TEA Model 510 Nitrogen Analyzer

For Explosives and Nitrosamines

The model 510 Analyzer provides, **fast, accurate, specific** analysis and detection of thermally labile nitro compounds found in **explosives**, and **environmental** and **biological** samples

Advanced Chromatography Systems

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Explosives Analysis Comes of Age

The TEA Model 510 Analyzer, is a highly specific instrument for the detection and quantitation of thermally labile nitro compounds found in munitions and explosives. It is a fast, sensitive, and accurate instrument - able to perform analyses in a simple and straightforward manner. The Model 510 will accept samples which are introduced directly or from a gas or liquid chromatographic interface.

With its high specificity for the nitrosyl radical, the model 510 is ideal for the analysis of munitions and explosive ordinance manufacturing, quality control, environmental monitoring, law enforcement, forensic, and legal investigations. It also has a unique application in health care.

- *Firearm discharge trace analyses* - identifies type and source of propellant.
- *Post-blast debris analyses* - identifies origin of explosives, even from dirty samples.
- *Quality control* - monitors quality of product formulations and checking for deterioration during storage.
- *Environmental analyses* - provides compliance checks on plant air and effluents.
- *Medical Monitoring* - identifies trace amounts of such vasodilators as nitroglycerine, and isosorbide dinitrate and its metabolites, in whole blood or serum, or even in the presence of proteins and lipid contaminants

Fast Results

The Model 510 is simple to operate and produces accurate results in less than 20 minutes. Conventional explosives analysis techniques, such as thin layer chromatography or mass spectrometry, can require considerable time to provide results.

High Specificity

The TEA model 510 is highly specific for compounds containing thermally labile nitro, nitroso, or similar types of groups. Even with highly complex mixtures, the instrument can detect and quantify nitroaromatic compounds, nitrofurans, and most nitroanilines and nitrotoluenes.

Unsurpassed Accuracy

Explosives analysis with the model 510 is simple and is unaffected by the presence of plasticizers, stabilizers, and other potential contaminants which cause interferences with other methods of detection. Small sample quantities - such as those collected from blast sites, downstream from manufacturing operations or found in body fluids - can be precisely measured

Superiority of Analysis

The TEA Model 510 Analyzer out performs other methods of explosives analysis - including HPLC analysis using such conventional detectors as UV or RI.

UV or RI detectors are not specific, and the accuracy of this method depends on the complete separation of all components in the mixture. This is frequently difficult because of the presence of stabilizers and plasticizers found in explosives.

Thin Layer Chromatography provides speed of analysis, but large sample quantities are required which could exclude those analyses where only trace levels of explosives may be found - such as in wastewater or post blast residues

Gas Chromatography using conventional detectors such as electron capture are easily overloaded by the presence of stabilizers or plasticizers when looking for trace amounts of explosives. Most explosives, by their very nature are thermally labile. They will undergo breakdown and will not survive the high GC temperature. Thermally stable aromatic nitro compounds are the exception.

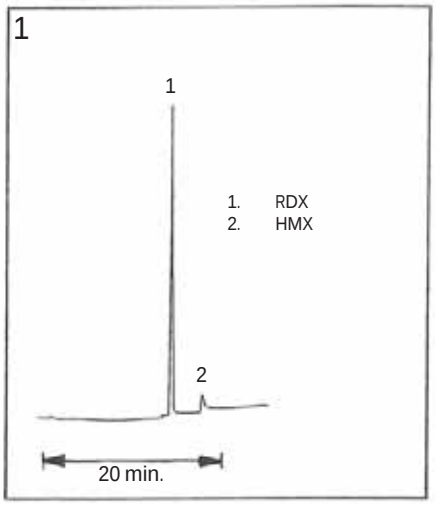
Mass Spectrometry often gives undesirable mass spectral fragmentation. Results tend to be ambiguous and therefore analysis by mas spectrometry can be difficult and complex.

