This Week's Citation Classic

Hinze W L. Applications of cyclodextrins in chromatographic separations and purification methods. *Separ. Purif. Method.* 10:159-237, 1981. [Department of Chemistry, Wake Forest University, Winston-Salem, NC]

This article summarized pertinent aspects of the existing knowledge of native and derivatized cyclodextrins (CDs) and their unique solute inclusion complexing ability. It also gave a comprehensive overview of their utilization in different separation science applications. New areas of potential applications were identified and original results on their CDs use as chromatographic mobile phase additives presented. [The *SCI*® indicates that this paper has been cited in more than 150 publications, making it the most-cited paper from this journal.]

Cyclodextrins and Separations: A Happy Marriage!

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I first became acquainted with cyclodextrins (CDs) as a consequence of a book chapter assignment[1] for a course given by Janos H. Fendler, as a student at Texas A & M University in 1973. Although that work concerned the effect of CDs on reaction rates, I was struck by their unique and selective inclusion complexing ability. One of my first research projects at Wake Forest concerned their utilization in chemical analysis and separations applications. While reviewing the literature in preparation for writing grant proposals to Sigma Xi and Research Corporation, I realized that there was a need for an overview article summarizing the published applications of CDs in chemical separations. Thus, I gladly accepted an invitation from Carl J. van Oss (editor, *Separation and Purification Methods)* in mid-1980 to write just such a review. This invitation was extended after my presentation of a paper entitled "The Use of Cyclodextrins in the Thin-Layer Chromatographic Separation of Aromatic Compounds," at the 1980 National ACS Meeting in Houston, Texas.

In retrospect, the reasons for the article's popularity are many. It was the first to combine fundamental information about CDs and their chemistry with an exhaustive survey of their utilization in separation science. It speculated on potential applications. It tied together and presented previous work that had been published in a wide array of journals typically not perused by analytical chemists. Thus, part of its high frequency of citation can be attributed to the convenience of finding pertinent references therein (214 articles were cited.) Another factor for its frequent citation stems from presentation of preliminary results that demonstrated the utility of employing CD-containing mobile phases in liquid chromatography. This application has subsequently become very prevalent.[2,3]

Most importantly, the article described use of CD stationary phases in chromatography and speculated on future developments of this technology, especially as it pertained to chiral separations. Indeed, the subsequent development of stable, chemically bonded CD (or derivatized CD) chiral stationary phases for liquid chromatography by D.W. Armstrong,[4] as well as CD-containing packed or capillary columns for gas chromatography by E. Smolkova-Keuleman-sova,[5] Armstrong,[6] and W.A. Konig[7] ushered in a new generation of chiral column materials. Our paper was cited in many of those types of articles. Lastly, utilization of CDs to enhance chromatographic detection modes was summarized. Subsequent articles concerned with use of CDs in analytical spectroscopic measurements also cited our work.

In summary, the comprehensive nature of the review, its timeliness in 1981. and its discussion/compilation of both classic CD chemistry and separation science applications make it useful to both CD chemists and separation scientists, which undoubtedly contributed to its frequent citation. A monograph,[8] half of which is devoted to CDs in separations, updates information in this field. One of the goals of the original article (i.e., "to stimulate further work in this area") appears to have been realized.

1. **Fendler J H & Fendler E J.** *Catalysis in micellar and macromolecular systems*..New York:Academic Press.1975. (Cited 1,115 times.)
2. **Hinze W L. & Armstrong D W.** Thin-layer chromatographic separation ortho. meta. and para substituted benzoic acids with aqueous solutions of alphacyclodextrin.Anal. *Lett.* 13:1093-104. 1980.
3 **Sybilska D.** Cyclodextrins as mobile-phase components of separation by isomers by reversed-phase high performance liquid chromatography.(Hinze W L &; Armstrong D W. eds.) *Ordered media in chemical separations.* Washington. DC: American Chemical Society. 1987. p. 218-34.
4. **Armstrong D W & DeMond W.C** Cyclodextrin bonded phases for the liquid chromalographic separation of optical, geometrical and structural isomers. *J. Chromatogr. Sci.* 22:411-5. 1984 (Cited 140 times.)
5. **Smolkova-Keulemansova E.** Cyclodextrins as stationary phases in chromatography. *J Chromatogr.* 251:17-34. 1982.
6. **Armstrong D W. l.i W. Chang C D & Pitha .J.** Polar-liquid, derivatized cyclodextrin stationary phases for the capillary gas chromatography separation of enantiomers *Anal. Chnem.* 62:914-23. 1990.
7 **Konig W A, Lutz S & Wenz G.** Modified cyclodextrins—novel, highly enantioselective stationary phases for gas chromatography. *Angew Chem.Int. Ed.* 27.979-80. 1988.
8. **Hinze W L & Armstrong D W.** eds. *Ordered media in Chemical separation.* Washington. DC: American Chemical Society. 1987. 293 p

Received August 21, 1991