TOWARDS PHYSICS INFORMED DECISION-MAKING FOR COMPLEX MIXING PROCESSES

The more you know, the less you need...

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BIGGER ISN’T ALWAYS BETTER...

Mixing is a crucial operation in numerous industrial sectors (i.e., food, cosmetics and drug development), and is greatly responsible for the yield, quality, and physicochemical properties of the end products.

Due to lack of fundamental knowledge, traditional design relies on limited empirical methods, leading to over-sizing and over-consumption of raw materials, energy, and polluters [1].

Estimates: lower yield from poor mixing (over ~£70 million) and complications in process development (over ~£360 million) [2].

SMART MIXING: DATA - CENTRIC ENGINEERING

Physics-based modelling: State-of-the-art CFD code based on a revolutionary interface tracking algorithm implemented on a massively-parallel computer architecture.

Machine learning: physics-informed data-driven predictions

THE CAPABILITIES OF OUR CODE

COMPLEX MORPHOLOGIES

HIGH TURBULENCE

SURFACTANT-LADEN

INDUSTRIALLY-RELEVANT OUTPUTS

SURFACTANT-FREE

Surfactant-laden

Deep insights into highly complex turbulent oil-water emulsification processes are obtained, unravelling knowledge inaccessible through experiments.

Relationships between surface tension, altered by the presence of surfactants, and drop deformation and breakup mechanisms are established and contrasted against a surfactant-free case.

The performance of the mixer with different set-ups can be accounted for through the droplet size distribution (top), as well as a detailed tracking of the complex temporal evolution of breakup and coalescence events (bottom).

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REFERENCES