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Ph.D. DISSERTATION DEFENSE

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Title:	Analysis of the Thermal Decomposition of Munitions Wastewater
Chairperson:	Dr. Nicholaus J. Parziale, Department of Mechanical Engineering, School of Engineering and Science
Committee Members:	Dr. Kevin Connington, Department of Mechanical Engineering Dr. Jason Rabinovitch, Department of Mechanical Engineering Dr. Christos Christodoulatos, Department of Civil, Environmental and Ocean Engineering Dr. Tsan-Liang Su, Department of Civil, Environmental and Ocean Engineering

ABSTRACT

Fabrication processes in munitions plants produce an Ammonium Nitrate laden wastewater stream which needs to be disposed of in accordance with regulatory guidelines. However, the presence of oxygen-rich nitrates and carbon containing compounds in this wastewater offers an opportunity to repurpose it as a nitrogen based monofuel. The thermal decomposition of small batches of the AN wastewater and control samples of various compositions at various pressures are explored in this work. Experimentally determined energy releases and emissions are reported and compared against the benchmarks of theoretically determined energy contents and ideal decomposition products to evaluate the "quality" of decomposition. Various thermal effects and associated heat flows during decomposition are measured using a Differential Scanning Calorimeter (DSC), and gaseous emissions from the samples are analyzed using a Fourier Transform Infrared (FTIR) spectrometer. The kinetics of the wastewater decomposition was investigated, and comparison of the associated activation energies showed that reaction mechanisms change with pressure. Further kinetic analysis revealed that the thermal decomposition of this wastewater is dominated by nucleation and diffusion reaction mechanisms in the melt phase. The insights obtained from this work helped provide appropriate guidelines for the design of a bench-scale continuous flow reactor and its operation procedures for scaling-up the investigation of converting this waste product to an energy source.