#### MINERAL PROCESSING

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# THE PERFORMANCE OF EXCAVATORS IN THE OVERBURDEN OF SOUTH-WEST SIBOVC FIELD IN KOSOVO

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#### ABSTRACT

Kosovo has significant reserves of coal, where their exploitation began in 1922, coal is a mixture of organic mineral material produced by a natural process of growth and decay, or an accumulation of debris both vegetal and mineral with some sorting and stratification. Based on the geological map, the Kosovo Basin is mainly a tectonic area filled with tertiary sediments. Old rocks represent the Basin area, in the west Paleozoic age and in the east by Upper Cretaceous sediments. In the Coal Basin of Kosovo, along with Tertiary sediments, Quaternary sediments that have a hydrogeological character are developed.

Currently coal is dug in the field of the new mine known as South-West Sibovc, which includes reserves of 123.4 million tons.

The first stage for the exploitation of coal mines is the removal of the overburden, so through the evaluation of the performance of the excavators, productivity can be improved, costs reduced and safety increased in the workplace. The evaluation of the excavators performance was carried out through the analysis of the reports for years 2019, 2020 and 2021, from which it appears that there was not a good utilization of the capacity of the five excavators that were analyzed: 2xSchRs 650, 2xSRs 1300.24 and SRs 470, based on reports the productivity for excavator SchRs 650 is between 74.5% to 113.1%, for excavator SRs 1300 is between 62.86% to 96.39% and for excavator SRs 470 is between 49.84% to 73.95%, but load coefficient is between 18% –38%. The normal utilization of the load factor for these excavators is from 45%–60%.

Good productivity analysis can identify areas that need improvement, and through improving the processes and work arrangements of excavators can lead to increased mine performance, reducing costs and increasing revenues.

Keywords: Excavators, productivity, performance, overburden, ratio

#### INTRODUCTION

Coal is a mixture of organic mineral material produced by a natural process of growth and decay, or an accumulation of debris both vegetal and mineral with some sorting and stratification.

Based on the geological map, the Kosovo Basin is mainly a tectonic area filled with tertiary sediments. Old rocks represent the Basin area, in the west Paleozoic age and in

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the east by Upper Cretaceous sediments. In the Coal Basin of Kosovo, along with Tertiary sediments, Quaternary sediments that have a hydrogeological character are developed [7].

## **METHODS**

The evaluation of the performance of excavators in the removal of overburden in coal mines is done through the evaluation of some main performance factors that affect the productivity and efficiency of the machine [1]. This evaluation can be done through several methods, but for this work these methods were used:

Direct observation by monitoring the activity of the excavators, evaluating their speed, position and ability to remove the overburden successfully.

Data analysis by analyzing annual reports that include information on the performance of excavators, evaluating how efficient and productive the excavator is in removing the overburden. This assessment is important for several reasons:

By evaluating the performance, we can determine the areas that need improvement and take the appropriate measures to increase productivity and efficiency [3].

Evaluating the performance of excavators helps in the efficient use of available resources, in case the excavator is not efficient, modifications, adjustments or even replacements with another device can be made, which can directly affect the minimization of costs and the improvement of safety [2]. Therefore, by evaluating the performance of excavators in the removal of overburden in coal mines, productivity can be improved, costs can be reduced and workplace safety can be increased.

#### **RESULTS - SOUTH-WEST SIBOVCI FIELD**

Kosovo has significant reserves of coal, where their exploitation began in 1922, currently coal is dug in the field of the new mine known as South-West Sibovc, which includes reserves of 123.4 million tons.

During the years 2019 - 2021 in the field of South-West Sibovc in the overburden, 4 systems were in use and these devices were applied: in the first system the excavator SRs 1300.24, in the second system SchRs 650, in the third system the excavator SchRs 650 and SRs 470, in the fourth excavator system SRs 1300.24 [6].



Fig.1. Technological scheme of work excavator SchRs 650 for two blocks and technological scheme of work excavator SchRs 650 for two blocks and subscale

The performance analysis was done by evaluating the planning and realization ratio for these devices as well as the use of time.

	20	19	2020			2021
Excavators	Production	Planning	Production	Planning	Production	Planning
SchRs 650 (E9M)	2,881,023	3025000	2,849,832	3335000	2,727,772	3255000
SchRs 650 (E10M)	3406209	3010000	3208251	3435000	2470953	3315000
SRs 1300.24 (E8B)	810849	1400000	2370065	2740000	1483585	2285000
SRs 1300.24 (E10B)	2257057	2720000	2848263	2955000	1744483	2775000
SRs 470 (E5M)	388240	525000	345082	535000	194386	390000

Table 1. Comparison of planning and production for the five excavators during the years 2019-2021



Chart 1. Reports between planning and production during the years 2019 - 2021

According to the reports [4], the realization of these equipment's is good if we are based on the planning of their production, for excavator SchRs 650 is between 74.5% to 113.1%, for excavator SRs 1300 is between 62.86% to 96.39% and for excavator SRs 470 is between 49.84% to 73.95%.

The normal utilization of the load factor for these excavators is from 45% to 60%, starting from this fact, then the utilization of these devices can be improved and the production capacity increases [5].

