IMPACT OF SLUDGE STORAGE ON DEWATERING AND CONVECTIVE DRYING

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Context

Annual production of sewage sludge in Europe is estimated at more than ten 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, this process is highly energy consuming and still needs to be optimized as it constitutes an important economic and environmental issue. This implies the improvement of knowledge about sludge drying, including the impact of the mechanical dewatering step. Before studying experimentally the influence of polymers type and dosage use for dewatering on the rheological properties and the drying process, it is necessary to assess the stability of the sludge during of the storage. Because sludge is a living material that can rapidly change, we use the method of experimental design in order to get maximum information with minimal testing, regarding sludge stability during storage.

Materials and Methods

Experimental design

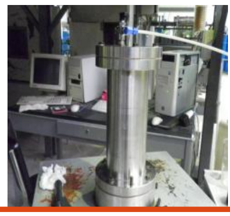
- 3 samples
  - Same measurements
  - 1 per week during 3 weeks
- Storage
  - Room temperature
  - Open container
  - Stirred

Sewage sludge samples conditioning

- WWTP of AIDE, Grosses Battes, Liège, Belgium
- Collected after thickening
- Dry Solids content (DS) = 1%
- Volatile Solids content (VS) = 37 % 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

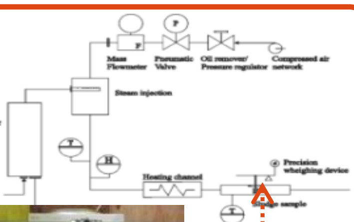
Mechanical dewatering in a normalized filtration-expression cell

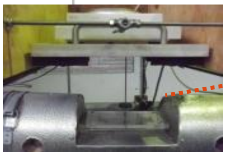
- Applied pressure = 5 bar
- Cake dryness = 17 $\%_{DS}$

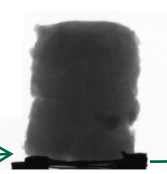


Convective drying tests

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







Sludge projection

X-ray microtomography

- Use to determine sample surface area
- Resolution : 41 µm
- Intermittent drying
  - Every 5 min during the first 20 min
  - Every 10 min after
    - ➔10 trials

Results

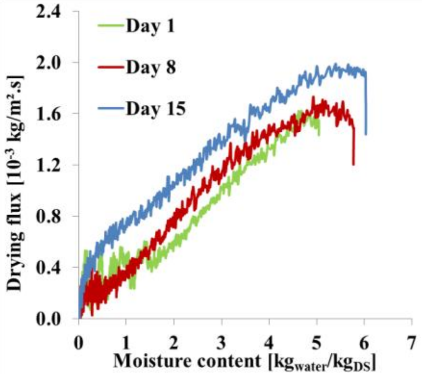
Impact of storage on DS, VS and Specific Resistance to Filtration

Sludge	Days	DS [%]	VS [%]	SRF [10^{13} m/kg]
A	1	1.04	35.4	1.14
	8	0.97	37.5	2.56
	15	0.88	40.4	1.76
B	1	0.74	35.4	5.08
	8	0.68	38.6	12.8
	15	0.64	41.3	23.1
C	1	0.78	36.5	7.41
	8	0.71	39.4	8.93
	15	0.65	40.9	21.5

- **An increasing of sludge age results in a decrease of initial dry matter content, an increase of both organic matter and in some cases SRF, that affects sludge filterability.**

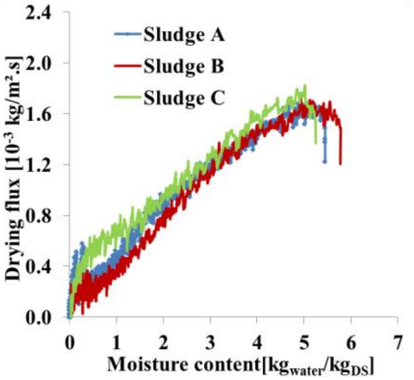
*(The **Krischer curves** represent the drying flux in function of sample moisture content expressed on a dry basis)*

Krischer curves for 3 increasing storage duration for sludge B



- **Results show that drying curves are similar for the 1st and the 8th day of storage.**
- **Drying kinetics is increasing after storage for 15 days for the same sludge sample.**

Krischer curves for 3 samples at day 8



- **Drying kinetic appears identical for the three samples of sludge on the 8th day.**
- **The same behavior is obtained for the 1st and 15th day.**

➡ **No significant effect of sludge variability in a week**

Conclusion and Prospects

This preliminary work was an attempt to put in evidence the impact of sludge storage. The results show that the drying kinetics is the same for the different sludge samples at each period of storage. This reflects a similar behavior for each period of time. Against, the kinetics are different for the same sludge at the end of increasing periods of storage, but similar for the 1st and the 8th day. For a better sludge stability, it is advised to consider a weekly renewal rather than keeping a long storage. Concerning dewatering, results show also that an increase of storage leads to the increasing of the specific resistance to filtration, and consequently provides a poor filterability.

In future works, the impact of polyelectrolytes type and dosage conditioning at lab scale will be investigated on dewatering, drying process and rheological measurements. The optimum dosage will be predicted by Capillary Suction Time (CST) and zeta potential determination.