Mesoscopic modelling and simulation of espresso coffee extraction

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ABSTRACT

A mesoscopic model for the simulation of espresso extraction based on the Smoothed Particle Hydrodnamics method is presented [1,2]. The model incorporates some essential features such as bimodal granulometry (fines-coarses) of the coffee bed, double (liquid/intra-granular) molecular diffusion and solid-liquid release mechanism. The porous structures ('coarses') are modelled as stationary solid regions whereas the migration of cellular fragments ('fines') is described by single-particles advected by the flow. The boundary filter is modelled as a buffer region where fines are immobilized while entering it, therefore providing a transient flow impedance. The model captures well the transient permeability of the coffee bed under direct-inverse discharge observed in experiments, showing the importance of fines migration on the hydrodynamics of the extraction.

The concentration kinetics for different molecular compounds (i.e caffeine, trigonelline and chlorogenic acid) are compared to experimental data for a traditional espresso extraction, showing excellent results [3]. The present work lays down the basis for the virtual analysis of coffee flavors by monitoring the hydrodynamic and microstructural effects on the balance of extracted key-odorant or taste-actives compounds in the beverage.

REFERENCES

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