UNIVERSITY OF FERRARA
- EX LABORE FRUCTUS -

11th OpenFOAM® Workshop
June 25-30, Guimarães, Portugal

IMPLEMENTATION AND EVALUATION OF AHLERT-MCLAURY EROSION MODEL ON A CYCLONE PARTICLE SEPARATOR

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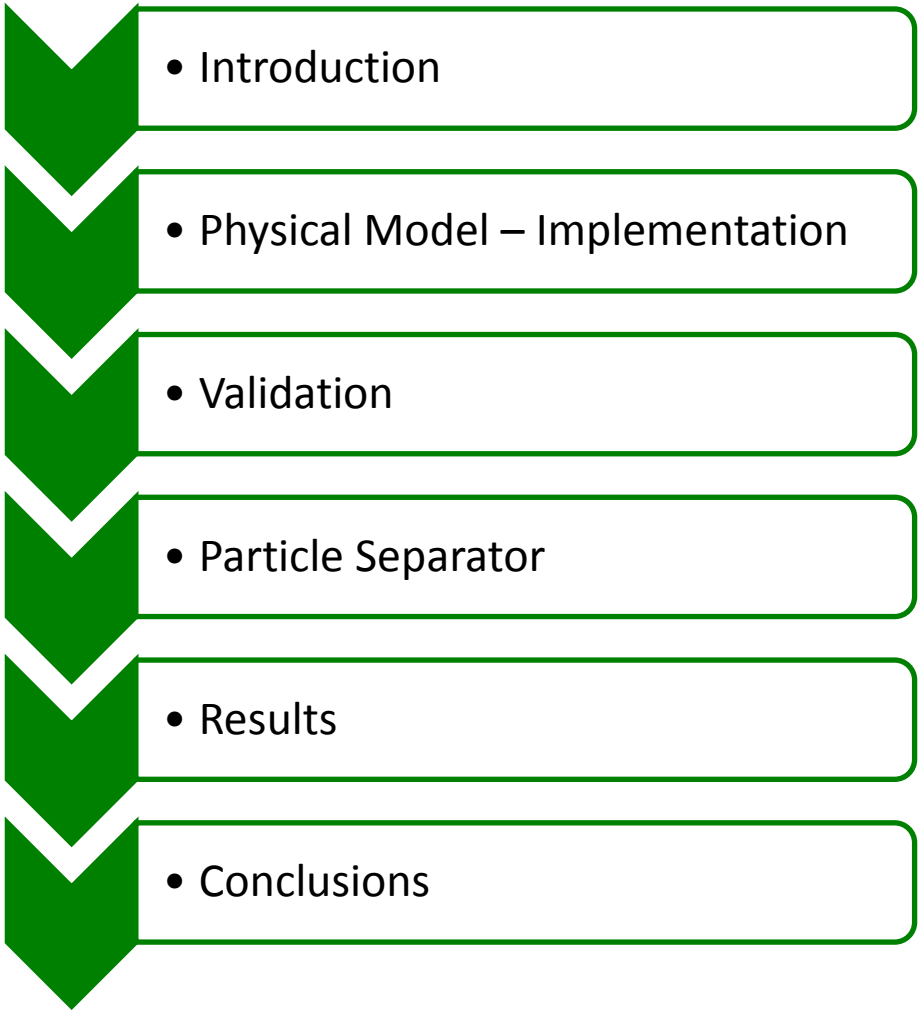
Fluid-A
Innovative start-up


• Introduction
• Physical Model – Implementation
• Validation
• Particle Separator
• Results
• Conclusions

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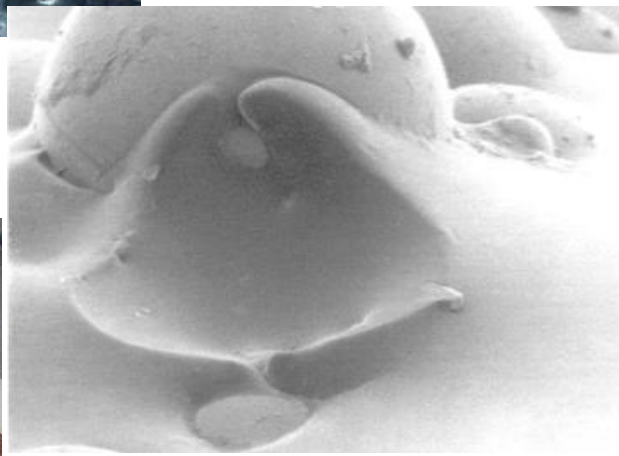
Surface degradation mechanisms

