Impact of sludge storage duration on its dewatering and drying ability

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Context

Annual production of sewage sludge in Europe is estimated at more than twelve million tons of dry matter. Use in agriculture and incineration are the main ways of valorization. In this context, sludge drying appears as an essential step after mechanical dewatering. It reduces the costs of storage and transport, allows the stabilization and the hygienization of sludge while increasing its calorific value. However, sludge is a colloidal system in which particle form a stable suspension in water, making him difficult to be separated from water. The addition of polyelectrolytes chemical is necessary to help the sludge particles to agglomerate into large flocs that can be separate by mechanical dewatering. Before studying experimentally the influence of polymer's type and dosage on dewatering performances and subsequent drying behaviour, it is necessary to assess the sludge variability during storage duration, because sludge is a highly fermentable material whose properties and composition can rapidly change.

Materials and Methods

Experimental design

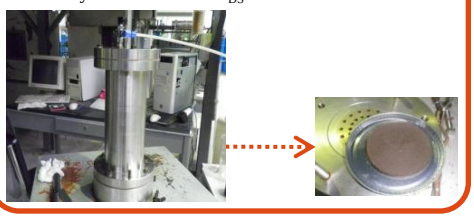
- Storage
  - Room temperature (25°C)
  - Continuous stirred
- Conditioning experiments:
  - Trial 1 : 1 per week during 3 weeks
  - Trial 2 : 1 per day during 1 week

Sewage sludge samples conditioning

- WWTP Grosses Battes, Liège, Belgium
- Collected after thickening
- Dry Solids content (DS) = 0.8±0.1%
- Volatile Solids content (VS) = 38 ±0.4% of Dry Solids content
- Polyelectrolyte: Zetag (18 g/kg$_{DS}$)
- Flocculation in Jar test:
  - Step 1: 200 rpm, 1 min
  - Step 2: 40 rpm, 3 min

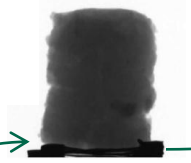
Mechanical dewatering in a normalized filtration-expression cell

- Applied pressure = 5 bar
- Cake dryness = 15.2±0.2 %$_{DS}$



Convective drying tests

- T = 130 °C
- V = 1 m/s
- Y = 0.005 kg$_{water}$/ kg$_{DA}$
- Cylindrical samples :
  - Height = 14 mm
  - Diameter = 14 mm
  - Initial weight = 2.5 g



Sludge projection

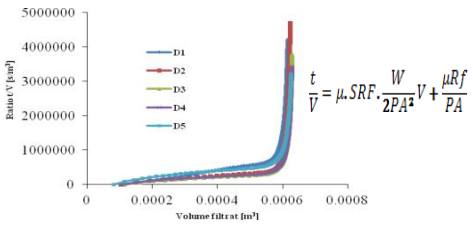
X-ray microtomography

- Use to determine sample surface area
- Image analysis (Matlab)
- Continuous drying → Velocity
- Intermittent drying → Surface
  - Every 5 min during the first 20 min
  - Every 10 min after
  - → 10 trials

→ **Flux**

Results

Impact of storage duration on the dewatering process

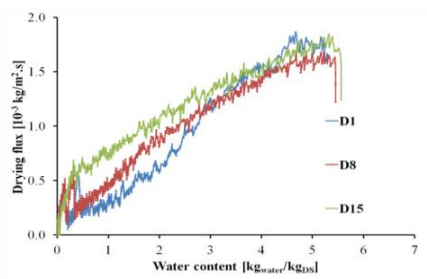


$$\frac{t}{V} = \mu.SRF.\frac{W}{2PA^2}V + \frac{\mu Rf}{PA}$$

	Trial 1			Trial 2				
Trials [days]	1	8	15	1	2	3	4	5
SRF [10^{13}m/kg]	3.16	5.12	6.13	1.58	1.35	1.28	1.07	1.08
Cake dryness [%]	16.6 ±0.2	14.9 ±0.2	14.1 ±0.2	15.5 ±0.1	15.1 ±0.6	14.6 ±0.4	14.8 ±0.5	14.6 ±0.3

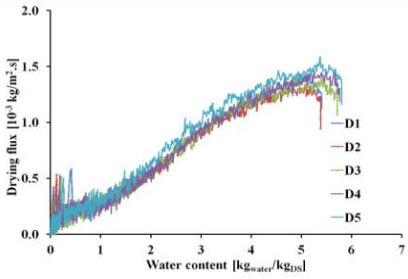
- The SRF value during the A series of experiments increased from 3 to 6.10^{13} m/kg and leading to decrease cake dryness, that indicated a worse sludge filterability.
- For B experiment, SRF remained constant and lowest, a good sludge filterability is obtained.

Krischer's curves during the drying at 1, 8 and 15 days of storage.



- Results show a large differences during the falling drying flux period at 1, 8, and 15 days of storage, consequently a poor repeatability is observed.

Krischer's curves during the drying at 1, 2, 3, 4 and 5 days of storage.



- A good repeatability is obtained for the drying curves obtained after weekly storage.

→ **No significant effect of sludge variability in successive 5 days, weekly renewal will be consider.**

→ **Reduce storage time can lead at a best sludge dewatering.**

Conclusion and Prospects

This preliminary work was an attempt to put in evidence the impact of sludge storage duration on both its dewatering and drying behaviours. About the dewatering process of the conditioned sludge, results reported that from a storage time longer than a week, an increase of the specific resistance to filtration is observed and, consequently provided a worse filterability.

Concerning convective drying, a good repeatability has shown for the drying curves obtained during 5 successive days from the collect day, whereas for sludge stored during more than one week, different drying behaviours were obtained. So it is advisable to use sample during five days and to consider a weekly renewal. In future paper, the impact of polyelectrolytes type and dosage at lab scale on the dewatering and drying process will be investigated more deeply.