

Branka Jovanović, Dragan Milošević*, Vladan Čanović*, Klara Konc Janković**

MANAGEMENT OF THE LIMESTONE MINING AND DEPOSITION PROCESS AT THE OPEN PIT "MUTALJ" FOR THE PURPOSE OF ACHIEVING THE NECESSARY QUALITY

Abstract

The open pit Mutalj is a part of the Lafarge Cement Factory of Beočin and its purpose is to supply the factory with limestone as one of the ore required for cement production. The required quality of the mined limestone is determined by the technological process of creating cement and, before all, the quality of marl as the essential ore. The Mutalj Basin is characterized by the fluctuating quality of limestone. The subject of this work is the methods applied in the mining and deposition in order to secure the required quality of limestone.

Keywords: mining, depositing, limestone quality, open pit, Mutalj

1 INTRODUCTION

The production of cement on Fruška gora had began in the beginning of the XIX century which was made possible due to the existence of primitive mineral ore, at first in a primitive manner and later in the Beočin Cement Factory (BCF), the oldest cement factory on the Balkans. Since the start of production up to today the factory has developed and improved the mineral ore exploitation and cement production processes.

Since 2002, the majority owner of the Beočin factory is the Lafarge company and LBFC had become a part of the Lafarge group with its headquarters in Paris. The Lafarge group is the world leader in the construction industry and employs 83,000 people in 75 countries.

The Beočin Cement Factory had a leading position in the local market even before, and with the Lafarge company behind it, the factory is positioned at the very top of the cement industry in Eastern Europe. Through modernization of production and solving the ecological problems, there is a possibility of taking the advantage of good

experiences of the Lafarge group from all around the world and the world business standards.

The planned capacities and the business radius of the LBFC are based on the local market.

The basic mineral ore for cement production are marl and limestone.

LBFC has, besides the factory in Beočin, two active open pits for ore mining required to produce cement:

1. Limestone open pit Mutalj, 19 km away, and
2. Marl open pit Filijala, 3 km away from the factory.

Limestone and marl are mined at the open pits of LBFC, are then transported to the Beočin factory where they are crushed, dried, ground up and homogenized. After that, the ore is heated and introduced into a furnace from which it exits as cement clinker, which is then cooled down and ground up with gypsum, ash and other additives being added after which the final product -

* Mining Institute, Belgrade, povrsinska@ribeograd.ac.rs

the cement, is packaged and transported to the consumer.

The proportions of marl and limestone in the base mixture is defined by a technological production procedure, depending on the quality of the starting components, primarily the content of CaCO_3 . According to the technological recipe at the start of production in the factory, the proportion was 3:1. Currently the proportion of marl and limestone is 60:40, with the limestone share tending to increase.

2 CHARACTERISTICS OF THE MUTALJ BASIN

The limestone basin of Mutalj is located on the south slopes of Fruška gora, between Sremska Mitrovica and Beočin.

The limestone basin Mutalj is explored on the surface of about 100 ha on in which thd limestone balance reserves were found in 43 ha.

The basin belongs to a group of sediment layered basins, with a roof and shelf configuration that is nearly the same as the terrain configuration. The altitude differences in the terrain of the contoured area of the basin, from NE to SW, are 60 m.

The useful minerals in the basin are carbonate sediments - real reef "Lajtovacki"

limestone made out of gray sandy and sandy-marl limestone and reef white, yellow to red limestone.

The thickness of the "Lajtovacki" limestone in the ore mass of the basin varies, from 6 m in the northeast, to 136 m in the south and southwestern area, 53.5 m on average. In general, the ore mass goes along the lines of west-east to northwest-southeast with a slight drop towards south to southwest. Thickness of the overlying waste sediments is 23.54 m on average, maximum 65 m in the east part of the basin.

The floor of the "Lajtovacki" limestone at the location of the Mutalj Basin is comprised of lake sediments, the so-called Vrdnik series, presented as colorful clastic clays with lenses of gravel-clay sandstones and layers of gray-green bentonite clays.

The overburden of the "Lajtovacki" limestone is made of quaternary deposits: the so-called Sremska series (of rusty red clay and sandy-gravel clay), loess formation and deluvial and colluvial alluvion of redeposited limestone Sremska series and loess.

According to the Mutalj Basin interpretation in the current study [3], two tectonic rift systems were established in the direction NW-SE and SW-NE, which separate parts of the basin in cascades (picture 1).

