

An Improved Analytical Method For the Separation and Quantification of Stabilizers and Stabilizer Degradation Products Extracted from Single and Double Based Propellants

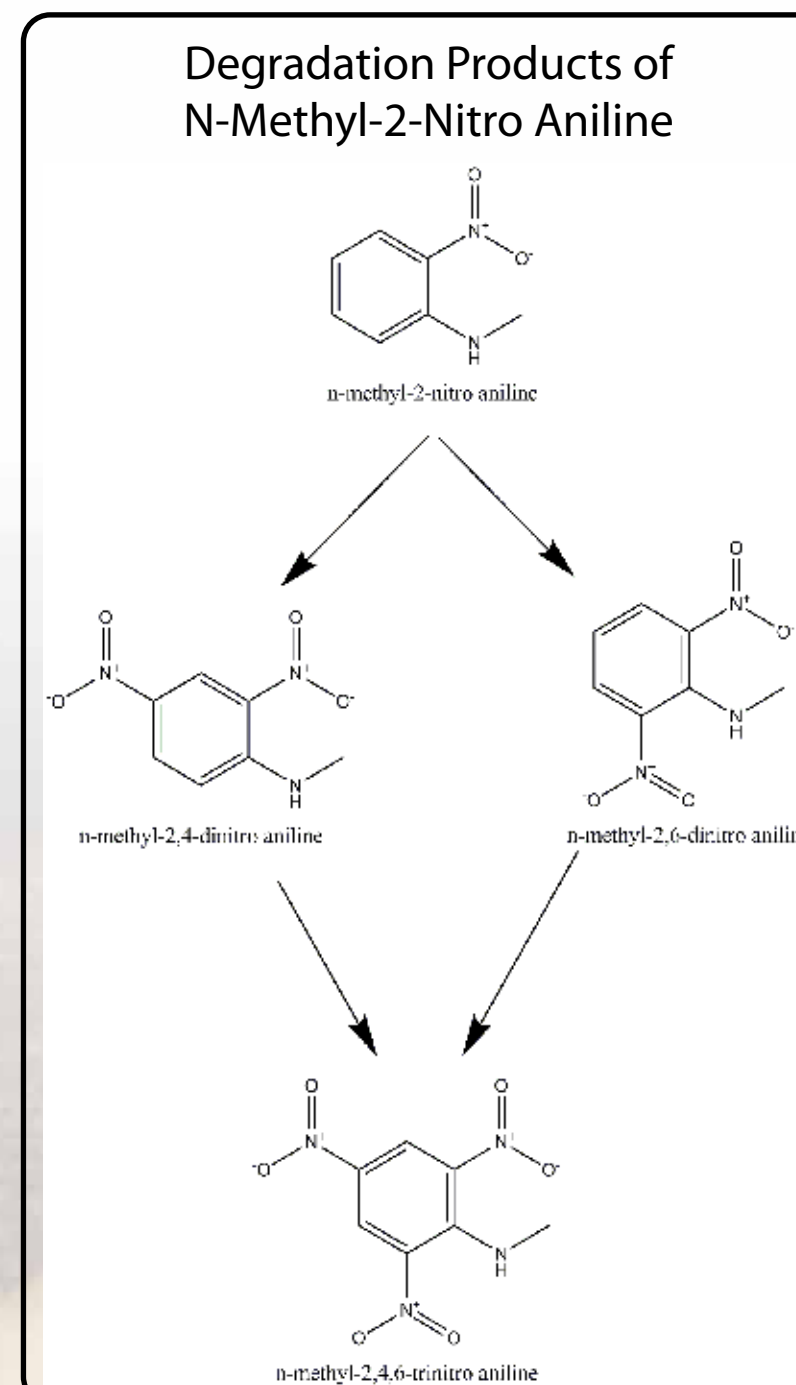
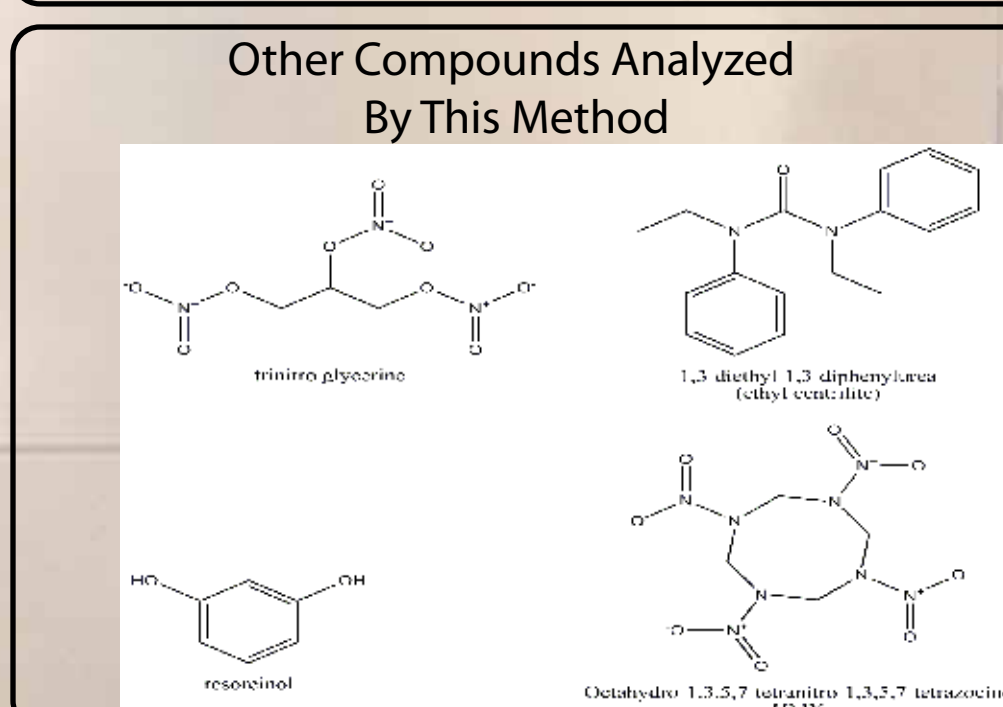
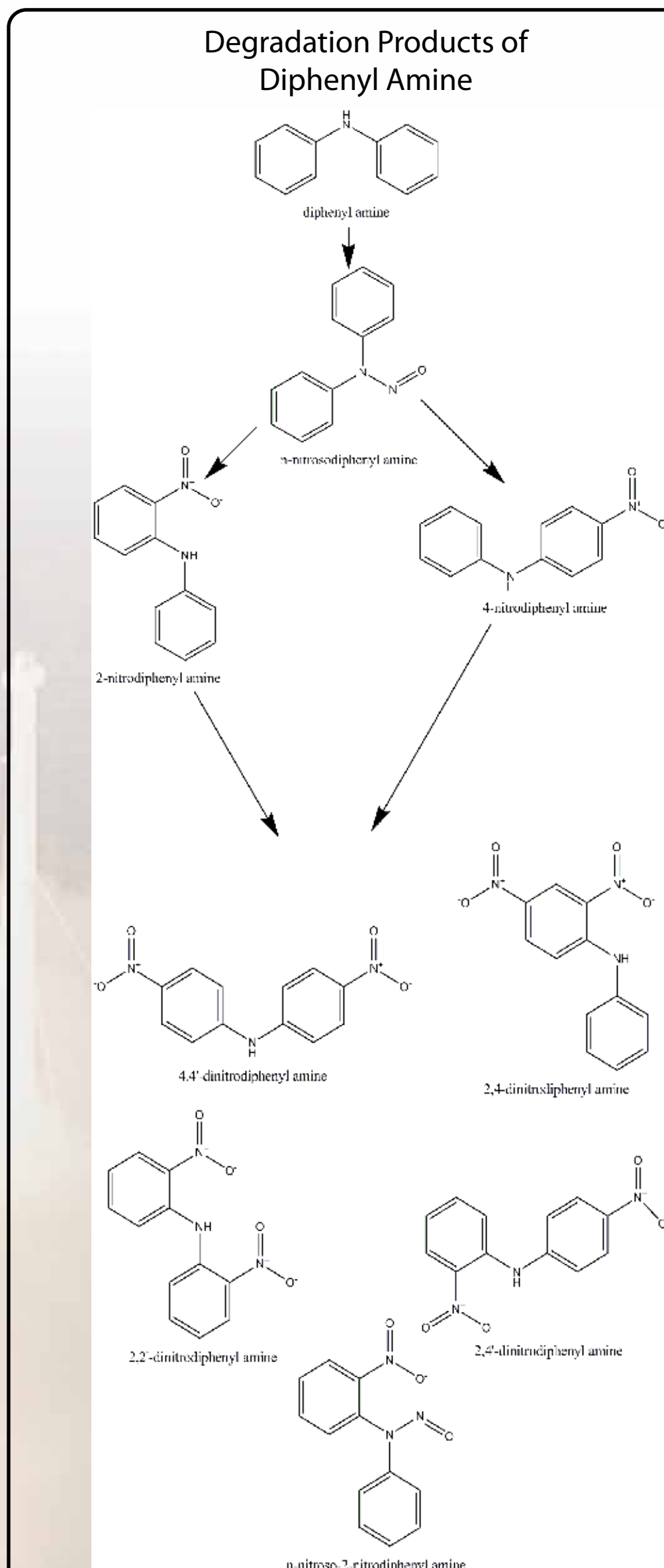
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An improved analytical method for the separation and quantification of stabilizers and stabilizer degradation products extracted from single and double based propellants has been developed. An ultra high performance liquid chromatograph (UHPLC) equipped with a photodiode array (PDA) detector resulted in an analysis time of 3 minutes versus 40 minutes when using a conventional HPLC system.