- Water droplets

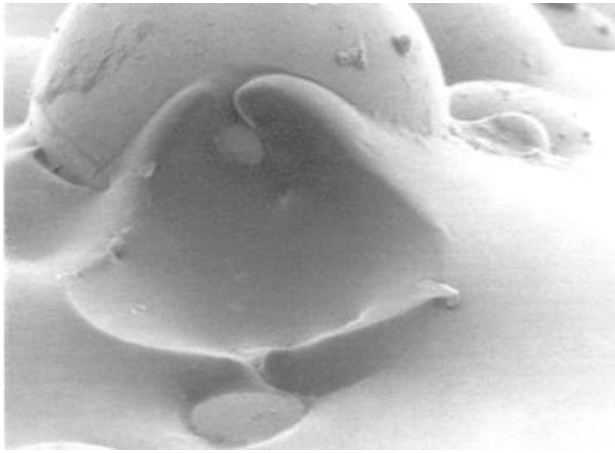
- Solid particles impingement

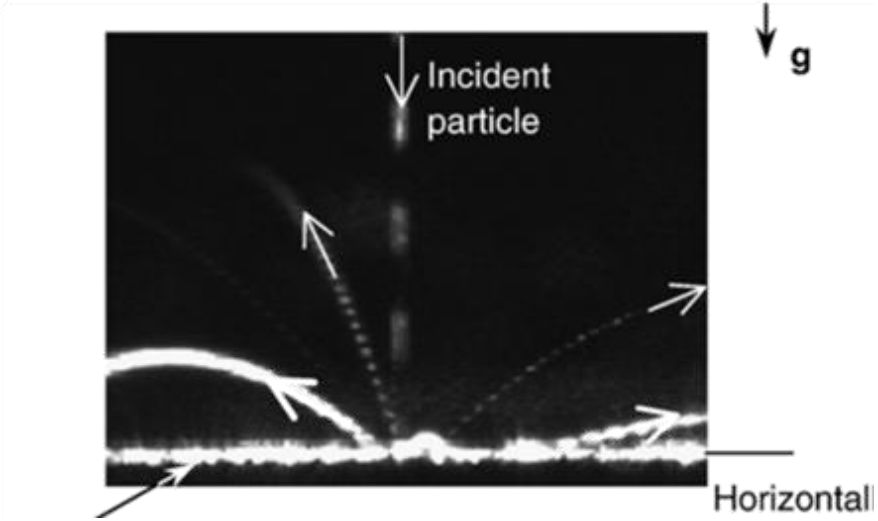


- Corrosion

Surface degradation mechanisms

- Solid particles impingement



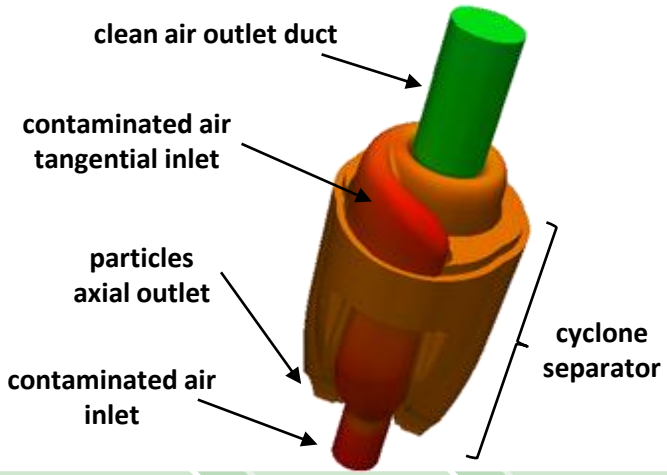


Research objective

- Implementation of the Ahlert-McLaury erosion model
- Validation with experimental results
- Effect of particles ingestion

(according to ISO 12103-1:2016)

on a particle separator



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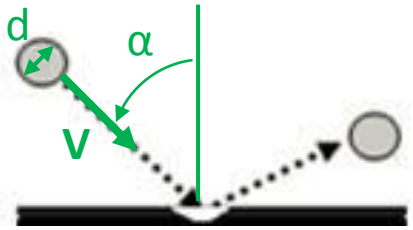
Ahlert – Mc Laury model

- Derives from the interpolation of experimental data
- Mac Laury correction: valid for aluminium
- Empirical relation:
  - Depends on particle shape
  - Angle and impact velocity are taken into account



Ahlert – Mc Laury model

$$ER = AF_S F_\theta V^n$$

Where

- A= empirical constant (depends on material)
- F_S= particle shape coefficient
- F_θ= angle dependance coefficient
- V = normal to the surface velocity
- n = empirical constant

