Stability of dry powder formulations used in drug delivery to the lungs studied one particle at a time

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1. Background

- Drug suspended within a liquid droplet, or mixtures of dry particles agglomerated to carrier particles
- Carrier particles are sugars such as glucose and lactose
- Difficult to predict how drug separates from carrier particle
- Can use particle engineering to optimise physical properties

Powder Formulations

Dry Powder Inhalers (DPIs)

Thermo dynamics

Drug Deposition

3 essential parameters:
- Compliance of the system
- Ideal dispersion of fine particles
- Clinical efficacy

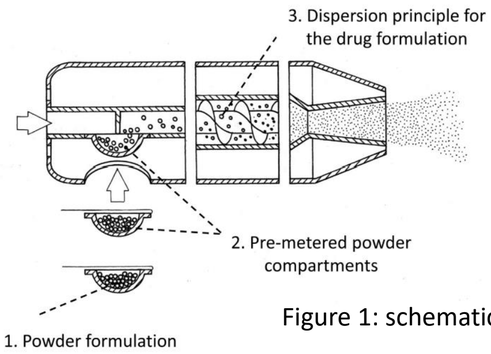

Figure 1: schematic of a DPI

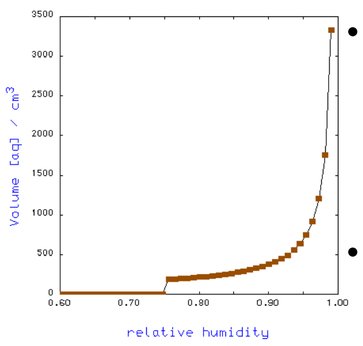

Figure 2: hygroscopic growth of NaCl with increased RH

- Hygroscopic growth occurs due to the increased RH (from 40 % to 99.5 %)
- Important for manufacturing process, storage, shelf life and delivery within the lung

Particle properties affecting deposition
- Size, shape, mass, morphology

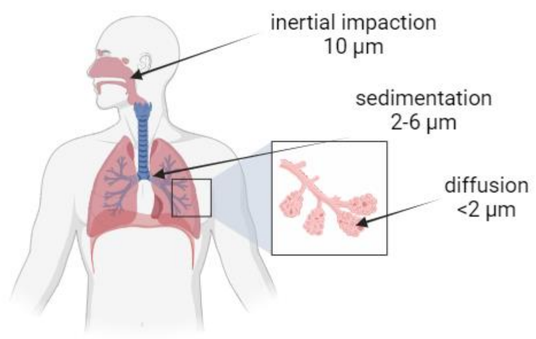

Figure 3: deposition location of particles

2. Statement of the Problem

- Study effects of RH and temperature on a variety of pharmaceutical formulations
- Understand effects of RH on manufacturing process, storage, shelf life and particle growth and deposition
- Understand how particle phase and moisture content vary particle to particle

3. Methodology

Electrodynamic Balance (EDB)

- Measure the forces upon a singular droplet suspended within an electric field
- Change in growth monitored by scattering of laser light
- RH and temperature can be altered

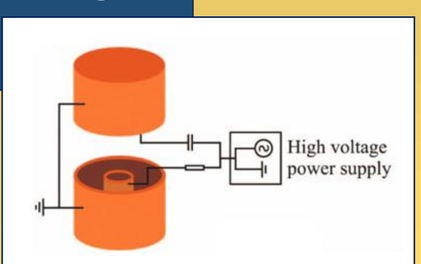

Figure 4: basic structure of an EDB experimental setup

Single Particle Electrodynamic Lung (SPEL)

- Two concentric cylinder electrodes
- Can suspend solid particles
- Can reach supersaturated condition
- RH and temperature can be altered

4. Objectives

1
1. To study the moisture resilience, clumping and coalescence of particles with respect to relative humidity.
2. To improve the stability and resilience of particles with respect to humidity.

2
1. Study the effects of relative humidity of specific drug formulations provided from Viatris.
2. To determine how the effects of relative humidity and temperature vary particle to particle within a sample.

3
1. Determine the optimum size, shape, mass and morphology of drug particles to control the dissolution rate.
2. Generate a predictive framework for the moisture response of APIs, carrier particles and engineered particles by spray drying

5. Responsible Innovation and Challenges

1. Am I using any propriety compounds? Who owns the IP?
2. What happens if I find a cure?
3. Is this process ethical?
4. How could this benefit the health service?

6. References

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