Thus, the TEA analyzer provides an ideal approach to explosives analysis.
It permits:

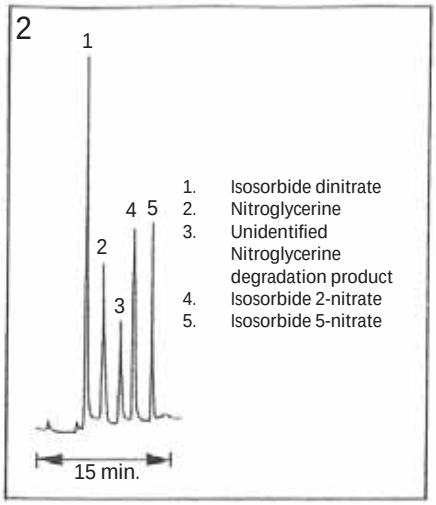
- analysis of small sample amounts
- detection even in the presence of stabilizers or plasticizers
- simple analysis
- fast results, and
- unsurpassed accuracy.

Applications

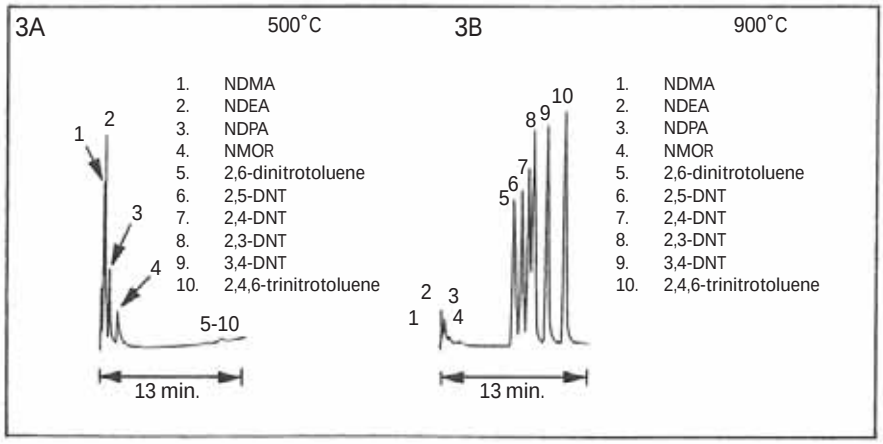
HPLC-TEA Explosives Analysis



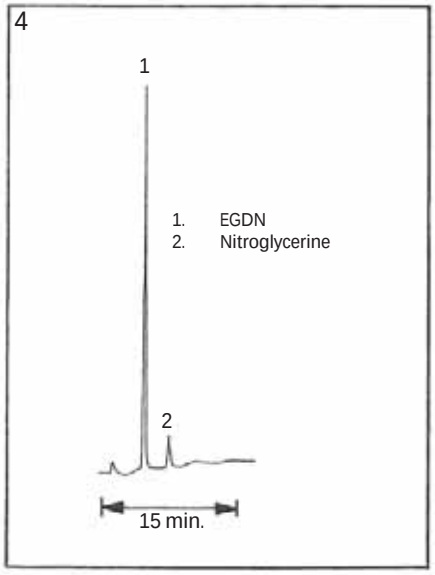
HPLC-TEA Anti-Anginal Analysis



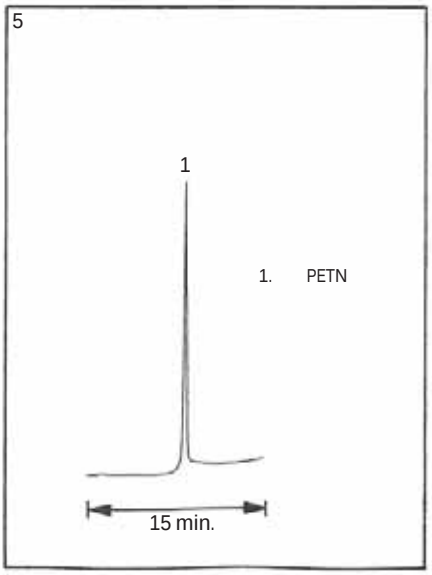
GC-TEA Selectivity: Nitrosamine/Nitro Compound Analysis



HPLC-TEA Dynamite Analysis



HPLC-TEA Letter Bomb Analysis



1) HPLC-TEA Explosives Analysis

20µl injection of a 5 µg/ml solution of a cutting charge. Attenuation: X256

2) HPLC-TEA Anti-Anginal Pharmaceutical Analysis

20µl injection of a 10 µg/ml solution. Attenuation: X64

3A and 3B) GC - TEA Selectivity: Nitrosamine/Nitro Compound Analysis

High selectivity of the TEA model 510 analyzer is achieved through control of the temperature of the catalytic pyrolyzer. Since nitrosamines cleave in the 350-550˚C temperature range, it is possible to separate them from nitro compounds which undergo cleavage at higher temperatures.

