Sensor-based material flow monitoring of drum sieve using 3D laser triangulation for automatic process evaluation

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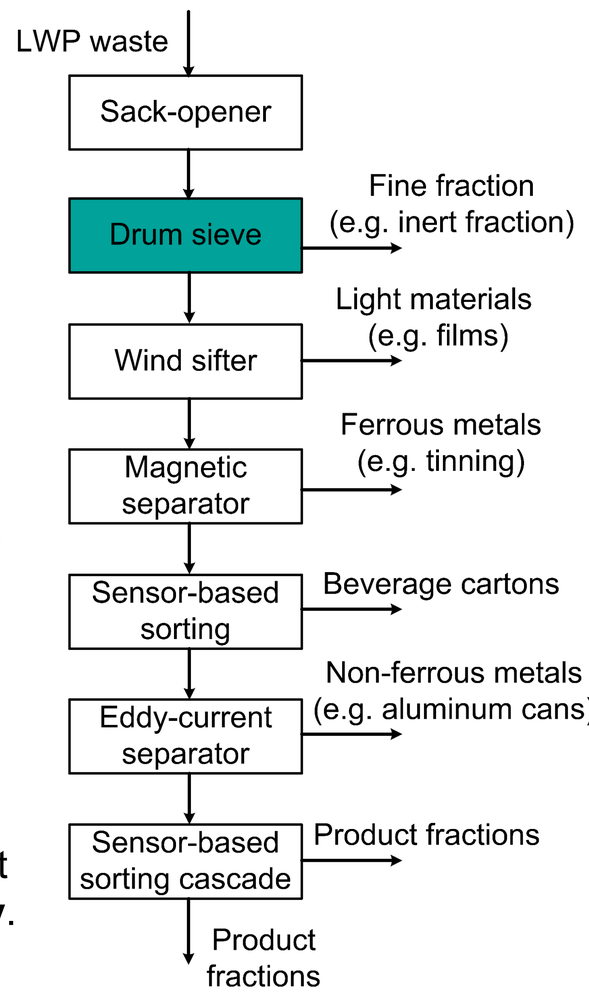
Motivation

- Only **30 wt%** of produced lightweight packaging is recycled.[1]
- **Automatic process control** could contribute to an improvement in sorting efficiency and overall mechanical recycling. [2]
- **Sensor-based material flow monitoring** [2] could contribute to the determination of parameters that cannot be measured manually.
- Aim: Determine influence of different parameters and possibility for a control concept to **improve sieving efficiency**.



Material and Method

Parameters

- Inclination angle*
- Rotation speed*
- Material feeding*
- 2D fraction share*

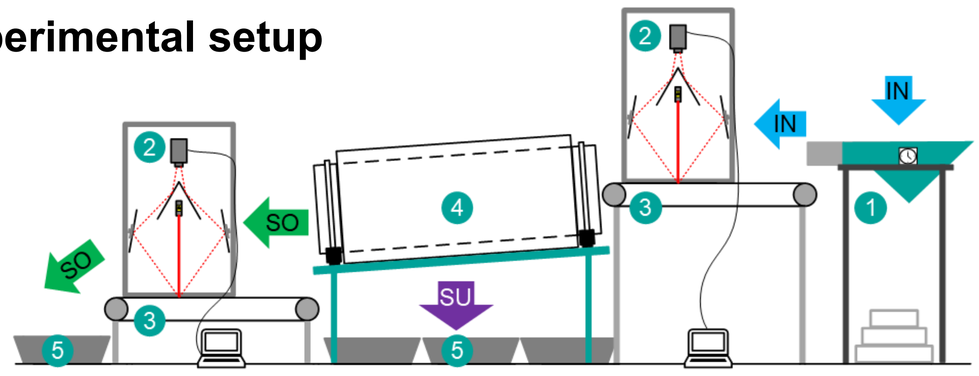
→ Filling level**

* manual setting

** measurement with sensors

Material

Experimental setup

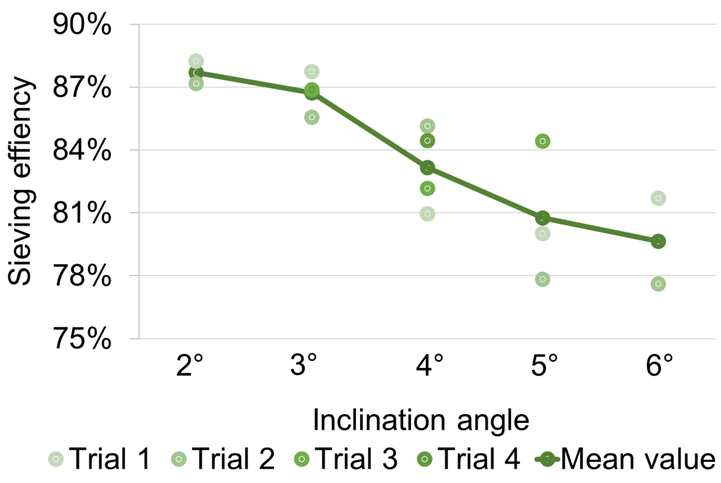


1 Vibrating chute with stopwatch
2 3DLT test rigs with data evaluation
3 Conveyer belt
4 Drum sieve
5 Collection of output material flows

