A Study on Real-time Evaluation of Uncertainty of PM-10 Concentration Determined by Tele-measuring Instrument

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***Abstract*—We developed a real-time particulate matter(PM-10) and its uncertainty monitoring instrument assisted by beta-ray absorption method and continuous tele-measuring system. According to the GUM as an authentic reference, 4 steps of operational procedures for uncertainty evaluation were included to general type of instrument; at first, establishment of a model equation of PM concentration, at second, calculation of each standard uncertainty, at third, calculation of combined standard uncertainty, at fourth, calculation of expanded uncertainty at 95% confidence level.**

The developed instrument was tested at Gwanpyeong-dong, Daejeon during Nov. 2023. Through this field application, expanded uncertainties at 720 data points of PM concentration were obtained. At the low level of PM concentration, 22.2 μg/m³, the expanded uncertainty value was 2.0 μg/m³ at the 95 % confidence level, while at the high level of PM concentration, 118.6 μg/m³, it was 9.8 μg/m³. The expanded uncertainty values versus PM concentration were well fitted with a second-order regression equation, $y = 0.00007\ x^2 + 0.073\ x + 0.36$ (μg/m³). In comparison with each uncertainty variance, it was revealed that the most important uncertainty source is the uncertainty of linearity quantified by equivalence evaluation between the PM concentration values obtained by beta-ray absorption method and direct weighing method. And the contribution rate of this uncertainty was 32% of total uncertainty.

It has revealed that the developed instrument has successfully managed to calculate and display real-time measurement uncertainty with various uncertainty source budgeting data.

***Keywords*— Real-time uncertainty evaluation. Measurement uncertainty, Particulate matter, PM-10, Air quality analyzer, Tele-measuring system**

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