

DEVELOPMENT OF RAW MATERIALS' EXPLOITATION FOR THE CEMENT PRODUCTION IN THE OPEN PITS »PARTIZAN« AND »PRVOBORAC« OF THE »DALMACIJA CEMENT« COMPANY

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Ključne riječi: Cement, Sirovine za proizvodnju cementa, Geološka istraživanja, Geomehanička ispitivanja, Površinska eksploatacija, Sanacija

The article presents the exploitation of mineral raw materials for the cement industry of Split from the beginning of this century till today. Geological and geomechanical characteristic of the open pits »Partizan« and »Prvoborac«, located within the same deposit and the technological exploitation process with basic parameters of successibility in both pits are detaily discussed. The works of open pits' reclamation which has to be carried out simultaneously with the exploitation itself are also considered, as well as the perspectives of further exploitation development, in accord with modern tendencies to the mining technology development.

U članku je iznesen prikaz eksploatacije mineralnih sirovina za cementnu industriju Splita, od početka ovog stoljeća do danas. Dataljnije su obrađene geološke i geomehaničke karakteristike kopova »Partizan« i »Prvoborac« koji se nalaze unutar istog ležišta, te tehnološki proces eksploatacije s osnovnim pokazateljima uspješnosti na oba kopa. Također, prikazani su radovi na sanaciji kopova, koju je potrebno provoditi paralelno sa samom eksploatacijom. Konačno, prikazane su perspektive daljnjeg razvoja eksploatacije u skladu sa suvremenim tendencijama razvoja rudarske tehnologije.

Introduction

According to their production volume, the open pits »Partizan« and »Prvoborac« belong to the biggest producers of mineral raw materials for the cement production in this country. The whole raw material production provides the cement factories having the same name as the pits, which deal within the »Dalmacija cement« company in Solin and are located on the Kaštela Gulf coast in the vicinity of the pits.

The both open pits are located within the boundaries of common exploitation mine field on a single bed of the mineral raw material spreading from the Kozjak mountain in the north to the Kaštela Gulf in the south, and from the Klis in the east to the Kaštel Štafilčić in the west. The open pit »Partizan« covers the western part of exploitation field, while the »Prvoborac« has developed in the eastern part, so that the distance between them amounts cca 800 m according to the present situation.

Marl exploitation for the Portland cement production on the locality of the existing open pit »Prvoborac« started still at the beginning of this century. The exploitation was first performed in the first marl bed and, later in the second one, too. In 1928 the first skip hoisting was introduced at the elev. +76 and 1930 the glory-hole method was introduced in exploitation of the first marl layer. In this period still two skips were built: on the elev. +40 in the western part and on the elev. +46 in the eastern part of the excavation field. Glory-hole maintained till the mid-sixties and was performed on two horizons, developed first on the elev. +40 and later on the elev. +24. The elev. +24 represents

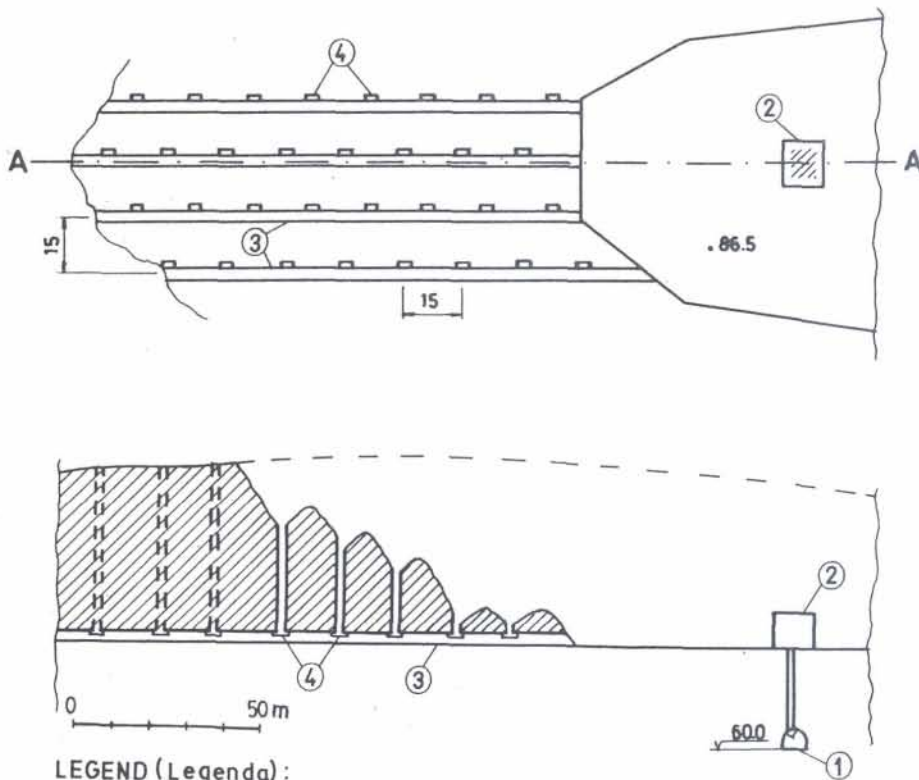
the final depth reached by glory-hole exploitation. The applied glory-hole method is presented by Figure 1.

After glory-hole exploitation on the first marl layer, 1964 in the exploitation of the second marl layer, the open pit excavation with multiple-raw blasting of raw material mechanized loading and transport was introduced. This phase of the open pit exploitation to 1989 was characterized by the increased exploitation of marl as the highest-quality mineral raw material in the deposit, begin found in two layers: the first, southern one with the thickness of 60 m and the second, northern one with the thickness of 55 m, the distance between them being 150–250 m.

Further forcing of mere marl layer exploitation would be reflected on the future open pit development in a damaging way and it would unavoidably lead to a successive liquidation due to inability of keeping the pit geometry stable and of developing the pit in depth.

