

A new and reliable method to measure cellulose in wastewater and sludge



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Introduction

- Cellulose from waste streams can become an attractive carbon source for the production of e.g. alternative fuels, bioplastics and flocculation material
- Municipal and domestic wastewaters are a potential source for cellulose recovery
- Toilet paper use in the Netherlands = 1 kg per person per month (*Ruiken et al. 2013*)
- This study shows a new and reliable method to measure the cellulose concentration in wastewater and sludge

Method

1. Extraction of cellulose from wastewater and sludge using sieves (stainless steel, 200 μm)
2. Drying of sieved material (115 $^{\circ}\text{C}$)

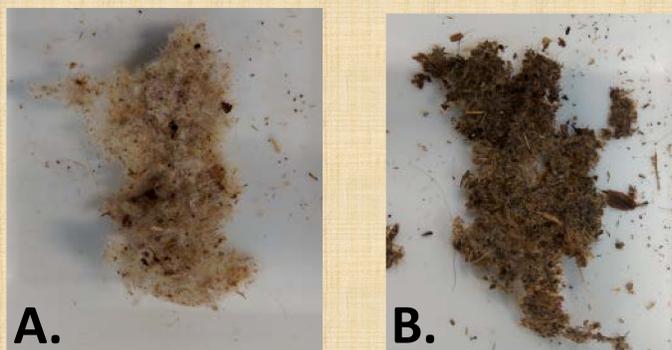


Fig. 1 Dried sieved material from wastewater (A.) and sludge (B.)

3. Digestion of known amount (e.g. 20 mg) sieved material with cellulase from *T. reesei* (Sigma Aldrich) at 40 $^{\circ}\text{C}$ in water/buffer in stirred tubes



Fig. 2 Set up for enzymatic digestion of sieved material

4. Enzymatic measurement of glucose concentration after centrifugation
5. Calculate converted cellulose content by using glucose concentration as follows:

$$\text{Converted cellulose (\%)} = \frac{\text{Glucose concentration, } \frac{\text{mg}}{\text{mL}} \cdot \text{buffer volume, mL}}{\text{substrate added, mg}} \cdot 100 \%$$

Results and conclusion

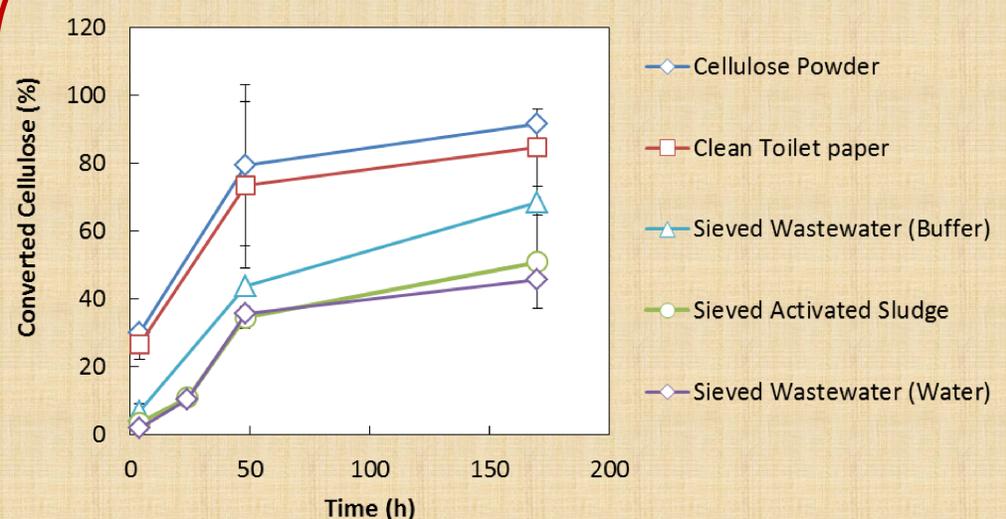


Fig. 3 Percentage of converted cellulose of cellulose powder (Avicel), toilet paper, wastewater and sludge

- Cellulose powder and clean toilet paper were used as a “standard” to determine required digestion time until 100 % cellulose was converted
- Cellulose content in wastewater sieving material was 70 % after 170 h when buffer was used as solvent
- Use of buffer avoided floating of sieved material on water surface, thus mixing and conversion of samples was improved (see results in which water was used)
- Cellulose content in activated sludge accounted for 50 % of dry matter

Outlook

- Compare enzymatic results with acidic hydrolysis
- Shorten time for enzymatic digestion e.g. by increasing temperature
- Measurement of cellulose content in various municipal wastewaters/sludges to test method stability including different matrices

References

Ruiken, C. J., et al. "Sieving wastewater–Cellulose recovery, economic and energy evaluation." *Water research* 47.1 (2013): 43-48.