SAFER BLASTING AGENTS AND PROCEDURES FOR
BLASTING IN GASSY NON-COAL MINES

Technical Progress Report
Period January 1 to March 31, 1993

By
Eric S. Weiss

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For:

Kathleen Overfield
RRTS Coordinator
U.S. Department of Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By:

U.S. Department of Interior
Bureau of Mines
Pittsburgh Research Center
Pittsburgh, Pennsylvania

MASTER

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OBJECTIVE

The U.S. Bureau of Mines' research program is focused on developing procedures and guidelines for acceptable underground oil shale blasting that fulfill the operational requirements for efficiency while maintaining a high level of safety when operating under gassy mine conditions. This work is aimed at providing new information, alternate methods, and innovation in underground blasting procedures. The results from this research will have direct impact on regulatory standards for blasting under gassy mine conditions. The Mine Safety and Health Administration is awaiting the results of this research to finalize and promulgate blasting regulations for Category 1-A oil shale mines (Regulation 30 CFR 57.22601 was stayed pending the results of this research program). Many of the research findings on low incendive explosive products have direct applications to other non-coal mining industries.

DISCUSSION OF RESULTS

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Incendivity tests are conducted in the Lake Lynn Cannon Gallery (LLCG) to determine preferred explosive/stemming combinations and blasting procedures that will reduce the probability of gas and/or dust ignitions during blasting operations under gassy mine conditions. The LLCG is a 22 ft long by 8 ft diameter horizontal cylinder open at both ends. A 5 ft long by 2 ft diameter steel cannon is mounted inside near one end and discharges towards the geometric center of the gallery.

Efforts are continuing on refining techniques for measurement of the temperature profile of the detonation products exiting the cannon bore hole. Exhaust temperature measurements are important in evaluating both the explosive's incendivity characteristics and stemming performance in cooling the detonation products exiting the bore hole. The development of a single wavelength probe is being explored to measure these bore exhaust temperatures. The sensor for the infrared instrument has been selected. A one-stage thermoelectrically cooled lead selenide (PbSe) detector with a built-in preamplifier will be purchased. The built-in preamp was selected in order to fit inside an explosion-proof housing. A temperature control unit with a heat sink will be used to control the operating temperature of the detector and the gain. Filters at the required wavelengths as well as the explosion-proof housing are available from our supply. Sapphire windows for the housings will be ordered. Currently, four vendors are being examined. Purchase of the components should occur by April 23rd. Delivery would be expected four to six weeks from that date.

Tests are continuing in the LLCG to evaluate the performance of the explosives in the Cannon Gallery. This test series is designed to measure the velocity of detonation of explosive products initiated in the steel cannon. Detonation velocity is an important criteria for determining an explosives' performance. Prior to standardizing testing of blasting agents in the Cannon Gallery, the tests with the rate probe will verify that these blasting agents are detonating at ideal velocities in the 0.25-in-diam bore.

A fiber optic probe is currently being developed that can accurately measure the explosive detonation velocity in the cannon and/or a blasthole. The probe will consist of twenty juxtaposed optic strands whose open ends are spaced at 5-cm intervals along the length of the explosive charge. A signal

(pulse of light) will be generated as a function of time as the detonation front reaches each of the probe locations. The detonation velocity can then be calculated based on these times and the spacings between the probes. This type of probe can be a practical alternative to the more complex and expensive coaxial cable reflectometry and resistance wire probes.

Tests were conducted using both a modified single fiber probe and a four fiber probe. An ionization device was placed juxtaposition to the fiber end to detect when the detonation reaches the end of the fiber buried in the explosive charge. The results showed that due to the optical transparency of the explosive, light from the detonation was detected by the fiber prior to the time the detonation front reached the fiber end. Methods to circumvent this problem are being studied. One method involved the coating of the ends of each strand to prevent light (produced from the detonation of the explosive) from entering prior to the time that the detonation front reached the end of each strand. In addition, the electronics were modified to incorporate a bank of 10 megasecond counters to measure the time of interval of the propagating detonation between fiber strand ends. This configuration will provide resolution in time which will result in about a 10 pct error in the calculation of the detonation rate. Various types of fiber (plastic or ribbon), which may provide a better signal, are also being explored. These compacted fiber ribbons will improve the packaging characteristics of the probe and may optimize signal strength. One of the three types of fiber ribbon was tested and it was concluded that the traveling light strength through the core was not satisfactory. To acquire better results, the electronic circuits will be placed on a printed circuit board (PCB). Once this PCB is complete, the modified probe will then be tested.

Once it is determined that the non-cap sensitive explosive products are detonating at ideal velocities in the Cannon Gallery, the testing to evaluate the data from the Cannon Gallery to that from the Permissibility Gallery located in the Bruceton facility will resume. These comparisons will be evaluated based on the relative data from each facility as part of the research effort to standardize the Cannon Gallery testing of non-permissible explosives for use in mining applications.

Based on the low incendivity data from the Cannon Gallery and several months of recent testing in their mine, Kennecott's Greens Creek base metal mine in Alaska had decided to exclusively use a low incendive bulk emulsion product in place of the low incendive water gel product for all blasting operations. As was the case with the low incendive water gel product, the use of this bulk product resulted in: no dust ignitions and related injuries and/or production/equipment losses; the elimination of pre-blasting measures of using stemming and water sprays, and the improvement of roadways due to the reduction of water. Several additional benefits resulted by using the low incendive bulk product: a one-half reduction in the loading times, a reduction in the frequency of drift washing, and significantly lower product costs.

PROGRAM PLAN AND COSTS

Charges This Quarter:

Total: \$32,140.00 (see attached Cost Management Report)

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