

Efficient Solid-liquid Separation of Pig Manure Using Acidification and Coagulation

Lin Shi and Xinmin Zhan

Civil Engineering
NUI Galway, Ireland
8th May. 2017



NUI Galway
OÉ Gaillimh



Hefei University
of Technology



China Scholarship Council
www.csc.edu.cn

Introduction

- More than 116 million tons of pork was produced in 2016.

Traditionally, pig manure is used for land application as it contains high concentrations nutrients (N and P).

- Pig manure is a big challenge for environment:
 - (1) Nearby lands is quite limited;
 - (2) Excessive pig manure application can cause the eutrophication.



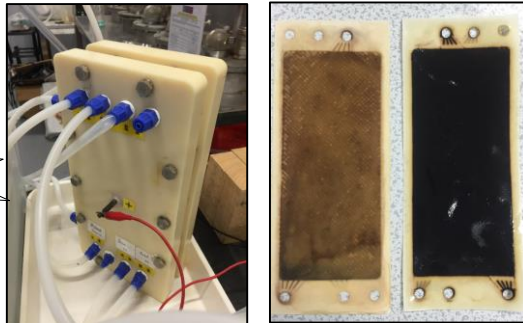
NUI Galway
OÉ Gaillimh

Introduction

Alternative strategy: **Recovery of nutrients.**

to extract and purer fertilizers via membrane process.

Electrodialysis (ED)



NUI Galway
OÉ Gaillimh

Introduction

Solid-liquid separation

- Coagulation and flocculation can improve the separation efficiency;
farmers separate the solid and liquid roughly
- Acidification may facilitate the hydrolysis of cellulose, release nutrients and aggregate fine particles.



Pig slurry 4% DM (medium soup)

Objective: to develop efficient solid-liquid separation methods



NUI Galway
OÉ Gaillimh

Materials and Methods

Pig manure was collected from a local pig farm in Galway County in Ireland. It had been kept in a pig slurry tank for many weeks before the collection.

Chemicals used:

- Acidification: HCl
- Flocculant:
 - Polyacrylamide (PAM)
- Coagulant:
 - PolyAluminum Chloride (PAC)



NUI Galway
OÉ Gaillimh

Materials and Methods

Coagulation/Flocculation Procedures:

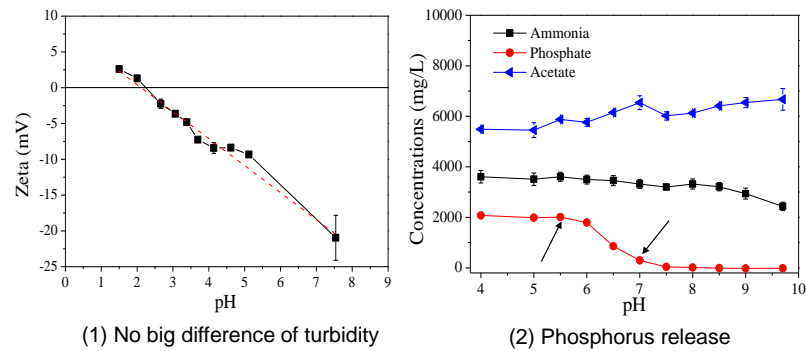
1. Add coagulant/polymer to 50 mL pig manure;
2. Mixing: (1) Fast mixing: 250 rpm for 2 mins.
(2) Slow mixing: 60 rpm for 10 mins.
3. Centrifuge at 3000 rpm (1500g) for 2 mins to simulate decanter centrifuge in pig farms.



NUI Galway
OÉ Gaillimh

Results and Discussion

Acidification

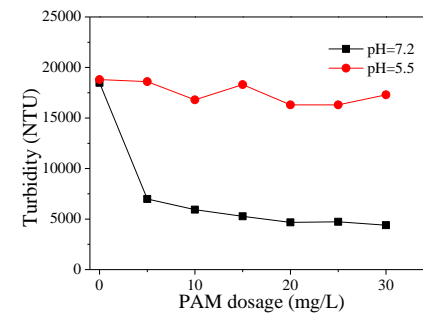


(1) No big difference of turbidity

(2) Phosphorus release

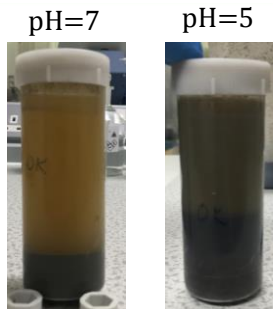
Results and Discussion

Flocculation (PAM)



