The relatively heterogeneous distribution of explosive residues in contaminated and remediated land makes field analysis techniques important in exploring the nature and distribution of these contaminants. Common current techniques for detecting trace explosives include ion mobility spectrometry (IMS) and gas chromatography (GC), usually coupled with mass spectrometry (MS); however, most of these devices are bulky, expensive, and require time-consuming procedures and well-trained operators [1]. In this regard, voltammetry may be a cheaper and more portable alternative for electro-active explosives [2]. The advantages of electrochemical systems for onsite/in situ measurements of explosives rely on high sensitivity and selectivity, reasonable linear concentration ranges, minimal space and power requirements, and low-cost instrumentation. Generally trinitro compounds (e.g., TNT and picric acid) are more readily reducible than the corresponding dinitro and mononitro analogs.

This work reports the development of a cyclic voltammetric (CV) assay for nitro-aromatics (trinitrotoluene (TNT) and dinitrotoluene (DNT)) using a glassy carbon electrode. A scan rate of 50 mV s⁻¹ was chosen, and NaCl was the supporting electrolyte. CV was performed in a potential range from 0.2 V to -1.2 V, and the characteristic peak potentials for each nitro-aromatic compound were determined. Calibration of TNT samples was based on the peak current at -0.52 V potential, and a linear dependence was found: \( I_{0.52\,V} = 0.2951 \, C_{\text{TNT}} + 8.266 \) (\( r = 0.996 \)), where \( I \) was peak current intensity (\( \mu \)A), \( C_{\text{TNT}} \): TNT concn. (mg L⁻¹), and \( r \): linear correlation coefficient. Characteristic peak potential of DNT samples was at -0.65 V, and linear calibration curve for the determination of DNT samples at this potential was: \( I_{0.65\,V} = 0.2968 \, C_{\text{DNT}} + 8.996 \) (\( r = 0.999 \)). Results showed that the CV method could provide a sensitive approach for the simultaneous determination of TNT and DNT in synthetic mixtures. Deconvolution of current contributions of mixtures at peak potentials of constituents was performed by multiple linear regression [3]. This method offers possibilities for monitoring land remediation of nitro-aromatic explosive–contaminated sites, and for kinetic munition modeling during shelf life.

KEYWORDS: Trinitrotoluene (TNT), Dinitrotoluene (DNT), Cyclic Voltammetry

REFERENCES: