Effect of Compressed Air Pressure on Particle Size Distribution During Aerosol Generation with Ultrafine TiO_2

Maria Malmlöf[1,2], Mattias Nowenwik[1] & Per Gerde[1,2]
[1]Inhalation Sciences, Hälsovägen 7-9, 141 57, Huddinge, Sweden, [2]Karolinska Institutet, Institute of Environmental Medicine, Nobels Väg 13, 171 65, Solna, Sweden

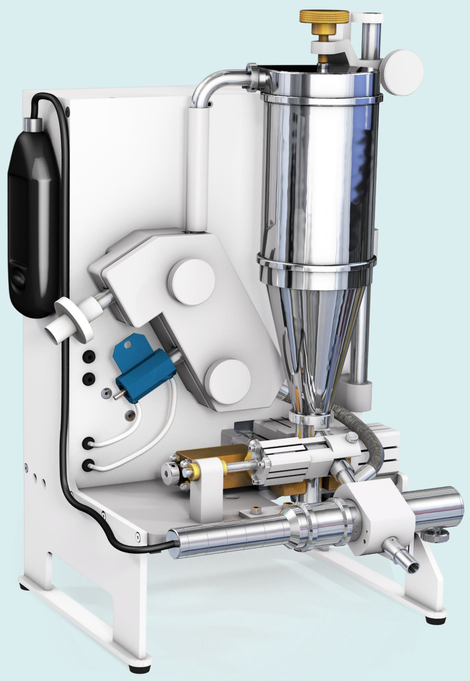

Figure 1. PreciseInhale.

Conclusion

The broadened range of varying the aerosol generation pressure of the PreciseInhale system, now spanning from 10 bar to 160 bar, increases the opportunities of optimizing generation conditions for a greater variety of powder substrates.

TiO_2 nanoparticles are more effectively deagglomerated when using a high generation pressure (160 bar) than a low pressure (10 bar).

Future

The possibility of varying the aerosol generation pressure more widely in the PreciseInhale system increases the opportunities of creating optimal aerosols for a greater range of inhalation research projects.

Introduction

The PreciseInhale system is an exposure platform for small-scale inhalation experiments by precisely dosing animals *in vivo,* lungs *ex vivo*, as well as for depositing material for *in vitro* dissolution testing.

100 bar was earlier used as default pressure while this seemed to deagglomerate most powders quite well. However, varying the generation pressure in more detail was found to enable aerosolization of more challenging powders, by increasing yield of some powders or to maintain more delicate engineered drug carrier particles intact during aerosolization.

The aim of this study was to investigate the effect of varying the generation pressure, on particle size distribution (PSD) of the same test powder.

Experimental methods

The material used was ultrafine TiO_2 (P25, Degussa). Around 1 mg was loaded in the powder chamber (figure 2) for each generation cycle.

Aerosol was generated through deagglomeration and the generation pressures chosen were 10, 100 and 160 bar. A Marple 9-stage cascade impactor was used for particle size determinations.

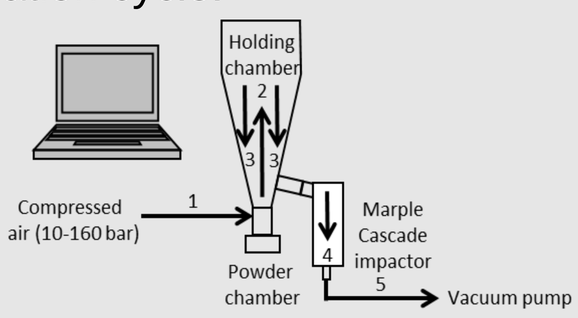

Figure 2. Schematic picture of PreciseInhale coupled to a cascade impactor for particle size determinations.

Aerosols generated at 10 and 160 bar were also deposited onto glass cover slips using a special aerosol holding chamberfor, for SEM analysis.

Results

The resulting aerosol concentrations generated were in the range of 1 200-2 500 µg/L and the aerosol yield exiting the PreciseInhale was 60-70% of loaded amounts. PSD curves with related data and SEM images are presented in figure 3.

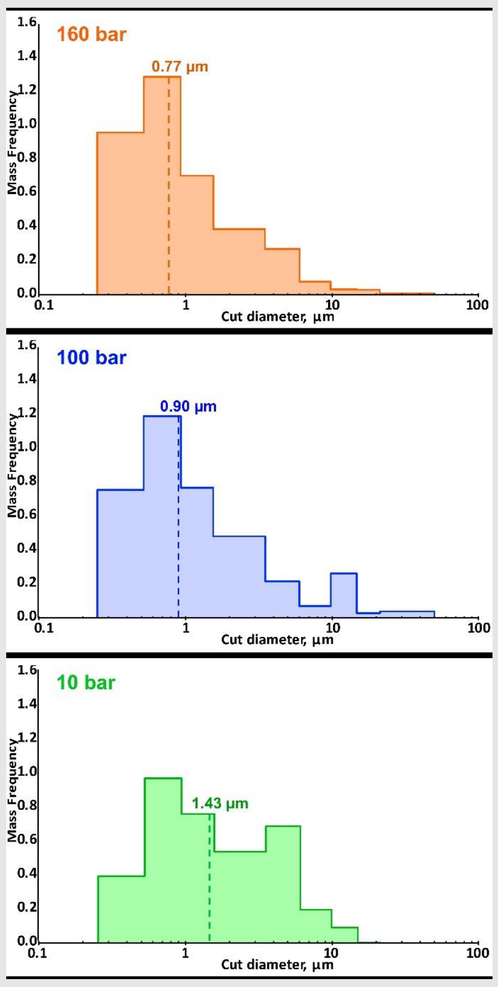

Figure 3. PSD curves, MMAD, GSD and SEM images for aerosols of TiO_2 generated at 10, 100 (no SEM) and 160 bar.

Generation pressure	10 bar	100 bar	160 bar
MMAD	1.43±0.42µm	0.90±0.10µm	0.77±0.07µm
GSD	2.88±0.04	2.66±0.09	2.42±0.37

Discussion

The higher the aerosol generation pressure used for TiO_2 nanoparticles in the PreciseInhale system, the finer the generated aerosols get, with less particle agglomeration and a narrower PSD.

Inhalation Sciences

Inhalation Sciences
Laboratory Manager *in vitro* Studies
Hälsovägen 7-9
141 57 Huddinge, Sweden
maria.malmlof@inhalation.se
www.inhalation.se

Karolinska Institutet
PhD student, Institute of Environmental Medicine
Box 210
171 71 Solna, Sweden
www.ki.se/imm

KAROLINSKA INSTITUTET * ANNO 1810 *
Karolinska Institutet