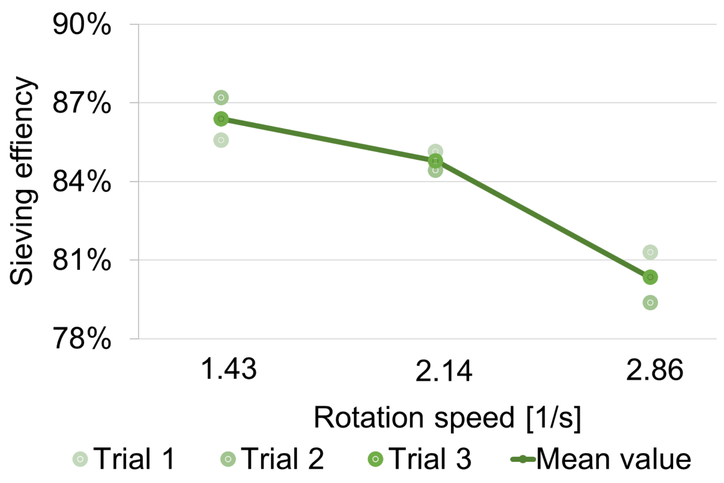
IN: Input; SO: Overflow; SU: Underflow; 3DLT: 3D laser triangulation

Results

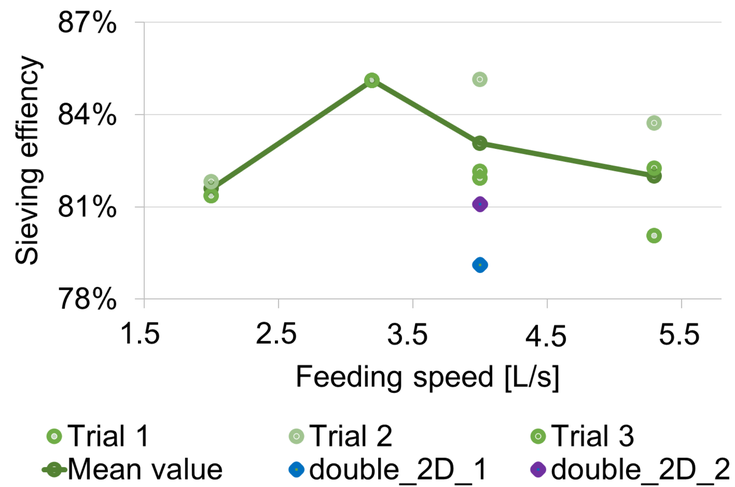
(a) Influence of inclination angle



(b) Influence of rotation speed



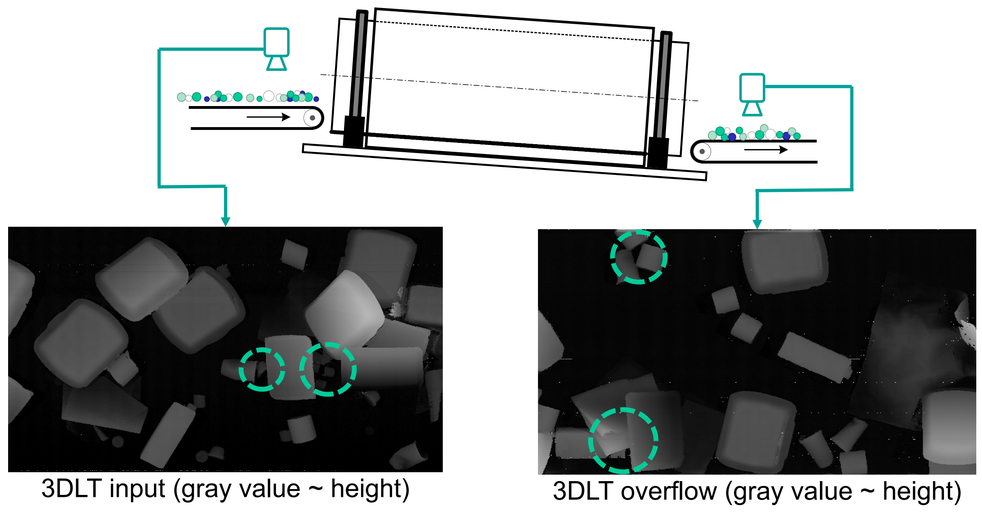
(c) Influence of feeding speed and 2D fraction share



Conclusion

► **3DLT can be used in drum sieve monitoring for lightweight packaging.**
- Online-determination of filling level is possible with presented test rig.
- Influence of filling level on sieving efficiency needs to be analyzed in combination with other parameters.
- Parameter settings could be automatically adjusted according to the 3DLT-based monitoring.

► **Due to the object overlapping, it is not possible to determine the screening efficiency online without segmentation algorithms**.
- Improvement in segmentation algorithms is necessary.



3DLT input (gray value ~ height)

3DLT overflow (gray value ~ height)

Reference

[1] Feil A, Coskun E, Bosling M, Kaufeld S, Pretz T. Improvement of the recycling of plastics in lightweight packaging treatment plants by a process control concept. *Waste Management & Research*. 2019;37(2):120-126. doi:10.1177/0734242X19826372.

[2] Kroell N, Chen X, Greiff K, Feil A. Optical sensors and machine learning algorithms in sensor-based material flow characterization for mechanical recycling processes: A systematic literature review. *Waste management* 2022;149:259–90. doi:10.1016/j.wasman.2022.05.015.

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