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Addressing the Biocide Residue Issue in Museum Collections Already in the Planning Phase: An Investigation Into the Decontamination of Biocide Polluted Museum Collections Using the Temperature and Humidity Controlled Integrated Contamination Manageme

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Abstract : Museum staff, conservators, restorers, curators, registrars, art handlers but potentially also museum visitors are often exposed to the harmful effects of biocides, which have been applied to collections in the past for the protection and preservation of cultural heritage. Due to stable light, moisture, and temperature conditions, the biocidal active ingredients were preserved for much longer than originally assumed by chemists, pest controllers, and museum scientists. Given the requirements to minimize the use and handling of toxic substances and the obligations of employers regarding safe working environments for their employees, but also for visitors, the museum sector worldwide needs adequate decontamination solutions. Today there are millions of contaminated objects in museums. This paper introduces the results of a systematic investigation into the reduction rate of biocide contamination in various organic materials that were treated with the humidity and temperature controlled ICM (Integrated Contamination Management) method. In the past, collections were treated with a wide range, at times even with a combination of toxins, either preventively or to eliminate active insect or fungi infestations. It was only later that most of those toxins were recognized as CMR (cancerogenic mutagen reprotoxic) substances. Among them were numerous chemical substances that are banned today because of their toxicity. While the biocidal effect of inorganic salts such as arsenic (arsenic(III) oxide), sublimate (mercury(II) chloride), copper oxychloride (basic copper chloride) and zinc chloride was known very early on, organic tar distillates such as paradichlorobenzene, carbolineum, creosote and naphthalene were increasingly used from the 19th century onwards, especially as wood preservatives. With the rapid development of organic synthesis chemistry in the 20th century and the development of highly effective warfare agents, pesticides and fungicides, these substances were replaced by chlorogenic compounds (e.g. γ-hexachlorocyclohexane (lindane), dichlorodiphenyltrichloroethane (DDT), pentachlorophenol (PCP), hormone-like derivatives such as synthetic pyrethroids (e.g., permethrin, deltamethrin, cyfluthrin) and phosphoric acid esters (e.g., dichlorvos, chlorpyrifos). Today we know that textile artifacts (costumes, uniforms, carpets, tapestries), wooden objects, herbaria, libraries, archives and historical wall decorations made of fabric, paper and leather were also widely treated with toxic inorganic and organic substances. The migration (emission) of pollutants from the contaminated objects leads to continuous (secondary) contamination and accumulation in the indoor air and dust. It is important to note that many of mentioned toxic substances are also material-damaging; they cause discoloration and corrosion. Some, such as DDT, form crystals, which in turn can cause micro tectonic, destructive shifting, for example, in paint layers. Museums must integrate sustainable solutions to address the residual biocide problems already in the planning phase. Gas and dust phase measurements and analysis must become standard as well as methods of decontamination.

Keywords : biocides, decontamination, museum collections, toxic substances in museums
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