Ahlert – Mc Laury model Implementation

- Implemented as a function object

CFD evaluation of undisturbed flow field

Particles seeding and lagrangian tracking

Postprocessing evaluation of the erosion pattern

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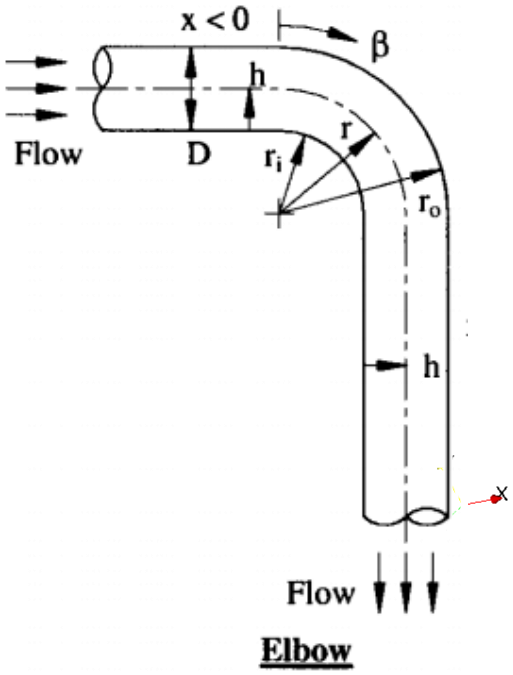
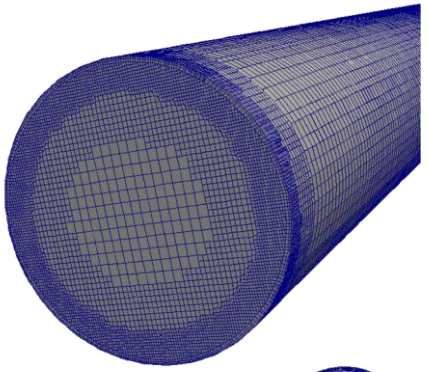
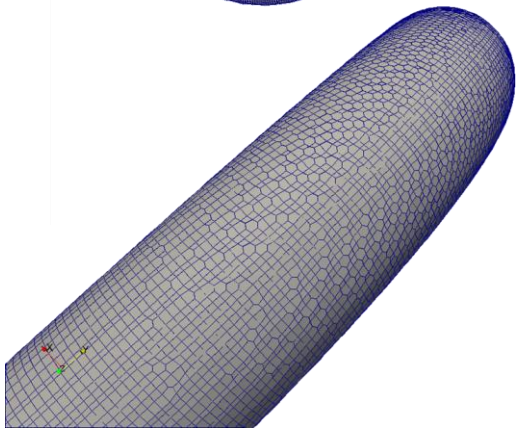
Validation – Bend Pipe test case

