Computer Aided Drying Process Engineering with HPC

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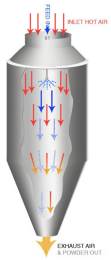
HPC4 MANUFACTURING

Spray drying: An established industry

Spray drying is an **economically important**, **energy intensive** global industry, but we have seen few advances in drying technology architectures and innovation…

Simple co-axial flow architecture



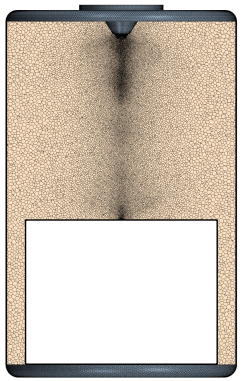
Dried food powders

- Spray drying *equipment* market valued at $3.85B in 2016, projected to grow to $5.8B by 2022[1]
- Worldwide, 30-40K spray dryers consume an average of **4.87GJ/ton** to evaporate water at **50-70%** efficiency[2]

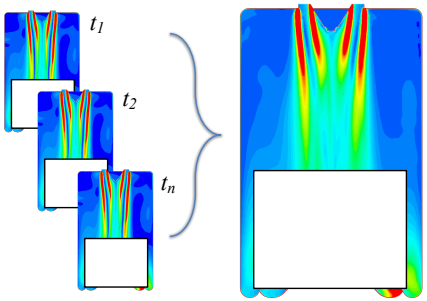
Equipment suffers from limited innovation
- Decades old unit-op designed for cheap energy
- Industry, end-users opt for retro-fits over new designs

Leveraging HPC to accelerate design

LLNL has partnered with **ZoomEssence** to use HPC and CFD to explore radically new, energy efficient designs *in silico*

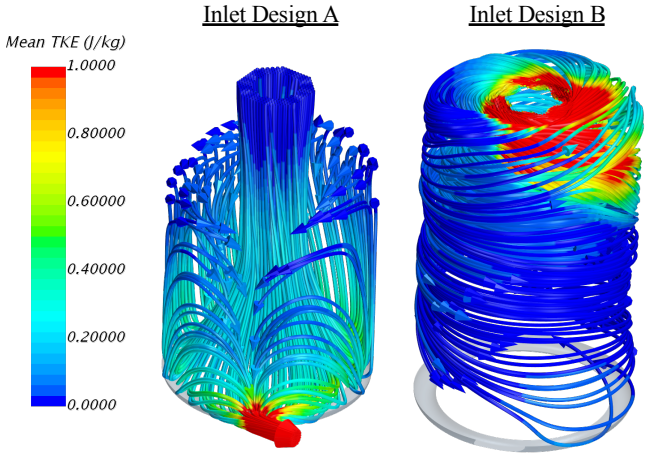


Time-average URANS turbulence simulations

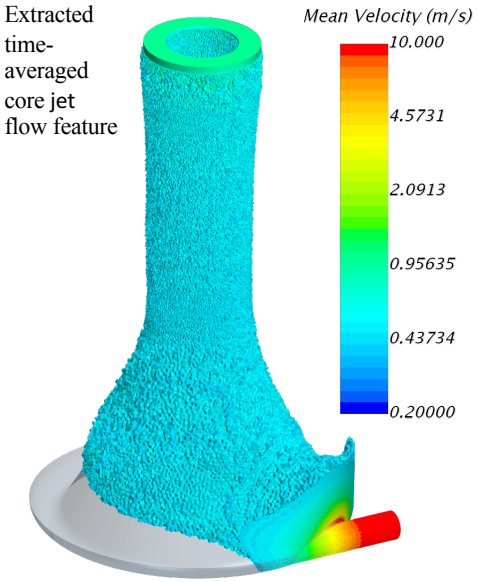


Rapid evaluation and detailed insight

Architecture modifications deeply impact mean flow patterns, flow energy, and residence time

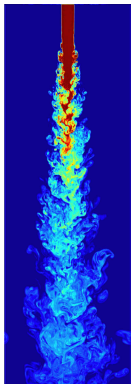


Extracted time-averaged core jet flow feature



Future Work

- Detailed turbulence modeling using LLNL developed Large Eddy Simulations
- Simultaneous heat and mass transfer, and particle tracking



Tangible Benefits

- Design guidance at costs of ~$100Ks as opposed to pilot plants running costs of ~$10M
- *Detailed* physical insight into flow mechanisms highlight new opportunities for advanced designs and processes, invention, and innovation

[1]Markets and Research
[2]Baker, C. G. J et al., *Drying Technology*, 23 356-386 (2005)

[G. C. Burton and C. P. Beetz]

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