



## Chromatography Courses

Schulungen und Chromatographie  
Bernd Mischke  
Rudower Chaussee 29  
12489 Berlin

Tel: +49 (0)30 6392 6390  
Fax: +49 (0)30 6392 6391

E-Mail: [chrompy@gclc-kurse.de](mailto:chrompy@gclc-kurse.de)

## Introduction to gas chromatography (Level 1)

Contents of Lectures, case studies and practicals:

### Introduction:

Gas chromatography: typical samples, applications Principles of separation, retention, capacity factor, selectivity, efficiency, plate number, resolution, linear velocity, flow

### Instrumentation:

Gas supply system: tubing, type of carrier gas, pressure regulation, flow control, settings  
injection: principles, direct injection, septum, parameters, syringe types and handling oven:  
influence of temperature, installation of a column

Detection: Linearity, noise, wander, drift, FID, TCD and ECD

### Qualitative and quantitative analysis:

Identification based on (relative) retention times.

Fingerprint

Detector response: height/area

Calibration curves: single point, multi point, linearity

Calculation methods: (normalized) 100%, external standard, internal standard

### The GC column:

Types of stationary phases: selection, percentage or film thickness, sample capacity, minimum and maximum temperatures, bleeding, column conditioning and storage

Packed columns: tube material, support material, coated packing

### Capillary columns:

Introduction features and properties

### Wide bore:

Comparison of a packed, a capillary open tubular and a wide bore column, column parameters, modification of equipment, installation of a wide bore column, optimizing an analysis on a wide bore column.

### Profile of course candidates:

The *above* course is intended for people who:

are new to, or have recently started using gas chromatography techniques:

have recently left college and have little or no knowledge of gas chromatographic procedures;

have limited experience only and wish to acquire a better understanding of qualitative and quantitative analysis and the instrumentation used;

generally want to improve their understanding of the fundamentals of gas chromatography.

# Capillary gas chromatography (Level 2)

Contents of lectures, case studies and practicals:

Summary of basic chromatographic principles:

Introduction to GC: equipment, chromatographic principles

Theoretical aspects: retention, selectivity, efficiency, plate number, plate height, Van Deemter equation, diffusion parameters, H-u curve, resolution, asymmetry

Capillary CC column:

Theoretical aspects: properties and features, efficiency, speed

Column: types, internal diameter, film thickness, WCOT, PLOT, sample capacity

Stationary phases WCOT: types, features, chemically/non-chemically bonded, selectivity, maximum and minimum temperatures, bleeding, deactivation

Stationary phases PLOT: types, features, applications

Tube material: fused silica, metal

Column conditioning, storage and practical aspects

Column choice and optimization:

Influence of length, type of stationary phase, film thickness, internal diameter instrument settings, effect of temperature, temperature programming, modification of program, linear gas velocity, carrier gas

Instrument aspects:

Carrier gases: types, purity, filtering

Gas supply system: (back-) pressure regulator, flow controller, needle valve, settings, ferrules and nuts

Column: installation

Oven: features

Injection techniques:

Direct, applications

Split: function, split ratio, split flow, advantages/disadvantages, critical operational parameters

Splitless and cold on-column: introduction

Comparison of injection techniques

Detection:

FID, TCD, ECD, NPD and FPD for capillary use: cell volumes, gas settings, make-up gas, critical operational parameters

Profile of course candidates:

The above course is intended for people who:

are already working with gas chromatography techniques and have a working knowledge of the basics of chromatography;

want to know more about capillary gas chromatography, capillary columns, column choice and optimization;

have experience based on routine work only and want to improve their understanding of the chromatographic theory as well as the practical aspects related to capillary gas chromatography

# Advanced gas chromatography (Level 3)

Contents of lectures, case studies and practicals:

Theoretical aspects concerning capillary columns:

Golay equation, band broadening, optimal linear gas velocity, (effective) plate number, phase ratio influence of carrier gas, column length, internal diameter and film thickness on resolution, speed, capacity and sensitivity

