Geotextile Filter Bags as a Cost-Effective Dewatering Solution for Agri-Food Wastewater Sludge (Wallonia – Belgium)

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➢ INTRODUCTION

Context & Challenges: SMEs in Wallonia

- High economy participation → 20.8% of Wallonia industrial revenue.
- Located in rural areas → Limited resources for WWT.
- Non compatibility with existing WWT technologies → Oversized, energy-intensive, chemically demanding, too complex and enormous cost for small operations.
- Needs → adaptable, low cost and sustainable WWT solutions.
- SWAM@SC Project → Multidisciplinary approach and resources.

Filter Bags (Geotextile Tubes)

Gravity-driven method for sludge dewatering. The solid retain is due to porous structure of the textile that allows water to drain.

Limitations:
- High filtration time.
- Storage requirement.
- Risk of sludge fermentation.
- Requires flocculation.

Advantages:
- Adaptable to small quantities.
- No specialized equipment.
- Easy to install and operate.
- Local furnishers.

Objectives and Impact

- Evaluate geotextile filter bags as solution for sludge dewatering.
- Various geotextile and filter materials were evaluated → Dehydration capacity ,cost, efficiency, and environmental compliance.
- Conduct laboratory and pilot-scale trials with real sludge from dairies, breweries, and meat-processing plants.

Keywords: Geotextile filtration, Dewatering, Wastewater Treatment.

➢ MATERIALS AND METHODS

Sampling
Samples from local WWTP Embour, Oupeye And Gosses-Battes
TSC : 20-50 g/L
Storage at 4°C 1 week

1. Raw Sludge Samples

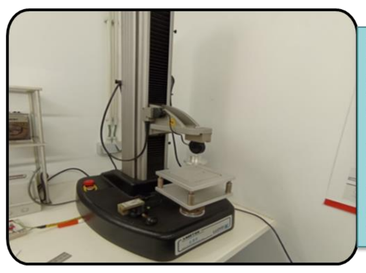
Standard Method

Drying at 105°C for 24h
Calcination at 550°C for 4h

2. Total Solid Content and Volatile Matter

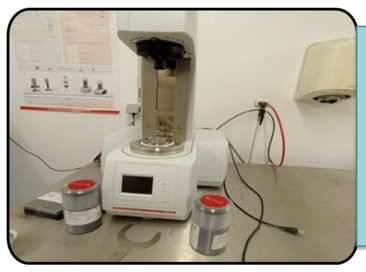
Standard Filtration Cell:
Jar test
Filtration: 1h at 5bar
Lianyl Filters C4/D/6
RSF → Filtration limits

3. Filtration test



Penetration:
60g; h=15 mm; V=1 mm/s
TPA:
Extruded cylinders
d=18 mm ; h=30 mm;
30% double compression

4. TPA and Penetration Test



Amplitude Sweep
γ=[0.01-100]%;
ω=1 Hz
1 min of pre-shearing
10 mins of recovery

5. Rheology Test

Filtration Performance Filter and filtration bag

100 ml → circular filter
10 and 50 L → Filter bag

6. Filter bag Test

➢ PRELIMINARY RESULTS

- Six different filtering tissues were tested, in four different conditions. Their filtration viability was assessed based on the presence (✗) or absence (✓) of solids in the filtered water.

Table . 1 Preliminary Screening of Filtering Tissues Based on Solids Retention After Pretreatment

Textile Sample	Tissue Material	Filtration opening (µm)	Viability for filtration: No treatment	Coagulation*	Flocculation **	Coagulation* and Flocculation**
T1	Polypropylene	40	✗	✓	✓	✓
T2		60	✗	✓	✓	✓
T3		120	✗	✓	✓	✓
T4		240	✗	✓	✓	✓
T5		330	✗	✗	✓	✓
T6	HD Polyethylene	400	✗	✗	✓	✓

*With $(Al(OH)_X\ Cl_Y)$
**Organic Polymer Klarfloc SPE 2523

- Tissues that achieved ✓ after coagulation, flocculation and both were retained for further testing.

- All geotextile materials tested in the 50 L trials showed similar filtration performance in terms of total solid concentration (TSC), with variations below 5%.

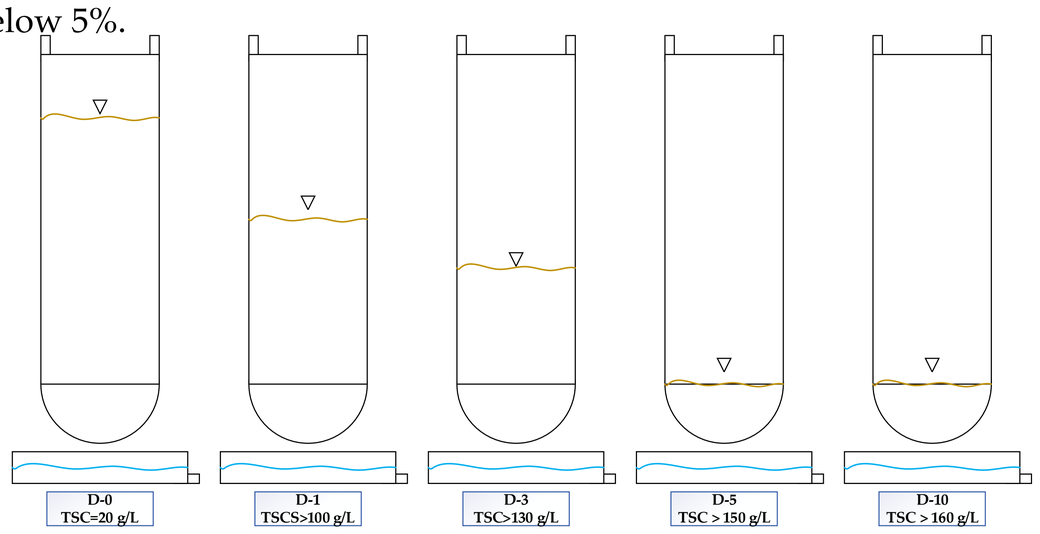


Figure . 1 Schematic bag filtration results

- Based on rheology, texture profile analysis (TPA), and penetration tests, a gradual decrease in storage modulus, hardness, and cohesiveness was observed during bag filtration, possibly due to sludge fermentation.
- Filtration using geotextiles stabilized at TSC values around 60% of those obtained through pressure filtration in the filtration cell.

➢ NEXT STEPS:

1. Pilot Construction & Commissioning

- Coagulation–flocculation module.
- 3-bag parallel filtration system, adjustable to multiple bag sizes.
- Mobile, modular, and easy to deploy.
- Sampling system for monitoring.
- Cycle capacity: 300 L.

2. Modular LCA Tool

- Combines multiple treatment technologies.
- Evaluates key environmental impacts.
- Includes water footprint.
- Excel-based: easy to use and interpret.
- Tailored for SME decision-making.

➢ PARTIAL CONCLUSIONS

- Geotextile bags offer a low-cost, low-energy dewatering solution for SMEs.
- All tested materials that passed the preliminary eliminatory test showed similar filtration performance (TSC variation < 5% at the end of the test).
- Sludge softens during filtration, likely due to fermentation.
- Achieved up to 60% of TSC compared to pressure filtration.
- The method can be scalable, simple, and site-adaptable.

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➢ ACKNOWLEDGMENTS

- The authors thank the Public Service of Wallonia and the European Regional Development Funds, Feder SWaM@Sc Project Portfolio.

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