Drilling and blasting of rocks pdf downloads online

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PREDICTING TOOL WEAR IN DRILL AND BLAST

Ralf J. Plinninger[1], Georg Spaun[1] and Kurosch Thuro[2]

Drill & Blast is a commonly used excavation method for the construction of underground openings (e.g. tunnels, caverns) in hardrock conditions worldwide. Wear of the employed tools may take place during different steps of the working cycle, affecting a wide range of machinery and materials. Although excavators, dump trucks or conveyor belts are also permanently exposed to the excavated rock mass and therefore undergoing geologically influenced wear, the wear of the rock cutting tools (i.e. drilling bits, excavator chisels, picks) is the most expensive wear phenomenon.

Drilling equipment and bit tool wear

Common blasthole diameters range from 38 to 48 mm and are typically drilled by use of hydraulic rotary percussive drilling hammers (impact power of about 15 to 20 kW). In most geological conditions, predominantly button bits are used which consist of a number of cemented carbide buttons inserted and/or solded into holes of a steel body (Figure 1). The properties of the button bit can be adjusted effectively to the local circumstances by variation of the amount of inserted buttons, button composition, button geometry, solding and steel quality or the bit's flushing system.

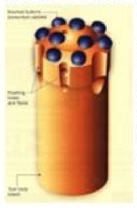


Figure 1. Main characteristics of a button bit.

Tool wear will occur under certain loads and temperatures just as one result of a complex tribological system. The material removal is caused by microscopic and macroscopic processes such as abrasion, adhesion, material fatigue or brittle failure of tool materials. Mode and rate of these processes are controlled by a vast variety of factors coming from the main fields of geology, tools and logistics. Engineering geologists, material scientists, mining and civil engineers have been researching these effects through the last decades at universities, research institutes and machine manufacturers to identify and quantify main influencing factors. Rock properties, joint features, weathering / alteration of rock, water situation, composition of inhomogenous rock masses and underground stress situation have been identified as major geological factors. Tool characteristics, flushing, feed, rotating velocity, temperatures, tool handling and rock supporting methods represent some main factors from the fields of tool and logistics.

CLASSIFICATION OF BIT WEAR

Wear type and the *wear rate* can be used as parameters describing the effect of the wear process. The *wear type* describes the specific form of wear observed on the tool. It can be described qualitatively by use of a wear classification system (Tab. 1). The *wear rate* describes the velocity of material removal from the tool. This term is normally expressed in drilled meters per bit [m/bit], also entitled the "drill bit lifetime". The wear rate is a basic factor for the calculation of tool consumption and wear costs. It can be obtained on site from measurements on single tools or calculations based on stock lists and delivery notes.

Classification of bit wear type

The bit wear type can be used as a "fingerprint" of the wear process. From its classification valuable information can be obtained about the typical processes taking place and geological and machinery causes for the encountered wear forms. A easy-to-use classification system for button bits is given in Table 1. It is evident, that transitions and mixed types between the presented types are possible.

Normal wear (BB-A1) may be observed when tool body and hard metal inserts are more or less evenly undergoing abrasive wear. This wear type is typical for abrasive rocks with high compressive strength, for example quartzite, gneiss, granite or quartzitic sandstones. The evenly wear distribution can be explained by

[1] Dipl.-Geol. Ralf J. Plinninger, Prof. Dr. Georg Spaun, Lehrstuhl für Allgemeine, Angewandte und Ingenieur-Geologie, Technische Universität München, Arcisstrasse 21, D-80290 München, Germany
[2] Dr. Kurosch Thuro, Ingenieurgeologie, Eidgenössische Technische Hochschule Zürich, Schweiz

Properties of Selected High Explosives

Robert Weinheimer
July 2002

ABSTRACT

This paper was presented at the 27th International Pyrotechnics Seminar, 16 – 21 July 2000 in Grand Junction, CO., and is an update on the PEP-1 Wall Chart that was presented at the Eighteenth International Pyrotechnics Seminar, July 1992, at Breckenridge, CO. The descriptive text has not changed. The Wall Chart has been corrected and updated with chemical symbols of the explosives. An Appendix of Engineering Tools has been added.