Comparison capillary dimensions

Injection techniques:

Split, splitless, cold on-column: principles, application field, concentration range, advantages/disadvantages, critical operational parameters in relation to band broadening in time/space, discrimination, speed, solvent effect, solvent focussing and cold trapping

Head space: static/dynamic, purge and trap

Thermal desorption

Special injection techniques: PTV, moving needle

Temperature in capillary GC:

Temperature retention, selectivity, resolution, column efficiency, flow rate

Column selectivity:

Type of stationary phase vs temperature stability, compatibility with detectors, sensitivity, peak symmetry

Chiral separations PLOT columns: inorganic adsorbents, polymeric adsorbents, molecular sieves, principles, application field

Multi column systems/column switching

Principles, advantages/disadvantages, pre separation, sample clean-up, pre concentration, peak purity

Hyphenated techniques:

Supercritical fluid extraction coupled to GC (SFE-GC):

on-line extraction, fundamentals of supercritical fluids, SFE vs off-line liquid or solid phase extractions

High **Speed** GC:

Principles, column dimensions, carrier gas, instrument aspects, advantages/disadvantages

Profile of course candidates:

The above course is intended for people who:

have a good theoretical knowledge of gas chromatography, at least to the level gained

after our intermediate (level 2) courses;  
want to gain ultimate understanding of the theory of gas chromatography;  
want to improve their knowledge of practical, operational and instrumentation aspects concerning capillary gas chromatography;  
want to master the different aspects of column selectivity, optimization and method development;  
want to be informed about specific topics and the latest developments in capillary gas chromatography.

# **Trouble shooting in gas chromatography**

Contents of lectures, case studies and practicals:

Fundamentals of problem solving:

How to structure, recognize and analyse problems, methods; remedying troubles

First check, spare parts and tools

Share the experience:

Problems concerning equipment, gases, samples, injection. connections, sample introduction columns, detectors

Problem solving from chromatograms:

Real-life aspects of 'bad' chromatograms are discussed, such as instability, ghost peaks, distorted peaks, baseline disturbances, repeatability problems

At the practical sessions the participants will try to analyse and solve problems in a structural way.

The purpose of this course is not to show you how to operate your individual system, but teaches you how to effectively deal with general chromatographic and instrument problems. Note that it is not a service training related to an instrument of a certain brand

Profile of course candidates:

The above course is intended for people who:

have at least one year of practical experience in gas chromatography;

have reached a knowledge level corresponding to our level 2 courses;

want to become more familiar with the practical aspects of (brand-independent) instrumentation;

want to test and improve their knowledge of practical and operational problems and the ways to solve them.

# Introduction to liquid chromatography(Level 1)

Contents of lectures, case studies and practicals:

## **Introduction:**

Liquid chromatography: typical samples, applications Principles of separation, retention: retained and unretained components Definitions: capacity factor, selectivity, efficiency, plate number, resolution

## **Instrumentation:**

Types: modular/integral

Pumps: constant pressure pumps, constant flow pumps (e.g. reciprocating plunger): principles, features and requirements, pistons, check valves, pump heads, gradient systems: low/high pressure mixing Injection valves Detectors: refractive index, conductivity, UV absorption, fluorescence, general aspects, noise, wander, response, linear dynamic range, instrumental band broadening

## **Columns:**

Dimensions, flow direction, packing procedure, start-up, maintenance, guard columns, storage

## **Qualitative and quantitative analysis:**

General aspects: accuracy, precision, justification, random errors and systematic errors identification: based on (relative) retention times, fingerprint Detector response: height/area Calibration curves: single point, multi-point, linearity Calculation methods: (normalized) 100%, extremal standard, internal standard

## **Liquid Chromatography:**

Column chromatography: adsorption chromatography, partition chromatography, features Reversed Phase Liquid Chromatography: non-polar bonded phases, features and advantages, applications RP stationary phase: silica, influence of stationary phase on retention and separation Mobile phase: influence on retention and separation, purity, degassing, composition, additives, safety, parameters, solvent strength (general), modifier type. isocratic vs gradient elution

