

**EFFECTIVENESS OF EMULSION EXPLOSIVES IN
QUARRYING IN HIGH GRADE METAMORPHIC
ROCKS IN SRI LANKA**

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Degree of Master of Science

Department of Earth Resources Engineering

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfillment of the requirements for the degree
Master of Science in Mining and Mineral Exploration

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DECLARATION

I declare that this my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person expect where the acknowledgement is made in the text.

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Signature of the candidate:

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K.P.R.Pathirana

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Date

The above candidate has carried out research for the Masters under my supervision.

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Senior Lecturer, Sarath Weerawarnakula

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Date

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Senior Lecturer, Eng.P.V.A.Hemalal

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Date

Abstract

In mining, blasting is the predominant method adopted for breaking consolidated rocks with the main objectives being extraction of minerals at minimum cost with minimum damage to the environment.

Explosive is a compound or a mixture of compound which is capable of undergoing extremely rapid decomposition with deflagration or detonation. When the explosive reaction takes place radial cracks are formed as a result of detonation pressure with fragmentations followed by gas pressure.

The optimization of explosive usage in Sri Lankan metamorphic rock is the main objective of this research. The detonation velocity of the explosive should match, as closely as possible, the sonic velocity of the rock to be blasted. The rock's sonic velocity is a reliable indicator of its structural integrity and resistance to fragmentation. With varying rock types, sonic velocities vary with varying structural formations.

Aggregate impact value is one parameter of hardness of rock. This study is conducted by considering the aggregate impact value as the indicator of hardness of rock. Test is planned, keeping blasting parameters constant namely hole diameter, explosives charge, burden, spacing and stemming against the different rock types with different aggregate impact values. The efficient use of explosives, along with the proper selection, will be the key to a successful blasting program. After comparison of the results of production rock volume and fragmentation formulate the explosives usage to get the optimum results that how explosives behave with the different rock types with different aggregate impact values or hardness.

Dautrich method is the first time practically used in Sri Lankan field to determine the velocity of detonation of emulsion explosives in this research. This method is indirect field test method for suggesting VOD of explosives and the determination of the VOD is based on the fact that processes that propagate at different linear velocities travel different distance, in the same time interval.

According to the blast results harder rocks fragmented with emulsion explosives, higher production volume were obtained than less hardness rocks. Increasing the hardness, increasing the production rock volume. Therefore, the relationship with hardness of rock and emulsion explosives usage is observed. Fly rock throw is more important to safety of blasting. This research indicates that fly rock distance is higher with AIV values more than 27. This result clearly indicates that emulsion explosives is very suitable for Sri Lankan metamorphic hard rocks.

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LIST OF ABBREVIATIONS

AIV	-	Aggregate Impact Value
AN	-	Ammonium Nitrate
ANFO	-	Ammonium Nitrate - Fuel Oil
BC	-	before crist
$^{\circ}\text{C}$	-	Celsius Degree
CEA	-	Central Environmental Authority
CJ	-	Chapman - Jouguet
DC	-	Detonating Cord
E	-	East
ft	-	feet
ftsec^{-1}	-	feet per second
g	-	gram
gcm^{-3}	-	gram per cubic centimeter
GSMB	-	Geological Survey And Mines Bureau
kg	-	kilo gram
kgm^{-3}	-	kilogram per cubic meter
kPa	-	kilo Pascal
LA AV	-	Los Angeles Abrasion Value
m	-	meter
m^2	-	square meter
mm	-	millimeter
ms^{-1}	-	meter per second
N	-	Newton
N	-	North
NMAS	-	Nominal Maximum Aggregate Size
Pasm^{-3}	-	Pascal second per cubic meter
Pd	-	detonation pressure
SSD	-	Saturated Surface Dry
UCS	-	Uniaxial Compressive Strength

UK	-	United Kingdom
USA	-	United State of America
VOD _{Emulsion}	-	Velocity of Detonation of Emulsion
VOD	-	Velocity of Detonation
VOD	-	Velocity of Detonation
VSO	-	Sonic Velocity
Z	-	Acoustic impedance