Excavators	Technical capacity (m <sup>3</sup> /h)	ical ity Load factor (%) h)		Effective capacity (m <sup>3</sup> /h)	Effective capacity (m <sup>3</sup> /year) Operating time min.	Effective capacity (m <sup>3</sup> /year) Operating time max.
					annual (4266h/y)	annual (5474h/y)
SchRs 650 (E9M)	2717	Normal	45%	1222.83871	5216629.94	6693819.10
		Max.	60%	1630.451613	6955506.58	8925092.13
SchRs 650 (E10M)	2717	Normal	45%	1222.83871	5216629.94	6693819.10
		Max.	60%	1630.451613	6955506.58	8925092.13
SRs 1300.24 (E8B)	2581	Normal	45%	1161.290323	4954064.52	6356903.23
		Max.	60%	1548.387097	6605419.35	8475870.97
SRs 1300.24 (E9B)	2581	Normal	45%	1161.290323	4954064.52	6356903.23
		Max.	60%	1548.387097	6605419.35	8475870.97
SRs 1300.24 (E10B)	2581	Normal	45%	1161.290323	4954064.52	6356903.23
		Max.	60%	1548.387097	6605419.35	8475870.97
SRs 470 (E5M)	1090	Normal	45%	490.6451613	2093092.26	2685791.61
		Max.	60%	654.1935484	2790789.68	3581055.48

Table.2 Normal and maximum effective capacity according to the load factor

#### Table 3. Real ratio between production in 2019 and effective capacity

Excavators	Production 2019	Ration Production in 2019/ Q <sub>ef</sub> for min. annual	Ration Production 2019/ Q <sub>ef</sub> for max. annual
SchRs 650 (E9M)	2 991 022	55.23%	43.04%
	2,881,023	41.42%	32.28%
SchRs 650 (E10M)	2406200	65.30%	50.89%
	5400209	48.97%	38.16%
SRs 1300.24 (E8B)	910940	16.37%	12.76%
	810849	12.28%	9.57%
SRs 1300.24 (E10B)	2257057	45.56%	35.51%
		34.17%	26.63%
SRs 470 (E5M)	200240	18.55%	14.46%
	388240	13.91%	10.84%

# Table 4. Real ratio between production in 2020 and effective capacity

Excavators	Production 2020	Ration Production in 2020/ Q <sub>ef</sub> for min. annual	Ration Production 2020/ Q <sub>ef</sub> for max. annual
SchRs 650 (E9M)	2,849,832	54.63%	42.57%
		40.97%	31.93%
SchRs 650 (E10M)	3208251	61.50%	47.93%
		46.13%	35.95%
SRs 1300.24 (E8B)	2370065	47.84%	37.28%

		35.88%	27.96%
SRs 1300.24 (E10B)	2848263	57.49%	44.81%
		43.12%	33.60%
SRs 470 (E5M)	345082	16.49%	12.85%
		12.37%	9.64%

Table 5. Real ratio between production in 2021 and effective capacity

Excavators	Production 2021	Ration Production in $2021/Q_{ef}$ for min. annual	Ration Production 2021/ Q <sub>ef</sub> for max. annual
SchRs 650 (E9M)	2,727,772	52.29%	40.75%
		39.22%	30.56%
SchRs 650 (E10M)	2470953	47.37%	36.91%
		35.53%	27.69%
SRs 1300.24 (E8B)	1483585	29.95%	23.34%
		22.46%	17.50%
SRs 1300.24 (E10B)	1744483	35.21%	27.44%
		26.41%	20.58%
SRs 470 (E5M)	194386	9.29%	7.24%
		6.97%	5.43%



Chart 2. Real ratio between production and effective capacity 2019 - 2021

#### DISCUSSION

After evaluating the productivity of these excavators in the overburden of the South-West Sibovc field for the years 2019, 2020 and 2021, it appears that the performance in relation to the load coefficient is not satisfactory, therefore in table 3, 4 and 5 a comparison is made for the normal utilization of load coefficient and its maximum utilization. Working hours in years ranging from 4266 h/y - 5474 h/y were also taken into account.

## CONCLUSIONS

According to the data presented in the tables of this paper, it appears that the excavators are not used in their nominal capacity, even their use for the years is very small. Based on tables 3,4 and 5, the excavators for the year 2019 compare with the minimum working hours SchRs650 were used (41.42% - 65.3%), SRs1300 were used (12.28 - 16.37%), SRs470 (13.91% - 18.55%), while if we compare it with the maximum utilization of load time and the maximum possible working hours, then the excavators were used: SchRs650 (32.28% - 50.89%), SRs1300 (9.57% - 12.76%) and SRs470 from (10.84% - 14.46%).

Excavators for the year 2020 compare with the minimum working hours SchRs650 were used (40.97% - 61.5%), SRs1300 were used (35.88% - 47.84%), SRs470 (12.37% - 16.49%), while if we compare it with the maximum utilization of load time and the maximum possible working hours, then the excavators were used: SchRs650 (31.93% - 47.93%), SRs1300 (27.96% - 44.81%) and SRs470 from (9.64% - 12.85%).

Excavators for the year 2021 compare with the minimum working hours SchRs650 were used (35.53% - 52.29%), SRs1300 were used (22.46% - 47.37%), SRs470 (6.97% - 9.29%), while if we compare it with the maximum utilization of load time and the maximum possible working hours, then the excavators were used: SchRs650 (27.69% - 40.75%), SRs1300 (17.5% - 36.91%) and SRs470 from (5.43% - 7.24%). Based in productivity of this excavators the load coefficient for this three year is between 18% - 38%.

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