Effects of the Orientation and Geometry of the Potential Applied Electrodes on Radio Frequency Heating

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Keywords: Microwave systems, mathematical modelling, manufacturing and thermal processing.

Radio frequency (RF) is assumed to be a volumetric heating process with its efficiency for shorter process times and better quality compared to conventional approaches. Through field parallel plate electrode type is commonly used in pilot and industrial scale systems for various thermal processing. Besides the parallel plate electrodes, where the top electrode is potential applied, through field staggered electrode systems, where the potential applied set might be bottom or top, are also used. Use of fringe field electrode types are other systems depending upon the size of the sample.

To compare these various electrode systems, a computational mathematical, developed (using Comsol V5.6, Comsol AB, Stockholm, Sweden) and validated with experimental data, were used for comparing the evolution of electromagnetic field and temperature distribution for an industrial scale thawing process.

Through field parallel and staggered electrode types were determined to be efficient for processing large sized bulk products while small sized lower thickness products were better to be processed in fringe field electrode configuration systems. The heating rate in the through field parallel electrode systems was the highest even at the same potential applied in the staggered through field cases. Local undesired high temperature evolution was observed in the fringe field electrode type systems, and hence a physical movement of the sample was specifically required compared to the other systems.

Electrode orientation and geometry in RF systems were determined to significantly affect the electromagnetic field distribution and resulting temperature evolution. It was rather important to decide upon the Rf system depending on the geometrical features of the samples for obtaining a uniform temperature distribution. Effect of the various configurations are required to determine in successive multi-cavity systems for sustainable processing.

Acknowledgement:
Ozan Altin is a scholar of the “YÖK 100/2000 PhD Project” supported by the Council of the Higher Education of Turkey.