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Modeling the dynamics of solid-liquid interactions with a microwave field - a Comsol approach.

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Although an established technique, microwaves (MWs) intensification of liquid-solid interactions still has several partially non-elucidated interesting aspects, concerning mainly the dynamics of such interactions and, consequently, how the MWs are continuously affected. Therefore, the mathematical modeling of MWs – matter interactions, either in multimode or monomode MWs applicators is of paramount importance. MWs irradiation intensifies heterogeneous processes due to preferential heating of one of the two phases, which has higher tangent loss. The complexity of the interactions dynamics comes from the temperature dependency of the dielectric properties of both phases – for non-isothermal processes, one of the phases could be preferentially heated at the beginning, and less and less heated to the end of the irradiation, depending on the temperature profile. Although several indirect proofs of this have been presented, still, there is no direct experimental proof that such a non-uniform heating appears.
The modeling, in Comsol Multiphysics®, of a monomode/multimode MW applicator in which ethanol/water solution (50% vol.) interacts with vegetable particles is discussed. The solid – liquid temperature difference is the result of two dichotomic processes: a) MWs generates heat in solid and b) heat is transferred to the surrounding liquid. With working temperature increase, the vegetable losses increase, while the solvent's decrease, therefore selective heating will be enhanced at high temperatures.

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