There is a need in the pyrotechnic, explosive, and propellant engineering and scientific community to compile the energetic material property and characteristic data for a single point reference. The objective of this paper is to fulfill that need for the properties and characteristics of selected high explosives of interest to the defense and aerospace industry. The information is collected from published literature and compiled for easy access in data sheet and wall chart format. Members of the engineering and scientific community of all disciplines are invited for input to the development of the knowledge base that is represented. Equally important to presenting the data is to identify the source as reference, which is listed at the end of this paper. This paper is updated periodically to include recent changes.

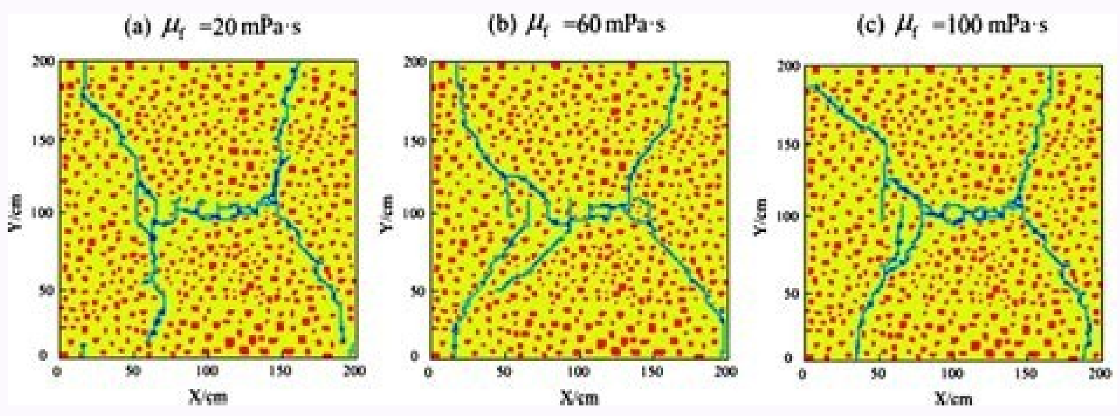
Explosives referenced in MIL-STD-1316 are discussed together with common secondary explosives:

