Application Note 18

Determination of Bis(2-chloroisopropyl) ether Using Chiral Capillary GC

Commercially available bis(2-chloroisopropyl)ether is only about 50% pure. The existing commercial sources of this material contain three optical isomers and an achiral contaminant, 1,1'-oxybis[3-chloropropane]. Under US EPA method conditions, the contaminant and the isomers elute closely and are typically not separated. Detailed chromatography, using an α-DEX 120 chiral capillary GC column, reveals the contamination now known to be present in commercially available bis(2-chloroisopropyl) ether.

Key Words:
- bis(2-chloroisopropyl)ether
- chiral capillary GC
- optical isomers

Supelco regularly receives comments about chemical standards, ranging from suggestions for new formulations to questions about the purity of material used in manufacturing. Over an extended period, several questions about the purity of the bis (2-chloroisopropyl)ether (BCIPE) used in our manufacturing process have been received. BCIPE, a byproduct in the manufacture of bis(chloromethyl)ether, is a toxic compound that is included as a constituent in a number of US EPA methods. Analysis is typically by capillary GC using an SPB™-5 (5% diphenyl/95% dimethylpolysiloxane) column.

Concerns about the purity of this raw material were not resolved through routine techniques, such as GC/MS or GC/IR. Available NMR data on this material indicate the probable existence of contaminant, but the contaminant is not verifiable by comparative technique. An additional technique, differential scanning colorimetry, failed to indicate the presence of contaminants in BCIPE.

Structurally, BCIPE contains two stereocenters and is optically active (Figure A). In molecules containing more than one stereocenter, the total number of stereoisomers will not exceed 2^n, where n is the number of stereocenters. Thus, four enantiomeric forms of BCIPE are theoretically expected, but close examination reveals the existence of a plane of symmetry within the molecule. This symmetry means that one optical isomer pair exists in the meso form and exhibits achiral behavior. Although separation of optical isomers is not expected under normal GC conditions, an α-DEX™ 120 chiral capillary GC column will resolve the BCIPE optical isomers (Figure B).

The α-DEX 120 capillary column contains 20% (w/w) permethylated a-cyclodextrin in a polysiloxane co-phase — offering a unique selectivity capable of resolving non-meso

Figure A. Bis(2-chloroisopropyl)ether (BCIPE) Isomer Structures

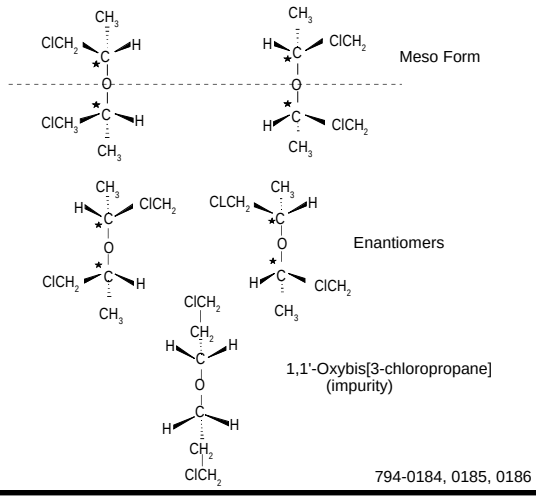
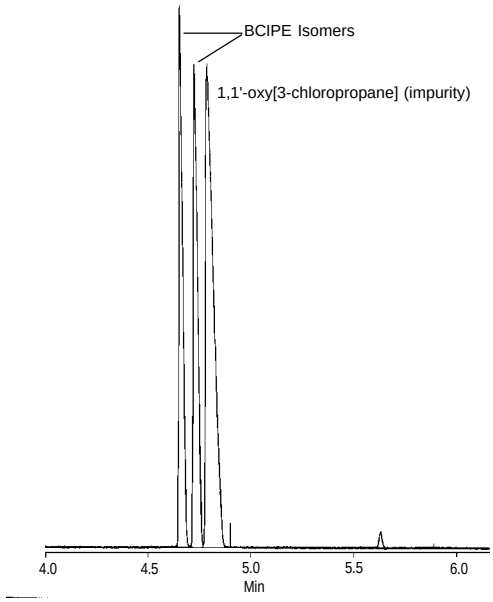


