

APPLICATION OF HIGH-VOLTAGE ELECTRIC FIELD FOR DRYING PROCESS

Thanit Swasdisevi^{a,*} and Somchart Soponronnarit^b

^aDivision of Thermal Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, 126 Pracha Uthit Road, Bang Mod, Thungkru, Bangkok 10140, Thailand

^bDivision of Energy Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, 126 Pracha Uthit Road, Bang Mod, Thungkru, Bangkok 10140, Thailand

*Corresponding author: Thanit Swasdisevi; E-mail address: thanit.swa@kmutt.ac.th

ABSTRACT

Electrohydrodynamic (EHD) from high-voltage electric field (HVEF) assisted drying has been successfully applied to enhance the drying rate of several agricultural products such as spinach, potato slab, pear, apple, *Andrographis paniculata* and *Aloe vera*. The mechanism of EHD drying was performed by the corona wind produced by applying a high voltage to the electrode pins. This corona wind disturbed the boundary layer of air at the surface of product led to evaporation enhancement. Through the review it was revealed that the moisture reduction rate increased with an increase in the high-voltage electric field. The HVEF significantly affected on the rate of moisture reduction at lower air velocity (0.2 m/s). It was also found that the specific energy consumption increased with an increase in applied voltage. The quality of dried product via EHD assisted drying process was higher due to a shorter drying time and using a lower drying temperature. In case of efficiency of EHD process, the multiple-needle electrode configurations had better efficiency than wire and single-electrode configurations. However, the application of HVEF to enhance drying system is still developing to increase the shelf life of perishable products.

Keywords: Corona wind, Drying, Electrohydrodynamics, Specific energy consumption

INTRODUCTION

Conventional drying methods used to preserve agricultural products usually involve the application of an air flow at elevated temperature or thermal radiation from radiator. Hot air drying is generally method performed to preserve agricultural products. However, it is a very energy-intensive operation and leads to much degradation of product quality due to elevated drying temperature (Krokida et al., Khraisheh et al.). Since a high drying temperature adversely affects the quality of product (Sunjka et al.), the application of novel techniques such as microwave, far-infrared radiation, freeze drying and superheated steam either alone or in combination with conventional drying methods are introduced to produce dehydrated products of higher quality. Recently, electrohydrodynamic (EHD) has received considerable attention because it complies well with both high product quality and low energy consumption (Bajgai et al.). The primary mechanism for the drying enhancement is the electric wind, also termed as corona wind, by applying high voltage to the electrodes. This corona wind is then directed toward the surface of product where drying is taking place, which disturbs

the boundary layer over the surface and thus enhancing the mass transfer between the product and ambient air. Because the corona discharge can occur at room temperature and atmospheric pressure, the EHD drying is attractive for low temperature applications. Hashinaga et al. (1999) used a multiple point-to-plate electrodes with high-voltage AC for drying the apple slices. They found that the initial drying rate increased 4.5 times over the ambient air drying. The effect of electric field strength, size of the point electrode and electrode gap on the drying rate was also investigated. Since the ozone and nitrous oxide are produced during a corona discharge, they attempted to measure the formation of extraneous compounds in the drying samples. The high-performance liquid chromatography revealed that the extraneous harmful compounds did not produce during the EHD drying. Lai, F.C. and Lai, K.-W. (2002) investigated the enhancement in drying rate of glass beads saturated with water and packed in the box using electric field.