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Chemical Characterization and Toxicologic Evaluation of Airborne Mixtures: The Chemical and Physical Characterization of XM819 Red Phosphorus Formulation and the Aerosol Produced by Its Combustion

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Abstract: The report describes the chemical and physical properties of the aerosol produced from the combustion of a red-phosphorus-sodium nitrate (NPNO3) formulation used in the XM819 mortar round. The aerosol was generated by burning fragments of the material in a convective air flow. As it was generated, the smoke was delivered to a 0.3 cubic meter exposure chamber from which samples for various analysis were taken. Generation and collection conditions were similar to those used for two other phosphorous obscurant sources, red phosphorus-butyl rubber (RPBR) and white phosphorus-felt (WPF), to allow direct comparisons between the aerosols. The RPNO3 material was also analyzed for composition and impurities. The formulation was found to be uniform in weight, density, and composition of phosphorus, extractable, sodium, nitrate, and silica. An epoxy containing no unreacted resin detectable by infrared spectroscopy. Elemental impurities were determined to be less than 0.1 percent by weight. Aerosol particle sizes measured by cascade impactor techniques, were within the respirable range, having median diameter slightly less than 1 micrometer. The composition of the aerosol was found to be primarily ortho-phosphoric acid, polymeric phosphoric acids, and water. Traces of carbon monoxide nitric oxide, and nitrogen dioxide were present in the gas phase. Nitrogen dioxide was slightly above NIOSH toxicity limits (maximum allowable exposure for short term exposure).

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