By reconstruction of the cement factory »Prvoborac«, beside marl exploitation, also the possibility for other kinds of mineral raw materials existing in the deposit has been created recently, with an additional homogeneity in order to attain a uniform content CaCO_3 of cca 76%. On this basis a new conception of the open pit »Prvoborac« development was established (discussed in the Main Mining Project at the beginning of 1989) enabling further exploitation through a longer period of time.

By the open pit »Partizan«, whose exploitation started later and developed by a system similar to the open pit »Prvoborac«, a new exploitation con-



LEGEND (Legenda):

- ① haulage tunnel (transportni tunel)
- ② crushing plant (drobilično postrojenje)
- ③ drift (hodnik razrade ležišta)
- ④ ore chutes (rudne šipke)

Fig. 1. Glory-hole method

Sl. 1. Metoda lijevaka

ception of all kinds of mineral raw materials in the deposit was accepted 1979, after the new rotary furnace »Polysius« was put into operation in the cement factory, and this was also presented in the Main Mining Project of Exploitation.

The identical assumptions for further development were accepted for both open pits, because they are on the same deposit and have very similar characteristics of raw material sediments. Yet, there are certain differences due to different situations of earlier performed exploitation works, which were considered as a basis for the new conception of development.

The creation of the new conception of development for the open pits »Partizan« and »Prvoborac« followed a detailed study of natural characteristics of the deposit, geomechanical exploitation conditions, technological conditions of mechanization application and other technological parameters which make the basis for the choice of the most favourable solutions and presuppositions to attain optimal technical and economic exploitation effects.

The dynamics of exploitation development, production capacity and mineral raw material quality are entirely compatible with the requirements of the cement factories, which during last 10 years have increased the volume of cement production by reconstruction of the existing and construction of new rotary furnices.

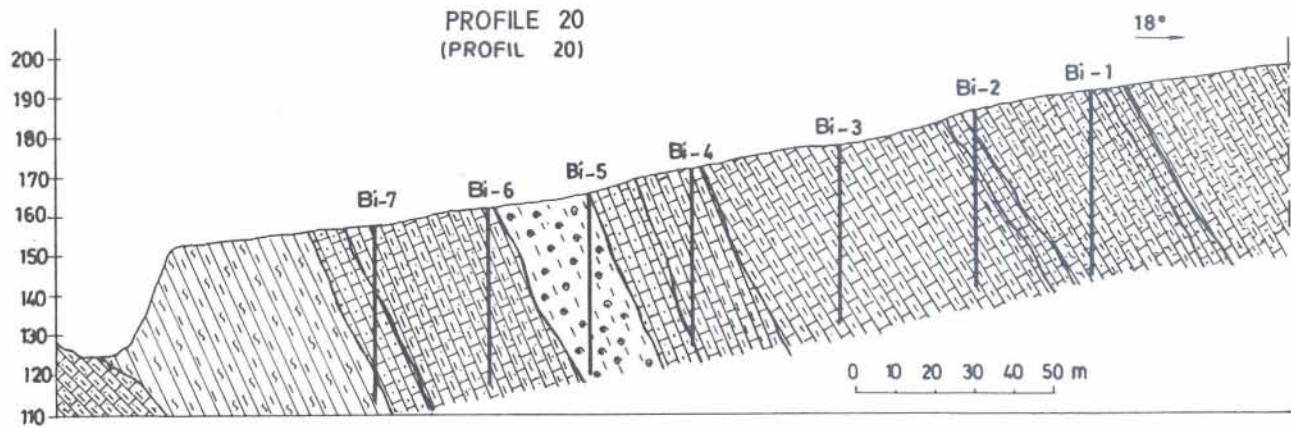
Geological characteristics of the deposit

The wider area of the deposit consists of eocene flysch sediments characterized by the rhythmicity of sedimentation

General strike of these sediments is almost compatible with the direction east-west, from east-southeast to westnorthwest but there are slight deviations present. Beds are under the angle of 30–35° in the direction northnortheast towards the Kozjak reef.

Geological cross-sections express clearly an obvious multiple exchange of existing petrographic members. Within this exchange two wider zones of limestone marl (»tupina«) are especially expressive, making a particularly favourable raw material for cement production and in their environment the open pits were most intensively developed. The thickness of these zones varies considerably, as a rule it is greater in the area with smaller slope. Figure 2 illustrates the geological profile 20 of the open pit »Partizan«.

The entire deposit within boundaries of exploitation field was tested by exploratory drilling. On the location »Partizan«, 129 boreholes were drilled in total length of 5815 m, and 122 boreholes in total length of 5866 m on the location »Prvoborac«. The content CaCO_3 was proved on the samples from each metre of the borehole. The recapitulation of



LEGEND (Legenda):




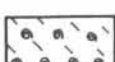

-  Mixture of marl, sandstone and limestone
(Izmjena lapora, pješčenjaka i vapnenca)
-  Marl and clay-marl
(Lapor i glinoviti lapor)
-  Calcarenite, calcisiltite
(Kalkarenit, kalcisiltit)
-  Numulitic marl
(Numulitski lapor)
-  Limestone marl, marly limestone
(Vapnenacki lapor, laporoviti vapnenac)

Fig. 2. Geological profile through the deposit of open pit »Partizan« (After B. Lukšić 1974)
Sl. 2. Geološki profil kroz ležište na površinskom kopu »Partizan« (B. Lukšić, 1974)

quantities and qualities of mineral raw materials (average content CaCO_3) proved on December 31, 1984 within the boundaries of common exploitation field is illustrated in Table 1.

Table 1 (Tablica 1.)

