Identifying the Mechanism and Subsequent Remediation of Foaming in Swine Manure Management Systems. Project 15-136 - IPPA
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Scientific Abstract:
Manure samples were collected monthly from October 2012 to October 2013 from 58 commercial swine finishing facilities with deep-pit manure storages in Central and Eastern Iowa. These samples, along with manures obtained from dietary feeding trials, were evaluated for a plethora of manure characteristics to provide insight into what may be causing foam formation.
Key summaries of the data:

Gas Phase (biogas production):

- Non-foaming manures had more than double the concentration of volatile fatty acids (VFA), precursor compounds used in methanogenesis, than foaming manures.
- Biological methane potential (BMP) of non-foaming manure was 23% higher than foaming manure much of it related to differences in VFA concentrations.
- Methane production rates (MPR) from foaming manure was on average 200% higher than MPR of non-foaming manure.
- The higher methane flux from foaming manure potentially also operates as an aerator causing fine particles in the manure entrained on bubbles to accumulate at the surface.

Liquid Phase (surfactant):

- Surface tension of non-foaming manure were significantly lower than foaming manure, which is opposite of what is expected if foaming manure was acting like a surfactant.
- Foaming manure had a higher foaming capacity than non-foaming manure; foam layers had higher foaming capacity than either manure presumably due to the accumulation of particles in the foam layer.
- Viscosity of the foam layer was significantly greater than underlying manure layers and this was true for both whole and centrifuged material indicating there was an accumulation of some substance in the foam layer present in either manure.

Sold Phase (particles):

- Foam was enriched in total and volatile solids and foaming manure tended to have a slightly higher solids concentration over non-foaming barns.
- The half-life of the foam for foaming manure was hours compared to minutes for non-foaming manure; half-life of the foam layer was an order of magnitude higher than manure.
- Average particle size of the foam material is significantly smaller than manure material.
- Foam layer enriched for particle size fraction between 2-25 µm with underlying foaming manure being depleted of particles in that size fraction.

- Foam stability enhanced by significantly higher viscosity keeping the foam layer wet and stable.
- Stabilizing molecules (i.e., tannins) that interact with proteins when added to non-foaming manures created stable foam indicating all manures have the capacity to form stable foam.
- Protein and carbohydrate concentrations were significantly higher in the foam layer of whole manure than either non-foaming and foaming manures.

Microbial Phase:

- Distinct manure surface texture (no-foam, crust, foam) was associated with specific microbial consortia.
- Indigestible fiber and protein were significantly abundant in crust and foaming sample diets.
- Free long chain fatty acid (LCFA) and Clostridia were one of the strongest correlations found in foaming samples.
- Different methane producing pathways were likely involved in no-foam, crust, and foam samples.