

BALKANMINE 2009

3rd BALKAN MINING CONGRESS
3. BALKAN MADENCİLİK KONGRESİ

October 1-3, 2009

İzmir-TURKEY

This Congress is supported by TÜBİTAK (The Scientific and Technological Research Council of Turkey)

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**UCTEA
The Chamber of Mining Engineers of Turkey**

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Published by Gurup Matbaacılık, Ankara, Turkey

Phone: +90 (312) 384 73 44 Fax: +90 (312) 384 73 46

Puplication No. : 160

ISBN : 978-9944-89-782-2

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Address: Selanik Cad. 19/3 06650 - Kızılay, Ankara - TURKEY

Phone : +90 (312) 425 10 80 Faks: +90 (312) 417 52 90

Web : www.maden.org.tr

E-mail : maden@maden.org.tr

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SUNUŞ

Odamız, gerek bilimsel ve teknik bilginin paylaşılması, gerekse ulusal ve evrensel meslek ilkeleri ve sorumlulukları temelinde uluslararası dayanışma amacıyla, diğer ülkelerin meslek örgütleriyle ve üniversiteleriyle iletişim içerisinde bulunmayı önemsemektedir.

Bu çerçevede söz konusu örgütlenmeler ile iletişime geçilmesi hususunda çalışmalar başlatılmıştır. Bu doğrultuda birincisi 2005 yılında Sofya’da, ikincisi 2007 yılında Belgrat’ta düzenlenen Balkan Madencilik Kongresi’nin üçüncüsü Odamızın ev sahipliğiyle ülkemizde düzenlenmektedir.

Dünyada bilim ve teknoloji alanında çok hızlı bir gelişim ve değişim süreci yaşanmaktadır. Üretilen bilginin her 2-3 yılda ikiye katlandığı ileri sürülmektedir. Bilime ve teknolojiye hakim olan güçler dünyayı da egemenlikleri altına almaktadır. Bu nedenle gelişmiş ülkeler bütçelerinden mühendislik- bilim teknoloji ve eğitim alt yapısına ayırdıkları payı gün geçtikçe arttırmaktadır.

Madencilik sektöründe aramadan uç ürüne kadar her aşamada ileri teknoloji kullanılmalıdır. Üretim ve kaynak performansının iyileştirilmesine ve yeni ürünlerin elde edilmesine yönelik olarak yeni gelişen teknolojilerin kullanımı, bu sektörün ülke kalkınmasına katkısı bakımından son derece önemlidir. Bu nedenle sektörde yüksek teknoloji kullanımı ve üretilmesine yönelik araştırma-geliştirme çalışmalarına öncelik verilmelidir. İleri üretim teknolojilerinin geliştirilmesi ve kullanımı, daha temiz ve daha etkin madencilik süreç ve ürünlerinin temini bakımından önkoşuldur.

Bu Kongre’de sektördeki teknolojik gelişmeler paylaşılırken, ülkemizin madencilik sektörünün tanıtımı da yapılacaktır. Balkan ülkelerindeki maden mühendislerinin ve yerbilimcilerin bir araya geleceği toplantılar da deneyimlerin ve teknik bilginin paylaşımı amaçlanmıştır.

Kongre’nin gerçekleşmesine katkı koyan Yürütme Kurulu Başkanı Bahtiyar ÜNVER başta olmak üzere tüm Yürütme Kurulu üyelerine, Balkan Madencilik Kongresi Koordinasyon Kurulu Üyesi Tevfik GÜYAGÜLER’e ve emeği geçen herkese teşekkür ederiz.

Saygılarımızla

YÖNETİM KURULU

FOREWORD

The 3rd Balkan Mining Congress (BALKANMINE 2009) organized by Balkan Mining Association, BALKANMINE and The Chamber of Mining Engineers of Turkey is held between October 1-3 in İzmir, Turkey. The primary objective of the Congress is to promote operational, economical and scientific information pertaining to all aspects of mining technology, energy and sustainable development.