In the samples represented by the chromatograms shown at the left (3A and 3B), there is a 20 fold excess of nitro compounds as compared with the amount of nitrosamines. However, *only* N-nitroso compounds are detected when the pyrolyzer temperature is set at 500˚C (3A). When the pyrolyzer temperature is increased to 900˚C, the nitro compounds are easily detectable (3B).

4) HPLC-TEA Dynamite Analysis

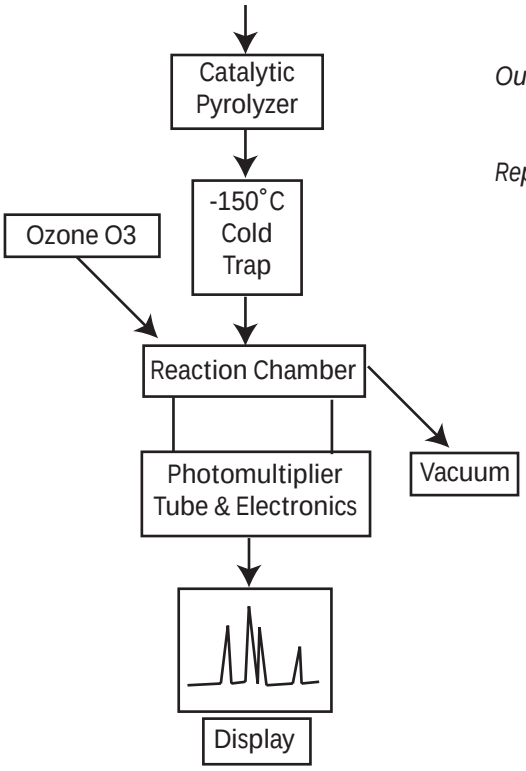
Sample Mixture of a 60% Giant gelatine dynamite. 20µl injection of a 5 µg/ml solution. Attenuation: X64

5) HPLC Analysis of Letter Bomb Residue

20µl injection of a 3µg/ml solution of a letter bomb residue. Attenuation: X64

Principle of Operation

The TEA Model 510 Analyzer ruptures compounds containing nitro groups to release the $NO^{\bullet}$ radical. These radicals further react with ozone, emitting infrared radiation which is measured by a photomultiplier tube. As shown in the figure below, the nitro compound is dissolved in a suitable solvent and introduced into a GC or LC system interfaced with the TEA Model 510 Analyzer. After chromatographic separation, the various components enter a flash catalytic heater (pyrolyzer) where nitrosyl radicals are produced. Organic compounds, solvent, and fragmentation products are removed by a cold trap. The nitrosyl radicals continue on into an evacuated reaction chamber where they are oxidized with ozone to produce electronically excited nitrogen dioxide. The excited NO_2^* decays to its ground stated giving off a burst of infrared light. The intensity of the infrared is proportional to the nitrosyl radical concentration, and thus also, to the concentration of the explosive compounds.



Specification

Model TEA 510 Analyzer

Compounds analyzed include, (but are not limited to) the following:
Nitrofurans
Nitrotoluenes
Nitroanilines
EGDN - Ethyl glycol dinitrate
PEDN - Pentaerythritol dinitrate
Petrin - Pentaerythritol trinitrate
PETN - Pentaerythritol tetranitrate
RDX - Cyclotrimethylene trinitramine
HMX - Cyclotetramethylene tetranitramine
NG - Nitroglycerin
TNT - 2,4,6-trinitrotoluene
Tetryl - N-methyl-N-2,4,6-tetranitroaniline
ISDN - Isosorbide dinitrate
NGU - 1-nitroguanidine

Configurations: The TEA Model 510 Analyzer may be used:

1. By itself, accepting direct injection of samples
2. In combination with gas chromatography
3. In combination with high-performance liquid chromatography

Selectivity: The system's high selectivity arises from its null response to many compounds which usually interfere with explosives analysis. In the GC and LC modes, compounds are further distinguished by their retention times. The selectivity ratio for EGDN to alcohols, aromatics, plasticizers, and stabilizers is greater than 10^7 to 1.

Sensitivity: Less than 1ng

Output: Twelve attenuation ranges (1, 2, 4 . . . 1024, 2048)

Reproducibility: Limited by the precision of the chromatographic system used.