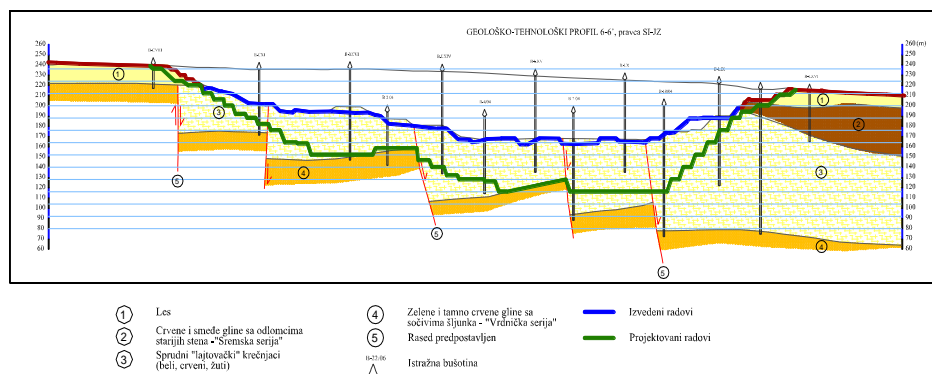


Figure 1 Geological - technological profile 6-6' in the NE-SW direction

Determination the limestone reserve boundaries [3] was done according to the content criterion of $\text{CaCO}_3 \geq 90\%$. Conducted geological explorations of the Mutalj

basin have shown that the average content of CaCO_3 in the limestone reserves within the established contours is 93.91% and that within the same contour there are content

changes of CaCO_3 to below 90 %. Figure 2 illustrates the map of the floor E-176 (h-12 m,

altitudes from 176 - 188 m) with shaded surfaces with content of CaCO_3 below 90 %.

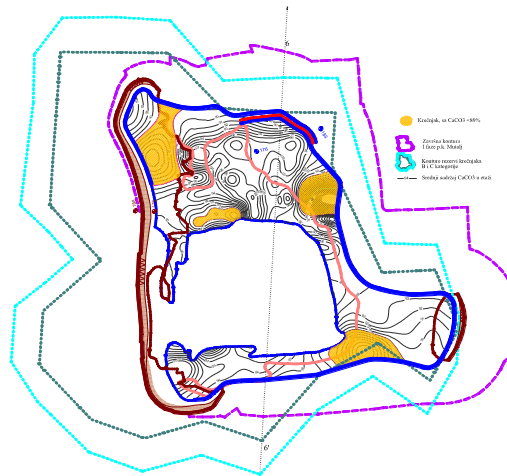


Figure 2 Map of the floor E-176 (in the contour of stage I of OP Mutalj) with content of CaCO_3 isolines

3 EXCAVATION PROCESS MANAGEMENT WITH THE OBJECTIVE TO EVEN OUT THE LIMESTONE QUALITY

In the contour of the I stage of OP Mutalj, the limestone quantities with the quality below border values are about 7%. In order to fully utilize the basin and to meet the technological process requirements in the cement factory of Beočin, exploitation at the open pit of Mutalj, selection and mixing of the lower quality limestone and higher quality limestone was carried out.

The basic equipment of limestone excavation at the OP Mutalj is a hydraulic dredge Liebherr 984C with a spoon $E=4.7 \text{ m}^3$ and hourly capacity of $Q_h=420 \text{ t/h}$.

The daily capacity of the Liebherr R 984 C dredge, with two-shift operation and 6-hour shift is $Q_d=5,040 \text{ t/day}$ and satisfies the daily factory requirements for limestone, $Q=5,000 \text{ t/day}$. Due to the changing quality of limestone in the basin, another hydraulic dredge is put into operation, Hyundai 450 LC with a "ripper" spoon $E=2.2 \text{ m}^3$, and hourly capacity of $Q_h=196 \text{ t/h}$ and daily capacity of $Q_d=2,350 \text{ t/day}$.

In order to equalize the quality of the limestone and to fully exploit the basin, the production was conceived so that the limestone is excavated with two hydraulic dredges (Liebherr and Hyundai) at two different locations. The excavated limestone is loaded in two separate locations onto trucks and transported to the reloading plateau at the east side of the pit, where the limestone is loaded into tractor trucks with permitted carrying mass of $M_{doz}=40 \text{ t}$ for transport via public roads.

At the reloading plateau the limestone of lesser quality is temporarily set aside, so that it could later be mixed with a higher quality limestone, loaded onto trucks and transported to the reception bunker of the primary crusher in the cement factory of Beočin.

In accordance with the adopted concept of limestone excavation in the Technical Exploitation Project [1], the designed production dynamics of limestone production at the OP Mutalj was carried out in such a way that the annual limestone production is con-

ducted by excavation in two different locations. As an illustration, Figure 3 presents the plan of excavation and overburden in the

IV year of exploitation with the shaded locations of limestone excavation and location of reloading plateau (2).



Figure 3 Plan of excavation in the IV year of the OP Mutalj - I stage

4 CONCLUSION

Limestone of the Mutalj basin with the average content of CaCO_3 of 93.91 % is considered as the quality cement mineral ore which does not require special processing measures. A smaller part of limestone in the basin (around 7%) is of lesser quality and as such is unacceptable as the ore in the cement factory. At the open pit Mutalj, the methods of equalization the limestone quality are applied during exploitation: through excavation of limestone with two dredges, at two locations and mixing of the lower quality limestone with the high quality limestone at the reloading plateau. The application effects of described methods for limestone exploitation management are the continuous shipping of quality limestone to the factory reception bunkers and also greater basin utilization.

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