Propellants containing Nitroglycerin or Nitrocellulose degrade over time. Stabilizers are added to help increase the lifetime of propellants. When stabilizer levels drop below a critical point the propellants can self heat and in some cases autoignite. Therefore, it is important monitor the level of stabilizers in propellants to ensure that the material does not represent a safety hazard. This is the primary purpose of this method.



This method can also be used to study propellant degradation in accelerated aging studies of single and double based propellants. It could also be used in forensic investigations of accident scenes and criminal activity.



Analytical Method
75 mg of propellant was placed into a 25 ml volumetric flask and brought to volume with 3:1 methanol/sec-butanol. This solution was sonicated for 30 minutes and filtered with a 0.20 um PTFE filter. This solution was then injected into the Waters Aquity-UPLC.

UPLC Method
Injection Volume: 2.5 ul
Column: Waters Aquity UPLC BEH C-18 150 mm x 2.1 ID x 1.7 um solid support material

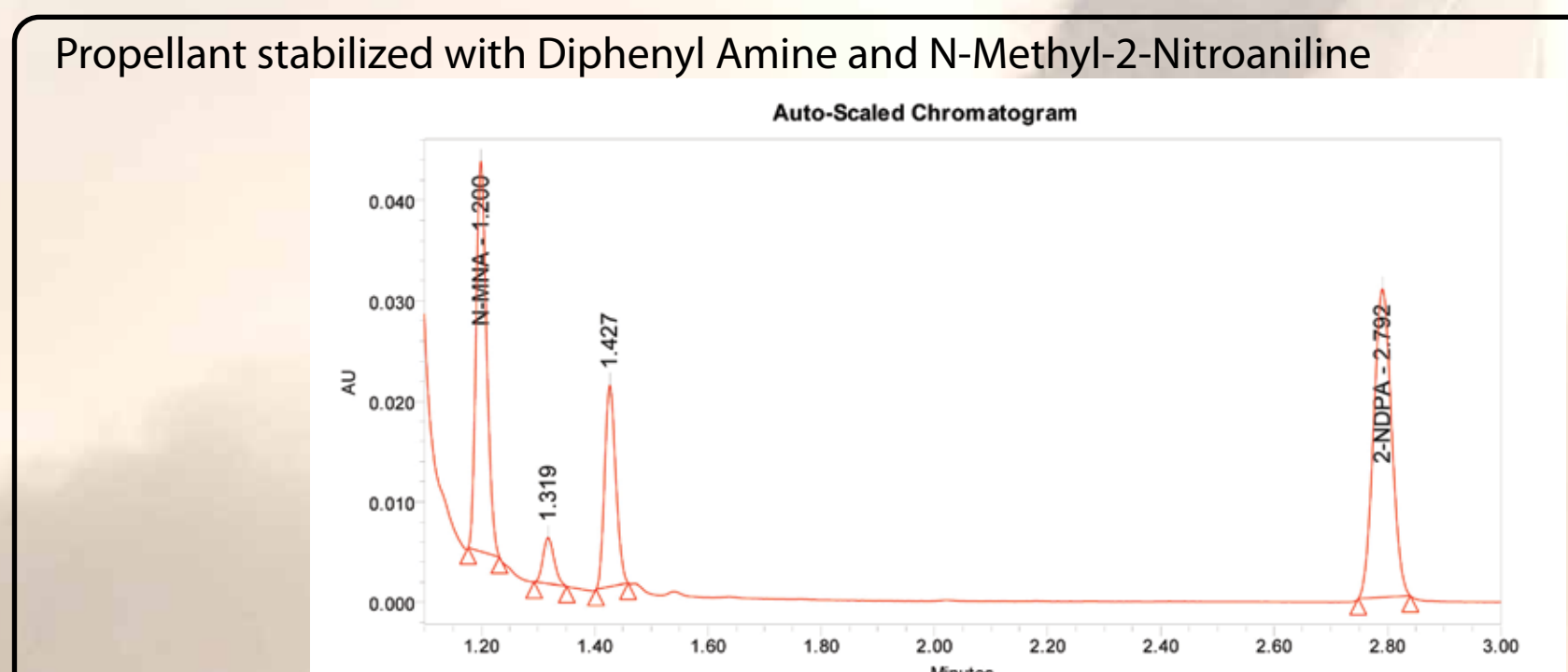
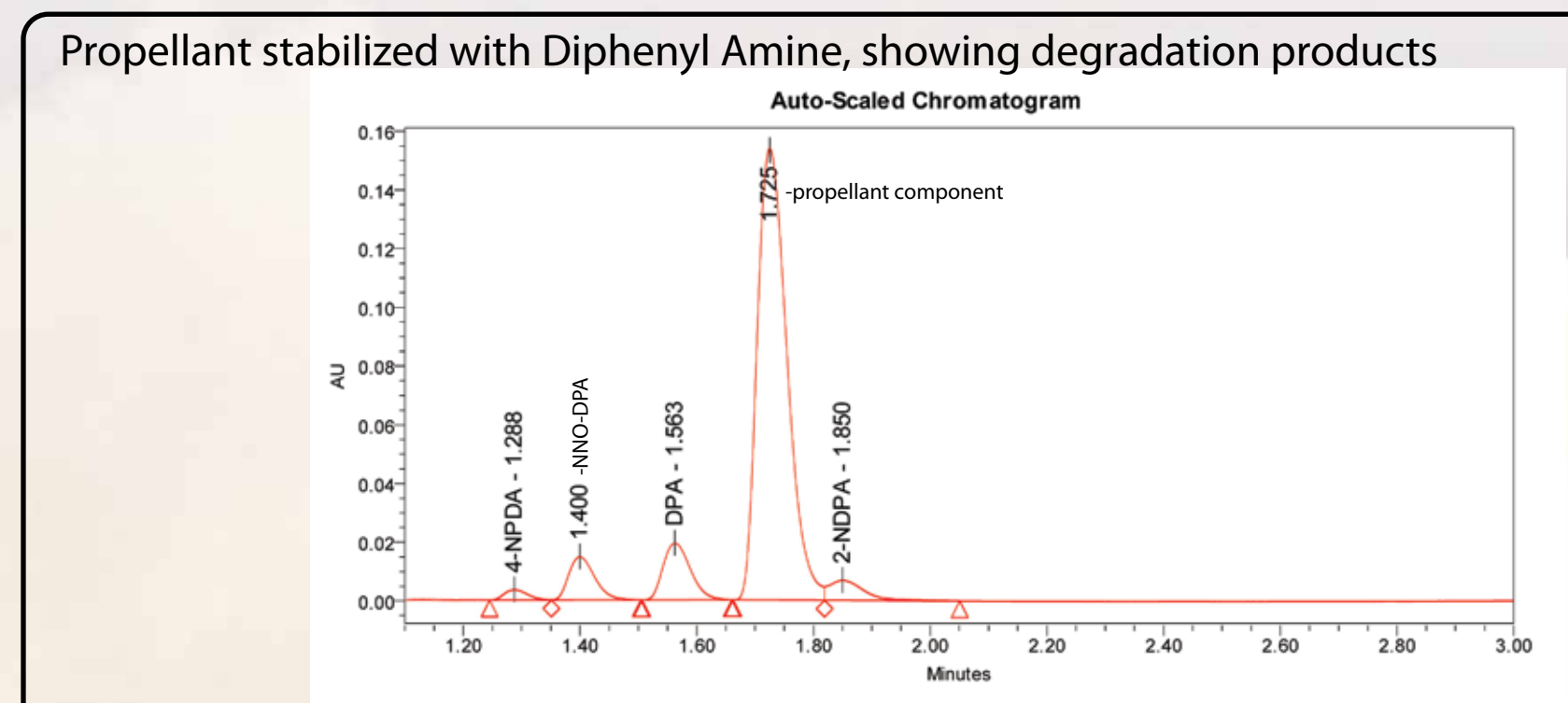
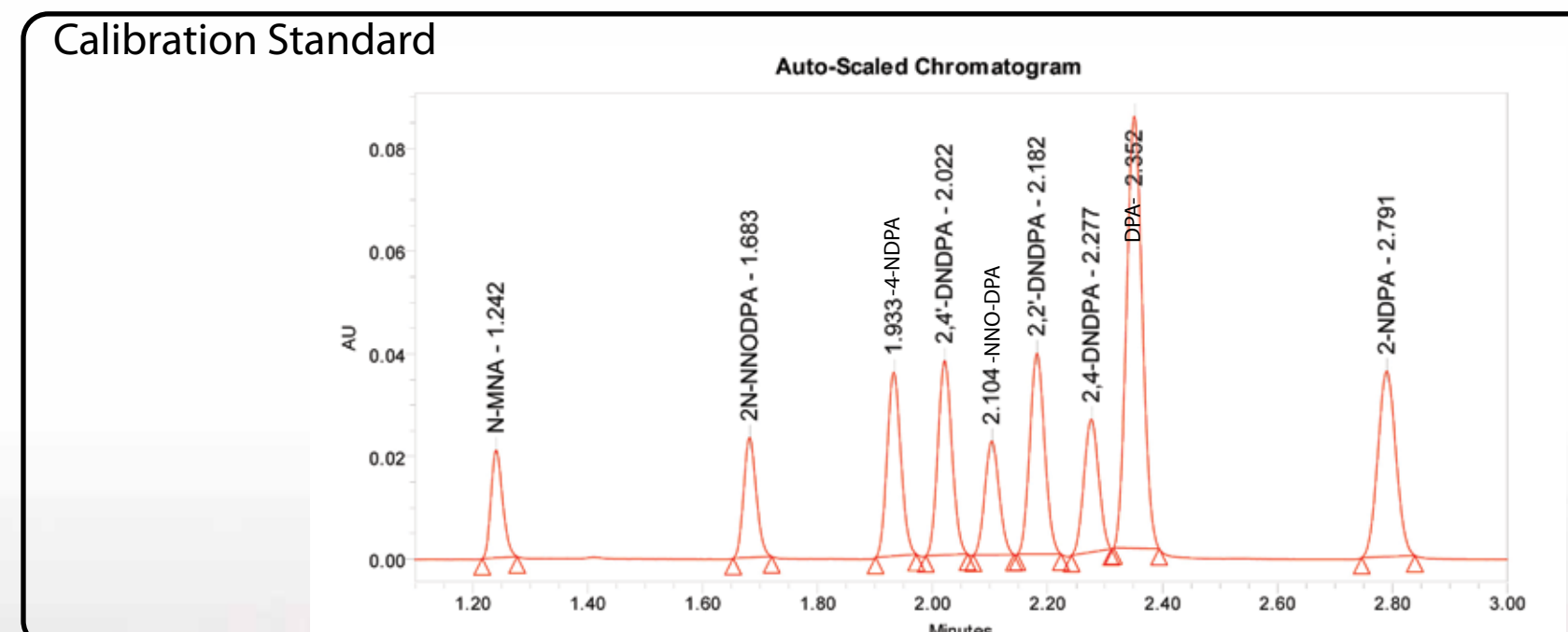
Mobile Phase: Isocratic, 38% Type II Dionized water (or equivalent) and 62% 0.2 um filtered HPLC grade Acetonitrile (or equivalent)

