SPONTANEOUS COMBUSTION FIRE DETECTION FOR DEEP METAL MINES

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ABSTRACT

Spontaneous combustion fires involving high-sulfide-content ores are a relatively infrequent yet serious safety hazard in mining. They are also the cause of lengthy mine shutdowns because they typically occur in areas of a mine where abundant fuel material is present but which are inaccessible for fire fighting. This Bureau of Mines report describes research to design, fabricate, and test in the laboratory and field a system that warns of spontaneous combustion fires in metal mines. Overall performance of the detection system was found to be satisfactory, in that the system was capable of reliably detecting low levels of combustion products believed to indicate the preflaming stage of spontaneous combustion in metal mines. Installation of similar systems in mines with a high risk of spontaneous combustion is recommended. Principal operating problems and recommended corrective actions are also discussed.

INTRODUCTION

Exothermic oxidation reactions in metal sulfide ores can occur in underground mines. If the heat generated by these reactions is not dissipated, temperatures sufficient for rapid oxidation and combustion of both the sulfides and the adjacent timber and other mine combustibles may be produced. Although spontaneous combustion fires are relatively infrequent, accounting for only about 2 pct of all underground noncoal mine fires, they are generally quite disruptive to mine operations and represent a significant safety hazard to miners. Spontaneous combustion fires often start in abandoned, backfilled, and/or caved mine areas where access for fire-fighting operations is difficult or impossible. Compounding the problem of accessibility is the large amount of fuel that is generally available to a spontaneous combustion fire. Fires on discrete pieces of equipment are generally of short duration because they self-extinguish when the available fuel is consumed. However, the large quantity of support timber present in many older mines can provide fuel sufficient for fires of many months' duration, and spontaneous combustion fires typically involve such support timber. Since 1950, about 57 pct of noncoal underground mine fires lasting longer than 24 h were caused by spontaneous combustion.

Though research is now under way, the precise chemical and physical mechanisms giving rise to sulfide oxidation and spontaneous combustion in mines are still not well understood. Hence, prevention of spontaneous combustion fires is generally limited to sealing abandoned, backfilled, and caved areas known to be susceptible to self-heating, in the