Removal of Solids and Major Plant Nutrients from Swine Manure Using a Screw Press Separator

SUMMARY

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Most swine production facilities in the United States, Canada, and Europe use liquid or slurry manure handling systems to facilitate the mechanization of collection, transfer, storage, and land application tasks. In cold climates, slurry swine manure is often stored until conditions are favorable for land application in lined earthen basins, below or above ground storage tanks, or in pits below slotted floors. In temperate and warm climates, it is common to treat and store swine manure in anaerobic or facultative lagoons. Liquid-solid separation has traditionally been viewed as a method to improve the pumping and irrigation characteristics of liquid manure, to generate solids for composting, and to use separated solids for refeeding (Lindley, 1982; Fedler et al., 1985; McClaskey, 1985).

Liquid-solid separation via gravity settling has been used extensively to reduce the solids content in feedlot runoff and flushed dairy manure. Mechanical separation techniques have been widely used with flush manure handling systems in dairy housing facilities. However, liquid-solid separation techniques have not been widely used in swine manure handling systems.

A screw press separator, loaned from FAN Separator ®, USA [1], was used to process swine manure from feeder-to-finish buildings that had a pit-recharge manure handling system. The objectives of the study were to:

1. observe the variation in the total solids concentration (TS) in the manure as a recharge pit is emptied,
2. determine the amount of TS, VS, COD, N, P, and K removed by the screw press, and
3. measure the dry matter and major plant nutrient content of the separated solids.

A screw press separator was temporarily installed on a commercial swine farm in Horry County, South Carolina. The separator had a 0.5 mm screen and was operated with a single 40 kg weight on each pressure plate arm. Samples were collected and analyzed to determine the variation in the removal of solids, chemical oxygen demand, and major plant nutrients. Prediction equations were developed from the data to describe the removal of TS, VS, COD, TKN, NH_4-N, organic-N, and TP. Separated solids were analyzed to determine the percent TS and the concentration of major plant nutrients. The prediction equations were used to calculate separator performance for a recharge pit with an average TS concentration of 20 g/L.

The following conclusions were developed based on the data and analyses.

- The amount of TS and VS removed by the separator increased in a parabolic manner with respect to total solids concentration of the separator influent (TS_{IN}).

- The percent TS removed varied from zero at TS_{IN} = 11.1 g/L to 24% at TS_{IN} = 70 g/L.
- The percentage of VS removed by the separator ranged from 1% to 31.7%.
- The screw press removed 34.9% of the COD from swine manure regardless of TS_{IN}.
- The concentrations of VS, TKN, NH_4-N, organic-N, and TP in the influent and effluent were found to correlate well with the total solids content. In addition, the regression equations for the VS, and major plant nutrients were not significantly different for the separator influent and effluent. Therefore, the reduction in volatile solids, nitrogen, and phosphorous due to liquid-solid separation was explained by the decrease in TS.
- The concentration of total potassium (TK) did not correlate with TS and was the same in the influent and effluent.
- The percentage of TKN, NH_4-N, organic-N, and TP removed by the separator increased with influent TS concentration in a similar manner as the removal of total solids. The amount of TKN removed ranged from 0 to 20.0%, removal of organic-N ranged from 0 to 23.8%, and the removal of TP ranged from 0 to 24.0%.
- The total solids content of the separated solids ranged from 22.6 % to 34.4%. The separated solids piled easily and did not emit a strong odor. The only plant nutrient concentrations that varied with the solids content were the organic-N, and TKN. On the average, 72% of the TKN was organic.
- The separated liquid was dark in color and would require additional treatment to reduce the odor generation potential.
- The actual removal of solids and plant nutrients from swine manure by a screw press will vary with the management of the building and how the separator is implemented in the manure handling system. For a typical pit-recharge swine building (TS_{AVE} = 20 g/L, settled layer TS = 55 g/L) a screw press would be expected to remove 14.9% of the TS, 19.6% of the VS, 9.2% of the TKN, 16.0% of the organic-N, and 14.8% of the TP added to the pit by the housed swine

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[1] Clemson University and Clemson University Extension does not endorse or recommend the FAN screw press over any other type of screw press separator that may be available.