- Flow validation: pipe with 90° bend



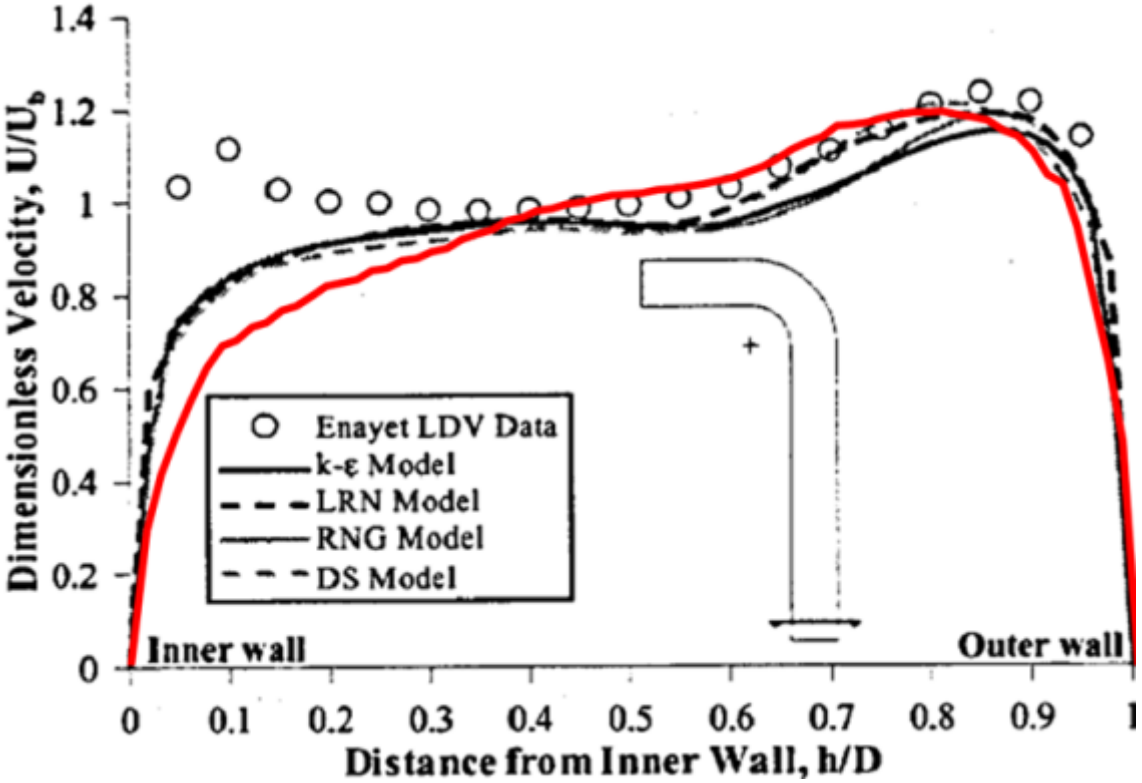




Edwards JK, et al., 2001 " Modeling Solid Particle Erosion …"
ASME. *J. Energy Resour. Technol.,* 123(4)

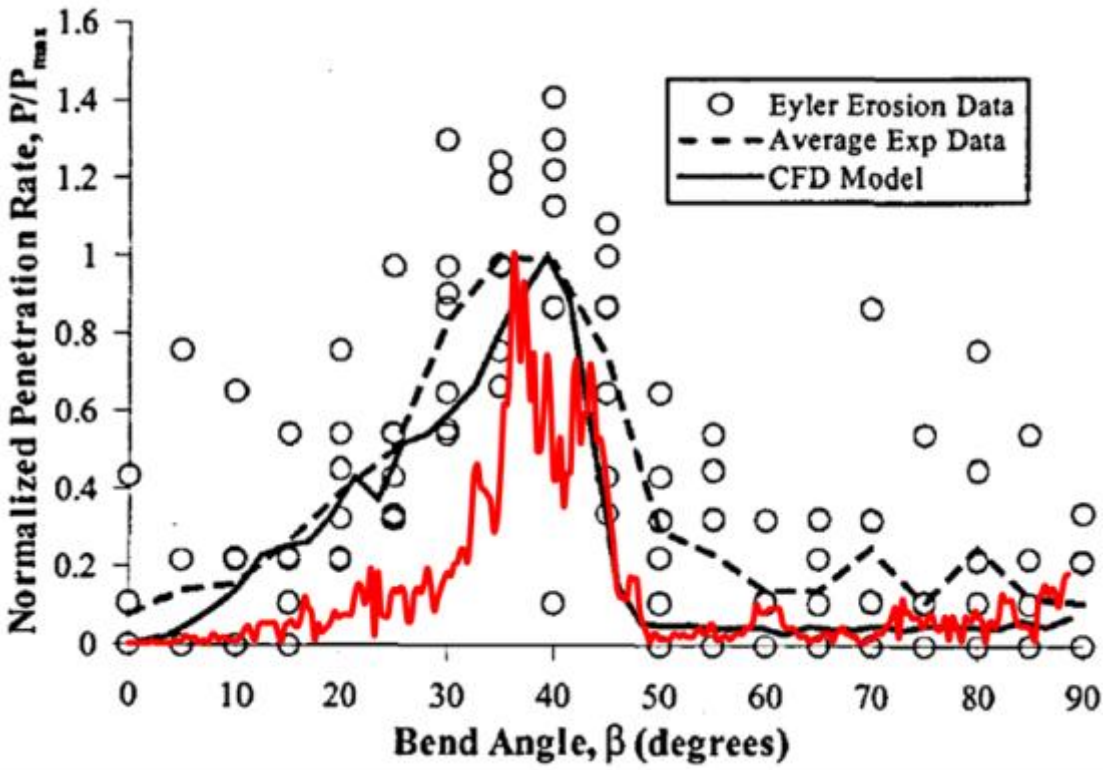
Validation – Bend Pipe test case

- Flow validation: results



Validation – Bend Pipe test case

- Erosion pattern validation: results



Validation – Bend Pipe test case

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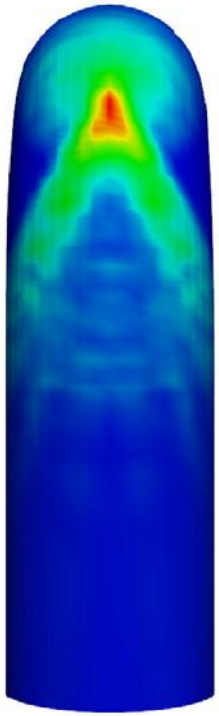
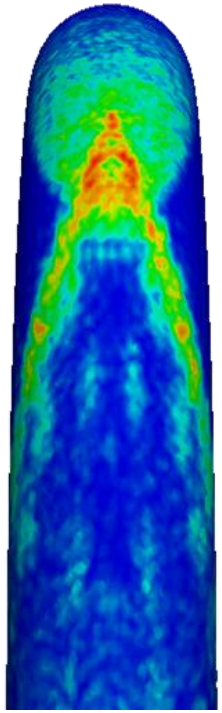


