# Understanding and optimizing drum separators using DEM

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# Bühler is part of the everyday life of billions of people







#### Market leadership in the industries we are active in



#### Our sustainability commitment

#### -60%

We have developed a pathway to achieve a 60% reduction of greenhouse gas emissions in our operations by 2030

(Greenhouse Gas Protocol Scope 1 & 2, 2019 baseline)

- Reducing energy consumption
- Procurement of renewable energy
- Renewable energy on site

We have committed to having solutions ready to multiply by 2025 that reduce energy, waste, and water by 50% in our customers' value chains -50%

- Services (digital)
- Increasing circularity
- Energy efficient technologies

Bühler's CO2e\* emissions amount to 43.13 million tons/year

Scope 1 and 2 (own operations): 0.1 million ton | Scope 3 downstream (use of our products): 42 million tons | Scope 3 up- and downstream (Purchase goods and logistics): 1.0 million ton \*Baseline 2019 | Carbon dioxide equivalent or "CO2e" is a term for describing different greenhouse gases in a common unit (CO2, N2O, CH4, etc)

#### Simulation is virtual prototyping – learning – testing.





#### Drum Magnet Separator.





# Simulation goals.

Getting an optimal product distribution over the drum.



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#### Simulation set up.





#### Product and interactions properties.

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• Oat Grains as polyhedral shapes with 30 facets of constant size of 2.6 mm.



• **Grain-Grain**: Hysteretic linear spring contact model with normal and tangential dissipation coefficient.



• Grain-wall interaction: Inelastic collisions, Frictional interactions with the wall.



# Flap of 4 kg.



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# Analytical model to estimate the optimal mass.

- One degree of freedom simplified model to ٠ estimate the angle and the throughput.
- The damping coefficients and contact ٠ force can be calibrated to fit with the simulation model.
- Model used to estimate an optimized mass ٠ based on desired inclinaison angle and throughput.



[s]

# Influence of the flap weight.

-0.388

-0.5 0 0.5

1.5



-0.388

-0.5 0 0.5 1 1.5

3.5

2.5

4 4.5 5 5.5 Time (s) 6.5

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8.5

7.5

# Flap of 4.6 kg.



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#### Flap 4.6kg – Sheet Deflector vs Cone distributor



#### Particle mass distribution in width



#### Flap 4.6kg – Sheet Deflector vs Cone distributor



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# Biggest separator size with 20 million particles.



# Calculation time and hardware ressource.

- Simulation cases from 3M to 20M particles depending on machine size.
- 2-GPU Nvidia A100 40 GB RAM.
- Simulated time of 10s.



#### Conclusion and next steps.

- Particle simulation with Rocky DEM as key technology for drum separators
  - Try virtually and save development costs and time,
  - Optimize design parts such as weight flap or inlet distribution,
  - Understand and quantify complex flow behavior.
- Prototype tests ongoing for further validation.

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