Numerical Study and Simulation in COMSOL Multiphysics of the Dilution Process During Dust's Sampling in Dry Machining

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Abstract

The importance of dilution issue during the dust measurement has risen in recent years with the interests of researchers and engineers working in environmental and occupational safety sector. In fact, the study of natural phenomena (sand wind, natural pollination, volcanic eruption, hurricane, etc.) or technological processes (machining process, mining's exploitation, powder's transportation, etc.) recommended adequate devices (SMPS, CPC, APS, LIDAR, DMPS, etc.), with best quality in the measuring. Furthermore, the excellent measurement of fines and ultrafines particles passed through the dilution of the initial concentrations, generally very high for a better assessment of the pollution degree. For high concentrations, the literature review show that, during aspiration of the metallic dust, the particles are affected by the many phenomena: electrical attraction, coalescence, glue on the pipe walls, agglomeration, condensation, sedimentation, leakage losses, etc. Otherwise, the processing systems of the measurement chain are specially realized by electronic components, highly sensitive to short-circuits and electrochemical attacks caused by the filing of metal particles (excellent electrical and thermal conductor). Also, the optical components (lenses, light source, etc.) are affected by the deposition of dust (obstruction of optical surfaces, absorption of optical radiation and deviation, etc.). Now, the interest of researchers are moving towards finding the appropriate dilution for better measurement of particle size and particle concentration. The aim of this Conference paper is the numerical study and graphic simulation of the dilution process during the particle measurement in dry machining. We used the Navier-Stokes equations and CFD k-ε model in COMSOL Multiphysics to obtain the graphic simulation of different stats of dilution during the variation of clean air added. Only the alternative with the same direction jet in the diluter can give a good result. The experiment validation with the similitude model confirmed the mean of dilution ratio: 4 with 95% confidence interval.

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