Type of mineral raw material (Vrsta mineralne sirovine)	OPEN PIT »PARTIZAN« površinski kop »PARTIZAN«		OPEN PIT »PRVOBORAC« površinski kop »PRVOBORAC«	
	Reserves A+B+C ₁ cat. Eksp. rezerve A+B+C ₁ kat. (t)	Average content CaCO_3 Prosječni sa- držaj CaCO_3 (%)	Reserves A+B+C ₁ cat. Eksp. rezerve A+B+C ₁ kat. (t)	Average content CaCO_3 Prosječni sa- držaj CaCO_3 (%)
Limestone (Vapnenac)	21 587 000	90.48	26 401 000	88.04
Marl (lapor)	15 042 000	76.48	19 157 000	75.50
Clay-marly raw material (glinovito-laporovita sirovina)	65 416 000	71.39	31 866 000	73.17
Limestone-marly raw material (vapnenacko-laporovita sirovina)	13 622 000	78.13	34 311 000	79.44
TOTAL (UKUPNO)	115 667 000	76.41	111 735 000	79.01

Open pits' contours comprise the reserves according to the presentation in Table 2.

Since a larger share of so called »high cement raw material« is present in the area confined by open pits, there is a possibility of extending the

Table 2. (Tabela 2.)

OPEN PIT (Površinski kop)	Reserves within open pit planned contours (rezerve unutar projektiranih kontura pov. kopa) (t)	Average CaCO_3 content (prosječni sadržaj CaCO_3) (%)	Production capacity (t/year) (projektirana proizvodnja, t/god.)	Life-duration of open pit (year) (životna dob površinskog kopa, god.)
PARTIZAN	52 655 000	75.90	2 050 000	25.7
PRVOBORAC	38 060 000	75.99	1 100 000	34.6

duration—life of the pits to over 100 years, if northern boundaries of the exploitation field and open pits containing »low cement raw material« as a larger share would be expanded for cca 120 m.

Geomechanical characteristics of the deposit

In order to provide the stability of working and final inclines at both open pits, intensive testings of geomechanical properties of mineral raw material sediments have been performed in the area of exploitation. As the obtained results are very similar, just the investigations at the open pit »Prvoborac« are presented here, where the following activities were carried out:

1. detailed recording of discontinuity, i.e. occurrences in layers and systems of fractures and the performance of contour diagrams,

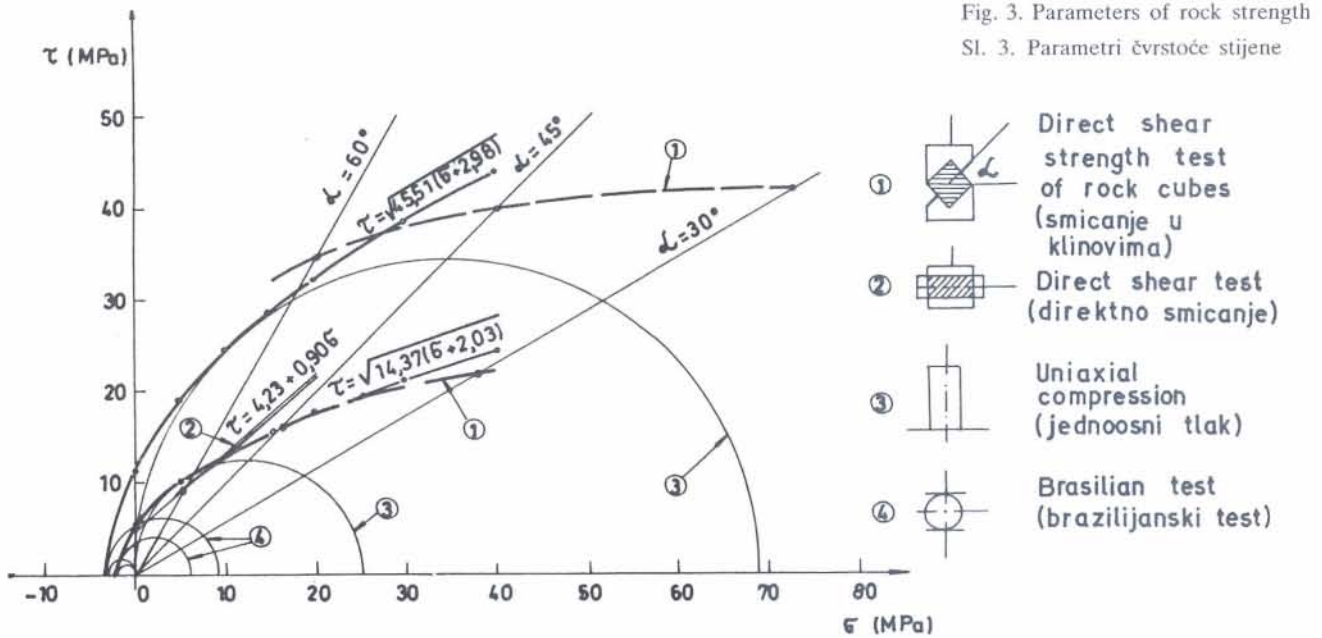


Fig. 3. Parameters of rock strength
Sl. 3. Parametri čvrstoće stijene

2. sampling of representative rock blocks and separation of samples by mechanical treatment,
3. laboratory testings of samples and defining of basic physical-mechanical rock properties,
4. stability analysis of working and final level inclines.

Laboratory testing implied the definition of density, uniaxial compressive strength, tensile strength by the Brazilian test, then direct shear test of undisturbed samples, direct shear strength test of rock cubes and shear along the discontinuity plane for naturally rough, polished and moistened fracture plane. Testing results have been statistically treated to obtain competent parameters for physical-mechanical rock properties presented in Table 3.

Table 3. (Tablica 3.)

