

OXYGEN BALANCED EMULSION-ANFO BLENDS FOR USE IN FLAMMABLE ATMOSPHERES

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1 Underlined numbers in parentheses refer to items in the list of references at the end of this report.

2 Reference to specific products does not imply endorsement by the Bureau of Mines.

3 A letter in parenthesis is assigned to each blasting agent as is listed in the tables.

ABSTRACT

The U.S. Bureau of Mines has been conducting research on the secondary explosion hazards associated with the mining of oil shale under gassy mine conditions. Explosive incendivity tests have been conducted in a 28 m³ (1000 ft³) gallery to evaluate the relative incendivity of experimental emulsion-ANFO blends. The incendivity was measured by determining the minimum inert stemming requirements for preventing the ignition of a methane-air atmosphere by the discharge of hot detonation products from a 5.7 cm (2.25 in) diameter borehole.

The relative incendivity of several blasting agents using ammonium nitrate, calcium nitrate, and sodium nitrate and with various oxygen balances were determined and compared with ANFO. Results indicate the less incendive blasting agents are generally more oxygen-balanced, contain sodium or calcium nitrates, and tend to generate less hydrogen and carbon monoxide. These excess fuels appear to burn outside the borehole, thereby contributing to the methane ignition process.

Results indicate that there is merit in tailoring an explosive's composition to reduce the probability of igniting the methane which is released during normal oil shale blasting operations. The proper selection of explosives and stemming materials should significantly reduce the probability of gas explosions under gassy oil shale mining conditions.