

## Gas Chromatography Problem Solving and Troubleshooting

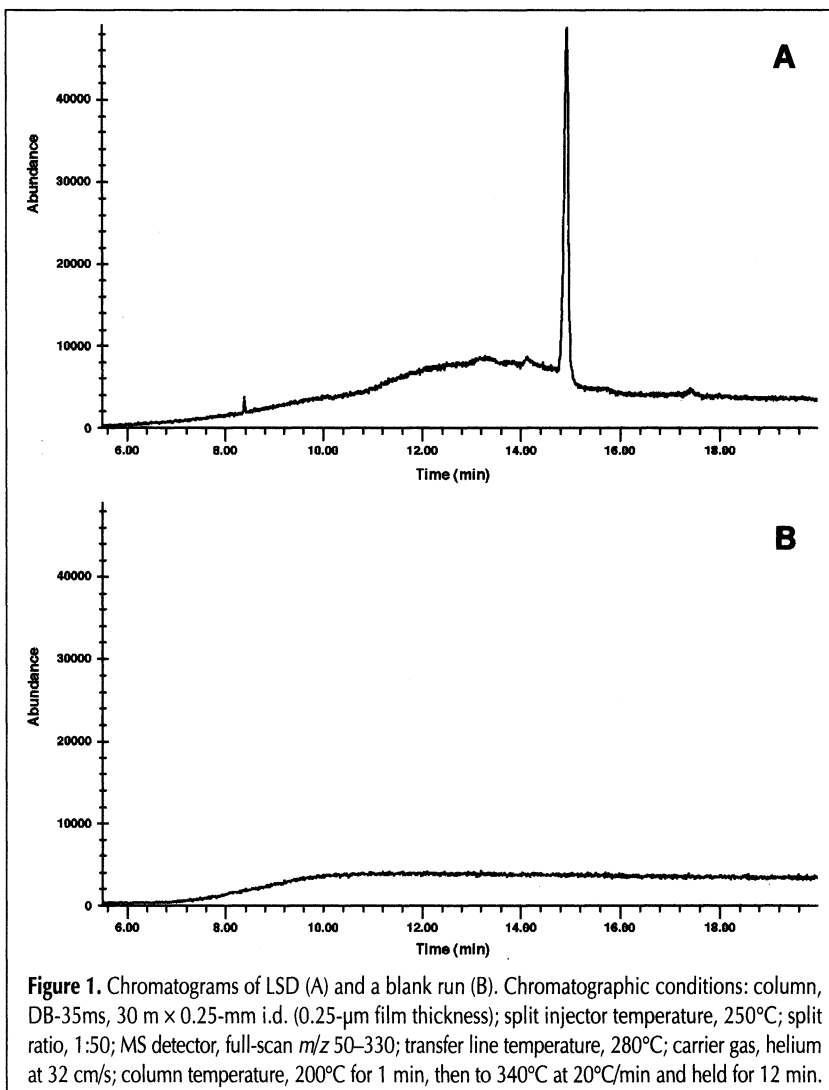
### Question:

In my LSD chromatograms, there is a large hump in the baseline prior to the LSD peak. This hump is not present in other drug chromatograms generated using the same GC and column. Also, the hump has occurred with several different columns. What is the cause of this baseline hump?

### Answer:

This particular baseline hump is indicative of compound decomposition in the column (Figure 1A). As the compound travels through the column, some of it degrades and one or more degradation products are created. Compound degradation may begin immediately or only above a particular column temperature or compound residence time in the column. The degradation products are created over a period of time and over a continuous length of column. The earliest produced degradation products are separated from the original compound peak by the greatest distance. These compounds comprise the portion of the baseline hump farthest away from the peak because they have traveled through the longest length of column (e.g., compound degradation that occurs in the initial length of the column). Since the decomposition is somewhat continuous and occurs over a large length of column, a large hump, not distinct peaks, are observed. Sometimes the hump is not rounded; it can be a plateau or an elevated flat portion of baseline. The hump or plateau can be thought of as hundreds or thousands of poorly resolved peaks, each one barely coeluting with the next one. This creates the appearance of a large hump or plateau instead of distinct peaks. In most cases, the degradation products are retained less by the column than the original compound. This places the hump before the peak; a hump after the peak indicates degradation products that are more strongly retained.

Any time a baseline disturbance or



**Figure 1.** Chromatograms of LSD (A) and a blank run (B). Chromatographic conditions: column, DB-35ms, 30 m × 0.25-mm i.d. (0.25- $\mu$ m film thickness); split injector temperature, 250°C; split ratio, 1:50; MS detector, full-scan  $m/z$  50–330; transfer line temperature, 280°C; carrier gas, helium at 32 cm/s; column temperature, 200°C for 1 min, then to 340°C at 20°C/min and held for 12 min.

