CHICAGOLAND PHARMACEUTICAL DISCUSSION GROUP

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PROGRAM: FINITE ELEMENT-BASED (FEM) CONTINUUM MECHANICS MODELING APPROACH USED FOR PREDICTING THE MECHANICAL BEHAVIOR OF POWDER MATERIAL IN THE COMPACTION PROCESSES

DATE: THURSDAY, FEBRUARY 27, 2025

SPEAKER: DR. SEAN GARNER, PRINCIPAL RESEARCH SCIENTIST, ABBVIE, INC.

In the advancement of drug product development, formulation design has evolved from a trial-and-error approach to a science and physics-based approach that considers material science properties and mechanical properties of the powder blend. The ability to predict the manufacturability and performance of a given powder blend greatly accelerates the development of formulation drug products. In pursuit of better predicting outcomes in drug product processes, practitioners of pharmaceutical science have turned to advanced modeling techniques. One such technique is the finite element-based (FEM) continuum mechanics modeling approach used for predicting the mechanical behavior of powder material in the compaction processes. Arguably, the most accepted continuum-based phenomenological model for simulating the compaction of pharmaceutical powders is the Drucker-Prager/Cap (DPC) plasticity model, known for its ability to be calibrated from a small number of experiments. In this work, a fundamental understanding of the modeling features of the DPC model, as well as the most commonly employed calibration procedures, are provided for two case studies.

The first case study involves using the DPC plasticity model in FEM to optimize tooling for a tablet-in-tablet drug product. This includes simulating the compaction of the tablet based on properties of both outer and inner tablets, utilizing different tooling geometries and materials (plastic vs. brittle). The objective was to identify ideal geometries to minimize mechanical failure while reducing tablet size, and to assess the role of material properties in mitigating cracking.

The second case study addresses the optimization of tooling with the DPC model and the use of tapered dies to mitigate cosmetic defects observed in tablets during manufacturing. The DPC model was pivotal in determining the optimal taper needed to produce robust tablets, enhancing the cosmetic quality of the final product. Furthermore, validations of the model were conducted by comparing density distributions obtained via simulations against those obtained through micro-computed tomography (micro-CT) experiments. These case studies highlight the effectiveness of the DPC modeling technique and demonstrate the sensitivity of results to the input data used to describe material behavior.

Dr. Garner is a Principal Research Scientist at AbbVie, where he has played a pivotal role for nearly a decade. In his tenure at AbbVie, Dr. Garner has contributed to various areas, including Materials Sciences within Small-Molecule Formulations, Small-Molecule Drug Product Process Engineering, Drug-Substance Process Engineering, and currently, Process Development Science and Technology. In his current position, he oversees operations and strategic planning for finite element computational modeling efforts. These efforts are aimed at understanding the behavior of powder materials and optimizing pharmaceutical unit operations. His research focuses on utilizing advanced modeling techniques to predict material behaviors within pharmaceutical unit operations and improve the quality of the resultant products. Before joining AbbVie, Dr, Garner received his Ph.D. from Drexel University. As a graduate student, he worked in the interdisciplinary field of Materials Science and Engineering in the Powder Materials Group (PMG) under the mentorship of Professor Antonios Zavaliangos, his research was centered on understanding particle-particle interactions under large deformations during die compaction. This work employed both the finite element method and the discrete element method.

TIME: 5:30 PM – SOCIAL HOUR
6:00 PM – DINNER
7:00 PM – MEETING
PLACE: DOVER STRAITS
890 US-45, MUNDELEIN, IL 60060
COST: $55.00

CLICK ON THE FOLLOWING LINK TO REGISTER: Register Here
ZELLE PAYMENT AT cpdq2022@gmail.com
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THE DINNER MEAL CHOICES ARE THE FOLLOWING:

1. PAN-FRIED GOLDEN TILAPIA FILET
2. BREAST OF CHICKEN LIMON
3. JUMBO SHRIMP & PASTA
4. PASTA PRIMAVERA – SERVED VETAGABLES (VEGETARIAN)

WHEN REGISTERING, PLEASE INDICATE YOUR SELECTED DINNER MEAL:

Meal Choice: Fish, Chicken, Shrimp or Vegetarian	First Name	Sur (Last) Name	Company

E-MAIL WILL BE SENT
CPDG ACCEPTS CASH, CHECKS (PERSONAL OR COMPANY) OR THROUGH ZELLE
FIRST FIVE STUDENTS ARE FREE
PLEASE MAKE RESERVATIONS EARLY NO-SHOWS WILL BE BILLED ACCORDINGLY
MORE INFORMATION CAN BE FOUND ON THE CPDG WEBPAGE:
https://aaps-cpdg.org/

Firm Registration Deadline of 12:00 p.m., Tuesday, February 25, 2025

DIRECTIONS TO THE FEBRUARY 27, CPDG MEETING AT DOVER STRAITS
890 US-45, MUNDELEIN, IL

- **EXIT I-94 AT TOWN LINE RD. (60)**
- **HEAD WEST ON TOWN LINE ROAD (60) AND TURN LEFT ONTO US-45 SOUTH**
- **TURN LEFT TO STAY ON US-45 S**
- **RESTURANT WILL BE ON THE LEFT-HAND SIDE OF THE ROAD**