SELECTION OF COAL AND OVERBURDEN TRANSPORTATION TYPE AT THE SURFACE COALMINE ON THE BASIS OF TECHNO-ECONOMIC ANALYSIS

Ph.D. Šefik Suljić
Coalmines "Kreka" Tuzla
Bosnia and Herzegovina

Ph.D. Sunčica Mašić
The University of Tuzla, RGGF Tuzla
Bosnia and Herzegovina

M.A. Suvada Durmić
Civil Service Agency of Federation of
Bosnia and Herzegovina

M.A. Amir Arnautović
High Transportation School-Tuzla
Bosnia and Herzegovina

ABSTRACT
In this work we have shown the method of optimization of coal and overburden transport in the case of Coalmine (surface coalmine) "Dubrave" in Dubrave. After identification and analysis of a problem with the transport of coal and overburden, we have approached the optimization of alternative solutions according to the criterion of minimum cost. Three variants of transportation were analyzed: by conveyor belts, by trucks and by railroad cars.
Bearing in mind the complexity of the problem of optimizing the transport of coal and overburden, for purposes of analysis an appropriate transport schemes are adopted, mathematical models for calculating economic parameters which are presented in the form of a flowchart were also set up, and then the software for calculation of transport costs was created as well.
Obtained results of optimization by variants are shown in the diagram which shows the most acceptable variant in regard to the techno-economical parameters.
Presented method of evaluation of the optimal choice of transportation of coal and overburden can be used at other facilities where transport is used in the production process, in which the transport costs have considerable influence on the final product price.
Key words: optimization, transport, coal, overburden

1. INTRODUCTION
Improving the transport process of overburden and coal at the coalmine "Dubrave" is possible by optimizing by the method of alternative solutions: by conveyor belts, by trucks and by railroad cars. Optimization is unimaginable without the modelling of a system. First, the volume of overburden and coal production is defined, and then we determine the legality of the changes that occur of the observed and defined parameters by time, in a defined area of transport routes. When a problem is identified, we have approached to its quantitative analysis by compensation of alternative solutions according to the criterion of minimum transport costs per unit of production expressed in $€/t$ or $€/m^3$.
Bearing in mind the projected coalmine capacity of $Q=3.000.000$ t/year, and development concept of the Coalmine "Kreka" in Tuzla, this work has the task to find the optimal solution of coal transport from a Coalmine the Power plant depot (storage).

2. MODELING AND CALCULATION OF THE COAL AND OVERBURDEN TRANSPORT
Bearing in mind the complexity of the problem of optimizing the transport of coal and overburden, for purposes of analysis an appropriate transport schemes are adopted, and they are shown in Figures 1, 2 and 3.
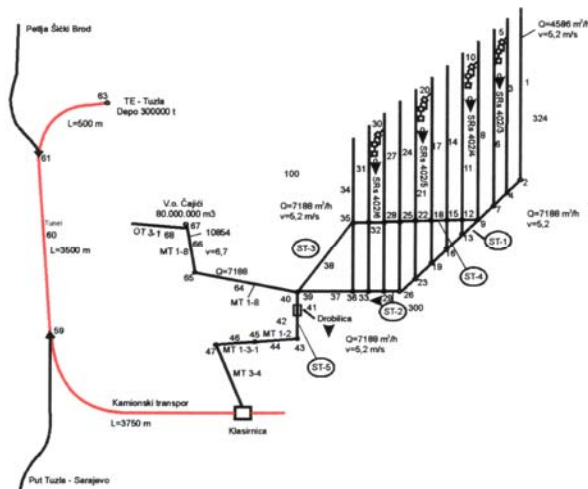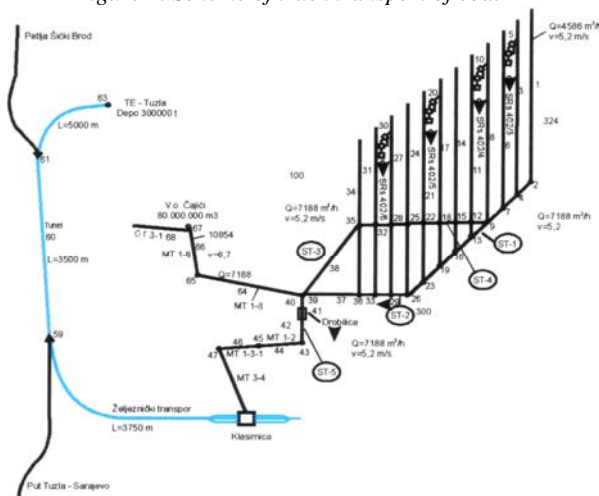
Figure 1. Scheme of truck transport of coal

