31 t (pesak) i iznosi 30 t u proseku, a korišćeni faktor nosivosti iznosi 0,67.

Uzimajući u obzir činjenicu da je kapacitet nosivost zglobnih kipera 24 m^3 zapremina tereta u jednom tovaru promeniće se sa 27 t (ogoljavanje) na 28 t (pesak) i iznosiće 27,5 t u proseku, a korišćen faktor nosivosti iznosi – 0,71.

Prilikom određivanja prosečne planirane brzine, pretpostavilo se da, u uslovima rudnika Lomonosov GOK prosečna planirana brzina zglobnih kipera po horizontalnog dužini od 2,5 km, određena eksperimentalnim putem, iznosi 25 km/h.

Pokazatelji izlaznih brzina po smeni vozača u poređenju sa kamionima po pređenom putu, tonama i kilometrima dati su u Tabeli 1.

Table 1 Indicators of output rates per shift for drivers of BelAZ trucks (acting) and ADT trucks (calculated) during mining of placer deposits in conditions of Mirny GOK

Tabela 1 Pokazatelji izlaznih brzina po smeni vozača BelAZ kamiona i ADT kamiona u toku rudarskih operacija za uslove odlagališta Mirny GOK

| Truck model | Average schedule speed, km/h | Load t | Trip duration, min | Output | | |
|---------------------------|------------------------------|--------|--------------------|----------|---------|---------|
| | | | | in trips | in tons | in t-km |
| 1.5 km distance | | | | | | |
| BelAZ-75473 | 16.4 | 29 | 16.0 | 23.2 | 672.19 | 1008.3 |
| Volvo A40E | 20.5* | 27 | 13.7 | 32.1 | 866.8 | 1167.4 |
| 2 km distance (stripping) | | | | | | |
| BelAZ-75473 | 17.9 | 29 | 18.8 | 20.2 | 585.31 | 1170.6 |
| Volvo A40E | 22.3* | 27 | 15.8 | 27.8 | 751.6 | 1503.1 |
| 2.7 km distance (sand) | | | | | | |
| BelAZ-75473 | 20 | 31 | 21.2 | 17.9 | 555.9 | 1500.9 |
| Volvo A40E | 25 | 28 | 18.0 | 24.4 | 684.1 | 1877.1 |

*average schedule speed of Volvo A40E is updated similar to the change of BelAZ-75473 speed depending on haulage leg

Calculations indicated that rated shift productivity of ADT on average is 18% higher, hence 18% more BelAZ trucks will be required to fulfill the same volume of transport work. Besides, Volvo trucks will be employed on transporting ground mass during a year period, excluding the period of spring flood.

In order to determine the second efficiency index - traffic handling cost - it is necessary to know operating costs on performing equal volume of transport work, which are formed according to the following articles: wages, fuel, lubricants, wear and repair of trucks, capital charges, general production costs.

In order to calculate operating costs on equal volume performance of transport work by BelAZ and Volvo trucks the following indicators were used:

- *average wage of a driver of technological motor transport is assumed at applied in a haulage company level in 2007;*
- *quantity of drivers per 1 truck is assumed at applied in a haulage company level – 4.1 person;*

Obračuni ukazuju na to da je normirana produktivnost smene zglobnog kipera u proseku za 18% veća, prema tome, 18% više BelAZ kamiona biće potrebno da se izvrši isti obim transportnog posla. Pored toga, Volvo kamioni biće upotrebljeni za prevoz zemljane mase tokom godine, ne uključujući period prolećnih poplava.

Da bi se odredio drugi indeks efikasnosti - troškovi održavanja prevoza - potrebno je znati eksplotacione troškove obavljanja istog obima transporta, koji se stvaraju prema sledećim stavkama: plate, gorivo, maziva, habanje i popravka kamiona, kapitalni troškovi, opšti proizvodni troškovi.