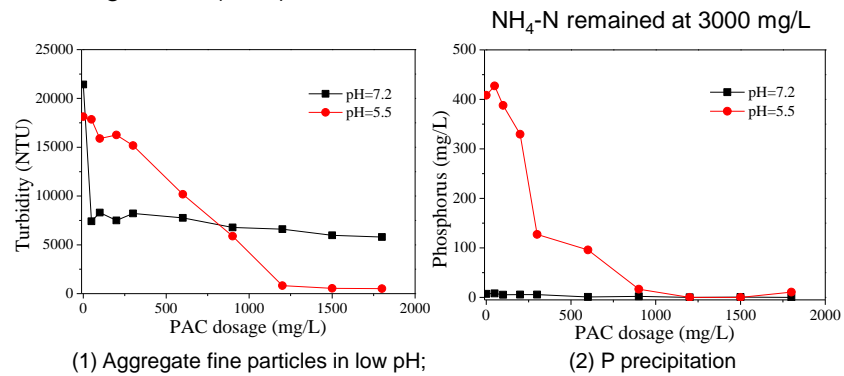
(1) Worked in raw pig manure, low dosage;

(2) could not remove nutrients



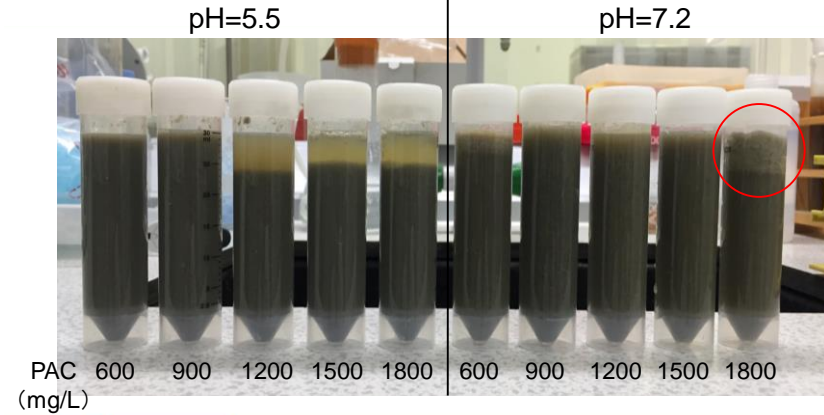
Results and Discussion

Coagulation (PAC)



NUI Galway
OÉ Gaillimh

Results and Discussion



NUI Galway
OÉ Gaillimh

Materials and Methods

Combination of flocculation, acidification and coagulation

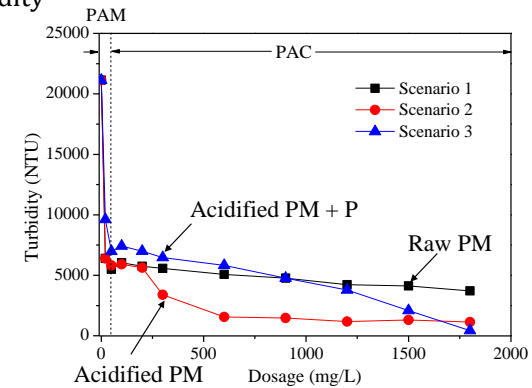
Table 1. Operational conditions of the experiment

Procedures	Scenario 1	Scenario 2	Scenario 3
Flocculation	20 mg/L PAM	20 mg/L PAM	20 mg/L PAM
Acidification I	–	–	to pH=5.5
Centrifugation I	1500 g	1500 g	1500 g
Acidification II	–	to pH=5.5	–
Coagulation	0~1800 mg/L PAC	0~1800 mg/L PAC	0~1800 mg/L PAC
Centrifugation II	1500 g	1500 g	1500 g



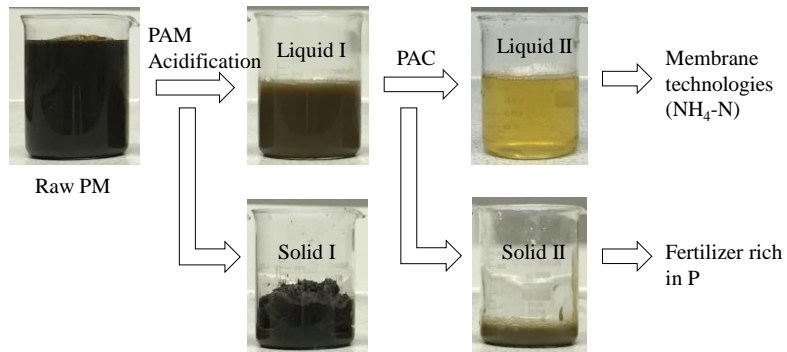
Results and Discussion

Turbidity



Results and Discussion

Two Stage Solid-liquid Separation Strategy:



Conclusions

(1) Coagulation and flocculation could decrease the turbidity of raw pig manure.

(2) Acidification and P precipitation could facilitate the solid-liquid separation.

Further work are needed to investigate the separation mechanisms

Thank you !

This research was supported by China Scholarship Council and Natural Science and Foundation of China (Ref: 51578205).

