Proceedings of the 6th World Congress on Momentum, Heat and Mass Transfer (MHMT'21)
~~Lisbon, Portugal~~ Virtual Conference– June 17 – 19, 2021
DOI:10.11159/enfht21.lx.003

An Ultrafine Particle Number Measurement System Operating Under Wide Temperature Rang

Dr. Longfei Chen
School of Energy and Power Engineering
Beihang University
Shahe Campus, Beihang University,Beijing,China
chenlongfei@buaa.edu.cn

Abstract

Developing a new non-volatile condensation particle counter (nv-CPC) which can operate at high temperature of up to 300°C, at which volatile organic compounds (VOCs) and water are in gaseous phase. Hence, the nv-CPC counts the number concentration of only non-volatile particles which are less susceptible to dilution conditions. Contrarily, the conventional condensation particle counter (CPC) operating at room temperature counts not only non-volatile particles but also organic particles formed via the condensation of VOCs or semi-VOCs. VOCs may experience coagulation, condensation and adsorption in the dilution plume and thus are highly sensitive to dilution conditions. Therefore, the conventional CPC inevitably suffers higher uncertainties than the nv-CPC due to VOCs presence. To achieve a reproducible measurement of particle number, the EU initiated the Particle Measurement Program (PMP) which specified a volatile particle remover (VPR) be used prior to particle counter to mitigate the VOCs artifacts. The controversial cut-off size and incomplete VOCs removal issues trigger the need to re-consider the methodology. The nv-CPC was calibrated based on the PMP protocol and was compared with the conventional CPC by challenging different mono-disperse particles screened via an electrical classifier. The nv-CPC size spectra were largely stable regardless of pre-process and dilution conditions for raw sample gas, whilst the CPC size spectra exhibited higher uncertainties. The parallel arrangement of the CPC and the nv-CPC also facilitates the on-line determination of size-resolved EC/TC (elemental carbons/total carbons) ratios on particle number basis, which could be more useful than the bulk EC/TC ratios measured by off-line filter-based technique. The distinction of PM emissions from different sources including a Santoro burner and a modern aero-engine was well characterized by using both particle counters in tandem.