In conjunction with the Congress, 3rd Mining, Natural Resources and Technology Fair of Turkey, MINEX 2009 is organized at the same location for the exhibition of mining products together with companies offering machinery, equipment, instruments, software and services to mining, processing and energy industries.

The papers included in the proceedings volume have been grouped under ten specific themes including, Balkan Mining Industry; Mineral Resources and Mine Geology; Exploitation; Process Engineering; Rock Engineering and Design; Computer Applications in Mining and Processing; Management and Mining Economics; Ventilation and Safety; Mining and Environment; History and Mine Education. The 98 papers included in this volume have been prepared by authors from 14 countries. I am confident to state that papers included in this proceedings volume are testimonials to the vibrant role that mining technology plays in the identification and establishment of routes to sustainable resource development, environmental protection and globalization.

Every successful congress stems from a teamwork approach. We owe gratitude to the members of the Organizing Committee, Balkan Mining Association Coordination Committee, Executive Board of the Chamber of Mining Engineers of Turkey and Chairpersons of the technical sessions. There is no need to mention that this proceedings volume and the BALKANMINE 2009 would not come to reality without contributions of the speakers and authors. Our most genuine appreciation also goes to the delegates for their interest and contributions to the success of the Congress.

We acknowledge with gratitude the financial support provided by TÜBİTAK, The Scientific and Technological Research Council of Turkey. We also owe gratitude to İZFAŞ, İzmir Fair Services Culture and Art Affairs Trade Inc., for their professional effort in the preparation of the Congress venue.

Once again, I thank all of the participants of the BALKANMINE 2009 for their contributions which will become instrumental in the enhancement of our scientific and professional development. I am delighted to reiterate that it is a great pleasure for me to welcome all friends and colleagues to İzmir, to a congress that you will find technically stimulating and socially enjoyable.

Dr. Bahtiyar ÜNVER

for the Organizing Committee

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Controlled Blasting with Demolition Agent

R. Dambov & R. K. Stefanovska

University of Goce Delcev, Faculty of Mining, Geology and Polytechnic, R. Macedonia

I. Dambov

ABSTRACT Over the last decades of last century and this years the interest in using non-explosive demolition has increased again. Several companies started producing various agents with various names and similar characteristics, but with the same conditions of use.

Unlike demolition by blasting, this method is environmentally friendly. The operation takes place quietly, with no seismic affects, dust, gases and no flying rocks. Rock cutting is done as needed and in the desired scale, with-out affecting the other rock mass or surrounding structures. In non-explosive blasting there are no work breaks, no evacuation of workers and machinery, and special safety at work, special requirements in traffic or other safety measures. These advantages have raised the issue with experts in the field of use and improvement of various agents or slurries for controlled cutting and demolishing of rock masses and structures. The first part of this paper points out the principles in the use of such agents, some properties and several examples for practical use (photos) in open pits for breaking of hard rock masses and demolishing concrete elements and construction facilities.

1 INTRODUCTION

NERS is an agent – a powder mixture composed of several chemical compounds with pronounced alkali properties and their expanding while mixing with water. The mixture possesses very high expansive power with high strain under pressure of over 50 MPa and expansive operating capacity of 18 000 lb/inch³.

These values vary based on the company that has produced the agent.

The major component part comprising NERS are iron oxides (2.5%), silicium (5.1%), aluminum (1.6%) and calcium (89.6%).

Its specific weight, compared with that of water, is 3.2 times higher, melting point amounts to 1 000°C, it is easily dissolved in water, with no odor and pronounced grey colour.

The time limit for use is 6 months, and when properly stored and kept with no moisture, it can be used for one year or more.

The consequences of inadequate use are the same as quicklime or cement. When operating, rubber gloves, goggles and dust proof mask are recommended.

