ICEEE 5

The 5th International Conference on Engineering, Energy and Environment
1–3 November 2017, Arnoma Grand Bangkok Hotel, Bangkok, Thailand.

Organized by

Saitama University 埼玉大学

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Proceedings

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The 5th International Conference on Engineering, Energy and Environment

Organizers

Faculty of Engineering, Thammasat University, Thailand
Nagaoka University of Technology, Japan
Saitama University, Japan
Tokyo Institute of Technology, Japan

November 1 - 3, 2017 Arnoma Grand Bangkok Hotel,
Bangkok, Thailand.

Please note that you may choose to either submit extended abstract OR full paper. If you choose to submit extended abstract, it will appear only in the Book of Abstract. If you choose to submit full paper, it will appear in the Conference Proceeding. Selected full papers will be recommended for publication in the following journals (subject to further review by the journals):

Symposium Background

The 5th International Conference on Engineering, Energy, and Environment (ICEEE) 2017 is rebranded from the International Symposium on Engineering, Energy, and Environment (ISEEE) which has been held for four alternate years, starting in 2008. This year it focuses on the theme involving contribution of innovative digital economy towards sustainable development.

Digital Economy is an economy that is driven by digital technologies. The growth of digital economy has widespread impact on the world's economy as well as every aspect of societies. It transforms the way organizations conduct their businesses as well as the way we live. What is more important is how innovative digital economy can make positive impacts towards sustainable development.

The rationale of the 5th ICEEE 2017 is to serve as a platform for international exchange on the latest issues involving the contribution of innovative digital economy towards sustainable development.

Welcome Speech

5th International Symposium on
Engineering, Energy, and Environment
(ICEEE 2017)
Arnoma Grand Hotel, Bangkok

November 2, 2017

Distinguished guests, ladies and gentlemen

It is my great pleasure and honor to be presiding over the opening ceremony of the Fifth International Conference on Engineering, Energy, and Environment.

It is interesting to note that the theme of this year's conference is "Contribution of Innovative Digital Economy towards Sustainable Development". As all of us have realized today, the digital economy does not belong to the distant future. It is what the world is facing right here and now. Nowadays, digital technology is not just a supporting tool for the workplace, but it has become part of our daily lives. The digital economy has dramatically changed our economic activities. It has become both opportunities and challenge to the society.

Engineering research can play an important role in fostering positive contribution of digital economy to the society. It is a good thing to know that engineers and scientists are paying increasing attention to how digital economy can lead to sustainable world. I would like to express my sincere appreciation to all the organizers and co-organizers of this Conference, and to all participants who present and discuss their research findings. It is hoped that this Conference will achieve its goal and be successful in every aspect.

It is my honour and privilege to declare open the 5th International Conference on Engineering, Energy, and Environment. I wish you every success.

Thank you

Dr. Somkit Lertpaithoon, Professor
Rector of Thammasat University

Welcome Speech

5th International Symposium on Engineering, Energy, and Environment (ICEEE 2017) Arnoma Grand Hotel, Bangkok

November 2, 2017

Distinguished guests, ladies and gentlemen

On behalf of the organizers, I would like to formally welcome you to the Fifth International Conference on Engineering, Energy, and Environment. This Conference is rebranded from the International Symposium under the same name, and it has now become the fifth in the series. This year our conference focuses on the theme involving contribution of innovative digital economy towards sustainable development.

The Conference is aimed at stimulating discussion and ideas toward the question of how sustainable society can be achieved by fostering an open and fair digital economy. Since digital economy is technology-driven, engineering research can play an important role in steering digital economy toward sustainability.

I would like to express my gratitude to all the organizers of this conference: Thammasat University, Tokyo Institute of Technology, Saitama University, and Nagaoka University of Technology, and to all the co-organizers, i.e. Hiroshima University, and Toyohashi University of Technology.

Finally, I would like to express my sincere appreciation to everyone involved in the organization of this conference and to the participants who have made this happen. Today I am most delighted to welcome you to ICEEE 2017, and thank you all for coming to this conference.

Thank you

Dr. Thira Jearsiripongkul, Associate Professor.
Dean of Faculty of Engineering, Thammasat University

Plenary talk

r. Kanchit Malaivongs, Associate Professor
Office of the Royal Society
Communication and Information Technology Commission,
Senate Thailand

Dr. Hiroshi Matsuyoshi, Professor
Director of International Institute for Resilient Society
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RENEW-07

Topological Analysis of an Air Flow Subjected to Electric Field

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Abstract

This research numerically investigates the characteristics of swilring flow induced by various patterns of electric fields. Electrode wires are installed normal to flow direction and two ground wires are placed along the side wall of a square duct. Effects of position and number of the electrode on flow are explored. Inlet flow velocity and applied electrical voltage are tested at 0.33 m/s and 20 kV, respectively. It is clearly observed from three-dimensional simulations that electric fields are not uniform in any planes and are highly dense around electrode ends, especially at the point near the ground wire. This causes the electrically-driven flow to occur in different swirling patterns. The details are discussed in this paper.

