H66 Elemental Analysis of Cremains Using X-Ray Fluorescence Spectrometry

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After attending this presentation, attendees will understand the results of a study conducted to determine whether X-Ray Fluorescence (XRF) spectrometry may be a useful tool in the analysis of potentially contaminated cremains.

This presentation will impact the forensic science community by providing information regarding a new analytical approach that could be used in the examination of cremated materials, especially if they are suspected of being contaminated with nonskeletal material.

Cremation can be achieved in various contexts including funerary practices as well as accidental or criminal incineration. During any process of cremation, contamination of the cremated remains is possible; this can happen naturally or unintentionally through taphonomic processes, or it can occur because of intentional improper cremation practices. Due to a number of criminal cases in which cremated remains have been contaminated or completely replaced with non-skeletal material (including the highly publicized Tri-State Crematorium in Nobel, Georgia involving the improper cremation of more than 300 bodies), it has come to the attention of investigators and forensic anthropologists that there is a lack of analytical methodology available for the examination of potentially contaminated human cremated remains. Especially with the growing efficiency of pulverizing machines used to grind cremated bones down to minute fragments and a fine powder, there is a need for instrumentation that can provide accurate analysis of these cremated remains to test for the presence of non-skeletal contaminants.

This study tested the ability of XRF to detect the presence of contaminants in cremated remains by assessing the elemental constituents of the sample. Specifically, a Bruker Tracer III-SD handheld XRF was utilized. The handheld XRF system has been developed as a general tool for crime scene investigation and, because of its portability, can be used to assess the elemental composition of evidence at the scene. Moreover, there is relatively little training required to use the instrument (although significantly more training is often required to properly interpret the results). A laboratory experiment was designed involving 11 samples of cremated remains of a standard poodle which were variably contaminated with concrete mix brand/type not listed or disclosed and then analyzed using the XRF. Bone is primarily comprised of the elements calcium and phosphorus. Calcium is also a significant component of typical concrete mixes, but it also contains other elements such as iron, silicon, and aluminum. Samples 1 and 11 contained 100% cremated remains and 100% concrete mix, respectively, and samples 2-10 successively decreased in cremated remains and increased in contaminant by 10%.

Results show that the elements detected in the samples were consistent with elements that comprise skeletal material and the contaminant used, and that the varying amounts of these materials in the test samples could be detected in the elemental photon counts of the instrument. The most significant changes were noted in the elements phosphorus, potassium, aluminum, iron, sulfur, and silicon. As the amount of cremated remains decreased, so did the levels of phosphorus and potassium. With increasing concrete mix, the levels of aluminum, iron, sulfur, and silicon increased.

It is therefore concluded that the handheld XRF is able to detect changes in the variable presence of cremated remains and the contaminant of the study samples. This approach can assist the forensic community by aiding forensic anthropologists and other analysts when examining cremated remains for the presence or degree of non-skeletal contaminant as well as assisting investigators by indicating possible improper or criminal cremation practices.

Cremains, Cremation, X-Ray Fluorescent Spectrometry

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