



Application Note 212

Analysis of Nitrocellulose using the CE440 Elemental Analyzer

Introduction

Nitrocellulose is the common name for a family of explosive materials based on the cellulose unit $C_{12}H_{20}O_{10}$. Included among these are pentanitrocellulose, dekanitrocellulose, and pyroxylin.

Historically, the nitrogen content of this compound, as well as other munitions, has been analyzed with a nitrometer using the standard method MIL-STD-286B method T209.9. This method is not only labor intensive, but also exposes the operator to carcinogenic mercury vapors.

The Exeter Analytical CE440 elemental analyzers use thermal conductivity detectors to simultaneously analyze the nitrogen, carbon and hydrogen content. Interferences are removed through column packings and the combusted sample is converted into non-toxic carbon dioxide, water vapor and nitrogen. These gases, along with the helium carrier, are vented during the cycle.

Previously, Control Equipment Corporation developed a method to successfully analyze the nitrogen content of a similar munition, pentaerythritol tetranitrate (PETN) on the CE440. It was found that by reducing the available oxygen supplied to the sample, thus preventing gaseous oxides of nitrogen from forming, accurate results could be obtained. Using a slightly modified approach, they were able to achieve the same for nitrocellulose. The following conditions have been established to accurately determine the nitrogen content in nitrocellulose compounds. This procedure also provides consistent carbon and hydrogen data.

- Combustion time - 28 seconds (eliminates one oxygen burst and thus provides a reduced oxygen environment).
- Combustion temperature - 1000°C
- Reduction temperature - 595°C
- Oxygen pressure - reduced to 15 psi
- Tin capsules (P/N 6703-0418), nickel sleeves (P/N 6703-0412) for sample containment
- Broad spectrum combustion aid (P/N 650-00008) added to sample, 8-10 mg per sample. Combustion aid added to capsule first and tared out. Sample is added on top, capsule sealed, then agitated to mix the sample with the combustion aid.

Comparison of the data obtained using the CE440 Elemental Analyzer versus the standard method (MIL-STD-286B method T209.9)

| SAMPLE | CE440 % Nitrogen | STANDARD METHOD % Nitrogen |
|---------------|-----------------------------|---------------------------------------|
| 1 | 13.11 | 13.12 |
| 2 | 12.65 | 12.6 |
| 3 | 13.25 | 13.16 |
| 4 | 13.21 | 13.19 |
| 5 | 13.18 | 13.09 |

The logo for Exeter Analytical, featuring the letters 'EAI' in a large, bold, serif font. A horizontal red line passes through the middle of the letters.

EXETER ANALYTICAL

University of Warwick Science Park, The Venture Centre, Sir William Lyons Road,
Coventry CV4 7EZ. United Kingdom

Tel: +44 (0)24 76323223 Fax: +44 (0)24 76323221 Email: sales@exeteranalytical.co.uk