Keywords: Fluid Flow, Electric Field, Electrohydrodynamics.

Introduction

Drying is an important means of preserving agricultural products, ceramics, etc., and hot wind drying is one of the most widely used methods, but the effects of the boundary layer or flow separation [1 - 3] makes the surface heat transfer efficiency low. As a result, it takes time to long drying and high energy consumption.

The flow control by electric field is an interesting method to highly increase the efficiency of the drying because there are no moving parts. [1, 4] also allows for easy control of the drying temperature of the product. [1] When a high voltage field is released into the air, it causes two areas. (the Ionization region and the drift region.) The force by the electric field causes the charged air to move fast in the direction from the electrode to the ground and transfer the momentum between the air. At the same time, the influence of the difference in velocity between the air being charged and not being charged or the influence of shear flow causes uncounted air to spin and this corona wind affect moisture transfer and heat transfer at the surface of porous media is better [1, 6].

Chaktranond and Rattanedecho [1] experimentally explore the hot air drying combined with electric fields to enhance the moisture removal and heat transfer to packed bed, which represents a porous medium. Moreover, the effects of different porosity layers on drying is examed. It is found that when the electrical voltage is applied, air streams rotate around the ground wire. This causes a high amount of heat to transfer onto the surface of packed bed, resulting in higher drying rate. In addition, arrangement of different porosity layers affects the capillary pressure in packed bed, and also significantly influence the drying rate.

Lai and Lai [6] install copper electrode wire and ground plate above and under packed bed, respectively. The results showed that the rate of drying varied according to the applied voltage and the influence of wind velocity decreases as the velocity of air in the opposite direction of the electric field is greater. Lai and Wang [7] repeat the experiments done by Lai and Lai [6] but also apply a heat souce under the packed bed. The results show that the influence of corona wind is highly effective when the packed bed has high moisture content or early period of drying process.

Ahmedou and Havet [8] perform the 2-D flow simulations to investigate the increase of heat transfer by electric field. Corona wind is generated from a single and multiple electrodes, assumed as a point. Electrodes are placed at the center of the tube and the ground is placed along the lower wall, which applied with heat flux. The results show that when the Reynolds number of cold air flow is low the Corona wind can increases the convective heat transfer coefficient by 3 times that of the non-electric field.

Saenewong Na Ayuttaya et al. [9] investigate air flow under the electric fields with 2-D simulation in which electrode and ground are assumed as small circle. The results show that the air velocity under the electric field varies inversely with the distance between the electrode and the ground.

This reseach numerically investigate the occurrence of electrically-driven swirling flow with the three-dimension simulation. The effects of electric field patterns on air is also discussed.

Numerical method

The computational domain and boundary conditions are shown in Fig.1. The dimensions of a square channel are 1.2 m long × 0.3 m wide × 0.3 m high. The electrodes are hung from the upper wall and two ground wires are placed in along the side walls.

In simulations, the inlet air velocity is controlled at 0.33 m/s (u_0) and the outlet is atmospheric pressure (p_0). High electrical voltage is tested at V = 20 kV (v_0).

Three-dimensional incompressible laminar flow simulation is performed through the continuity and Navier-Stokes equations solved by COMSOL Multiphysics 4.4

$$\nabla \cdot \vec{u} = 0 \qquad (1)$$

$$\rho\left(\frac{\partial \vec{u}}{\partial t} + (\vec{u}\cdot\nabla)\vec{u}\right) = -\nabla\vec{p} + \mu\nabla^2\vec{u} + \vec{f}_{ee} \qquad (2)$$

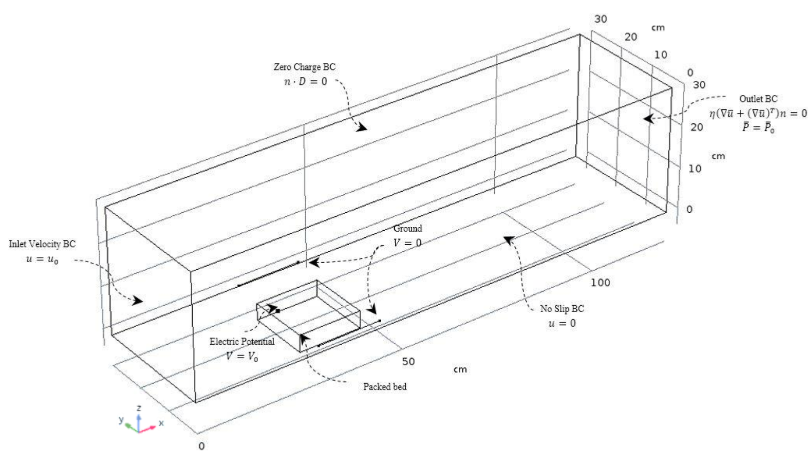

Fig. 1. The computational domain and the boundary conditions

Where $\vec{u}$ is velocity of air flow, t is time, $\vec{p}$ is pressure, ρ is density of air, μ is viscosity of air, and $\vec{f}_{ee}$ is the force by electric field.

