



Thesis Announcement M.Sc. (with internship option)

Rate-Dependent Modeling of Pharmaceutical Tableting

// Background

Tablet manufacturing is central to modern pharma and relies on powder compaction—a process with elastic, viscous, and plastic responses that evolve over milliseconds. These rate-dependent effects can drive defects like spring-back and capping. This thesis offers a hands-on route to understand and control such phenomena by combining laboratory tableting experiments with physics-based, data-informed modeling suitable for industrial screening.

// Scope and Objectives

- Build a reduced-order, physics-based model to predict rate-related risks in tableting (e.g., spring-back, capping).
- Replace empirical “strain-rate sensitivity” with a mechanistic, interpretable process metric, e.g. the Deborah-like number (material relaxation time vs. press dwell time).
- Establish a practical strategy to identify material relaxation times from in-die compaction data (force–displacement–time).

// Research Plan

- Internship (3–6 months, Leverkusen):
 - Operate a Medelpharm StylOne tableting simulator; plan and perform tableting trials; collect high-quality in-die measurements; run complementary material characterization.
- M.Sc. thesis (B.Sc. may be considered upon request)
 - Model development: Implement a compact elasto-viscoplastic description of powder compaction with stress relaxation; connect model outputs to risk indicators used in manufacturing.
 - Calibration and validation: Derive relaxation-time parameters from experimental data; validate the screening model on independent datasets; quantify predictive performance for process windows.
 - Optional extension: Explore a 3D finite element workflow (COMSOL) to test sensitivity to tooling, geometry, and operating conditions.

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