Mechanical Simulation of Fugitive Feedlot Dust Emissions

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BACKGROUND

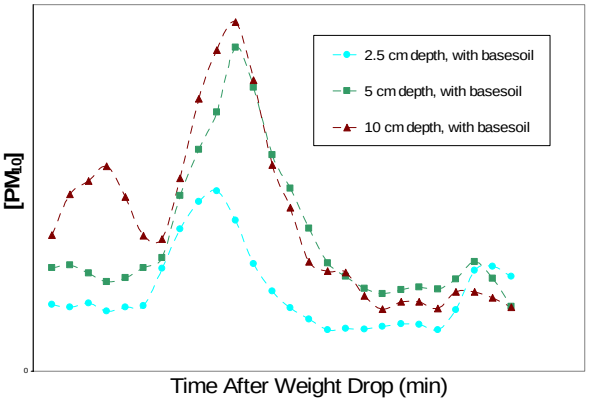
The Texas Agricultural Experiment Station (TAES-Amarillo) and our research partners at Kansas State University (KSU) are using a benchtop apparatus to simulate the mechanical hoof action that produces fugitive dust in the feedyard. The simulation focuses on four variables that appear to influence the *intrinsic dust susceptibility* of the feedyard surface: moisture content, uncompacted manure depth, bulk density and organic matter content. Those parameters are varied individually in the weight-drop test chamber (WDTC), in which the kinetic energy of a falling weight generates dust emissions that are subsequently measured via a filter placed in the downstream air.

OBJECTIVES

The main objective of this project is to simulate and correlate mechanical hoof action with the emission of fugitive dust. Subsidiary objectives include: a) resolving the horizontal and vertical energy components involved in front- and rear-hoof emissions, b) defining the role and significance of moisture, surface mulches and chemical amendments in relation to the intrinsic dust susceptibility of feedyard surfaces and c) projecting the effectiveness of animal-behavior modifications on dust emissions.

RESULTS / BENEFITS

- Preliminary results appear to validate manure harvesting as an effective BMP (see graph).
- Increasing moisture content decreases the intrinsic dust susceptibility *if* the moisture is distributed throughout the uncompacted manure layer.
- Manure-derived dust is highly hygroscopic, which means that the moisture content responds significantly to changes in relative humidity. Increased RH influences dust susceptibility in two ways: (a) by increasing the physical cohesiveness between manure particles; and (b) by increasing the effective aerodynamic equivalent diameter (AED) of an individual particle, increasing the amount of energy required to suspend it in air.
- This physical model, which relates hoof energy to fugitive dust emissions, may be generalized to predict the effectiveness of dust-control best management practices (BMPs). We will be able to screen candidates such as solid-set sprinklers, manure harvesting, surface mulches, chemical applications and animal behavior.



(Graph courtesy R. Maghirang, KSU)

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