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Almac Voice

HPLC -CAD Analysis: A Powerful Solution for Challenging Pharmaceutical Analysis

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As pharmaceutical products, medical devices and speciality chemicals become increasingly complex, so too do the analytical challenges associated with their development and manufacture. Many compounds of interest, including polymers, PEGylated materials, lipids, surfactants, sugars and certain excipients, cannot be easily analysed using conventional UV-based HPLC methods due to little or no UV absorbance. This can create difficulties when trying to detect, quantify or characterise materials that are critical to product quality and performance.

In these situations, High-Performance Liquid Chromatography coupled with Charged Aerosol Detection (HPLC-CAD) can provide an effective alternative. By enabling the analysis of compounds that are often difficult to detect using traditional approaches, HPLC-CAD has become an increasingly valuable technique across pharmaceutical, medical device and speciality chemical development.

At Almac Sciences, our analytical scientists support clients with the development and application of HPLC-CAD methods for a wide range of challenging materials. Combined with access to Almac's wider analytical capabilities across Europe and the United States, clients benefit from both local scientific expertise and a broader network of specialists who can support projects from early development through to commercial manufacture.

Why HPLC-CAD

One of the key limitations of conventional HPLC-UV analysis is its reliance on a compound's ability to absorb light. While highly effective for many pharmaceutical compounds, UV detection is often unsuitable for materials that lack a chromophore or produce only a weak UV response.

Charged Aerosol Detection works differently. Rather than measuring light absorption, CAD generates a response based on the mass of non-volatile analyte reaching the detector. This allows a much wider range of compounds to be detected, regardless of their optical properties. As a result, HPLC-CAD is particularly useful for the analysis of:

- PEGylated compounds
- Polymers and oligomers
- Surfactants
- Excipients
- Lipid-based formulations
- Medical device coatings and extractables.
- Raw material and process-related impurities

The technique can also be valuable when suitable reference standards are unavailable or limited, helping to support quantitative analysis during development, manufacturing and quality control activities. For organisations working with increasingly sophisticated products and formulations, HPLC-CAD provides another analytical option when traditional detection methods reach their limits.

Developing the Right Analytical Approach
Successful HPLC-CAD implementation begins with understanding the material being analysed and the questions that need to be answered. Method development is rarely a one-size-fits-all exercise and often requires careful optimisation of chromatographic conditions, detector settings and sample preparation techniques to ensure robust performance.

As part of method development, scientists will typically evaluate key parameters including specificity, precision, accuracy, sensitivity and robustness. The level of development required will depend on factors such as product complexity, regulatory requirements and the intended use of the analytical method

At Almac Sciences, support can be provided across the full analytical lifecycle, including:

- Feasibility assessments
- Method development and optimisation
- Method verification
- Method validation
- Analytical method transfer
- Release testing
- Stability testing.
- Technical investigations and troubleshooting

Throughout a project, our scientists work closely with clients to ensure analytical methods are not only technically robust, but also appropriate for their stage of development and future regulatory requirements.

Access to Broader Analytical Expertise While HPLC-CAD can solve many challenging analytical problems, complex development programmes rarely rely on a single technique. Generating a complete understanding of a product often requires multiple analytical approaches working together.

Through Almac's network of analytical laboratories across Ireland, the UK and the USA, clients have access to a broad range of complementary capabilities, including:

- HPLC-UV and UHPLC analysis
- LC-MS and advanced mass spectrometry
- GC and GC-MS.
- Dissolution testing and method development
- Elemental analysis
- Physical characterisation
- Stability studies
- Analytical method development, transfer and validation
- Quality control testing.

This integrated model enables clients to access specialist expertise and advanced analytical technologies through a single trusted partner, reducing project complexity and accelerating programme delivery.

Supporting Development from Early Phase to Commercial Manufacture
Analytical challenges can emerge at any stage of a product's lifecycle. Early development programmes may require methods to characterise novel materials, while later-stage projects often focus on validation, transfer, routine testing and regulatory support. Whether supporting formulation development, process optimisation, technology transfer or quality control activities, HPLC-CAD provides an effective solution for compounds that are difficult to analyse using conventional detection approaches. By combining practical HPLC-CAD experience with strong scientific collaboration, Almac Sciences helps clients generate reliable analytical data that supports confident decision making throughout development and manufacture.

Conclusion

As pharmaceutical and medical device products become more complex, analytical strategies must continue to evolve. Techniques such as HPLC-CAD provide a practical and reliable solution for compounds that fall outside the capabilities of traditional UV detection, enabling improved characterisation and robust quantitative analysis across a wide range of applications.

At Almac Sciences Athlone, clients benefit from hands-on experience in HPLC-CAD alongside access to the wider scientific expertise available across Almac's global analytical organisation. Together, these capabilities help organisations tackle difficult analytical challenges, generate high-quality data and keep development programmes moving forward with confidence.



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