Rock characteristic (svojsvo stijene)	Symbol (simbol)	Unit (jedinica)	A-group of greater strength (A-grupa veće čvrstoće)	B-group of less strength (B-grupa manje čvrstoće)
1. Bulk density (zapreminska masa)	ρ_{sr}	kg/m ³	2578	2578
2. Uniaxial compressive strength (jednoosijalna tlačna čvrstoća)	σ_{tst}	MPa	68.86	25.16
3. Tensile strength (vlačna čvrstoća)	σ_{vst}	MPa	2.98	2.03
4. Normal shear strength component under angle (normalna komponenta čvrstoće na smicanje pod kutom):				
a) = 30°	σ_{n30}	MPa	72.38	37.56
b) = 45°	σ_{n45}	MPa	40.29	16.55
c) = 60°	σ_{n60}	MPa	19.94	5.26
5. Cohesion (Kohezija)	c	MPa	0.286	0.286
6. Angle of internal friction (kut unutrašnjeg trenja)	φ	°	40.8	40.8

Compressive, tensile and shear strengths are by the use of Sobotka's equation included into an even envelope curve of limiting stress circles for the A group of greater strength and the B group of less strength, (figure 3).

The stability of working and final level inclines was analysed according to the criterion of discontinuity and the criterion of potential sliding plane through the rock mass, and the elements of working and final inclines were established as presented on Figures 4 and 5.

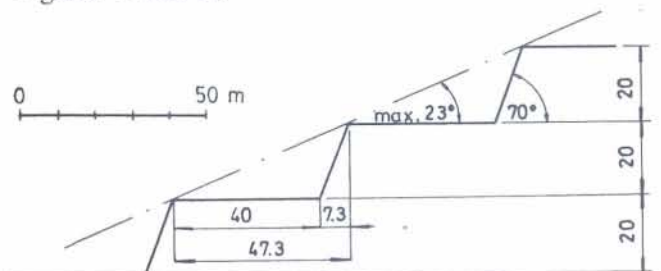


Fig. 4. Working slope of the open pits «Partizan» and «Prvoborac»

Sl. 4. Radna kosina na površinskim kopovima »Partizan« i »Prvoborac«

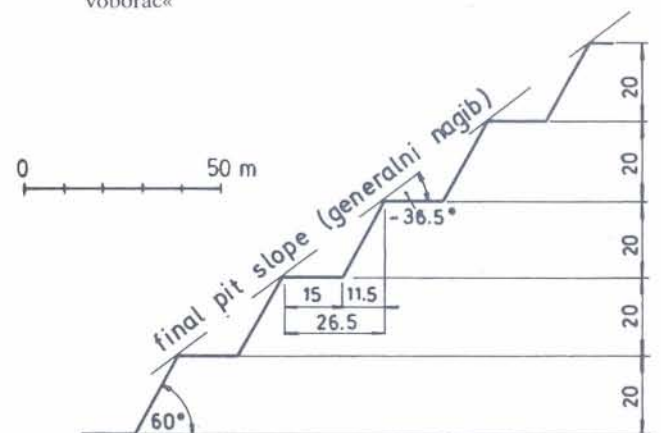


Fig. 5. Final slope of the open pits »Partizan« and »Prvoborac«

Sl. 5. Završna kosina na površinskim kopovima »Partizan« i »Prvoborac«

Conception of the open pits' development

Foundation for the conception of the exploitation of the open pits »Partizan« and »Prvoborac« is discussed in the main projects and is based on the extension of exploitation activities from the narrow working area »tupina« in the central part of deposit to the northern area with the so called »low cement raw material« and to the southern area with the »high cement rock material« spreading to the boundaries of approved exploitation field. Such a conception of common production of several components according to established ratios, beside additional homogeneity in the structures of cement factories, enables to attain constant quality of mineral raw material with the content of about 76% CaCO_3 which is the basic requirement for the technological process of cement production.

Such a conception is maximally adapted to the existing activities at the open pits, so that further works of opening new levels as well as of development and exploitation make as a whole a continuous transition to the new-planned solutions.

Production capacity is defined according to the needs of cement factories, thus the established exploitation conception enables quick restructuring to larger production if necessary.

Technological solutions for further development of formerly formed levels and for the opening of new ones are based on the same principles for both open pits. Essential structures are the main traffic arteries located approximately in the middle of the deposit southwards from the crushing plant and to the most distant working level in the north. They are built according to the standards for the two-way traffic and adapted to the situation of the ground with maximal slope of 8% (rise in the direction of empty vehicles' movement). Maximal length of the main traffic arteries at the open pit »Partizan« amounts cca 1700 m, and at the open pit »Prvoborac« cca 2300. All levels at the pits were opened by immediate cutting from the main traffic arteries, whereby the flexible production is attained enabling simultaneous works on several working levels in all types of mineral raw material and the accomplishment of homogeneity already in the technological production process itself. Besides, by such solutions an independent development of each level is enabled within the determined dynamics of the pits' development, the shortest distance of mineral raw material transportation and reliable and economical operation of the complete technological process. The illustration of the opening and the level development is presented in Figures 6 and 7.

Both open pits are of height type, the fundament level of the open pit »Partizan« being located at the elev. +80 and of the open pit »Prvoborac« at the elev. +90. According to height, the division was made into levels at the elev. +80, +100, +120, +140, +160, +180 and +200 at the open pit »Partizan«, and at the open pit »Prvoborac« at the elev. +90, +110, +130, +150, +190 and +210. Differences in the formation of levels are the consequence of the former particular approach to the development of these pits as independent productive mining

structures, so that their identity could not be established in the new conception either. However, in the plan for the open pit »Prvoborac«, which followed that for the open pit »Partizan« after eleven years, the connection of these two open pits in the field of geological cross-section No.2 was planned (Figure 8). By the solution of linking, the lowering of the open pit »Prvoborac« in the cross-section No. 2. for 10 m is assumed, so it will be mined along the length of 125 m of this part of the pit along the slope of 8%. To the advantage of such solutions there is also the fact, that the area supposed for the linking has not been under exploitation so far.

Technological process of the exploitation

The exploitation technology was chosen on the basis of consideration and analysis of the most relevant factors influencing the guiding of technological process e.g.: natural characteristics of the deposit, the aimed production capacity and the mineral raw material quality, characteristics of the existing and chosen mechanization, experiences from the exploitation of mineral raw materials at these and other open pits of the »Dalmacija cement« company up to now. According to such consideration the discontinuous system of mining, loading and transportation of mineral raw material was accepted as the most favourable for existing exploitation conditions.