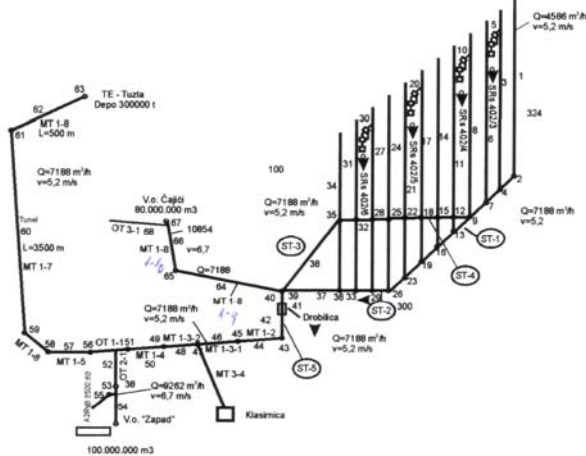*Figure 2. Scheme of railroad transport of coal*

Figure 3. Scheme of coal transport by conveyor belts

In order to intensify works on the opening and exploitation of an excavation site and to achieve the best production and economic effects, and depending on the specific geological and engineering-geological conditions, in most cases is determined the use of three different types of transport: by truck, railroad cars and conveyor belts.

Truck transport has the greatest use in excavation of coal deposits which have complex conditions of excavation, thin and sheer layers of useful substances, so that the progress of the front of mine works is very quickly. Truck transport provides the best economic effects, in comparison with other types of transport, when applied to the medium-sized surface coalmines, with transport distances 0.2-7 km, the ascent of 8-10% and the radius of road curves not less than 25-30 m.

Transport by railroad cars in modern surface coalmines in almost all countries of the world is very prevalent. One can say that this model of transport today is still at the first place, regarding the total volume transport of the masses. In the future, predictions are that the rail transport would be reduced, due to the appearance of more advanced modes of transportation.

Transport by conveyor belts is applicable in the case of triturated materials, with prior introduction of grinding in the technological process at the surface Coalmine.

Figure 4 presents a model of calculation of economic parameters of coal transport by the variants.
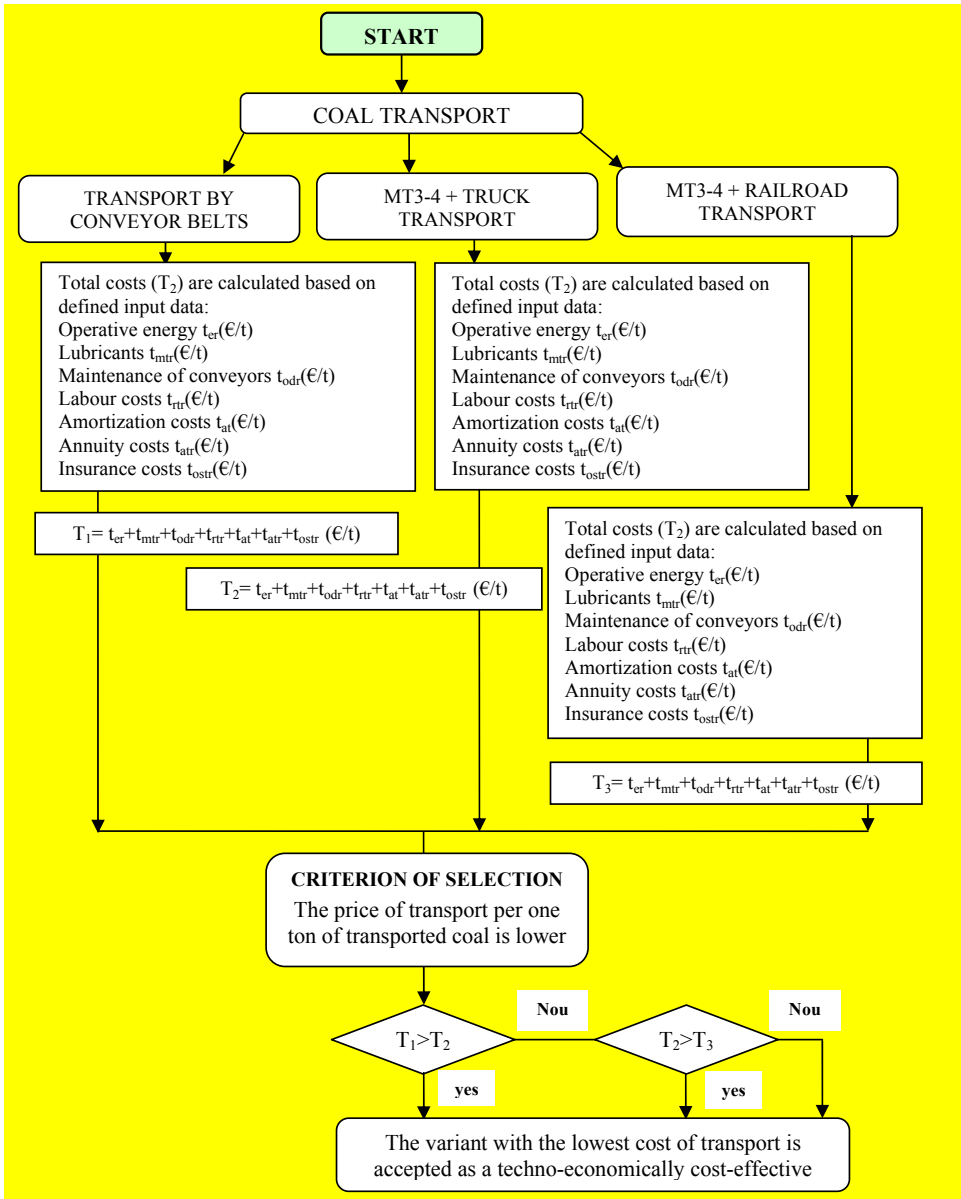
Figure 4. Model of calculation of economic parameters of coal transport by variants