## **Isocratic and gradient elution:**

Isocratic elution Gradient: instrument and solvent related parameters, profile, elution strength, gradient range, blank, scouting gradient, development of a gradient, modification and optimization, practical aspects

Profile of course candidates:

The above course is intended for people who:

- are new to, or have recently started using liquid chromatography techniques;
- have recently left college and have little or no knowledge of liquid chromatographic procedures;
- have limited experience only and wish to acquire a better understanding of qualitative and quantitative analysis and the instrumentation used;
- generally want to improve their understanding of the fundamentals of liquid chromatography.

# Principles and practice of modern HPLC (Level 2)

Contents of lectures, case studies and practicals:

## Introduction to HPLC:

Equipment, chromatographic principles

Theoretical aspects: retention, selectivity, efficiency, plate number, plate height, equation, diffusion parameters, H-u curve, resolution, asymmetry

HPLC techniques:

Typical compounds, HPLC modes

Adsorption chromatography: LSC, stationary phases, mobile phases, applications, advantages/disadvantages

Partition chromatography: LLC, principles, disadvantages Chemically bonded phases: features, non-polar bonded phases (RPLC) Polar bonded phases: structure, features and applications of diol phases, amino phases and cyano phases Ion exchange chromatography: principles and mechanism, stationary phases, mobile phases, detection Size Exclusion Chromatography: SEC, GFC, GPC, principles, applications

Reversed Phase Chromatography (RPLC):

Features, properties and advantages, applications Reversed phase materials: preparation, properties, surface structure, carbon Loading, coverage, monomeric /polymeric, end capping, influence of stationary phase on retention and separation, retention order, selectivity Mobile phase: influence on retention and separation,

modifiers, solvent strength, polarity and selective interactions, practical use of solvent

selectivity Ion suppression, dynamic ion exchange: principles, parameters, practical aspects

Column dimensions:

Packing performance, particle size, wall effects, internal diameters, practical aspects, pressure drop, column dimensions vs analysis time, sensitivity, economical and operational aspects

Optimization:

Goals, influence of  $k'$ , and N on resolution Optimization of a separation: operational parameters, analysis time parameters, optimization vs separation, time, capacity, sensitivity

Profile of course candidates:

The above course is intended for people who:

are already working with liquid chromatography techniques and have a working knowledge of the basics of chromatography;  
want to know more about HPLC techniques, HPLC columns, column choice and optimization.

## **Troubleshooting in liquid chromatography**

Contents of lectures, case studies and practicals:

Fundamentals of problem solving:

How to structure, recognize and analyze problems, methods and remedying troubles First check, spare parts and tools

### **Share in our experience:**

Problems concerning equipment, solvents, samples, pumps, connections, sample introduction, columns, detectors

### **Problem solving from chromatograms:**

Real-life aspects of 'bad' chromatograms are discussed, such as instability, ghost peaks, distorted peaks, baseline disturbances, repeatability problems.

At the practical sessions the participants will try to analyse and solve problems in a structural way.

The purpose of this course is not to show you how to operate your personal HPLC system, but to teach you how to effectively deal with general chromatographic and instrument problems. Note that it is not a service training related to an instrument of a certain brand.

Profile of course candidates:

The above course is intended for people who:

have at least one year of practical experience in liquid chromatography;

have reached a knowledge level corresponding to our level 2 courses;

want to become more familiar with the practical aspects of (brand-independent) instrumentation;

want to test and improve their knowledge of practical and operational problems and the ways to solve them.

Common conditions for customers:

for every course the customers can take part by appointment only. The announcement has to be sent by fax, email or letter with full name of customer, factory and address. The courses are limited to citizens of the European Community.

Based on the bill payment has to be done before the course starts (10days).

In the course price included are:

the course (9 -16.30)  
a course manual (English or German)  
non alcoholic drinks  
lunch every day  
certificate

Not included are travel and hotel costs. A hotel near my lab/ office can be organized.

Languages for courses possible: English, Polish, Russian, German