MLM: Dust Explosion Potential Warning System

JOHN FOSS, ALAN LAWRENZ, Michigan State University — A quite large range of materials, when dispersed as a dust cloud in air, can support an explosion. Empirically derived minimum explosive concentration (MEC) values are typically in the range: 30-80 grams/m$^3$; that is, nominally 2.5-8.3% of STP density. Currently, there is no field-deployable measurement system to determine the mass loading (grams/m$^3$) of airborne dust. Proof-of-concept measurements for the MSU Mass Loading Monitor (MLM) are reported. A charge of dusty air, ingested into a cylinder, is accelerated ($a_p=ct$) by a driving piston and partially ($\approx 8\%$) discharged from the open end of the cylinder. The deformable control volume momentum equation can be integrated with respect to time to yield $\alpha(t) - \beta(t) = \gamma \rho(t)$ where ( ) will indicate with (w) or without (w/o) dust. The pressure integral ($\alpha$) and the shear integral ($\beta$) balance the momentum within the cylinder at the end of the smoke plus the integral of the momentum flux. The kinematic attributes of these terms are represented by $\gamma$. It will be shown how the mass loading ($\rho_w - \rho_{w/o}$) can be determined. A full length paper (The Mass Loading Monitor Fundamental Principles And Proof Of Concept) will be published in Meas. Sci. and Tech.