INFLUENCE OF CAVITY SIZE AND MATERIAL PROPERTIES ON THE UNIFORMITY OF DIELECTRIC HEATING USING DISTRIBUTED SOURCES AND NOVEL SOLID-STATE MICROWAVE AMPLIFIERS

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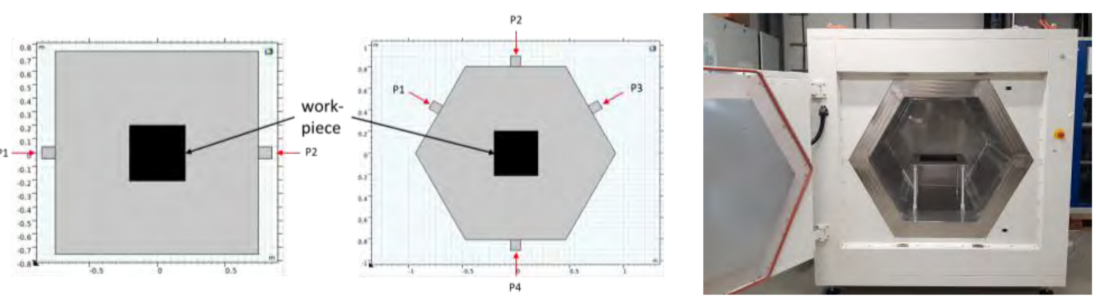
Undoubtedly, dielectric heating using microwaves offers the potential to improve many industrial processes with respect to energy efficiency and process time. Nevertheless, microwave heating requires to overcome the major challenge in achieving a homogeneous heating of the work piece while being exposed to the inhomogeneous electromagnetic field that exists in the microwave applicator. Modern solid-state amplifiers allow to control the electromagnetic field that is radiated by the microwave antennas and that is finally dissipated into the work piece. That is possible by frequency tuning over a wide frequency range, a precise control of the phase and the output power.
The aim of this work is to investigate the achievable temperature homogeneity by making use of frequency, phase and amplitude tunability of the microwave sources in the available ISM frequency band. Various cavities with distributed microwave sources are assumed. An optimization-based superposition of modes is investigated based on 2D electromagnetic simulations using COMSOL Multiphysics. Furthermore, the results that are model based are verified with experiments on an industrial scale microwave system. Particularly a modified microwave oven of company Vötsch Industrietechnik GmbH with a hexagonal cross section and a circumferential diameter of 1 m and a depth of 1 m is used. Up to 10 novel solid-state-based microwave generators of company HBH Microwave GmbH with 1 kW microwave power each can be considered. The power is coupled into the cavity via cross-polarized slotted waveguide antennas. The recording of the evolving temperature profiles in various work pieces is performed using an infrared camera analogous to the experiments described in [1].



a) b) c)

Fig. 1. a) 2D simulation model in COMSOL Multiphysics – rectangular. b) 2D simulation model in COMSOL Multiphysics – hexagonal. c) Real measurement setup.

References

1. Neumaier, D., Sanseverino, S., Link, G. and Jelonnek, J., "*Homogeneous Dielectric Heating in large Microwave ovens by excitation of multiple eigenmodes at their resonance frequencies*, 17th International Conference on Microwave and High Frequency Heating, 2019, pp. 166-173.