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CITE: (U) (b) (2)

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SERIAL: (U) (b) (2)

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COUNTRY: (U) NORTH KOREA (KN).

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SUBJ: (b) (2) NORTH KOREA'S USE OF BULK AMMONIUM NITRATE EXPLOSIVES TO BUILD UNDERGROUND FACILITIES (U)

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WARNING: (U) THIS IS AN INFORMATION REPORT, NOT FINALLY EVALUATED INTELLIGENCE. XXXX XXXXXX XX XXXXXXXXXX XXXXXXXXXXXX.

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DEPARTMENT OF DEFENSE

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DOI: (U) 20060405.

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REQS: (b) (2)

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SUMMARY: (U) NORTH KOREAN SCIENTISTS PUBLISHED THREE RESEARCH PAPERS ON DRIFT BLASTING OF TUNNELS USING BULK AMMONIUM NITRATE EXPLOSIVES AND A PAPER ON COMPOSITION OF EXPLOSION PRODUCTS AND EXPLOSION HEAT. THE RESEARCH INDICATED THE DPRK IS TRYING TO IMPROVE EFFICIENCY IN THE CONSTRUCTION OF UNDERGROUND FACILITIES. ENCLOSURE.

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TEXT: 1. (U) SCIENTISTS OF THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA (DPRK), INCLUDING ((CH'OE)) YONG-CH'O'L, PUBLISHED THREE RESEARCH PAPERS ON DRIFT BLASTING OF TUNNELS IN A MINING ENGINEERING JOURNAL AND OTHER JOURNALS. OTHER DPRK SCIENTISTS ALSO PUBLISHED A RESEARCH PAPER ON COMPOSITION OF EXPLOSION PRODUCTS AND EXPLOSION HEAT IN A CHEMICAL ENGINEERING JOURNAL.

2. (U) DRIFT BLASTING OF TUNNELS

DPRK SCIENTISTS ((CH'OE)) YONG-CH'O'L, KIMCH'AEK ENGINEERING COLLEGE, AND OTHERS PUBLISHED THREE RESEARCH PAPERS ON DRIFT BLASTING OF TUNNELS IN DPRK JOURNALS. THEY USED BULK AMMONIUM NITRATE EXPLOSIVES FOR ANALYSIS. SUMMARY OF EACH PAPER FOLLOWS.

A. (U) FACTORS IN BLAST HOLE PLACEMENT (b) (2)

RESEARCHERS CALCULATED THE DISTANCE BETWEEN WEDGE-CUT RELIEVING-CUT BLAST HOLES AND THE LINE OF LEAST RESISTANCE OF A BABY-CUT BLAST HOLE WHICH ARE FACTORS IN DECIDING BLAST HOLE PLACEMENT IN DRIFT BLASTING OF A TUNNEL AT AN ANTHRACITE COAL MINE (ENCLOSURE).

(1) (U) FIRST STEP

RESEARCHERS DETERMINED THE DISTANCE BETWEEN BLAST HOLES AS FOLLOWS. WHEN RESEARCHERS USED BULK AMMONIUM NITRATE EXPLOSIVES TO BLAST ARENACEOUS SLATE, THE SIZE OF THE FRACTURE REGION WAS 8.3 CENTIMETERS (CM) AND THE DISTANCE BETWEEN BLAST HOLES WAS 0.166 CM (FIELD COMMENT -- 0.166 CM PROBABLY 16.6 CM). THIS INDICATES THAT THE ROCK MASS PORTION IS FRACTURED COMPLETELY WITH HIGH BLASTING EFFICIENCY WHEN THE DISTANCE BETWEEN BLAST HOLES IS LESS THAN 10 CM.

(2) (U) SECOND STEP

NEXT, RESEARCHERS DECIDED THE LINE OF LEAST RESISTANCE OF A BABY-CUT BLAST HOLE. A LINE OF LEAST RESISTANCE OF A BABY-CUT BLAST HOLE IS DECIDED BY FORECASTING A BLAST CRATER CONNECTING FRACTURE REGIONS OF EACH BLAST HOLE. AS A RESULT, RESEARCHERS COULD IMPROVE BLASTING EFFICIENCY WHEN THE LINE OF LEAST RESISTANCE WAS LESS THAN 40 CM.

B. (U) ANALYSIS OF BLASTING MECHANISM ACCORDING TO DETONATING METHOD (SIC) (b) (2)

RESEARCHERS ANALYZED CHARACTERISTICS OF SHOCK WAVE AND EXPLOSIVE PRODUCT GAS (SIC), GENERATED BY ROCK MASS BLASTING, WHEN THEY AFFECT ROCK MASS. RESEARCHERS ALSO ANALYZED BLASTING CHARACTERISTICS OF DIRECT AND INVERSE INITIATIONS. THEY USED BULK AMMONIUM NITRATE EXPLOSIVES FOR THEIR ANALYSIS.