The principle parameters for the open pit such as: bench height and bench width, working slopes and final slopes are defined on the basis of the carried out geomechanical estimations of stability and practical experiences which guarantees for the performance of exploitation in stable conditions of working environment.

The mineral raw material deposit is covered with a thin layer of waste (in average cca 0.5 m) and in the exploitation technology there are practically no bigger problems with overburden. Overburden is removed by bulldozer piling to the working level wherefrom it is loaded and delivered to overburden bench located in the southern part of the open pit.

In the technological process of exploitation there were some problems and restrictions that found adequate solutions in the planning documentations, the most relevant among them being the following:

- determination of precise production dynamics according to particular types of mineral raw material and to individual levels, in order to attain constant quality of the mixed mineral raw material with the content of cca 76% CaCO_3 ,
- solution for mass blasting technology by restriction of explosive consumption for one degree of firing and totally on the blasting field for the parts of open pits in direct vicinity of a settlement,
- exploitation performance with as slight devastation of the area and environment pollution as possible, and the establishment of sanitation measures continuously during exploitation, which is especially important considering the location of open pits in the tourist area.

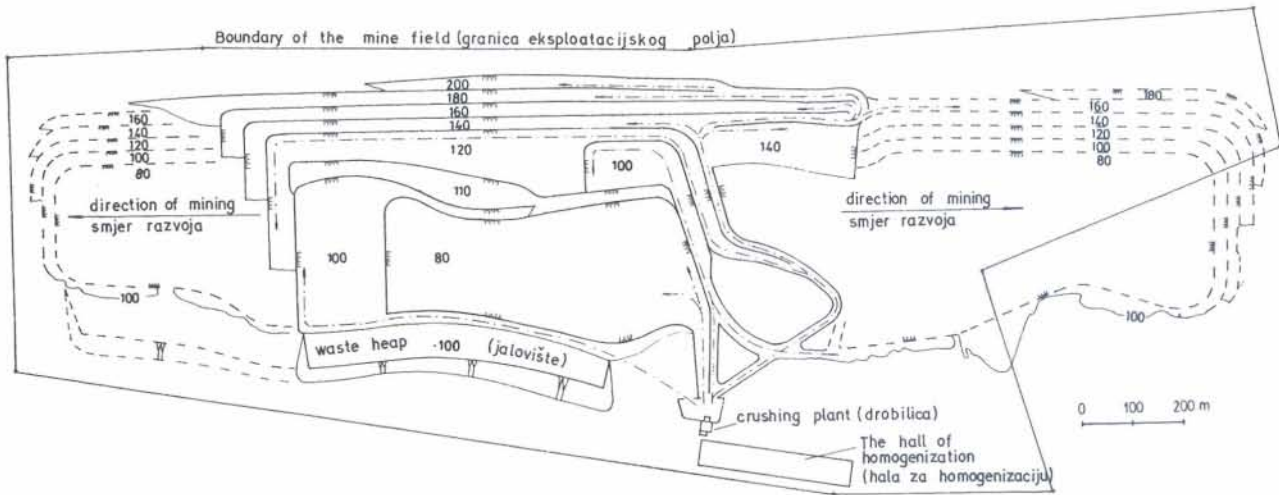


Fig. 6. Development of the open pit »Partizan« (4th phase)
 Sl. 6. Razvoj površinskog kopa »Partizan« (4. faza)

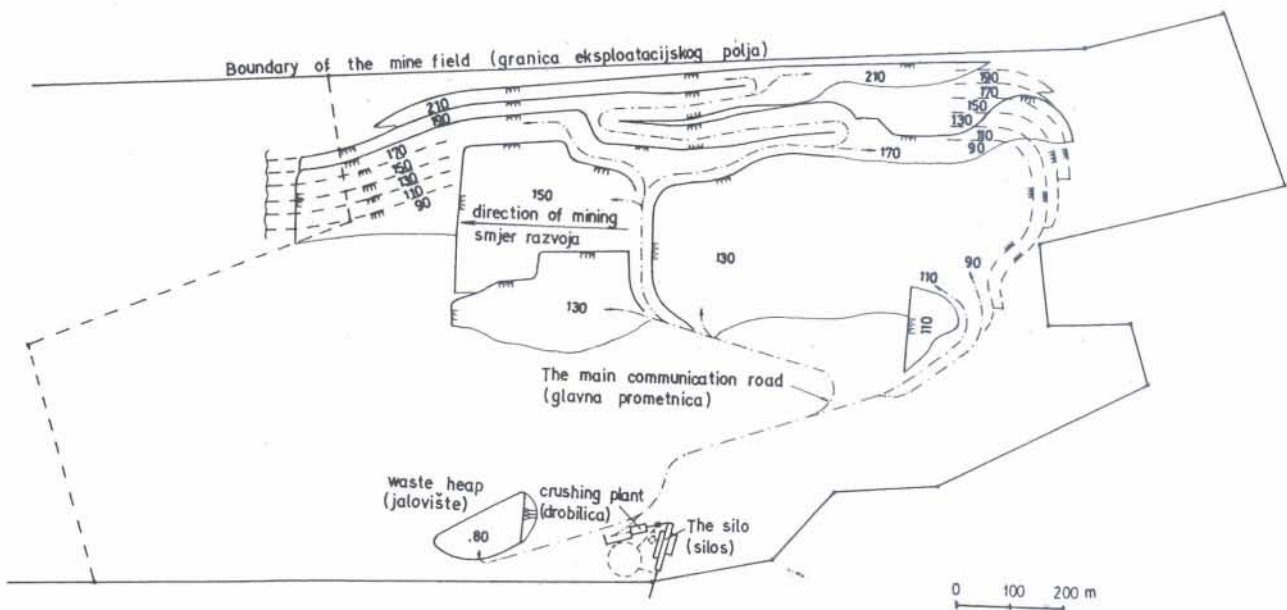


Fig. 7. Development of the open pit »Prvoborac« (2nd phase)
 Sl. 7. Razvoj površinskog kopa »Prvoborac« (2. faza)

