Dehydrated sewage sludge viscoelastic behavior: impact of coagulant, flocculant and filtration pressure

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Introduction

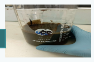
Variability

Sludge Origin
- Source: Industrial, domestic
- Composition: inorganic, organic

Sludge treatment
- Thickening
- Type and dosage of coagulant and flocculant
- Dehydration technology: filtration, centrifugation
- Storage time

Dehydrated sewage sludge viscoelastic behaviour

Laboratory scale the dehydration


Liquid sludge DS = 2%

Coagulant and Floculant addition


Flocculated sludge 2% < DS < 6%

Filtration


Dehydrated sludge 10% < DS < 30%

Keywords: Dehydrated Sewage Sludge, texture, rheology, viscoelasticity.

Problems
- Literature focused on liquid sludge
- Non standardized measurements
- Lack of data
- Pasty phase
- Loss of structure

Importance
- Predictable Behaviour: Consistency and Stability
- Improve pumping, mixing
- Enhance dewatering and drying
- Product Quality and Safety
- Reduce Operational Costs

Materials and Methods

Experimentation sequence


WWTP Embourg (Liège – Be)


Chemical Engineer Hall B17(a) - Ulg


Total solid content and Volatile Matter


Filtration and specific resistance to filtration


Capillary suction time (CST)


Jar test: Coagulation and floculation


Penetration and Texture profile analysis test


Rheology – Amplitude sweep

Results and Analysis

Three different types of flocculants where used in this study

Results

- The optimal dosage (OD) of flocculant was based on the minimal CST value, which corresponded to the minimal SFR value.

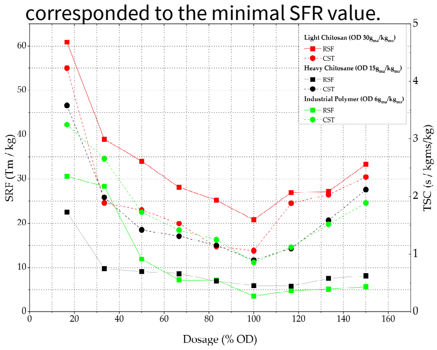


Fig. 1: Variation of TSC and SRF in relation with % of optimal flocculant dosage.

- Hardness and G' are proportional to the flocculant dosages until reaching an optimal limit where there is no further influence.

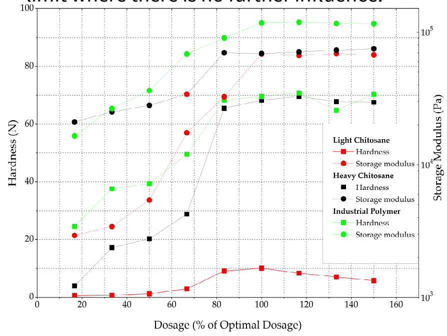


Fig. 2: Variation of hardness and storage modulus in relation to the % of optimal flocculant dosage.

- In the range of pressure studied, this variable did not show appreciable effects on hardness and the storage modulus G'

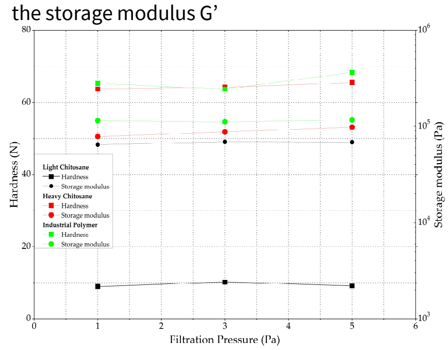


Fig. 3: Variation of hardness and storage modulus in relation to the filtration pressure

Conclusions

By systematically investigating and characterizing the viscoelastic properties of DSS, this study provides valuable data that can inform both academic research and practical applications in wastewater treatment. The study on the viscoelastic behavior of dehydrated sewage sludge (DSS) revealed several key findings:

- **Standard Methodology:** The methods used in this study represent a significant step towards the standardization of the characterization of dehydrated sewage sludge (DSS). This standardization is demonstrated by the reproducibility of the results and the similarities observed, even when different types of flocculants are used.
- **Optimal Dosage:** The optimal dosage (OD) of flocculant was determined based on the minimal Capillary Suction Time (CST) value, which also corresponded to the minimal Specific Resistance to Filtration (SFR) value.
- **Proportional Relationship:** Hardness and storage modulus (G') increased proportionally with the flocculant dosages until reaching an optimal limit, beyond which no further influence was observed.
- **Pressure Effects:** Within the studied pressure range, filtration pressure did not show appreciable effects on hardness and the storage modulus (G').

References

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