Flow Rate: 0.4 ml/min

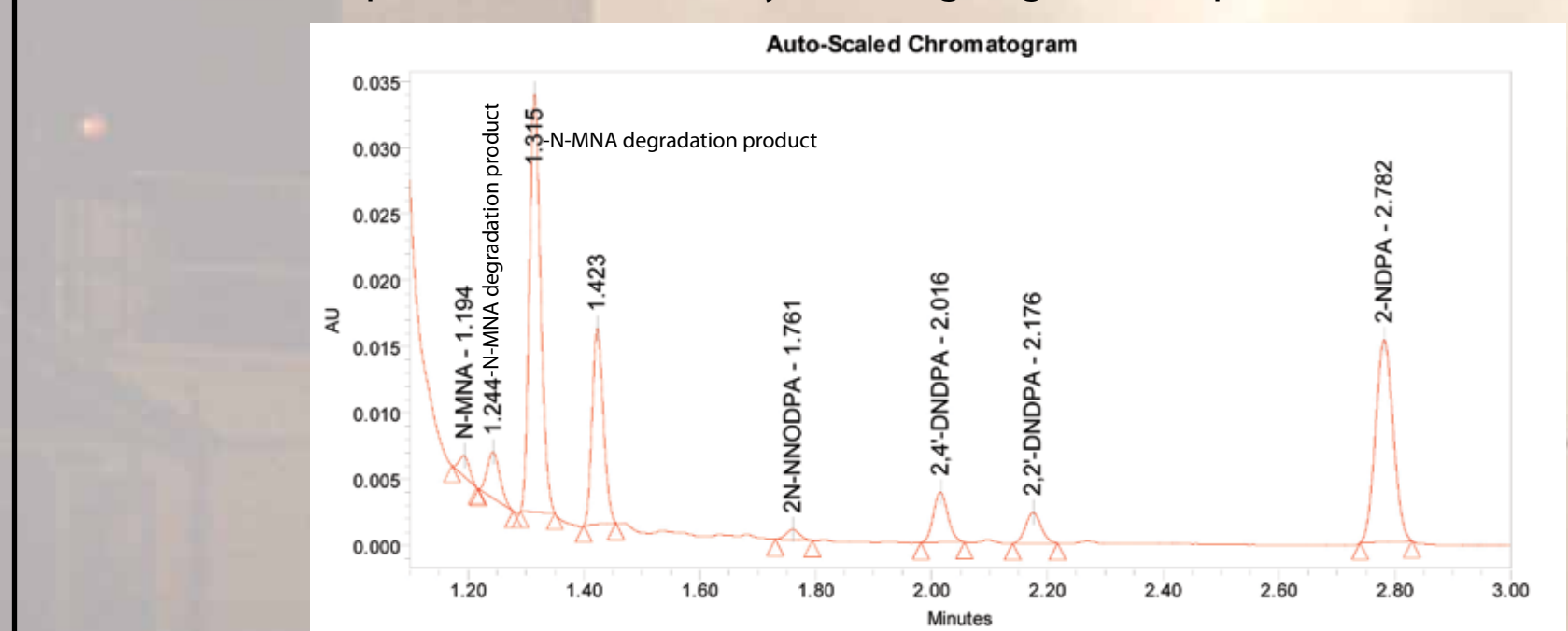
Detector: PDA, 254 nm extracted for quantification

Sample Temp: 42 °C

Column Temp: 42 °C



Propellant stabilized with Diphenyl Amine and N-Methyl-2-Nitroaniline, after aging at increased temperature and humidity, showing degradation products



This poster describes a general method for looking at propellant stabilizer, stabilizer degradation products, as well as other constituents of propellant formulations using UPLC systems using a PDA detector. The use of the PDA detector provides UV spectra that can be used to assess peak purity. These compounds can be detected at the picogram level.

This analysis can be done in under 3 minutes. The extraction technique eliminates matrix interference by reducing the nitrocellulose in the final extract. The fast analysis time reduces solvent usage by over 90%. Lengthy HPLC analyses can benefit by converting to the methodology presented in this discussion.

HPLC techniques can easily be transferred to UPLC. This allows the researcher to greatly increase throughput and reduce the cost of analysis.