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Solidification/Stabilization of Lead and Chromium with the Aid of Bagasse as an Additive to Portland Cement

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alternative techniques, such as ICP-OES and ICP-MS, the R&D investment focus has become somewhat skewed to such techniques. As a consequence, investment in AAS development has concentrated on manufacturing and cost improvements rather than the more fundamental characterisation of the technique.

This paper will demonstrate that significant improvements in both the analytical capability and convenience of the AA technique are eminently possible by the application of further fundamental characterisation.

Employing a series of experiments designed to better quantify the spatial and temporal characteristics of the atomisation system, the work has developed a new model of the atomisation process under many varying analytical conditions. Armed with this better understanding, the work programme has enabled the design of a totally new optical measurement system, more closely related to the atomisation model. In turn this has required a novel new optical approach in order to make such a design a practical proposition. Despite the high optical demands placed on such a system, a method will be proposed which employs relatively simple optical components.

Advanced ray tracing, FEA and other computer aided techniques will be discussed, which have been found necessary in order to fully optimise this new approach. Fundamental analytical data and real, everyday analyses will be presented to demonstrate the improvements achieved.

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THE PRACTICAL USE OF A VARIABLE MAGNETIC FIELD STRENGTH LONGITUDINAL ZEEMAN BACKGROUND CORRECTION TECHNIQUE WHEN APPLIED TO SPECTRAL INTERFERENCE STUDIES IN GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY (GFAAS)

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The practical use of Zeeman based background correction techniques are well established in the field of Graphite Furnace Atomic Absorption Spectrometry (GFAAS).

However, Zeeman background correction techniques have long suffered from a range of detrimental effects caused by the magnetic field strength effect applied to the background correction system. These problems may manifest as a depreciation in analytical sensitivity, calibration rollover effects and increased spectral interference from interfering species.

This work demonstrates the importance of optimizing the magnetic field strength of a rapidly modulating Zeeman background correction system to overcome a range of practical Zeeman based analytical problems.

Practical examples show the effect of magnetic field strength optimization using a range of interference and sample matrix types.

The study reinforces the premise that calibration roll over is a result of the sensitivity achieved as influenced by the applied magnetic field and where the magnet field strength is the only variable. The performance indicator for the employed Zeeman-effect, the magnetic sensitivity ratio (MSR), provides a useful predictor of the analytical working range given the same instrument operating conditions. The MSR reaches a maximum where the wavelength shifted components of the absorption profile do not overlap the emission band from the lamp and therefore do not absorb light emitted from the lamp. The work shows that careful selection of magnetic field strength reduces and in some instances eliminates unwanted absorption thereby improving sensitivity and extending the analytical working range.

The work also reveals that for some elements increasing the magnetic field strength is not always beneficial and shows the importance of optimizing the magnetic field strength to enhance sensitivity. The effect of spectral interference by concomitants was investigated and the work demonstrates that field optimization could decrease the effect.

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SOLIDIFICATION/STABILIZATION OF LEAD AND CHROMIUM WITH THE AID OF BAGASSE AS AN ADDITIVE TO PORTLAND CEMENT

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A significant portion of modern industrial waste is disposed by solidification in cements and slags. To be successful, a solidification/stabilization (S/S) procedure must constrain waste to prevent leaching (migration of waste through the soil), especially by ground water. Solidification/stabilization of hazardous wastes is a widely used technology; therefore, it is very crucial to be able to evaluate its effectiveness and to make attempts to improve the technique. Cement has been found to be effective for some heavy metals while ineffective for others. The fact that cement alone is not working satisfactory for all wastes is a clear indication that an alternative matrix for S/S is needed. The primary objective of this project is to design a better matrix for S/S of hazardous waste that will be effective and economically feasible by adding an adsorbent additive to the waste/cement matrix. The waste will be stabilized by complexing with the large molecule preventing the waste from leaching. The adsorbent to be used is lignin, but to make the process more economically feasible, the source of lignin will come from the large excess of bagasse (byproduct of milling or diffusing sugar cane ≈ 1.8 million tons annually in Louisiana) produced each year from sugar cane processors. One of the components of bagasse is lignin, approximately 22% by weight. This excess bagasse will be used as an adsorbent additive to the cement in a effort to develop a better matrix to entrain heavy metal waste.

Preliminary results indicate that using bagasse as an additive to cement could be effectively improving the S/S of metal wastes. Lead nitrate and sodium chromate were used as model heavy metal wastes with a metal to cement ratio of 1:10. Samples were analyzed by following the Environmental Protection Agency recommended Toxicity Characteristic Leaching Procedure and determining metal leaching concentrations by Atomic Absorption. Samples containing bagasse typically leached less than 0.5 mg/l of lead and 900 mg/l of chromium, while samples containing no bagasse leached approximately 7 mg/l of lead and 1600 mg/l of chromium. Results indicate that using bagasse as an additive to cement is effectively improving the S/S of these metal wastes.