Fall 11-10-2022

Electromechanical Effects on Micro and Nano Particles Generated from Drug Delivery Devices and their Implications in Flow and Deposition Efficiency

Mohammed Ali
The University of Texas at Tyler, mohammedali@uttyler.edu

Mark Miller
University of Texas at Tyler, mmiller@uttyler.edu

Recommended Citation

Ali, M., & Miller, M. (2022, Nov 9-11). Electromechanical effects on micro and nano particles generated from drug delivery devices and their implications in flow and deposition efficiency [Paper presentation]. ATMAE Annual Conference, Louisville, KY, United States.


DRIVING
TECHNOLOGY
FORWARD
2022
ANNUAL
CONFERENCE
9-11TH NOVEMBER
The
GALT HOUSE
Legendary • HOTEL • Louisville
LOUISVILLE, KY
ATMAE
LEAD • INNOVATE • COLLABORATE
The Association of
Technology,
Management, and
Applied Engineering

THURSDAY, NOV 10
11:42 AM - 12:00 PM
JASMINE

ELECTROMECHANICAL EFFECTS ON MICRO AND NANO PARTICLES GENERATED FROM DRUG DELIVERY DEVICES AND THEIR IMPLICATIONS IN FLOW AND DEPOSITION EFFICIENCY

Mohammed Ali, The University of Texas at Tyler
Mark Miller, The University of Texas at Tyler

This experimental investigation was undertaken to quantify the electrostatic charge and aerodynamic size distribution of the medicinal drug particles inhaled through an in-vitro mouth-throat (MT) in order to compare the amount of drugs can be delivered to the human lung while mimicking a patient is either sitting or lying. The MT model is a cadaver-based replica cast of human oral-pharyngeal-laryngeal region. Tested drug aerosols were generated by a commercially available metered dose inhaler (MDI). The MT model was placed inside a humidity (95%) and temperature (37oC) controlled chamber. Its mouth-inlet was positioned horizontally and vertically to simulate sitting and lying administration, respectively. The laryngeal-exit was connected to the aerosol sampling chamber (ASC) and the ASC was also connected with an electronic single particle relaxation time analyzer (ESPARTA). In each run, the ASC was cleaned and evacuated down to 36 cm of mercury so that a bolus of 4 liters of aerosol could be drawn at a rate of 30 L/min for a period of 8 seconds. Aerosols were generated from a single puff (for each run) into a spacer (Valve Holding Chamber), and instantly inhaled through the MT as bolus. Once the ASC was filled after 8 seconds of inhalation, the valve between the ASC and the ESPARTA was shut and a circulating fan was started instantly. Then the ESPARTA was started characterizing aerosol particles aerodynamic diameter and electrostatic charge simultaneously in real time. The results show that deposition of total (charged and uncharged) particles in the MT was double for lying position compared to sitting, which can be explained by inertial impaction of the oral jet at the bend of oral cavity, and gravitational settling of the pharyngeal and laryngeal jets when flowing horizontally through these two regions. Whereas, charged particles deposition was ten folds for lying compared to sitting. In this case, an effect of electrostatic image charge force on particle deposition efficiency can explain the outcome. In addition, particle deposition in the sitting position did not suffer gravitational settling rather it helped aerosols to move faster beyond larynx.

THURSDAY, NOV 10
11:42 AM - 12:00 PM
AZALEA

NEEDS ASSESSMENT OF LEAN AND INDUSTRY 4.0 SKILLS IN THE MANUFACTURING SECTOR

Oyetunji Steven Olaniba, Iowa State University
John R. Haughery, Millersville University of Pennsylvania
Gretchen A. Mosher, Iowa State University

Technological innovations are constantly reshaping the manufacturing ecosystem and influencing how processes are conducted in this industry. The nature of skills required of personnel working in the manufacturing industry are also being influenced and bringing about constant skill changes and the emergence of new skills at an increased rate. For manufacturing stakeholders, the increase in technological innovations have brought about the need to recruit personnel with adequate manufacturing skills required to navigate and implement emerging Smart Manufacturing, Smart Product, Smart Working, and Smart Supply Chain infrastructures and processes. Such manufacturing industry required skill include Lean and Industry 4.0 skills, which are the subjects of this study.

This study investigated Lean and Industry 4.0 skills required by the U.S. manufacturing industry. The presentation showcases the Lean and Industry 4.0 skills required in the manufacturing industry identified from manufacturing job posting data collected from n=1358 LinkedIn job advertisements in 30 northeastern and central region states of the U.S. Adapting the Industry 4.0 technology implementation pattern framework developed by Frank et al., (2019), the identified Industry 4.0 skills were classified into the four front-end technology dimensions of Smart Manufacturing, Smart Product, Smart Working, and Smart Supply Chain. Also, Lean skills identified were classified into nine characteristic and practice categories of Just-in-Time-Practices, Resource Reduction, Human Relations Management, Improvement Strategies, Defects Control, Supply Chain Management, Standardization, Scientific Management, and Bundled Techniques following the Lean practice tools classification by Langstrand (2009).

Major Points:

- Industry 4.0 skills required in the U.S. manufacturing Industry
- Lean skills required by manufacturing organizations with Industry 4.0 transformation and implementation programs
- Recommendations and implications of the research findings

Implication for ATMAE Audience:

The audience will gain an understanding of important Lean and Industry 4.0 skills required for transforming manufacturing enterprise processes from that of conventional manufacturing to Industry 4.0 compliant manufacturing. The industry audience will be able to connect essential Lean and Industry 4.0 skills to their corresponding Industry 4.0