G.C. Pereira et al., 2014, "Numerical prediction of the erosion… ", J . Powder Technol. , 261



Present work

- Introduction
- Physical Model - Implementation
- Validation
- **Particle Separator**
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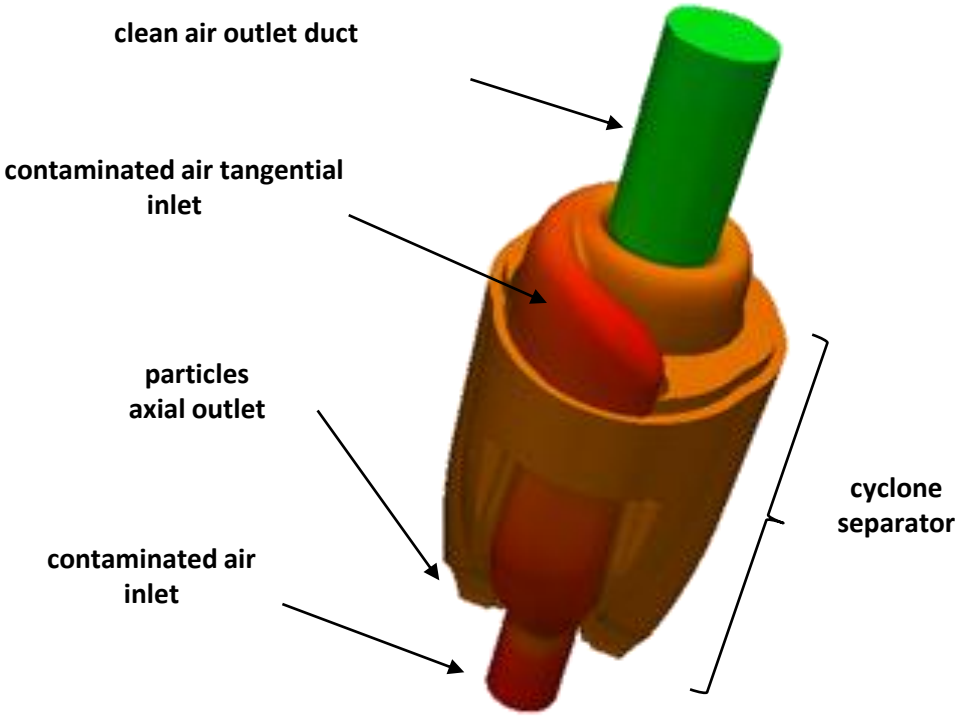
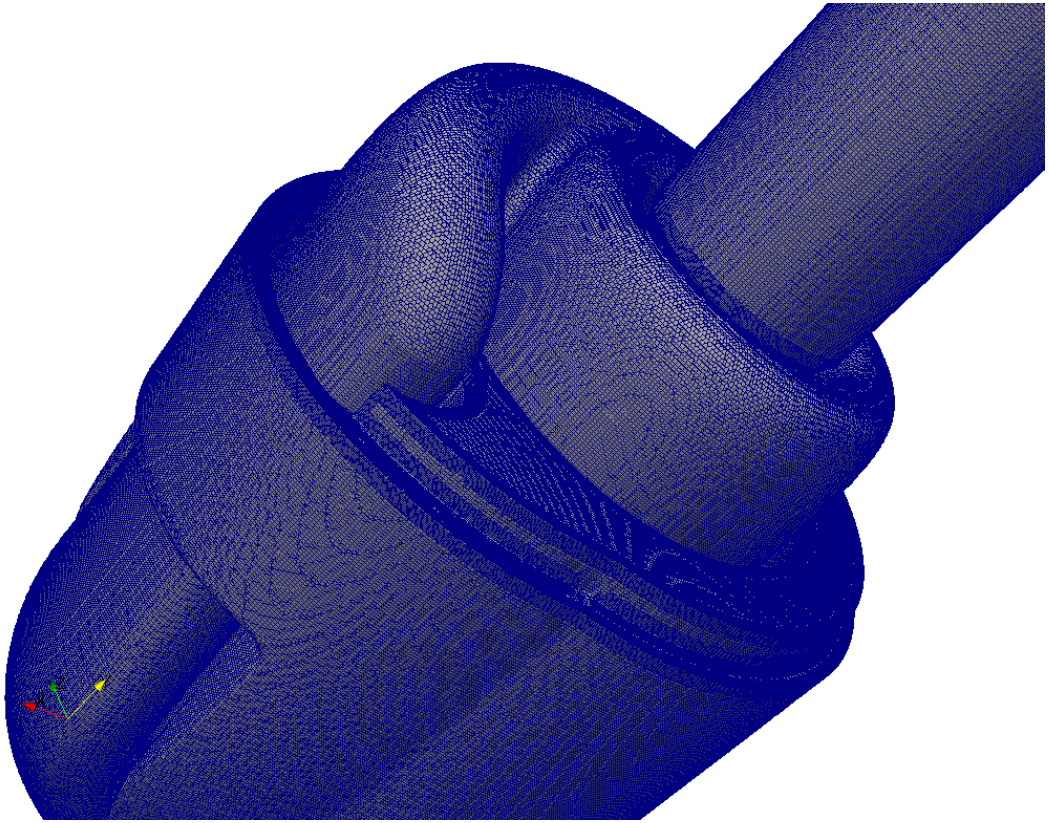
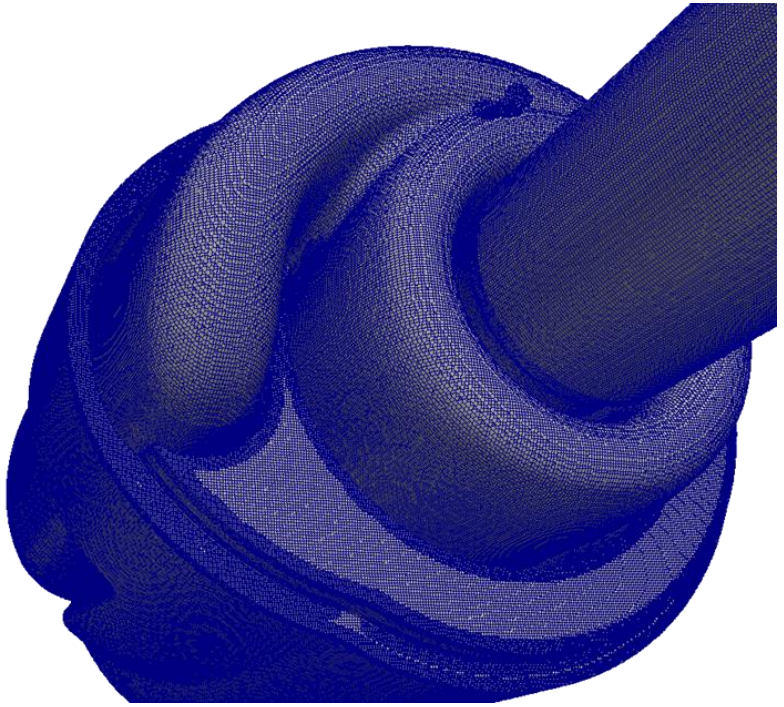
Particle Separator

