Effect of Slurry acidification on solid-liquid Separation and characteristics of resulting fractions

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Introduction

Acidification

Acidification of animal slurries reduces ammonia emissions and affects composition of the slurry by modification of physical and biochemical properties.

Since composition is modified, acidification may affect separation process.

Fertilizing value of slurry increases since less nitrogen is lost, environmental pollution minimized and health of animals protected.

Solid-liquid Separation

Widely used at farm scale as management tool:

Allows farmers to better handle the slurry fractions obtained.

Transportation costs are reduced by concentration of nutrients and dry matter in the solid fraction, avoiding unnecessary storage capacity in the farms.

Can be performed using several processes: Screw press, sieving, centrifugation or sedimentation.

Separation efficiency is affected by slurry composition and technique used.

Acidification + Solid-liquid Separation

- A combined process is of interest since both approaches are complementary and acidification may affect separation efficiency.
- A combined treatment should efficiently prevent gaseous emissions, increase fertilizer value of slurry and reduce transport and energy costs.

Objective To combine acidification with two separation techniques (Screw press and Centrifugation) and assess the effect of acidification with H_2SO_4 on the characteristics of the resulting solid and liquid fractions.

Materials and Methods

- Concentrated H_2SO_4 was used to acidify fresh pig slurry from a farm in Torino from pH 7.4 to pH 5.5.
- Screw press (SP) (Fig.1a) and centrifugation (CF) (Fig. 1b) were tested separately and in combination.
- The effect of slurry acidification with H_2SO_4 on solid and liquid fractions composition was analyzed (Table 1).
- Fertilizer value evaluated by potential of N mineralization (PNM) after incubation 8 days at 40° C (Fig. 1c).

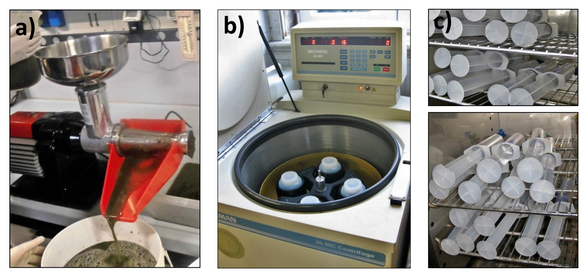

Fig. 1. a)Screw Press, b)Centrifuge and c)Syringe Incubation for 8 days at 40° C

Results and Conclusions

- Acidification increased DM content being significantly higher in solid fraction (S) obtained by SP. That increase may be the reason of the proportion increment of S obtained when acidifying by using both techniques.
- Total C increased when acidifying due to inhibition of the organic matter turnover on microbial decomposition (Sorensen et al., 2009). Both separation techniques showed higher amounts of total C in SFs than LFs.
- Soluble C decreased when acidifying due to inorganic C removal (Fangueiro et al., 2009).
- Total phosphorus (P_t) was higher in S fractions than L by both techniques.
- Acidification promoted a significant increment of P_t in S by SP and a decrease in S by CF. Acidification promote P solubilization appearing higher content in LFs.

Table 1. Characterization of acidified and non-acidified pig slurry and obtained fractions by mean values of 3 replicates in weight basis followed by letters showing significant differences (P<0.05).