1.1 Conditions for Use

Because of its expansive characteristics, it is used in controlled cutting, breaking and demolishing of AB logs and slabs, large stones, marbles, granites, limestone or any other material (fig. 1). It is simple to use and process. It is mixed with water and then holes, natural cracks or slits are filled.

NERS is a non-explosive agent and is safer than other explosives, does not cause quakes, vibrations, there is no rock flying and does not produce toxic gases. It achieves

good results and is cost effective compared with other methods. There is no need of special permit for operation. Only equipment and experience are needed.

This is so called environmentally friendly product with MSDS factor of safety.

Breaking, demolishing and cutting are done according to a schedule of drill holes with earlier defined parameters regarding distance, the diameter and amount of slurry to be used.

The operation in cutting lamellae is done safely, simply and easily taking in consideration the controlled expansive breaking. NERS can also be used to make very thin slabs or onyx blocks, marble, granite and other kinds of stone suitable for processing.



Figure 1. Results of the use of NERS in granite blocks.

It can be used in areas where explosives cannot be used. Cleaning up the site is safer, faster and easier if one respects the rules for work environment and the surrounding. The impact of these products to the surrounding is obvious: there is less material to throw away, no cleaning is required, and after use there is no smoke or any chemicals left.

All this makes it possible NERS to be safe to work in closed premises, where it does not collect dust and the possibility of dust contamination is excluded.

When the use of explosive is required, it can lower operation costs for breaking and at

the same time increase safety since it is used for cracking of weaker structures. It allows the use of less explosive and provides safer breaking or fall of the structure.

NERS is used for: Breaking of various rocks (marble, granite, onyx, limestone), demolishing of massive reinforced concrete structures, demolishing of bases for placing of heavy machinery, demolishing of supports, logs, walls or slabs in bridges, excavation in tunneling, underground demolishing, various concrete structures, shafts, pools etc.

1.1.1 Manner of use

NERS mixture is poured into earlier prepared holes according to schedule and depending on the general condition of the rock or the structure (location, physico-mechanical and structural characteristics).

The technique of performance, the number and manner of drilling the holes is conditioned by the characteristics of the material to be obtained or finalized, the appearance and shape of free (open) surfaces, the desired shape and the scale of block excavation for further processing.

NERS packing can be different depending on the producer. Most often it is packed in polyethylene sacks of 20 kilos each. Another way of packing for delivery is in waterproof boxes the size 15" x 11", each box containing 4 plastic packages of 5 kilos each.

Drilling

Depth of drill holes should amount to 80 – 90% of the block thickness, lamella or concrete element. The distance between holes should be determined based on resistance strength to the cutting of rock, concrete etc.

Holes are drilled by a drilling hammer or other drilling tools used for rocks and concrete. It is recommended the holes to be the diameter of 30 – 40 mm, depending on the type of NERS, to maximum of 50 mm (fig. 3).

In the first use of the technique, experimental drilling series of various diameters and distance are done.

Determination of optimal diameter and distance between the holes is done based on the quality of cut surfaces that have been obtained and their general appearance.

In practice, the distance between holes amounts to 10 – 30 cm depending on the drilling diameter, NERS type and the material drilled.

In enforced concrete the distance amounts to 20 cm, in hard compact rocks it amounts to 15 – 20 cm, whereas in rock of primary, visible direction of cutting the distance can amount to 30 cm or more.

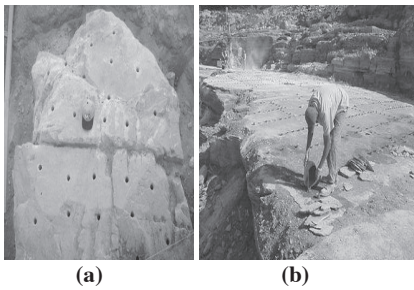


Figure 3. Use of NERS in given conditions, (a) drilling a hole, (b) filling of hole.

