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Application Notes
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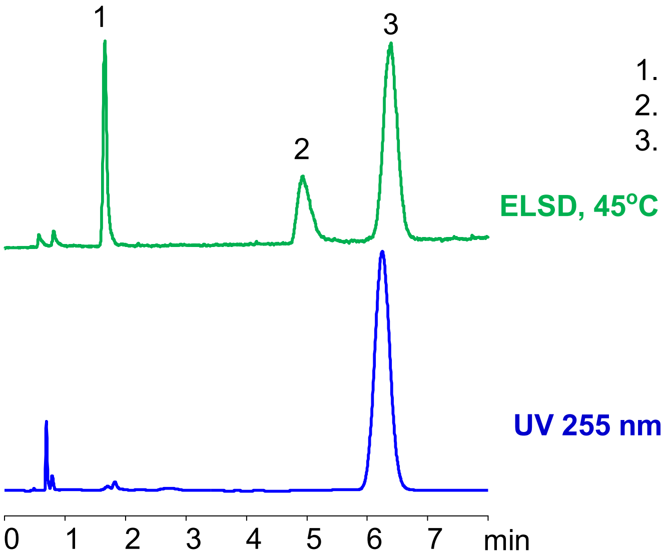
HPLC Separation of Opioid Drug and Two Acidic Counter-ions on Heritage MA Mixed-Mode Column



1. Chloride ion
2. TFA ion (approx. 0.5 mg/ml)
3. Opioid Drug (approx. 2 mg/ml)

Column:	Heritage MA
Dimensions:	4.6x50 mm, 3 um, 100A
Mobile phase:	25% ACN with 50 mM AmAc pH 4
Flow rate:	1 ml/min
Detection:	ELSD 45°C, UV 255 nm
Injection:	10 uL

Application Notes

The **Heritage MA mixed-mode column** was used for the separation of an opioid drug and its two acidic counter-ions. The stationary phase combines reversed-phase hydrophobic retention, anion-exchange, and cation-exclusion mechanisms, providing complementary selectivity for ionic and neutral components in complex pharmaceutical mixtures. This design allows simultaneous retention of basic, neutral, and acidic analytes based on their polarity and charge.

The stationary phase carries hydrophobic alkyl ligands and positively charged functional groups, enabling hydrophobic, electrostatic, and ion-exclusion interactions. The basic opioid cation is retained mainly by reversed-phase mechanism, while the acidic counter-ions interact strongly through anion-exchange with the protonated ligands. Cationic species are partially excluded due to charge repulsion, which improves peak shape and reduces co-elution.

Separations were performed using ACN and ammonium acetate buffer in isocratic mode. Baseline resolution was achieved with elution order governed by polarity and charge: the acidic counter-ions eluted first, followed by the more hydrophobic opioid drug. Variation of buffer pH and ionic strength produced predictable retention shifts consistent with mixed-mode behavior.

This study demonstrates the versatility of the **Heritage MA mixed-mode column** for the separation of formulations containing oppositely charged species. Its combination of reversed-phase, anion-exchange, and cation-exclusion mechanisms provides tunable selectivity and high reproducibility for both analytical and preparative HPLC applications.