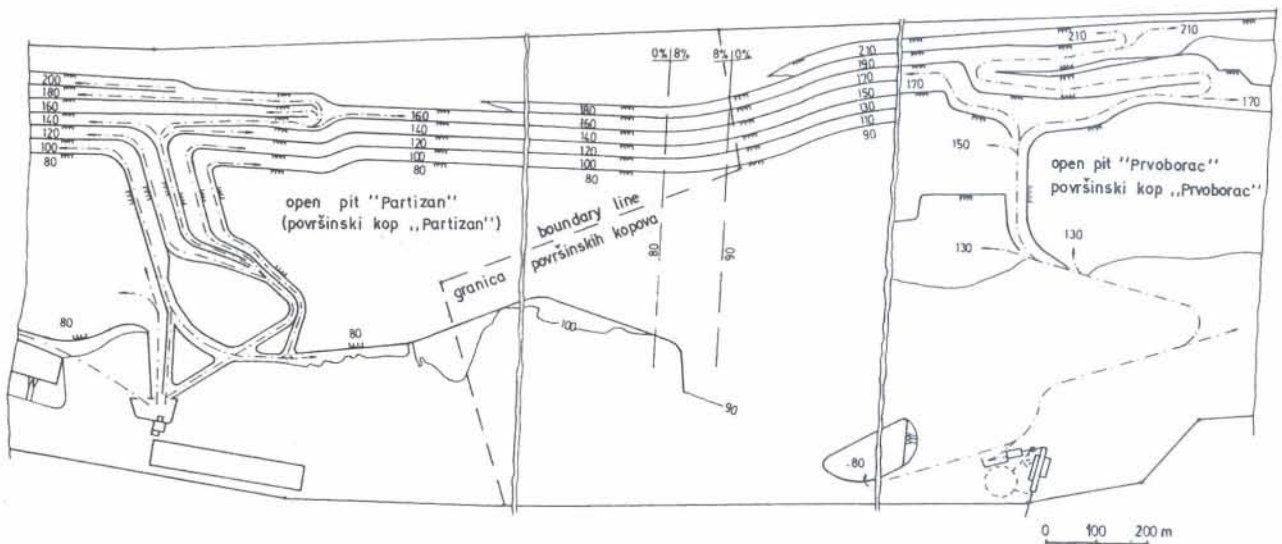


Fig. 8. Situation of linking the open pits »Partizan« and »Prvoborac«
 Sl. 8. Situacija spajanja površinskih kopova »Partizan« i »Prvoborac«

Table 4. (Tablica 4.)

PARAMETERS OF EXPLOITATION (Parametri eksploatacije)	Unit of measure (jedinica mjere)	Open pit »PARTIZAN« realized in 1988. (površinski kop »PARTIZAN« ostvareno u 1988.)	Open pit »PRVOBORAC« (površinski kop »PRVOBORAC«) realized in 1988 (ostvareno u 1988.)	planned in 1988 (planirano u 1989. g.)
1	2	3	4	5
1. production capacity of mineral raw material (proizvodnja mineralne sirovine)	t/year t/god.	1 190 000	788 609	1 100 000
2. production capacity of overburden (proizvodnja otkrivke)	m ³ /year m ³ /god.			19 395
3. drilling volume for multiple raw-blasting (obim bušenja za masovno miniranje)	m ³ /year m ³ /god.	37 554	26 287	26 861
4. drilling volume for multiple raw-blasting (obim bušenja za masovno miniranje)	m ³ /m ³ m ³ /m ³	0.0789	0.0856	0.0628
5. volume of loading machines (volumen utovarnih sredstava)	m ³	12	6.4	9.6
6. production capacity per m ³ of loading machine (proizvodnja po m ³ utovarnog sredstva)	m ³ /m ³ /year m ³ /m ³ /god.	39 667	47 945	44 585
7. volume of transportation machines (volumen transportnih sredstava)	m ³	80	34.8	69.6
8. production capacity per m ³ of transportation machine (proizvodnja po m ³ transportnog sredstva)	m ³ /m ³ /year m ³ /m ³ /god.	5 950	8 817	6 150
9. number of employers (broj zaposlenih)		96	70	45
10. production effects (proizvodni učinci)	m ³ /emp/ year m ³ /radn./god.	4 958	4 383	9 511
11. oil consumption (potrošnja nafte)	l/m ³	1.24	1.04	1.20
12. consumption of oil and lubricant (potrošnja ulja i maziva)	kg/m ³	0.084	0.062	0.0041
13. consumption of explosives (potrošnja eksploziva)	kg/m ³	0.044	0.41	0.051

Basic indications of the successful exploitation at the open pit »Partizan«, where the exploitation according to the above discussed conception has been carried out for ten years already, and the comparative data realized in 1988 and planned 1989 for the open pit »Prvoborac«, where the introduction of this conception is in progress, are expressed in Table 4.

Reclamation of the open pits

The exploitation in the open pits »Partizan« and »Prvoborac« up to now has considerably altered the landscape round the town of Split. This fact is an important problem having in mind, that Split is one of major transition centres of tourism on the Adriatic coast.

Destruction of the vegetation and degradation of the Solin coast brings about the need for systematic carrying out of the reclamation activities, which would continuously remove i.e. alleviate the disturbances due to exploitation.

Carrying out reclamation works is based on the solutions in the »Project of Reclamation of the Open Pits in the Factory Dalmacija Cement« completed 1979 by the Institute for Adriatic Culture and Karst Reclamation, Split – The University of Split, composed of:

- biologic–technical reclamation works, i.e. planting of trees, bushes and climbers on the terraces and plateaus of the open pit and
- technical–camouflage works i.e. installation of wire nets covered with climber plants on the cuts and cliffs.