1.1.2 Preparing NERS for filling

In a large vessel the powdered agent is mixed with 30 – 40% water so that the slurry obtained is suitable for filling and handling. The ratio between water and powdered NERS is 1:3.

For obtaining better coherence of the slurry, a mixer, concrete cement or shovels can be used. For example for a sack of 5 kg NERS (11 lb.) 1.5 l (0.39 gallons) of common water is added. It is mixed as long as the mixture of water and powder becomes slurry.

Before filling starts, holes should be cleaned up from dust or small pieces by a blower. NERS slurry should be filled within 10 to 15 min after mixing. This means that its properties are valid for a certain period of time. This is one of the advantages of the slurry since this space period allows additional preparations and safety in all further steps.

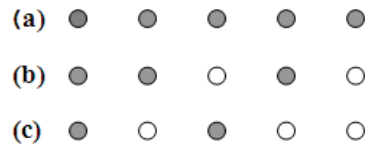


Figure 4. Geometry of possible patterns of holes and manner of filling; (a) all holes are filled; (b), (c) empty holes are left as buffer zone.

Owing to the chemical composition and the amount of certain component parts this period differs depending on the type of NERS.

For some NERS types this space period can last up to 1 hour. After this, it says in the technical characteristics, that the NERS jelly – slurry heats up (its temperature increases), gradually hardens and is in the phase of swelling or its volume increases.

In the three dimensional area in the hole, after this period, it causes significant dynamic strain overcoming boundary strength, first of all that of pressure and extension of the rock or material, causing, in that manner, rock cutting, breaking or other kind of deformation, depending on the hole pattern, parameters of the method and the shape of the rock massif or element.

The holes must not be filled to the top, but 2.5 cm lower than the surface. Before filling, the slurry is mixed and poured into the holes. During filling, no air gaps should be present in the holes. For filling of horizontal holes a grouting pump is used, whereas clay or well-prepared plugs for stopping are required.

The effects can be seen after 30 – 40 minutes, depending on the weather conditions, temperature, humidity and hardness of rocks or concrete.

Cracking of the material can be noticed after 2 hours, and complete action is fulfilled after a period of 24 hours, which is the maximum expanding time.

One package of 20 kilos of powdered NERS is enough to fill a hole pattern of 10 m, the diameter of 38 mm. It should be mentioned that it is not always necessary to fill all holes.

1.2 Effects of NERS Action

After filling, one should not look closely and directly at the holes. The type of NERS should be selected depending on the temperature. For better results it is important to know the temperature of the material and the air. This is so because rock or concrete temperatures can differ from that of the air.

In summer the best time to use NERS is early in the morning or evening when the temperature of the material is low.

Material with high temperature may cause explosion. In summer the hole must be covered with tarp to protect it from sunlight in order to avoid possible explosion. It can be done with tarp or wet hay. In summer, some ice can be put in the material.

In winter NERS is mixed with 1% calcium chloride. If the slurry gets dry and does not have any effects, some more common water is poured into the filled holes to neutralize the action.



Figure 5. NERS effects in different materials and conditions.

2 CONCLUSION

The material for non-explosive controlled breaking, cutting and demolishing for our conditions and use has been translated as NERS (non-explosive demolishing means). In Bulgaria it is known as BRS – a type of Bulad. It is known as NEDA in Great Britain and the USA. In the Republic of Macedonia its use has not been allowed since the material has no permit or license for use (the procedure is in progress).

The high quality and safety in its use speaks for its high efficiency and possibilities for application in industry, urban environments and domestic conditions and, generally, in many difficult and complicated conditions of operation.

REFERENCES

- Djabarov, N., 2000, Bezvzivnoe razrusavane (rascepvane) na skalni i drugi tvrdi materiali, III International Meeting for Drilling and Blasting, RGF, Ohrid R. Macedonia
Web address for NERS.
Catalogues and brochures of world's manufacturers.