The force by electric field is computed by Coulomb force *(3)*.

$$\vec{f}_{ee} = q\vec{E} \qquad (3)$$

Where q is the density of charge and $\vec{E}$ is the electric field.

Additionally, the electric is obtained by the Maxwell equation.

$$q = \nabla \cdot \varepsilon \vec{E} \qquad (4)$$

$$\vec{E} = -\nabla V \qquad (5)$$

Where ε is the permittivity of air and V is the electric potential.

Results and discussion

Fig 2 shows the distribution of the electric field strength in the x-y plane at z = 2 cm when the electrode at x = 30 cm. The electic field more from electrodes towards ground position. When the number of electrode increases the electric field force lines become stronger, resulting in higher air velocity, as shown in Fig 3. and more violent flow motion

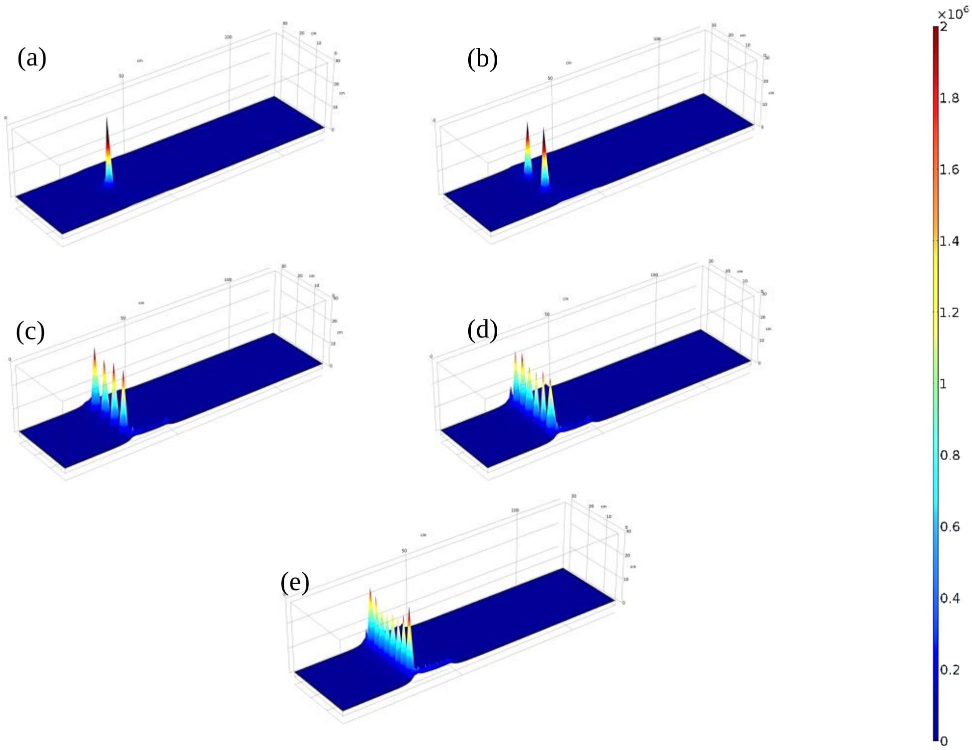

Fig. 2. The distribution of electric field in various the number of electrodes with V = 20 kV : (a) 1 (b) 2 (c) 4 (d) 6 and (e) 8 electrodes.