- Cyclone inertial particles separator
- Used for the air cleaning
- Subject to erosion
- Size distribution and composition according to ISO 12103-1:2016



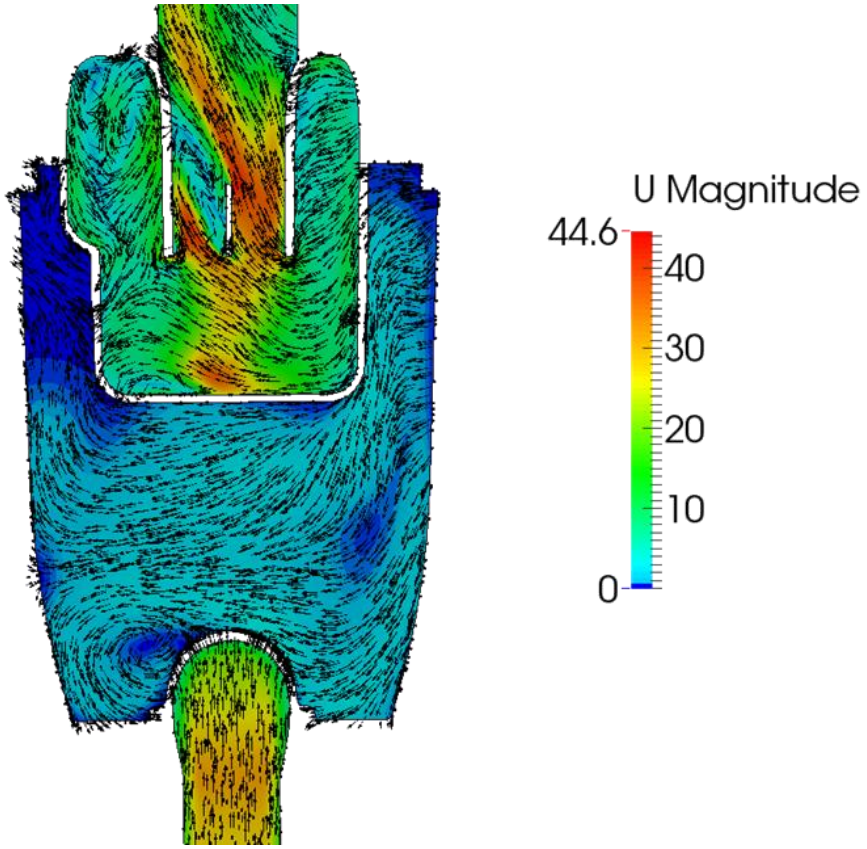
Particle Separator – Mesh





Particle Separator – Flow field

- Difference in static pressure drop (ANSYS): 1%



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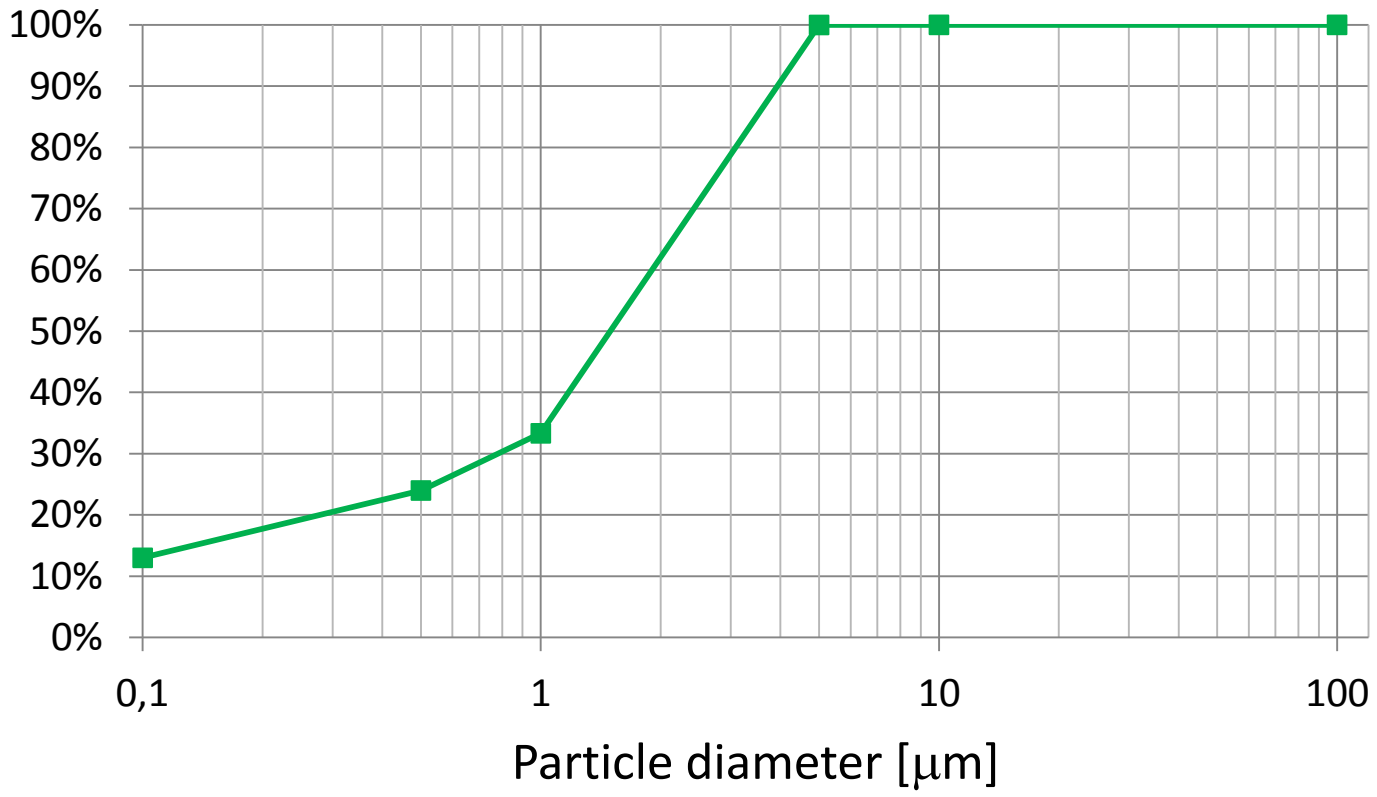
Filtering efficiency