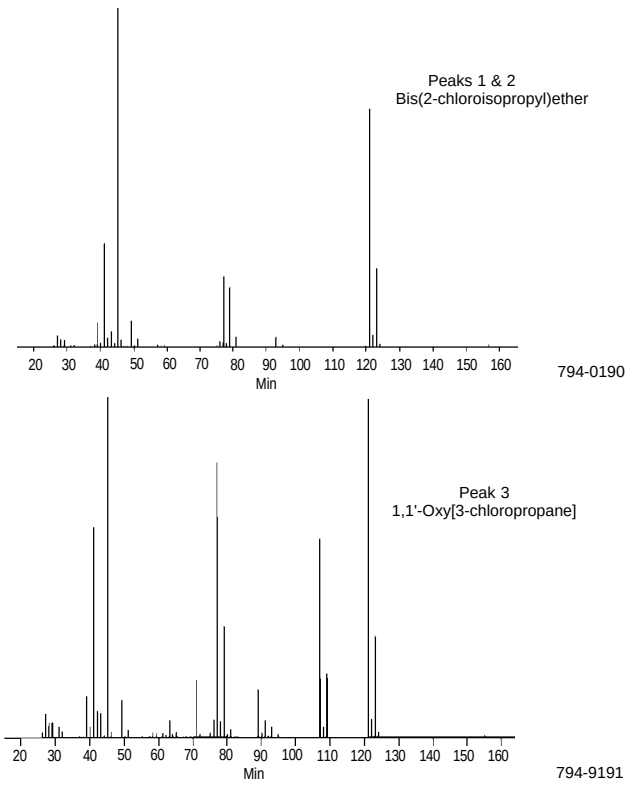
Figure B. Total Ion Chromatogram of BCIPE Isomers on an α-DEX 120 Capillary Column

Column: **α-DEX 120, 30m x 0.25mm ID, 0.25µm film**
Cat. No.: **24310**
Oven.: 70°C to 200°C at 2°C/min
Carrier: helium, 20cm/sec
Det.: Mass Spec (Scan 18-500 amu)
Inj.: Direct, 1µL



stereoisomeric forms. When a BCIPE sample was analyzed on this column, three peaks were observed instead of the anticipated two (Figure B). A mass spectrum of the peaks confirmed two BCIPE isomers, and a single achiral contaminant. The contaminating compound, 1,1'-oxybis[3-chloropropane] is very similar in fragmentation pattern to BCIPE — so similar that, unless the analytical search is specific, it is unlikely that this contaminant will be discerned (Figure C).

Figure C. Fragmentation Patterns of BCIPE and 1,1'-Oxybis[3-chloropropane]



Contact our Technical Service Department (phone 800-359-3041 or 814-359-3041, FAX 814-359-5468) for expert answers to your questions.

One generally accepted route for synthesizing commercial BCIPE involves the condensation reaction of 1-chloro-2-propanol. Supelco learned that this starting material is only commercially available in a technical grade containing about 30% of an alcohol impurity. It is this impurity which forms the contaminant, 1,1'-oxybis[3-chloropropane]. This contaminant was observed in all commercially available BCIPE samples reviewed. The BCIPE studied was found to be only about 50% pure on the basis of comparative peak areas. (This value is estimated because an authentic reference BCIPE of 98% or better purity is currently unavailable.)

Supelco is presently exploring synthetic routes to prepare BCIPE free of 1,1'-oxybis[3-chloropropane]. Until this work is completed, we will determine the purity of every lot of BCIPE used in our manufacturing, and report this information on the Certificate of Analysis accompanying each product. While Supelco typically corrects for raw material purity during the gravimetric preparation of standards, it was decided not to do this for BCIPE. Because commercially available BCIPE is approximately 50% pure, and the impurities are not easily resolved, the apparent amount of BCIPE in a purity corrected solution would be double that normally expected in a prepared reference solution.

If BCIPE is a constituent in your analytical work, the results you are obtaining are probably high by about 50%. Extra consideration should thus be given the data you report about this compound. If it is critical that you obtain an accurate measurement of the BCIPE in your sample, and you are not using a standard obtained from Supelco, quantitation of your material using the Supelco α-DEX 120 capillary column is highly recommended.

Ordering Information:

α-DEX 120 Fused Silica Capillary GC Column	
30m x 0.25mm ID, 0.25µm film	**24310**
Bis(2-chloroisopropyl)ether, neat	
1000mg	**48498**
Bis(2-chloroisopropyl)ether	
5000µg/mL in methanol	**40040-U**

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