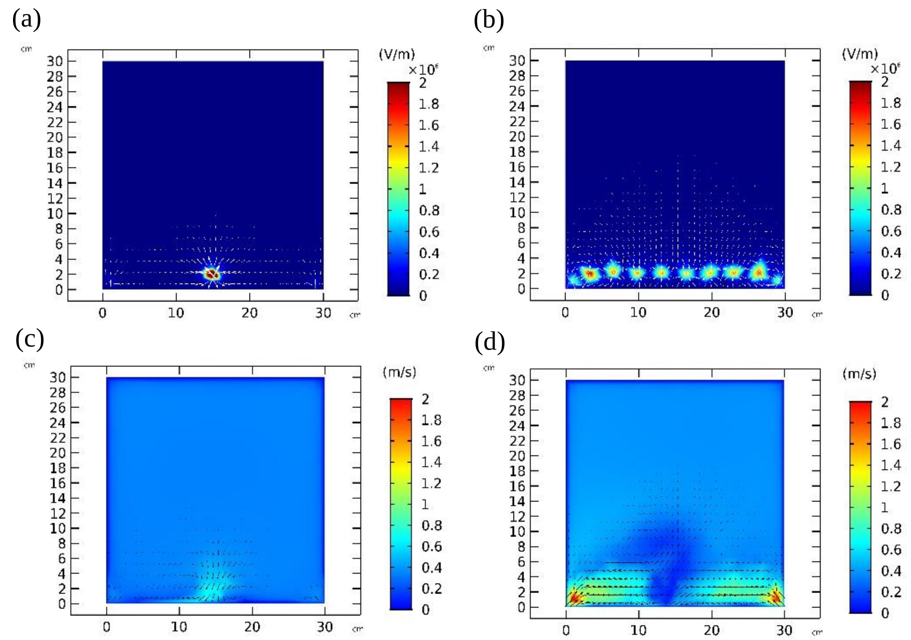

Fig. 3. Characteristics of corona wind and the distribution of electric field in the cross-sectional y-z plane at x=30 cm : the distribution of electric field (a) 1 and (b) 8 electrodes. characteristics of corona wind (c) 1 and (d) 8 electrodes.

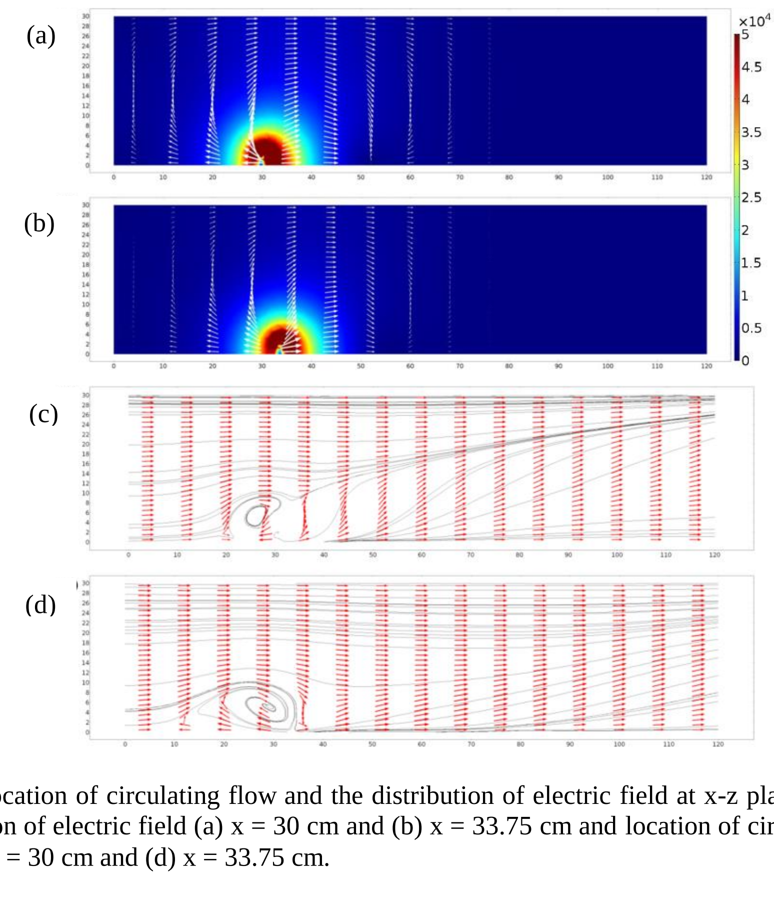

Fig. 4. Location of circulating flow and the distribution of electric field at x-z plane : the distribution of electric field (a) x = 30 cm and (b) x = 33.75 cm and location of circulating flow (c) x = 30 cm and (d) x = 33.75 cm.

Fig 4 shows the flow of airflow in the x-z plane at y = 15 cm. and 8 electrodes installed at z = 2 cm. From the figure, the location of circulating flow of packed bed occurs in front of the packed bed and occupy some surface of the packed bed and this is due to the force due to the electric field in each location relative to the location of the electrode and the ground. When the distance between electrodes decreases the force due to the electric field is greater and results in more turbulent winds.

Conclusions

The research can be summarized as follows.

• When the number of electrodes increases, the force due to the electric field increases.

• The installation location, electrode and ground affect the shape and size of the generated wind. When the installation location of electrode is in front of the packed bed, the turbulent winds of violent turbulence occur on the front of the packed bed. And when installing electrodes above the surface of the packed bed, it will cause more intense wind spiral to cover the surface of the packed bed.

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