By applying the presented model of calculation we get the results of specific costs of coal transportation (€/t) of the adopted variants of transportation, from separation unit in coalmine to the power plant depot, for the annual coal production of 3.000.000 tons. The results of transport costs for alternative solutions are shown in the diagram, Figure 5. The resulting values of the specific cost of transport by the variants, give an advantage over other two types of transport. In this study we used mathematical modelling calculation of basic parameters of railroad, truck and conveyor belts transport in the form of algorithms and software. When calculating the cost of transportation, for every ton of coal transported is assumed to receive the same amount of material costs, costs of direct production work and indirect production costs. Unit cost is calculated by dividing total costs by the number of transported units (tons of coal). Production costs are all production costs except direct material costs.

They include production labour, indirect materials, energy, amortization of facilities etc. Direct materials are provided at the beginning of the process in the sector of coal and overburden transport. Production costs are added evenly during the transportation of coal in the observed period. In this study we have adopted that the costs of procurement, construction and operation of all storey, gathering-transport, main carriers/conveyors, and the costs of construction and operation of the tunnel, are in constant values and in the same level affect on the economy of railroad, truck and conveyor belt transport of overburden and coal, and do not affect unit costs of transport.
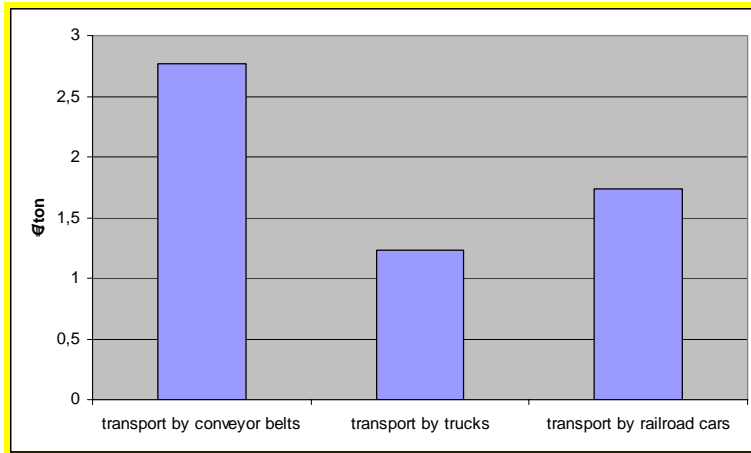

Figure 5. Transportation costs for certain variants of transport, per unit of a mass transported

3. CONCLUSION

By analyzing the basic influencing factors of coal transport in the described model, it can be concluded that the truck transport of coal is the most efficient. To make the process of production performance of truck transportation to give the maximum effects, it should cover different aspects of exploitation efficiency of truck fleet, from design stage and production of truck, then truck adaptability to changing conditions of exploitation, optimizing the transport process, the area of technical exploitation of truck and prediction of its technical status, as well as the economic effects of optimization of the productivity of truck.

The process of coal transportation includes the system of cost accounting of certain operations. Accordingly, the system of operation costs calculation is applicable to the observed, as well as to the other similar transportation systems. The main characteristic of the presented approach to mathematical modelling of transportation is that based on data obtained by calculation, it is possible to perform the optimization of the transport process. In transport, as well as in other fields of material production, all the technological and organizational solutions are getting their utilization value only through their successful economic valorisation.

4. REFERENCES

[1] The main Coalmine project PK "Kreka-Dubrave" Tuzla-Coalmine technological part, 1983.
[2] Kolarić Vojislav, The Economics of railroad traffic, Belgrade 1968.
[3] Borović Ranko, Conveyor belts, Belgrade 1979.
[4] Opricović S., Multicriterial optimization, Belgrade 1986.
[5] Čičak M., Organization of railroad traffic, Belgrade 1990.
[6] Reuf Kapić., The Economy of Company, Tuzla 1995.
[7] Perović D., Cost theory, Svjetlost, Sarajevo 1988.
[8] Robinson J. and Eatwell J. Introduction to modern economics. CKD, Zagreb 1996.
[9] Šuklev B., Economic prediction, Belgrade 1987.
[10] Berberović Š., Stavrić B., Theory and methodology of costs, Informator, Zagreb 1985.
[11] Božidar S., Gordana K., Business systems management, Belgrade 2002.