AEROSOLS PARTICLES DEPOSITION IN THE LUNGS: EFFECT OF FLEXIBILITY OF WALLS

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Aerosol medication has been used to cure lung diseases for years. Medical aerosols particles are mostly prescribed because of their local effects. It is therefore important to be able to localize aerosol particles deposition sites in order to improve treatments efficiency and/or reduce side effects.

This project is performed within collaboration between the University of California at San Diego and the VKI. Numerical simulations on aerosol particles deposition in the lungs are carried out at the UCSD. Experimental work is undertaken at the VKI to validate CFD results. DC projects in the past few years in bio-fluid concentrated in aerosol particles deposition inside the acinus region of the lungs. Reynolds number in this area is very low (below 0.1), and mean velocity is below 10 $mm.s^{-1}$.

This DC project involved the design and the manufacturing of a scaled up transparent model of an alveolate branch with moving walls. Highly viscous silicon oil was used in order to match the Reynolds number similarity of the flow. Flow inside the model was generated by gravity. Deformation of the model was due to the hydrostatic pressure of the working fluid acting on the walls of the model. The wall displacements of the alveolus were controlled with a piston. PIV measurements were performed to observe the influence of walls flexibility on the flow inside the alveolus. PTV measurements were also performed in order to observe the influence of moving walls on aerosol particles trajectories inside the acinus.

The complete model set-up was installed in the HMT lab. In-vitro PIV and PTV measurements were performed with fixed walls configurations at different alveolar volumes. The same measurement techniques were also used for the model with moving walls configuration. Several deformation rates were investigated.

The expansion or contraction of the alveolus induces an alveolar flow rate. This induced flow rate changes the alveolus flow field. Results in terms of streamlines pattern were similar to those obtained from theoretical resolutions or numerical simulations found in the literature. The induced transversal velocity also has an influence on the trajectory of the aerosol particles. These particles were penetrating deeper inside the alveolus during its expansion but they did not deposit.

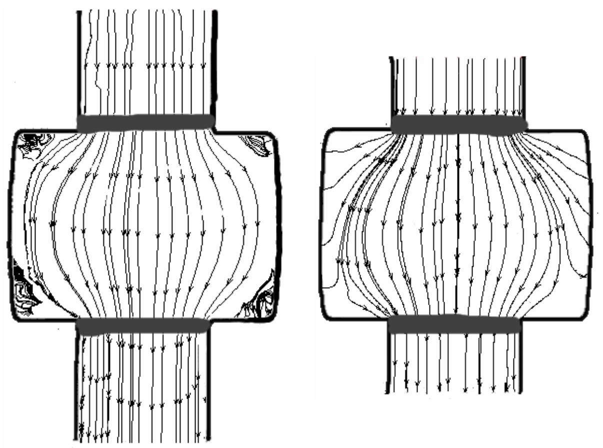

Figure 1: Streamline sinside the alveolus model – fixed walls (left) – moving walls (right)

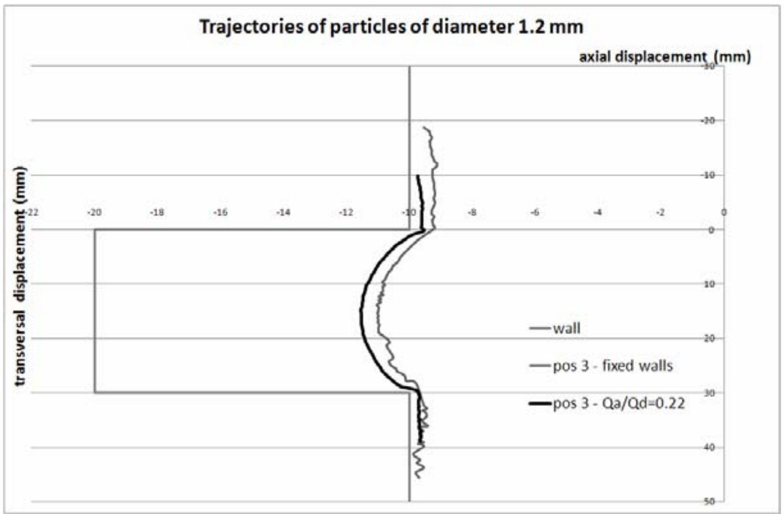

Figure 2: Trajectories of particles