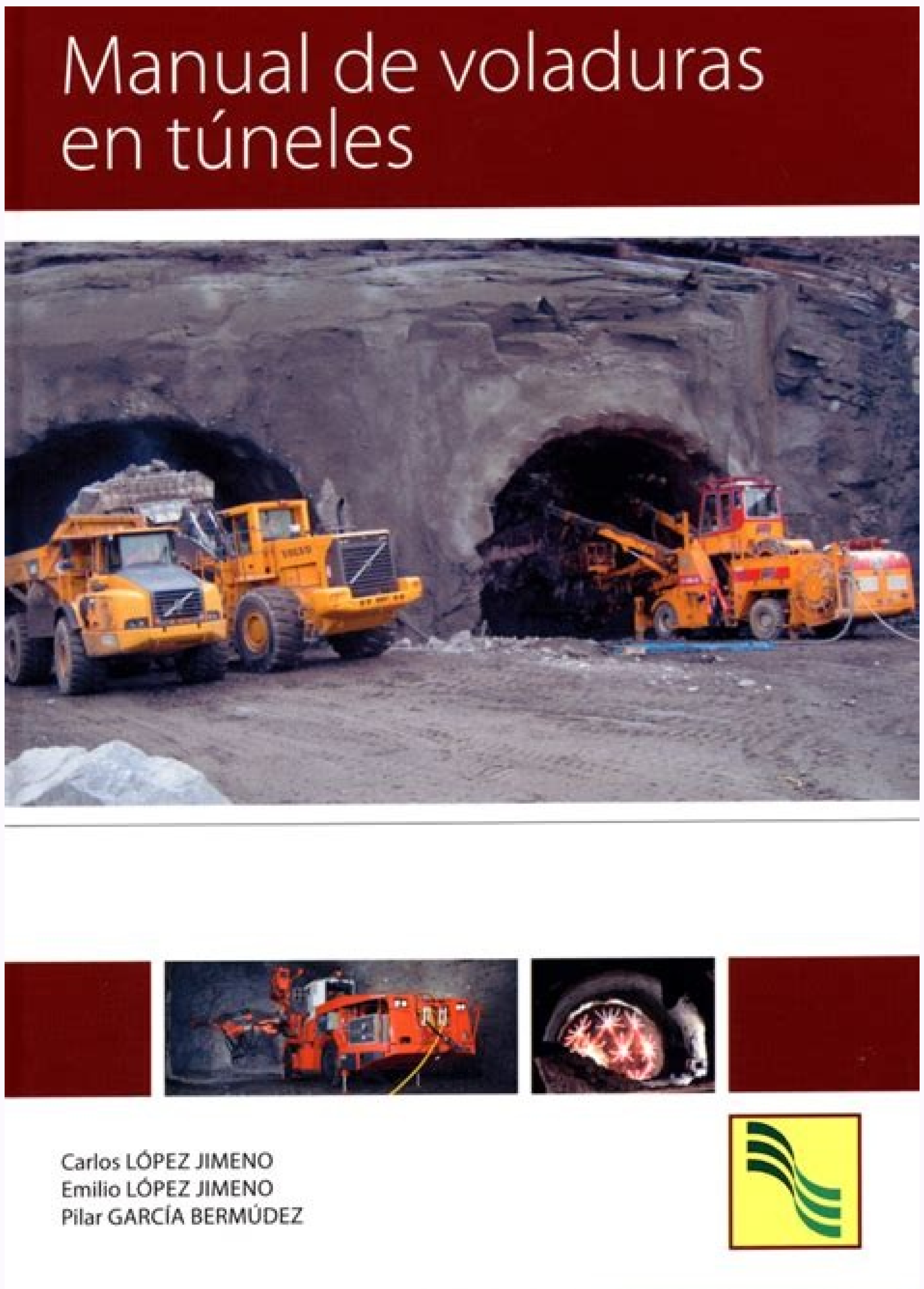
MIL-STD-1316 EXPLOSIVES	COMMON EXPLOSIVES
COMPOSITION A3	RDX
COMPOSITION A4	HMX
COMPOSITION A5	DATB
COMPOSITION CH6	TATB
PBX-9407	PETN
PBXN-5	CYCLOTOL
PBXN-6	TNT
DIPAM	COMPOSITION B3
HNS-I	XTX-8003
HNS-II	OCTOL
TETRYL	

All the 'Compositions', and PBXN-6, and CYCLOTOL are RDX based; PBXN-5, and OCTOL is HMX based; XTX-8003 is PETN based; The 'TOLs' (CYCLOTOL and OCTOL) contain TNT as a second ingredient. TETRYL is no longer manufactured and is being phased out as a MIL-STD-1316 explosive. DATB and TATB are explosives with limited published literature found to be available.

Explosive properties and characteristics of interest are discussed:

Chemical Composition	Hygroscopicity
Density	Thermal Stability
Crystal Hardness	Heat of Combustion
Autoignition	Heat of Reaction
Critical Temperature	Heat of Formation
Melt Point	Heat of Products of Detonation
Decomposition Temperature	Shock Sensitivity Threshold
Gas Volume	Laser Initiation Threshold
Detonation Pressure	TNT Equivalency
VOD Formulae	Brisance
Velocity Of Detonation	Impact sensitivity
Temperature of Detonation	Friction Sensitivity
Vacuum Stability	Explosive Specification





Drilling and blasting techniques. Drilling and blasting method.

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