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Application News

No. G329

Gas Chromatography

Example of Use of Alternate Carrier Gas in GC Analysis: Change from He Gas to N_2 Gas

Helium (He) has mainly been used as the carrier gas for gas chromatography (GC), but limited availability and a sharp rise in the price of He have become issues. In recent years, hydrogen (H_2) and nitrogen (N_2) have been actively used as alternate carrier gases for He. As an example of an analysis in which the carrier gas was changed from He to N_2, this article introduces an example of an analysis by the vegetable oil (olive oil) immersion method for plastic materials using GC-FID. In this analysis, we used the overall migration test referred to the European Committee for Standardization, EN1186 "Materials and articles in contact with foodstuffs - Plastics (No 10/2011)"

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Points to Note when Changing Carrier Gases

Fig. 1 shows an example of the characteristics of HETP (height equivalent of one theoretical plate), which shows the separation efficiency of a column when using He, N_2, or H_2 as the carrier gas.

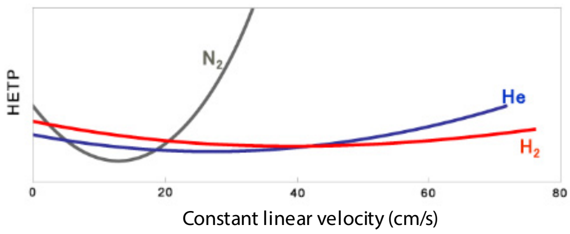

Fig. 1 Example of Relationship of Constant Linear Velocity and HETP of Carrier Gases

Although the HETP value changes depending on the constant linear velocity, in order to maximize the separation performance of column, it is important to conduct the analysis at the constant linear velocity which minimizes HETP as far as possible. For example, the optimum condition with He is in the vicinity of 30 to 40 cm/s. On the other hand, when analyzed using N_2 under He - optimized conditions, separation performance of the column will decrease due to the difference in HETP. The left side of Fig. 2 shows part of a chromatogram when using He, but as shown on the right, when the same constant linear velocity is used with N_2, it is no longer possible to separate C 18:0 and C18:1.

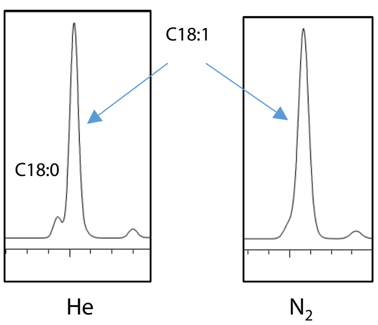

Fig. 2 Difference of Separation with He and N_2 at Linear Velocity of 40 cm/s

Calculation of Optimum Linear Velocity by *EZGC*®

In this experiment, the optimum conditions when using different carrier gases were studied using the method conversion program *EZGC*® Method Translator, which is available from Restek Corporation via the internet. Fig. 3 shows the screen of *EZGC*® Method Translator. When the conditions for He are input in the "Original" column and the alternate carrier gas type is selected under "Translation" column, the optimum parameters for the alternate carrier gas are displayed. It is also possible to select the priority of the analysis by using the "Result" item. For example, select "Speed" when you wish to shorten the analysis time, and select "Efficiency" when separation efficiency is the priority. Because the focus in this experiment was separation of C 18:0 and C18:1, the method was translated by selecting "Efficiency," which prioritizes separation efficiency, and the program calculated the optimum constant linear velocity of 18.11 cm/s.

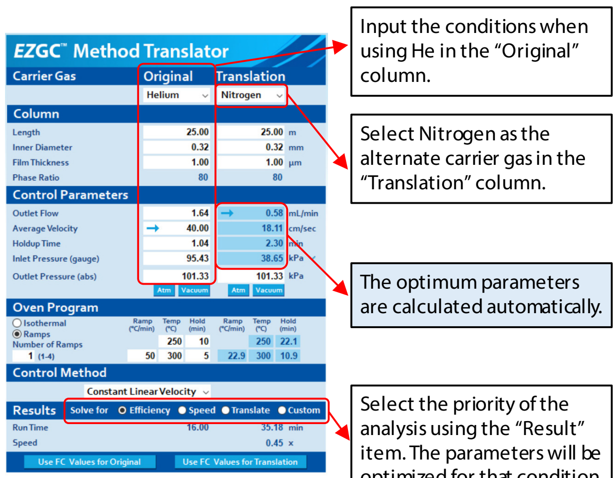

Fig. 3 *EZGC*® Method Translator Screen

Use of Gas Selector

Gas selector (P/N: S221-84916-41), which is a dedicated option of Nexis™ GC-2030, not only changes the gas flow lines, but also makes it possible to switch between two types of carrier gas from the software. Use of the gas selector in combination with *EZGC*® enables easy calculation and control of N_2 for low-cost analyses which do not require high resolution, and He or H_2 when high resolution, high speed analysis is necessary. For details concerning the gas selector, please refer to Application News No. G328.

