2015-02 Progress Report
The Development and Commercialization of
Aerobic Digestion of Poultry Manure to Produce BioActive Fertilizers

Trial 6 is underway… both it and Trial 5 had severe initial oxygen limitation in part due to high % Dry Matter; Trial 5 - 8.2%, Trial 6 - 11.2% (6.2% from manure the rest from ~ 290 L of mother liquor i.e. the residual from Trial 5). The installation of a dissolved oxygen and foam control loops will soon be underway; this should enhance the fermentation process especially to get higher temperatures from better oxygen delivery and foam control.

A grant request was submitted to the Canadian Poultry Research Council, CPRC, (would bring in $22 k) to trial fermenting turkey manure; the Chair of the Alberta Turkey Producers would be participating. [Would be excellent to get a couple more Stakeholders.] Communication with CPRC was encouraging. ACIDF vetted the proposed use of project funds to obtain a CPRC grant. SPFG was identified as a potential financial contributor.

The limited data to date suggests:

i. a pH near 7 yields 'a strong themophilic step' as seen in Trial 3, pH 7.3 [December 1, 2015 report]
ii. acidic pH's have less nutrient loss as seen in Trial 4, pH 6.3

Hypothesis: Lower pH's (to some extant) avoid high-pH induced phosphate divalent cation precipitates
and NH_3 off-gassing…

To be vetted: *A neutral pH favours microbial activity (as given by temperature) whereas the more acidic the broth*
the less nutrient loss.

The next series of trials will use nitric acid instead of phosphoric as the pH control agent. Having less phosphate in the broth should help minimize nutrient loss due to phosphate precipitates; suspect the additional nitrogen will boost the temperature. This series will utilize a different oxygen delivery system which will allow a threefold increase in oxygen flow.

Initial thoughts for using our solutions for field fertigation trials suspect the phosphate levels to be too high – using nitric (or sulphuric) acid will decrease the phosphate levels and may lead to less nutrient loss due to phosphate precipitates.

Please note attached:

I. Trial 4 Fermentation Run graphs - highlights:
    i. the temperature doubled by day 2 but the maximum 10 lpm of oxygen was unable to keep up to the microorganism demand
    ii. reducing the oxygen to 7 lpm [to lower the foam] caused a temperature drop similar to Trial 3's lowering to 5 lpm
    iii. no foam (nutrients) were lost

iv. canola oil as an antifoam agent (greatest volume added to date > 200 mL) was used in addition to a silicone based antifoam agent likely contributed to decreased themophilic temperatures below 60 °C

II. Trial 4 Nutrient and Mineral Profiles - highlights:
   i. phosphate increased up to 5,200 ppm (rather than decline after a peak) throughout the run
   ii. it took ~1/3 more H_3PO_4 acid to maintain pH 6.3 compared to 7.3
   iii. ammonium NH_4 displayed a similar curve as phosphate [constant build up to 2,700 ppm] Trial 3 peaked at day 9 to 2,000+ ppm then declined to 1,600 [pH induced off-gassing?
   iv. dissolved calcium maintained its asymptotic curve but had twice the final concentration (60 ppm) than ~neutral pH Trial 3
   v. there was more potassium, dissolved solids and the hardness ($CaCO_3$) was also greater

From the graphs, the dissolved nutrient concentrations appear ~constant after day 9 (or so…) yet the continuation of themophilic conditions indicates microbial activity. Does this suggest as one community dies out, another starts up by digesting the previous community or does the mineralization process continue (albeit to a lesser extent) by digesting the more difficult to breakdown components?

Future work will involve the use of flocculation agents to decant the broth after 2 weeks of fermentation as a means to investigate the merit of shorter fermentation cycles. So far 30 day cycles yield the most decant… A Scope of Work / General Service Contract is underway for a water treatment company to determine the best flocculating agent to get our decant product – the goal is to obtain *more* and *clearer* decant per batch in the *shortest period* of time.

III. Trial 5 Fermentation Graphs - highlights: the temperature almost tripled after one day – with No Foam although antifoam was added at t = 0; it had a peculiar odour (as does Trial 6) oxygen limitation is the suspected cause – the smell wasn't the typical anaerobic (H_2S) smell.

IV. Trial 5 Nutrient and Mineral Profiles – highlights. An overall increase in nutrients and minerals (due to higher % Dry Matter i.e. fed the bioreactor more manure) – also had higher nutrient loss in particular manganese likely due to higher pH 6.8. There was an increase in bound metals (Mn, Fe and Zn) don't know how this relates to phosphate precipitates i.e. does this analysis "un-bound" phosphate precipitates?

V. Decant vs Residual (Mother Liquor) highlights the differences and value of mother liquor