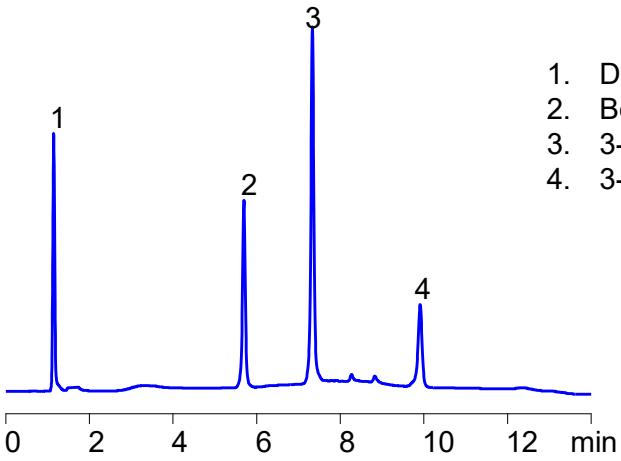
HPLC Analysis of Components of Black Powder on Amaze HA Mixed-Mode Column



1. Dicyanamide
2. Benzoic acid
3. 3-Nitrobenzoic acid
4. 3-Nitrobenzenesulfonic acid

Column:	Amaze HA
Dimensions:	3.0x100 mm, 3 um, 100A
Mobile phase:	ACN/Water/Acid or buffer
Flow rate:	0.6 ml/min
Detection:	220 nm

Application Notes

HPLC separation of chemical components found in a black powder formulation was achieved on **Amaze HA mixed-mode column**. The stationary phase of **Amaze HA** incorporates both reversed-phase and anion-exchange functionalities, providing dual retention mechanisms suitable for analytes with differing polarity and ionization. The hydrophobic alkyl chain allows interaction with non-polar aromatic structures, while the strong anion-exchange site retains acidic and anionic species. The combined mechanisms enable the resolution of complex inorganic–organic mixtures such as propellant or pyrotechnic residues containing aromatic acids, sulfonates, and nitrogen-rich energetic compounds.

Dicyanamide (DCA) is a nitrogen-containing compound frequently used as a stabilizer and combustion modifier in energetic formulations. It enhances burn rate uniformity and reduces decomposition of nitrate esters. Dicyanamide is small, highly polar, and weakly acidic; it is retained on the **Amaze HA column** primarily by anion-exchange interaction, while its minimal hydrophobicity results in early but distinct elution. Benzoic acid serves as a preservative and mild combustion regulator, influencing decomposition pathways and overall stability. Its weak acidity and aromatic ring yield moderate retention through both reversed-phase and anion-exchange mechanisms. 3-Nitrobenzoic acid, a nitrated aromatic oxidizer precursor, represents a partially oxidized compound that contributes to the energetic balance of the mixture. The nitro group increases acidity and polarity, resulting in stronger anion-exchange retention compared with benzoic acid, while still exhibiting some hydrophobic contribution. 3-Nitrobenzenesulfonic acid is a highly polar sulfonated aromatic compound often formed as a by-product or stabilizer in nitration processes. It is strongly acidic and strongly retained by the anion-exchange sites, typically eluting last due to its dual charge and high polarity.

The **Amaze HA mixed-mode column** provides superior selectivity and resolution for these chemically diverse components, allowing simultaneous analysis of nitrogen-rich, carboxylic, and sulfonated aromatic species in one chromatographic run—ideal for characterization of energetic materials and their degradation products.