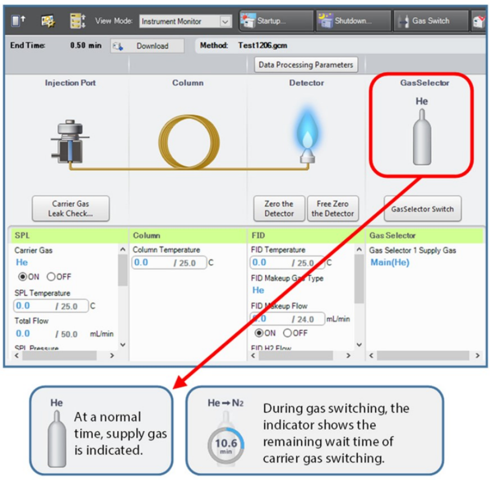

Fig. 4 Screen of Carrier Gas Switching Function of Gas Selector

Example of Analysis Using Optimal Linear Velocity for Carrier Gases

When an analysis was carried out with N_2 as the carrier gas using the linear velocity calculated by *EZGC*® (Table 1), the chromatogram shown in Fig. 5 was obtained. Although the analysis time was long in comparison with an analysis using He carrier gas (Fig. 6), an evaluation of the resolution R of C18:0 and C18:1 confirmed that resolution was almost the same, as R = 0.93 was obtained with the nitrogen carrier and R = 0.90 was obtained with the helium carrier.

Table 1 Analysis Conditions

Injection	: Split (1 : 50), 320 °C
Carrier gas	: He, N_2
Carrier gas control	: Column linear velocity He 40.0 cm/s N_2 18.1 cm/s (calculated by *EZGC*®)
Column	: BP-1 (25 m × 0.32 mm I.D., 1.0 µm)
Column temp.	: He 250 °C (10 min) – 50 °C/min – 300 °C (5 min) N_2 250 °C (15 min) – 50 °C/min – 300 °C (5 min)
Detector	: Flame ionization detector (FID), 320 °C

* Calculation of the optimal linear velocity by *EZGC*® is applicable to the GC-2010 series, GC-2025, and GC-2014 (capillary models) in addition to the Nexis™ GC-2030.

* The optional gas selector can only be used with the Nexis™ GC-2030.

Conclusion

An analysis was conducted using the method conversion program *EZGC*® Method Translator, assuming that the carrier gas is changed from He to N_2. This experiment confirmed that the optimum linear velocity condition for N_2 carrier gas can be obtained easily by only inputting the conditions for He currently being used.

If the optional gas separator is used, simple switching of carrier gases is possible in LabSolutions™. Automatic switching of carrier gases is also possible during continuous analysis, and multiple analyses with different separation requirements using the optimal carrier gas for each analysis can also be conducted automatically in a single sequence.

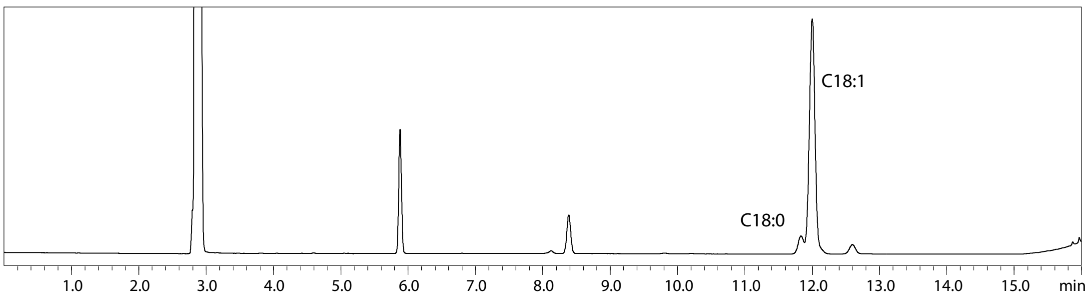

Fig. 5 Chromatogram when Using N_2

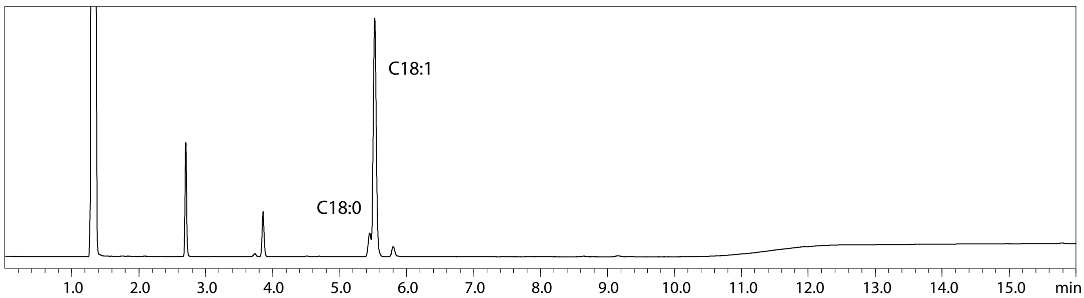

Fig. 6 Chromatogram when Using He

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