

Project title: A Study on Mass and Heat Transfer Enhancement in A Porous Packed  
Bed with Electrohydrodynamics (EHD)

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University approves this thesis toward partial fulfillments of the requirements for the  
degree of Bachelor of Engineering in Mechanical Engineering

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## Abstract

Conventional drying food preservation method is very important for agricultural industrial in Thailand and by increase the drying rate of this method will reduce time and energy that use during the drying process. This thesis aim to experimentally the enhancement of heat and mass transfer in saturated and unsaturated packed bed by using hot air applied with electric field, namely Electrohydrodynamic (EHD).

In the experiment, hot air conduct through electric heater and flow in the wind tunnel of 15×15 cm cross section, four- electrodes wires(Positive pole) and one-negative wire(Ground pole) are installed perpendicular and cross to air flow direction. The temperature of approximately 60°C and bulk mean velocity air is 0.33 m/s and Reynolds number, ( $Re = \rho U D_h / \mu$ , where  $\rho$  is density of air at 60°C,  $\mu$  is viscosity of air at 60°C, and  $D_h$  is hydraulic diameter) of air flow is 2610.58. The voltage apply uses in this experiment are 0, 10 and 15kV. For glass beads, we use 2 different size of glass bead which is 0.125 and 0.38 mm. the experiment is divided into 11 different cases varies by voltage supply ( $V = 0kV, 10kV, 15kV$ ) and arrangement of bead layers.

From the experiment we found that the electric field causes a vortex wind around electrode which is called “corona wind”. This phenomenon will greatly increase the heat and mass transfer rate around the surface of packed bed. In case of single-layer packed bed (one beads size contain in packed bed), we found that moisture evaporation rate increased by 1.8-2.2 times (The rate increased directly proportional to the voltage increased) comparing EHD drying to conventional drying. In case of double-layers packed bed, Fine-Coarse packed bed dry better than Coarse-Fine packed bed by 3.13-3.67 times. This because capillary pressure in smaller beads is higher than the bigger beads and EHD has much influence at the surface. As a consequence, the Fine-Coarse packed bed have better drying rate.

**Keywords:** Drying rate, heat and mass transfer, electrohydrodynamics, corona wind, packed bed