(1) (U) FIRST STEP

WHEN EXPLOSIVES IN BLAST HOLES EXPLODE, ROCK MASS RECEIVES DYNAMIC PRESSURE CAUSED BY SHOCK WAVE AND QUASI-HYDROSTATIC PRESSURE CAUSED BY EXPLOSIVE PRODUCT GAS EXPANSION. AS MUCH AS 15-20 PERCENT OF THE EXPLOSION ENERGY IS CONSUMED AS SHOCK AND STRESS WAVES AND MOST OF THE REMAINING ENERGY IS CONSUMED FOR EXPLOSIVE PRODUCT GAS.

(2) (U) SECOND STEP

NEXT, RESEARCHERS ANALYZED BLASTING BY DIRECT AND INVERSE INITIATIONS. JUDGING FROM ANALYTICAL RESULTS, THE SCALE AND DURATION OF THE STRESS WAVE DYNAMIC PRESSURE AND THE EXPLOSIVE PRODUCT GAS QUASI-HYDROSTATIC PRESSURE IS IMPORTANT IN ROCK MASS FRACTURE. THE STRESS WAVE WAS STRONGER AND THE EXPLOSIVE PRODUCT GAS PRESSURE LASTED LONGER IN INVERSE INITIATION RATHER THAN DIRECT INITIATION.

C. (U) STUDY OF BLASTING BY INVERSE INITIATION (b) (2)

(1) (U) FIRST STEP

RESEARCHERS COMPARED RATIONALITY BETWEEN DIRECT AND INVERSE INITIATIONS IN DRIFT BLASTING OF AN ANTHRACITE COAL MINE TUNNEL. RESEARCHERS USED BULK AMMONIUM NITRATE EXPLOSIVES AND RESIN-WRAPPED DETONATING CORDS.

(2) (U) SECOND STEP

EXPLOSIVE PRODUCT GAS REMAINED IN BLAST HOLES 10 TIMES LONGER IN THE INVERSE INITIATION COMPARED TO THE DIRECT INITIATION, SO INVERSE INITIATION PRODUCES A STRONGER DETONATION WITH HIGHER FRACTURE EFFECTS. INVERSE INITIATION WAS SUPERIOR IN DIGGING SPEED AND LESS EXPENSIVE.

3. (U) CALCULATIONS FOR DETONATION PROPERTY OF CONDENSED EXPLOSIVES (SIC) (b) (2)

- DPRK SCIENTISTS ((TO'NG)) SO'K-MIN AND ((YANG)) KI-SO'K PUBLISHED A RESEARCH PAPER ON A METHOD OF CALCULATING COMPOSITION OF EXPLOSION PRODUCTS AND EXPLOSION HEAT IN A DPRK JOURNAL.

(1) (U) FIRST STEP

- RESEARCHERS DEVELOPED AN EASIER AND MORE ACCURATE METHOD OF CALCULATING THE COMPOSITION OF EXPLOSION PRODUCTS AND EXPLOSION HEAT AT C-J POINT (b)(7)(E)

(2) (U) SECOND STEP

- COMPOSITION OF EXPLOSION PRODUCTS WAS CALCULATED. RESEARCHERS FOCUSED ATTENTION ON CHANGES OF COMPOSITION OF EXPLOSION PRODUCTS ASSOCIATED WITH DENSITY CHANGES. THEY PRODUCED THEIR OWN EQUATION OF STATE (EOS) EXPLOSION HEAT WHICH IS LARGER AT HIGH DENSITY WHILE EXPLOSION HEAT IS SMALLER AT LOW DENSITY. RESEARCHERS CONFIRMED CORRECTNESS OF THEIR EOS, USING ANOTHER TYPE OF EOS WHICH DESCRIBES THE STATE OF EXPLOSION AND ALSO CALCULATES COMPOSITION OF HEXOGEN EXPLOSION PRODUCTS.

(3) (U) THIRD STEP

- RESEARCHERS CALCULATED EXPLOSION HEAT. THEY PRODUCED AN EOS, CONSIDERING THE LINEAR CHANGES OF EXPLOSION HEAT AT C-J POINT ASSOCIATED WITH CHANGES OF EXPLOSIVE DENSITY. TO CONFIRM CORRECTNESS OF THE EOS, THEY USE PETN, RDX, TETRIL, PA, AND TNT

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RESEARCHERS COMPARED EXPLOSION HEAT CALCULATED WITH ANOTHER TYPE OF EOS WHICH DESCRIBES THE STATE OF EXPLOSION AND EXPLOSION HEAT CALCULATED WITH THE RESEARCHERS' EOS AND FOUND THAT THERE WAS LESS THAN ONE PERCENT ERROR BETWEEN THE VALUES.

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ENCL: (U) AVAILABLE ON WEBSITES -- ONE ENCLOSURE.

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DISSEM: (U) FIELD -- NONE.
WARNING: (U) XXXX XXXXXX XX XXXXXXXXXX XXXXXXXXXXXX.
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