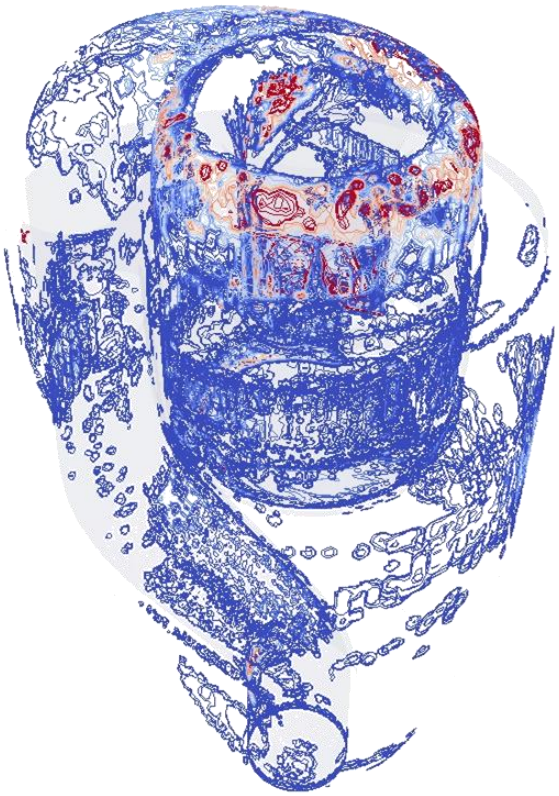
Erosion Pattern

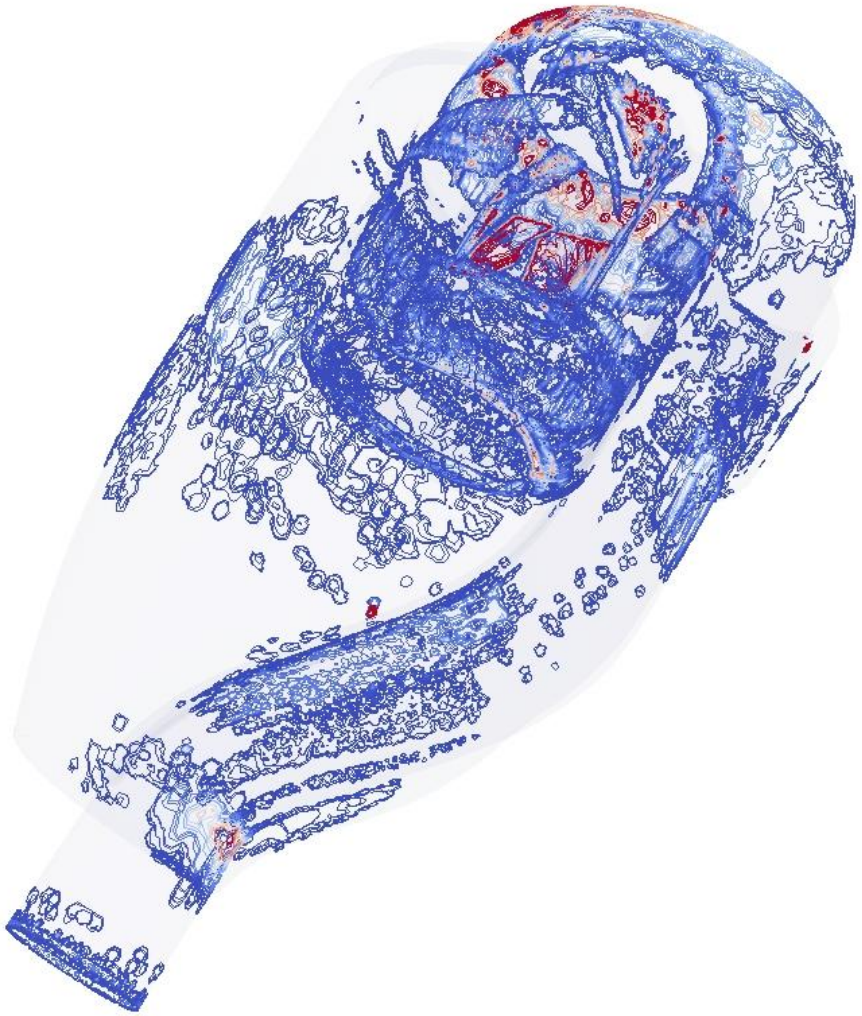
1.5 µm

10 µm

Overall erosion

- Peak of erosion in the spiral of the inlet duct





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Conclusion

- In this work an erosion model has been successfully implemented and the effect of a standard particle distribution is evaluated

The main contribution of this work can be summarized as

- Evaluation of the filtering efficiency of a real component with new standard particle distribution
- The effect of the particle distribution on the cyclone in terms of surface degradation are evaluated

Limitations & Future Work

- The erosion is implemented as a function object: no update of the mesh
- Only spherical particle have been tested: real particle population have different shapes
- No deposition is accounted for in this application