Organic pollutants in museums and their relationship with iron corrosion

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Abstract

Indoor air quality in museums is important for protection and conservation of artifacts. In this study, four museums located in different regions of China were selected, including Beijing, Qingdao, Wuhan, and Guangzhou. To investigate the museum environment, indoor air and dust samples were collected and analyzed in 11 rooms. Temperature and humidity were monitored continuously. Simulated and archaeological iron block samples were placed at each sampling location, and their mass change were measured periodically to evaluate corrosion levels. Over 120 volatile and semi-volatile organic pollutants were detected and quantified, including carbonyls, organic acids, phthalates, polyaromatic hydrocarbons, organophosphates, pesticides, etc. Among them, more than 60% of pollutants had a detection frequency over 50%. The results indicated that organic pollutants were widespread in museums. Ranking of environmental factors were conducted based on both the results of multiple methods of statistical analysis, and chemical properties of pollutants. As a result, many chemicals may influence iron corrosion, most of them were seldomly reported before. The reaction mechanism and quantitative correlation between pollutants and iron artifacts were investigated. Cyclohexanone was found to be catalyzed by iron to form organic acids. For acetic acid, 10 mg/m^3 was a safe value of concentration for iron samples under 50℃ and 90%RH. Our work provided more understanding of pollutants in museums and their relationship with iron artifacts. The findings guarantied further research on the environmental impacts on cultural heritage artifacts.

Keywords

museums; organic pollutants; iron corrosion; reaction mechanism; quantitative correlation