Chromatographia (2014) 77:525–526
DOI 10.1007/s10337-013-2601-9

BOOK REVIEW

Fabrice Bertoncini, Marion Courtiade-Tholance and Didier Thiébaut: Gas Chromatography and 2D-Gas Chromatography for Petroleum Industry. The Race for Selectivity

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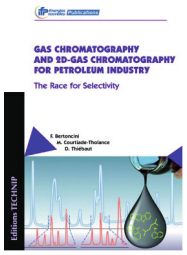
Published online: 6 November 2013



Bibliography
Gas Chromatography and 2D-Gas Chromatography for Petroleum Industry. The Race for Selectivity
Fabrice Bertoncini, Marion Courtiade-Tholance, Didier Thiébaut
Editions Technip, Paris, France, 2013, pp xxiii + 340
ISBN 978-2-7108-0992-0
EUR 60.00, USD 72.00

In 1991, Liu and Phillips published what is now known as comprehensive two-dimensional GG (GC × GC) in which the effluent from a non-polar standard capillary column is sampled (modulated) at short time intervals and these samples sent as pulses to a short, narrow-bore capillary column coated with a polar stationary phase. GC × GC has the potential to improve the peak capacity of about 250 peaks for the single capillary column into several thousand. This idea has been pursued by several academic groups and instrument companies. Several major instrument companies have instruments on sale for GC × GC.

This book is largely an account of work undertaken from 2005 onwards by a number of PhD students at the Ėcole Supérieure de Physique et de Chemie Industrielles de la Ville de Paris (ESPCI) in conjunction with the IFP Energies Nouvelles (IFPEN), the former French Institute of Petroleum. The book starts with a list of abbreviations—an excellent idea but some of the entries such as FID and HPLC seem unnecessary, while others used in the book are not listed. Chapter 1 gives an account of the composition of crude oils and the current methods of analysing the various fractions. This is a good introduction although, probably due to lack of space, it cannot hope to be comprehensive. The second part of the chapter concerns the analysis of oil fractions that rapidly becomes less detailed as the boiling range of the fractions increases. This leads to an outline of GC × GC which is capable of separating individual compounds in the kerosene and diesel boiling ranges. The second chapter starts with the theoretical aspects of GC × GC where the peak capacity, of an ideal system is the product of the peak capacities of the two columns ($n_1 \times n_2$) although this is not attainable in practice. However, separation is greatly enhanced and there is also an enhancement of sensitivity due to the focussing effects of the modulator. The chapter goes on to give a good description of GC × GC in practice helped by some excellent figures.

One of the disadvantages of the technique is that the data do not appear as the peaks that all chromatographers are familiar with, but as "blobs" more reminiscent of TLC. Three out of the four authors of Chapter 3 on data handling are mathematicians/computer experts and as a consequence a lot of this chapter is very heavy going. They spend an appreciable amount of the chapter discussing generalities applying to single column GC such as establishing a baseline and deconvoluting partially resolved peaks before going on to the main topic of 2-D data handling. The chapter ends with a discussion of simulated distillation which is surprising since this is essentially a low resolution technique; indeed, the standard method specifies a column with a low number of plates. This chapter is excellent for those with the necessary mathematical and programing knowledge but it will not appeal to the majority of analytical chemists, more interested in the end results rather than the means of achieving them.

Chapter 4 is concerned with the coupling of GC to LC and SFC. Off-line LC supplying discrete samples for

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further analysis by GC is almost as old as GC itself but this chapter is concerned with on-line LC and SFC connected directly to GC on one form or another, starting with simple LC-GC in the notation of this book and ending with LC × GC × GC. Coupling LC to GC on-line is difficult due to the incompatibility of the mobile phases. If one is analysing 1,000 samples a week then it is logical to try to couple them on-line, but for a small sample throughput the need for on-line analysis is not necessary. Chapter 5 deals with the detailed analysis of the kerosene and diesel/biodiesel fractions of oil. It starts by considering the current methods available most of which only measure bulk properties such as total sulphur or total nitrogen or a limited group analysis by MS. It then goes on to describe the much more detailed information that can be obtained by GC × GC and SFC × GC. It also describes the detailed analysis of the sulphur and nitrogen compounds present by GC × GC-MS with selected ion monitoring.

Many years ago, I suggested that the smoke point of kerosene was related to the aromatic content and it would be possible to obtain the smoke point by GC. This suggestion was derided by refinery chemists who pointed out that they were not going to replace a cheap and simple piece of equipment by something costing a hundred times as much and requiring a graduate to operate it and interpret the results. It seems to me that the authors of Chapter 6 are in a similar position. They show that they can obtain the Cetane Index, density and viscosity by GC × GC. Some of the properties they list require a relatively large amount of sample which may not be available from a small-scale rig, but density and viscosity require only a millilitre of sample. The Cetane Index is readily calculated from four properties which will be determined anyway. Chapter 7 is largely a review of selective detectors which have been well-covered in other publications (see for example, Journal of Chromatography Library, Volume 56). The chapter ends with an interesting discussion of the composition of coal-derived liquids. The book ends with a final chapter on simulated distillation although as pointed out above I find it a rather surprising topic for GC × GC. Each chapter ends with numerous references, some going up to 2011, but many seem to be of French secondary sources rather than originals. Some of the work included gives the impression of a solution looking for a problem and reminds me of a former colleague who presented with a white crystalline solid identified it with the aid of mass spectrometry as sodium acetate, a conclusion he might have reached with the aid of a test tube and a Bunsen burner.

The book has been translated from French by Lionbridge, an American company that specialises in technical translations. It gives the impression of having been translated word for word with the aid of a dictionary/computer program. There are numerous examples (including the book's title) but one on page 284 will suffice where oxygenated compounds are said to be "not very present" where "in low concentration" or "in small amounts" would have been appropriate. Overall, I think the original book will sell well in France, but the translation joins quite a number of books on comprehensive 2-D GG published in the last few years and it does not add much to the overall corpus.