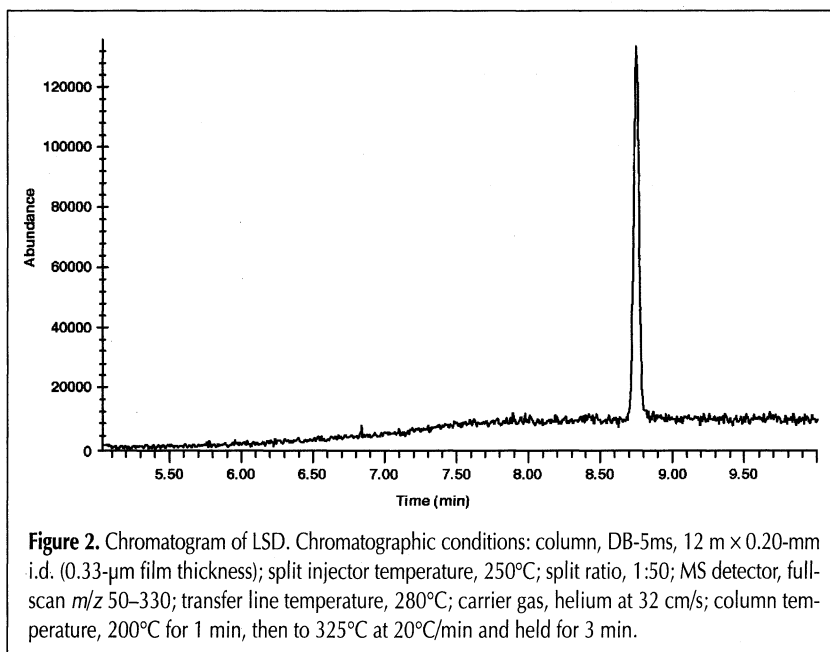
The purpose of *Chromatography Problem Solving and Troubleshooting* is to have selected experts answer chromatographic questions in any of the various separation fields (GC, GC-MS, HPLC, TLC, SFC, HPTLC, open column, etc.). If you have questions or problems that you would like answered, please forward these to the *Journal* editorial office with all pertinent details: instrument operating conditions, temperatures, pressures, columns, support materials, liquid phases, carrier gas, mobile phases, detectors, example chromatograms, etc. In addition, if you would like to share your expertise or experience in the form of a particular question accompanied by the answer, please forward to JCS Associate Editor, *Chromatography Problem Solving and Troubleshooting*, P.O. Box 48312, Niles, IL 60714. All questions/answers are reviewed to ensure completeness. The *Journal* reserves the right not to publish submitted questions/answers.

Dean Rood  
Associate Editor

interference occurs, running a background blank is a good idea. A blank run measures the GC's contribution to the background signal. The same column and conditions need to be used. The blank run for the column used in the LSD analysis is shown in Figure 1B. The background is typical for this column and these conditions. The visible baseline rise is caused by normal column bleed. Since the baseline hump does not appear in the blank run, it is safe to assume that the problem is related to the sample or the injection process. There is additional information that indicates that this conclusion is correct: the baseline hump does not appear with other drug analyses performed with the same column and GC system. If the column or GC was at fault, the baseline hump would occur with the other analytes (provided the GC conditions are not significantly different).

If compound degradation is thermally induced, reducing the retention time and column temperature minimizes or eliminates the amount of degradation. Reducing retention time by increasing column temperature often does not work, because the higher temperature induces more compound decomposition. Changing some aspect of the column is often the best choice. Using a less-retentive stationary phase, a shorter column length, or thinner film are the usual options. Figure 2 shows the LSD chromatogram obtained with a column that differs in stationary phase and all three dimensions. A much shorter column (12 m rather than 30 m) was selected to significantly reduce the retention time and, subsequently, the compound's residence time in the column. This allowed the use of a lower column temperature (325°C rather than 340°C) to obtain an acceptable run time. The combination of these two factors eliminated any apparent LSD degradation in the column, thus eliminating the appearance of the baseline hump. This column also had a thicker film. If any of the LSD degradation was induced by the fused-silica tubing, the thicker film reduced the amount of interaction and decreased the amount of degradation. This may have also contributed to the elimination of the baseline hump.

Compound degradation in the injector has a different appearance. Any degradation products are rapidly created in the injector and then introduced into the column. Since two or more compounds are now introduced into the column, two or more distinct peaks are observed (provided the degradation product is separated from any other sample peaks and there is no further degradation in the column). One peak corresponds with the original compound, and any additional peaks correspond with the same number of degradation products.



**Figure 2.** Chromatogram of LSD. Chromatographic conditions: column, DB-5ms, 12 m  $\times$  0.20-mm i.d. (0.33- $\mu$ m film thickness); split injector temperature, 250°C; split ratio, 1:50; MS detector, full-scan  $m/z$  50–330; transfer line temperature, 280°C; carrier gas, helium at 32 cm/s; column temperature, 200°C for 1 min, then to 325°C at 20°C/min and held for 3 min.