These solutions are already in application at the open pit »Partizan« simultaneously with the deposit exploitation (Figure 9) and the same is also supposed for the open pit »Prvoborac«, after the solutions from the new »Main Mining Project« start to be applied.

Perspectives of further exploitation development

By the realized connection of the open pits »Partizan« and »Prvoborac«, new perspectives for further progress of the entire technical process of mineral raw material exploitation will be created. Such perspectives are based on the real possibilities of performing certain technological actions which will increase the complete production to a higher technical level and make it considerably more efficient and profitable.

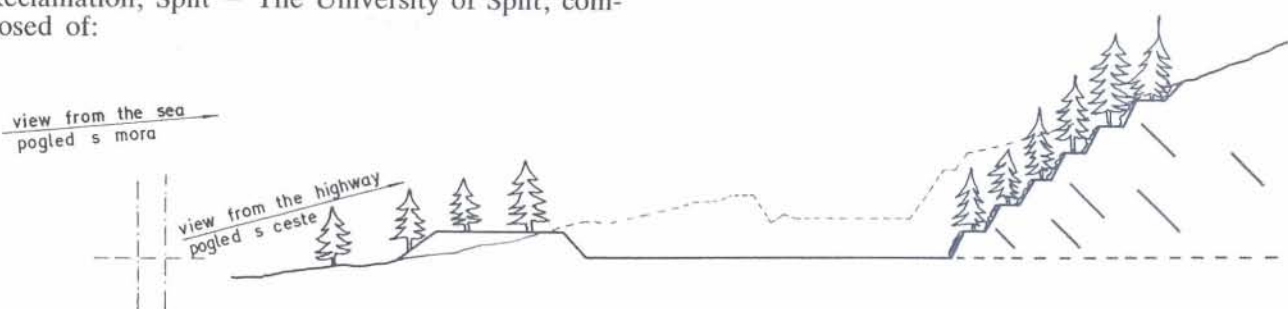


Fig. 9. Reclamation of the open pit »Partizan«
Sl. 9. Sanacija na površinskom kopu »Partizan«

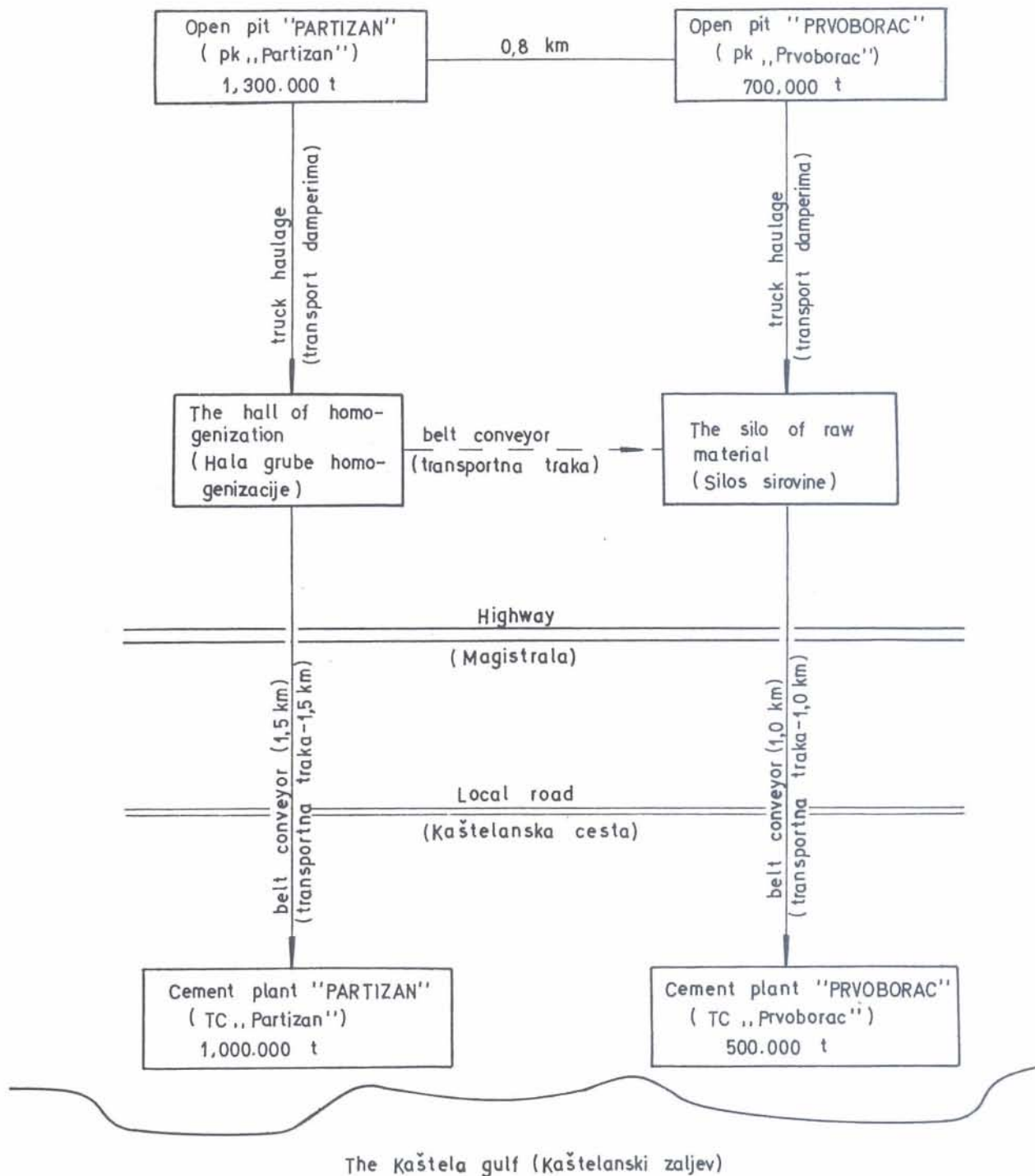


Fig. 10. Illustration of production and transportation of raw material
Sl. 10. Shematski prikaz proizvodnje i transporta mineralne sirovine