Kako bi se izračunali eksplotacioni troškovi na jednakom obimu prevoza putem BelAZ i Volvo kamiona, korišćeni su sledeći pokazatelji:

- *Prosečna plata vozača tehnološkog prevoznog sredstva – pretpostavlja se da je na nivou prevoznog preduzeća u 2007;*
- *Broj vozača po 1 kamionu – pretpostavlja se da se primenjuje prema nivou prevoznog preduzeća - 4,1 osoba;*

- *specific consumption of fuel* by trucks BelAZ in 2007 constituted 103.6 g/t-km. Specific consumption of fuel by ADT in conditions of Lomonosov GOK constitutes on average 104.9 g/t-km, and by BelAZ – 98.6 g/t-km, that is 6% less. Considering the foresaid we assume specific consumption of fuel by ADT in conditions of Mirny GOK 6% higher, which will constitute 109.8 g/t-km;
- *calculation of required oils and lubricants* – engine, transmission, hydraulic oils, lubricant grease, cooling liquids – for compared truck models, was made in accordance with recommendations of manufacturers on oil types and periods of their replacement;
- *defining the costs on purchasing trucks* we assume that for equipping BelAZ trucks "Bridgestone" LST (large-size tyres) 21.00R35 will be used. Volvo trucks are equipped with "Goodyear" LST, in future utilization of "Bridgestone" 29.5R25 tyres is planned. The price of LST 21.00R35 is 4111.4 \$US or 97 000 roubles, and LST 29.5R25 – 6383.5 \$US or 150 000 roubles (including customs duty and hauling charges);
- *service life* of BelAZ trucks in conditions of Mirny GOK is 6 years or 500 000 km. We assume service life of Volvo trucks for 10 years as in Lomonosov GOK;
- *general production costs*, which include expenses for maintenance, repair of trucks and overhead costs, constitute up to 50% in the structure of traffic handling cost in Mirny GOK haulage company.
- *specifična potrošnja goriva* od strane kamiona BelAZ u 2007. godini bila je 103,6 g/t-km. Specifična potrošnja goriva od strane zglobnih kipera u uslovima rudnika Lomonosov GOK iznosi u proseku 104,9 g/t-km, a BelAZ kamiona – 98,6 g/t-km, odnosno za 6% manje. Imajući u vidu gore navedeno prepostavljamo da će specifična potrošnja goriva od strane zglobnih kipera u uslovima rudnika Mirni GOK biti za 6% veća, što iznosi 109,8 g/t-km;
- *Izračunavanje potrebnog ulja i maziva* – motor, prenos, hidraulična ulja, mast za podmazivanje, tečnost za hlađenje - za uporedene modele kamiona, izvršeno je u skladu sa preporukama proizvođača u pogledu vrsta ulja i perioda njihovog menjanja;
- *Određivanje troškova kupovine kamiona* – prepostavljamo da će za opremanje BelAZ kamiona biti korišćene gume "Bridgestone" LST (gume velikog obima) 21.00R35. Volvo kamioni su opremljeni gumama "Goodyear" LST, a za buduće korišćenje planirane su gume "Bridgestone" 29.5R25. Cena za LST 21.00R35 je 4111,4 USD ili 97 000 rubalja, a LST 29.5R25 – 6383,5 USD ili 150 000 rubalja (uključujući carinu i troškove prevoza);
- *Vek trajanja* BelAZ kamiona u uslovima rudnika Mirni GOK je 6 godina ili 500 000 km. Prepostavlja se da je vek trajanja Volvo kamiona 10 godina kao u rudniku Lomonosov GOK;
- *Opšti proizvodni troškovi*, koji uključuju troškove održavanja, popravku kamiona i režijske troškove, iznose do 50% u strukturi troškova održavanja saobraćaja u prevoznom preduzeću Mirni GOKa.

Calculation of operating costs, made in the levels of 2007 prices and consumption of material resources at 2007 level (LST – at the level of 2008 prices), indicates that cost value of transport work of Volvo A40E trucks is 2.0% lower than of BelAZ 75473 trucks.

Calculation of cost value on items of expenses is given in Table 2.