Samples	% of WS	DM (g Kg^{-1})	N_t (g Kg^{-1})	$N\text{-}NH_4^+$ (g Kg^{-1})	P_t (g Kg^{-1})	P sol (g Kg^{-1})	C_t (g Kg^{-1})	C_t sol (g Kg^{-1})
WS	-	33.8^{g}	3.4^{e}	1.8^{de}	0.6^{f}	0.0^{e}	25.0^{g}	4.2^{bc}
AWS	-	38.9^{f}	3.3^{e}	1.7^{e}	0.8^{e}	0.3^{bc}	27.7^{f}	3.2^{d}
SP-L	90	23.5^{i}	3.1^{fg}	1.8^{cde}	0.5^{fg}	0.0^{e}	16.1^{i}	4.7^{bc}
SP-S	10	137.4^{b}	4.6^{b}	1.9^{bcd}	1.9^{c}	0.0^{e}	120.6^{b}	4.4^{bc}
CF-L	71	15.4^{j}	2.8^{h}	1.9^{abc}	0.6^{fg}	0.0^{e}	10.4^{k}	6.9^{a}
CF-S	29	105.7^{d}	4.6^{b}	2.0^{ab}	1.9^{b}	0.0^{e}	85.3^{d}	4.9^{bc}
SP-AL	87	29.1^{h}	3.2^{f}	2.0^{ab}	(0.1)^{h}	0.3^{a}	18.6^{h}	4.9^{b}
SP-AS	13	151.6^{a}	4.3^{c}	1.9^{abc}	1.9^{b}	0.2^{d}	128.5^{a}	4.4^{bc}
CF-AL	67	22.8^{i}	3.0^{g}	2.0^{ab}	0.4^{fg}	0.3^{a}	13.3^{j}	4.5^{bc}
CF-AS	33	95.6^{e}	4.1^{d}	1.9^{abc}	1.4^{d}	0.3^{bc}	77.3^{e}	4.0^{cd}
SP+CF-AL	92	22.6^{i}	3.0^{g}	2.1^{a}	0.4^{g}	0.3^{ab}	13.2^{j}	4.2^{bc}
SP+CF-AS	8	125.4^{c}	5.6^{a}	2.0^{ab}	2.4^{a}	0.3^{cd}	96.1^{c}	4.2^{bc}

WS: Whole Slurry; **AWS**: Acidified Whole Slurry; **SP**: Screw Press; **CF:** Centrifuge; **L**: Liquid Fraction; **S**:Solid fraction; **SP+CF-AL**: Liquid fraction from CF of acidified L from SP. **SP+CF-AS**: Solid fraction from CF of acidified L from SP.

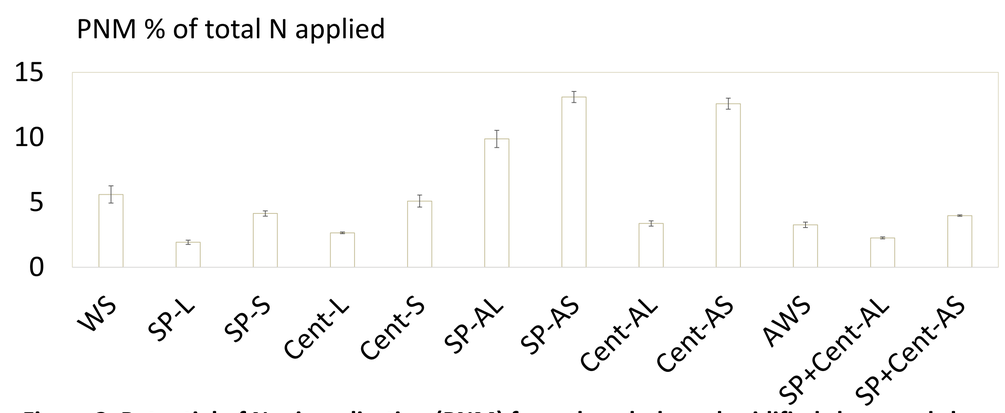

Figure 2. Potential of N mineralization (PNM) from the whole and acidified slurry and slurry fractions as % of total N applied.

- Total N content was higher in SFs increasing significantly when acidifying and using SP and obtaining the highest amount in SF from combination of both techniques.
- N mineralization occurred in all samples studied (Figure 2) and no immobilization was observed.
- The highest PNM value observed was in acidified solid fraction from screw press.
- The PNM increased in acidified SFs as well as in the acidified liquid fraction from screw press which also had the highest C:N ratio observed. Therefore, acidification may promote N mineralization.

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ReUseWaste