The technological actions have essentially technical and organizational character and are based on the following assumptions:

- organization of mineral raw material production as a united whole, which would attain a more complete and rational use of mechanization, decrease of the number of employers, increase of labour productivity, more efficient work organization and more profitable production. Logical development of a united open pit from the west towards the east forming the final pit contours

would offer the possibility of successive performance of final reclamation works immediately after the advance of exploitation works, which would considerably improve the ecological conditions,

- concentration of works in the narrow production area and introduction of mechanization of larger capacity would considerably improve basic technological and economic parameters of exploitation.
- by organizational solutions of transportation it is supposed that for the existing production level

only one common hall could be used with the plant for rough homogeneity, which would avoid the expensive investment to build one new hall more (Figure 10).

Modern tendencies for the growing efficiency of mining technology, which is oriented to mass production and a more complete mechanization and automatization of the technological process require such an approach whose application of the discussed technological solutions would provide real hope for the realization of these objectives.

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Razvoj eksploatacije mineralnih sirovina za proizvodnju cementa na površinskim kopovima »Partizan« i »Prvoborac«, »Dalmacija cement« – Solin

S. Vujec, B. Perić i B. Kovačević

U članku je prikazana eksploatacija mineralnih sirovina za cementnu industriju Splita na površinskim kopovima »Partizan« i »Prvoborac«. Početkom ovog stoljeća lapor je, kao najkvalitetnija sirovina za proizvodnju cementa eksploatiran primjenom metode lijevaka (glory hole method), koja je prikazana na slici 1. Sredinom šezdesetih godina prešlo se je na eksploataciju lapora površinskim kopom uz dobivanje mineralne sirovine masovnim miniranjem, te mehaniziranim utovarom i transportom.

Rekonstrukcijom tvornica cementa »Partizan« i »Prvoborac«, stvorena je mogućnost eksploatacije i drugih vrsta mineralne sirovine, prisutnih u ležištu koje se dodatno homogeniziraju s ciljem postizanja ujednačenog sadržaja CaCO_3 od cca 76%, što je osnovni zahtjev tehnološkog procesa proizvodnje cementa. Na toj osnovi, postavljena je i nova koncepcija razvoja površinskih kopova »Partizan« i »Prvoborac«, obrađena u novim Glavnim rudarskim projektima 1979, odnosno 1989. godine.

Oba kopa nalaze se u istom ležištu koje čine naslage eocenskog fliša. Na slici 2 prikazan je karakteristični geološki profil, na kojem je jasno vidljiva višestruka izmjena petrografskih članova. U ležištu je prisutna i izražena tektonika s povijanjem slojeva po pružanju i nagibu navlačenjem i pojavom više poprečnih rasjeda.

Ležište je unutar granica eksploatacijskog polja istraženo istražnim bušotinama, a rekapitulacija količina i kvalitete mineralnih sirovina prikazana je u tablici 1. Projektiranim konturama površinskih kopova obuhvaćene su rezerve prikazane u tablici 2.

U svrhu osiguranja stabilnosti radnih i završnih kosina, obavljena su na oba površinska kopa detaljna geomehanička ispitivanja, a dobiveni rezultati prikazani su u tablici 3 i na slici 3. Analiza stabilnosti načinjena je po kriteriju diskontinuiteta i kriteriju potencijalne klizne plohe kroz stijensku masu, te su usvojeni elementi radnih i završnih kosina, kako je to prikazano na slikama 4 i 5.

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Temelj koncepcije eksploatacije na površinskim kopovima zasniva se na proširenju eksploatacijskih radova s uskog otkopnog fronta »tupine« u središnjem dijelu ležišta, na sjeverno područje s tzv »niskom« komponentom i južno područje s »visokom« komponentom, te utvrđivanje precizne dinamike proizvodnje po pojedinim vrstama mineralne sirovine i pojedinim etažama u cilju postizanja konstantne kvalitete miješane mineralne sirovine sa sadržajem CaCO_3 od cca 76%.

Kapacitet proizvodnje definiran je prema potrebama tvornica cementa, s time da postavljena koncepcija eksploatacije omogućuje brzo prestrukturiranje i na veću proizvodnju u slučaju potrebe.

Osnovne objekte na oba površinska kopa predstavljaju saobraćajnice, locirane približno po sredini kopova, od drobilnog postrojenja na jugu do najudaljenijih radnih etaža na sjeveru. Kopovi su visinskog tipa, s po sedam radnih etaža visine 20 m, s time što je osnovna etaža na površinskom kopu »Partizan« na koti +80, a na kopu »Prvoborac« na koti +90 (prikazano na slikama 6 i 7).

Radi prirodnih karakteristika ležišta, zadanog kapaciteta proizvodnje i kvalitete mineralne sirovine, karakteristika postojeće i odabrane mehanizacije, te dosadašnjih iskustava na ovim površinskim kopovima, usvojen je diskontinuirani sistem dobivanja, utovara i transporta mineralne sirovine.

Osnovni pokazatelji uspješnosti eksploatacije na površinskim kopovima »Partizan« i »Prvoborac«, prikazani su u tablici 4.

Za kopove je od velike važnosti provođenje sanacionih radova paralelno s eksploatacijom, zbog njihove blizine gradu Splitu, kao jednom od glavnih tranzitnih centara turizma na obali Jadranskog mora (slika 9). Perspektive daljnjeg razvoja eksploatacije na ova dva kopa nalaze se u njihovu spajanju (slika 8 i 10), čime bi se cjelokupna proizvodnja podigla na viši tehnički nivo i učinila efikasnijom i rentabilnijom.