Multifactor colorimetric analysis on pH-indicator papers: an optimized approach for direct determination of ambient aerosol pH

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Direct measurement of the acidity (pH) of ambient aerosol particles/droplets has long been a challenge for atmospheric scientists. A novel and facile method was introduced recently by Craig et al. (2018), where the pH of size-resolved aerosol droplets was directly measured by two types of pH-indicator papers (pH ranges: 0 – 2.5 and 2.5 – 4.5) combined with RGB-based colorimetric analyses using a model of G-B (G minus B) versus pH. Given the wide pH range of ambient aerosols, we optimize the RGB-based colorimetric analysis on pH papers with a wider detection range (pH ~ 0 to 6). Here, we propose a new model to establish the linear relationship between RGB values and pH: \[ \text{pH}_{\text{predict}} = a \times R_{\text{normal}} + b \times G_{\text{normal}} + c \times B_{\text{normal}}. \] This model shows a wider applicability and higher accuracy than those in previous studies, and is thus recommended in future RGB-based colorimetric analyses on pH papers. Moreover, we identify one type of pH paper (Hydrion® Brilliant pH dip stiks, Lot Nr. 3110, Sigma-Aldrich) that is more applicable for ambient aerosols in terms of its wide pH detection range (0 to 6) and strong anti-interference capacity. The determined minimum sample mass (~180 µg) highlights its potential to predict aerosol pH with a high time resolution (e.g., ≤ 1 hour). We further show that the routinely adopted way of using pH color charts to predict aerosol pH may be biased by the mismatch between the standard colors on the color charts and the real colors of investigated samples. Thus, instead of using the producer-provided color chart, we suggest an in-situ calibration of pH papers with standard pH buffers.

Reference:


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