The received after calculations efficiency has become one of the arguments for purchasing of two articulated dump trucks Volvo A40E in the fourth quarter of 2008.

Izračunavanje eksploatacionih troškova, izvršeno na nivou 2007. cene i potrošnja materijalnih resursa na nivou 2007. godine (LST - na nivou cena iz 2008.), ukazuje na to da je nabavna vrednost prevoza Volvo A40E kamiona manja za 2% od BelAZ 75473 kamiona.

Izračunavanje nabavne vrednosti po stavkama troškova dato je u Tabeli 2.

Prihodi nakon izračunavanja efikasnosti postali su jedan od argumenata za kupovinu dva zglobna kipera Volvo A40E u četvrtom kvartalu 2008.

Table 2 Calculation of ground mass traffic by BelAZ-75473 and Volvo A40E trucks handling cost during development of placer deposits in conditions of Mirny GOK

Tabela 2 Proračun cena transporta zemljanih masa kamionima BelAZ-75473 i Volvo A40E u toku izgradnje odlagališta u uslovima of Mirny GOK

| Items of expenses | Units | BelAZ-75473 - 2007 fact | Volvo A40E forecast |
|------------------------------------|---------------------|-------------------------|---------------------|
| Source data | | | |
| Quantity of trucks | | 1 | 0.82 |
| Traffic | 1000 t-km | 1274.1 | 1274.1 |
| Truck cost (with VAT and shipment) | 1000 roubles | 9378.3 | 14321.9 |
| Average wage of a driver | 1000 roubles | 37.7 | 37.7 |
| Number of drivers | Person | 4.1 | 3.4 |
| Specific consumption of fuel | g/t-km | 103.6 | 109.8 |
| Fuel consumption, total | t | 132.0 | 139.9 |
| Cost of 1 t fuel | 1000 roubles | 17.4 | 17.4 |
| Cost of 1 tyre | 1000 roubles | 96.6 | 150 |
| Service life of a truck | years | 6 | 10 |
| Calculation data | | | |
| Expenses on drivers; wages | 1000 roubles | 1853.9 | 1520.2 |
| Expenses on fuel | 1000 roubles | 2298.3 | 2436.2 |
| Expenses on lubricants | 1000 roubles | 165.6 | 104.0 |
| Expense on LST | 1000 roubles | 579.7 | 900.0 |
| General production expenses | 1000 roubles | 6735.6 | 6602.8 |
| Capital charges | 1000 roubles | 1563.1 | 1432.2 |
| Charges on social needs | 1000 roubles | 370.8 | 304/0 |
| Total | 1000 roubles | 13566.8 | 13299.4 |
| Cost of 10 t-km | roubles | 106.5 | 104.4 |

Actual productivity of ADT will be determined according to the results of the first year of operations.

Stvarna produktivnost zglovnih kipera biće određena prema rezultatima u prvoj godini poslovanja.

3 CONCLUSION

- Application of trucks Volvo A40E with articulated frame during development of placer deposits and preparation of dredge grounds instead of trucks BelAZ-75473 will allow reduce:
- number of trucks operating on the development of placer deposits, by 18% due to much higher output;
- expenses on maintenance and operation owing to lower cost value of transport work performance (by 2.0%).
- Application of ADT will provide regular utilization of motor transport by months during a year (except May).

3 ZAKLJUČAK

- Upotreba kamiona Volvo A40E sa zglovnim ramom tokom rada na nalazištima i pripremi zemlje umesto kamiona BelAZ-75473 omogućće smanjivanje:
- Broja kamiona koji rade na eksploataciji nalazišta, i to za 18%, zahvaljujući mnogo većoj proizvodnji;
- Troškovi održavanja i rada zbog manje nabavne vrednosti obavljanja prevoza (za 2,0%).
- Upotreba zglovnih kipera omogućće redovnu upotrebu motornog transporta svih meseci tokom godine (osim u maju).

Reviewal / Recenzija: prof. dr Miloš Grujić