Performance Testing of Screw-Press Solid Separators: Comprehensive Solids Analysis and Nutrient Partitioning

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Vincent KP-6L

Vincent KP-6L Screw Press Solids Separator with $^3/_8$ x $^3/_8$" notched screw and 0.050" screen

PressTech Agri-Press

PressTech Agri-Press with a Continuous Flight Screw and a 0.006" Wedge-wire Screen Preceded by a Bauer Hydro-sieve Static Screen

Introduction

A standard performance testing protocol for mechanical manure solids separators has been developed and tested. The protocol measures separator press-liquor throughput and dry-mass capture efficiency across a range of input total solids (TS) concentrations. Preferential partitioning of nutrients into the solid or liquid phase was also measured.

This protocol was used to test two commercially available screw-press manure solids separators, a *Vincent* KP-6L and a *PressTech* Agri-Press, with dairy manure slurries. Direct comparisons cannot be made between the two screw-presses because the Agri-Press was not tested as a stand–alone unit; it was preceded by a Bauer hydro-sieve static screen.

Materials & Methods

Performance tests were conducted at the University of Tennessee Dairy Experiment Station in Lewisburg, TN. It is a 175-cow facility using a scrape waste collection system.

Test Procedure

- Manure & bedding were scraped & stored prior to testing (~20% TS)
- Scraped solids & dilution water were mixed to achieve 10% TS
- Slurry was pumped from the tank to the separator
- Test duration was based on the time required to recover ~50 gal of press-liquor
- Press-cake & press-liquor volumes were weighed on load cells
- After testing 10% TS, the slurry was subsequently diluted, mixed & tested at 8, 6, 4, 2 & 1%TS
- Samples were analyzed for TS, VS, soluble P, total P & TKN

Dry-mass capture efficiency was calculated as follows:

$$\text{Dry-mass capture efficiency} = \frac{m_{in}(\%TS_{in}) - m_{PL}(\%TS_{PL})}{m_{in}(\%TS_{in})} \times 100 = \frac{m_{PC}(\%TS_{PC})}{m_{in}(\%TS_{in})} \times 100$$

Where m_{in} is mass influent, m_{PL} is mass press-liquor and m_{PC} is mass press-cake.

Summary

The results illustrate the importance of having performance data specific to the manure that the unit will be operated with. Test results provide a comprehensive analysis of the evaluated unit; thus allowing a planner to estimate the expected through put of material, the resulting mass of solids to be removed and the total solids (TS) content of the pressed cake as affected by the influent TS concentration. This is important information when sizing process sumps and solids storage areas; it is critical to selecting a unit that can be operated in the time frame desired by the dairy operator.

Acknowledgements Vincent Corp., Press Technology & Manufacturing, Inc., Adam Daugherty, UT Dairy Experiment Station, Galena Melnichenko

Vincent KP-6L

Solids analysis

- Evaluated at TS concentrations ranging from 0.4 to 7% TS
- Press-liquor flow rate increased as influent TS decreased (Fig. 1)
- Press-cake consistency remained constant throughout the test
  - *average press-cake TS was 28.9% (± 1.3%) (Fig. 1)*
- Dry-mass capture efficiency decreased with decreasing TS (Fig.2)

Nutrient partitioning

- TP and TKN were preferentially partitioned into the press-cake (Fig. 3)
  - *greater partitioning was noted in slurries with lower TS influent*
- Soluble P preferentially partitioned into the press-liquor (Fig. 3)

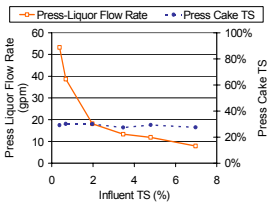

Figure 1. Press-liquor Flow Rate and Press-cake Total Solids from KP-6L as Affected by Influent TS

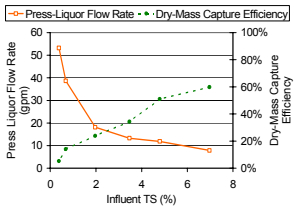

Figure 2. Dry-mass Capture Efficiency by KP-6L as Affected by Influent Total Solids.

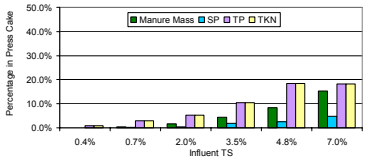

Figure 3. Nutrient Partitioning – Percentage of Constituent within the Press-Cake on a Wet Basis

PressTech Agri-Press

The separation system tested utilized a static-screen pre-thickening unit and an Agri-Press screw-press unit. Results listed here show overall system performance, not that of the screw-press alone.

Solids analysis

- Evaluated at TS concentrations between 1.2 to 8.5%
- Press-liquor flow rate increased as influent TS decreased (Fig. 4)
- Press-cake consistency remained constant throughout the test (Fig. 4)
  - *average press-cake TS was 29.7% (± 5%)*
- Dry-mass capture efficiency remained fairly constant
  - average dry-mass capture efficiency was 32.1 (± 8.5%) (Fig. 5)

Nutrient partitioning

- TP and TKN were preferentially partitioned into the press-cake (Fig. 6)
- Soluble P was preferentially partitioned into the press-cake in higher TS input slurries (Fig. 6).

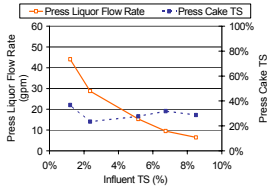

Figure 4. Press-liquor Flow Rate and Press-cake Total Solids from Agri-Press as Affected by Influent TS

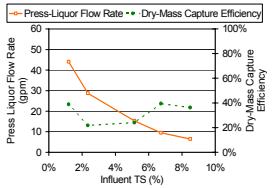

Figure 5. Dry-mass Capture Efficiency by Agri-Press as Affected by Influent Total Solids.

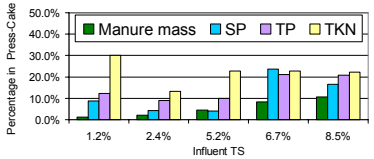

Figure 6. Nutrient Partitioning – Percentage of Constituent within the Press-cake on a Wet Basis