Numerical simulation of the gas mixing behavior in a soot measuring system

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In order to establish a primary soot aerosol standard for the calibration of aerosol instrumentation, a high-accuracy soot generator as well as a well-defined aerosol conditioning, dilution, and homogenization unit is needed. In this contribution, the mixing behavior of different gases under different junction conditions was numerically investigated to gain insight for favorable setup geometries and flow conditions of soot measuring systems. The overall goal was to find the design that leads to the fastest mixing of the different incoming gas components for a given pipe length. For this purpose, in [1] a main pipe with two symmetrically arranged side inlet pipes was considered, where the angle of inclination of the side pipes as well as the inflow conditions were varied. It was found that, in general, the required pipe length to reach a sufficiently homogeneous gas mixture decreases with increasing inclination angles exhibiting the best performance at obtuse angles. Furthermore, it has been observed that the turbulent Schmidt number used in the turbulence modeling of the transport equation of the mass fraction of aerosol-laden gas has an important influence on the speed of mixing. In general one can say that, the smaller the turbulent Schmidt number, the faster the mixing. Nevertheless, it can also be observed that the qualitative behavior how the mixing length in- or decreases with changes in the geometry is invariant under different turbulent Schmidt numbers. In addition, the influence of different sample probe tubes on the mixing behavior is considered.

[1] G. Lindner, S. Schmelter, R. Model, A. Nowak, V. Ebert, and M. Bär. A computational fluid dynamics study on the gas mixing capabilities of a multiple inlet system. *ASME. J. Fluids Eng*, **138**:031302–031302–9, 2015.