

Plant-based Extracts – Process Development and Production

Plant extracts are used on industrial scale for the production of pharmaceuticals, food and cosmetics. The world market volume for pharmaceutical ingredients from plant extracts is currently around 100 billion € with annual double digit growth rates. The market for herbal extracts as food additives, functional food and nutraceuticals is about 500 billion € world-wide, and for aromas and flavours appr. 10 billion €. Current trends, such as “soft medicine”, “natural products”, “wellness”, but also “...away from fossil fuels”, “regional raw materials”, etc. strengthen the growth of this industry.

In contrast, currently used technology is no longer “state-of-technology” and is accessible for everybody. Significant technology upgrade is required to maintain and further develop existing markets. Introducing new extraction and purification technologies however is associated with high technical risks for the users, especially in view of continuously increasing regulatory demands.

Methods for process development and processing technologies of complex molecules are becoming more and more efficient and thereby economical.

Latest developments in unit operations and apparatus used as production equipment as well as newest process design methodology based on simulation in combination with lab experiments have enabled these advances.

During this training course, design and combination of unit operations, like solid-phase extraction (solvent-/water-based and supercritical), liquid-liquid extraction, precipitation and adsorption/chromatography will be addressed. These are established key technologies, which are applied as highly efficient separation processes in production. Further, botanical, chemical and analytical basics are presented.

Researchers, engineers and technicians involved in process development, production, or process control and monitoring should be acquainted with the efficient transfer of extraction and purification sequences from lab to production scale. Solid theoretical and experimental knowledge as well as a grasp of the potentials of newest design concepts can be of great help in meeting of the time pressure and significant effort in daily project work.

After the course every participant should be...

- » able to apply modern plant-based extraction methods and their design in the daily project work.
- » acquainted with suitable apparatus for handling solids, liquid-liquid extraction and chromatographic operations of process design.
- » able to understand the regulatory environment for agro-chemicals, food additives, aroma ingredients and pharmaceuticals, and to assess their implementation.
- » able to set up experiments for the design of solid phase extraction, liquid-liquid extraction incl. PHWE pressurized hot water extraction, precipitation and chromatography total process integration.
- » lay out screening of necessary additives (e.g. solvents, supercritical fluids).
- » acquainted with the selection of suitable analytical methods.
- » consider botanical basics in process optimization.
- » able to perform scale up of these unit operations.
- » well informed about potentials and limits of process design of plant-based extraction and purification methods by means of simulation and Design of Experiments (DoE).
- » able to evaluate Green Technology, Biobased World/Bio-economy, Waste Valorization concepts
- » Process Analytical Technology (PAT) with PLS-statistics and the regulatory Quality by design (QbD) approach

Presentation of content

The content of the course will be presented in lectures with the opportunity for discussion. The course language is either English or German depending on the majority of participants and as stated upon registration.

Starting from basics the theoretical background will be laid. These basics will be deepened in interactive tutorials and examples. Typical applications will be chosen.

An experimental introduction in solid-liquid extraction (maceration and percolation), as well as extract purification with distillation, liquid-liquid extraction, membrane technology, crystallization/ precipitation and chromatography (batch and continuous) will be given in the laboratory.

Process design and scale-up are treated in theory, followed by hands-on simulation tutorials.

Target group

The target group consists of scientists, process engineers and lab-technicians, involved in process development, pilot plant operation or production. Besides basic knowledge in IT/MSOffice no prior knowledge is required.

Course material and infrastructure

Each participant will be provided with a handbook containing the lectures at the beginning of the course. The experimental part will take place in the institute’s laboratory and the simulation tutorials on laptops provided. The experiments will be run in groups of 2-4 participants.

Lecturers

Dr. D. Gerard (Flavex)
 Prof. Dr. R. Hänsch (TU Braunschweig)
 Dr. K. Hudel (Christ)
 Dr. J. Treutwein (Trifolio-M)
 Dr. M. Oberle (Merck)
 Dr. B. Steinhoff (BAH Bonn)
 Prof. M. Tegtmeier (TU Clausthal)
 Prof. J. Strube and coworkers (TU Clausthal)

(subject to modifications)

Location

Clausthal University of Technology
 Institute for Separation and Process Technology
 Leibnizstr. 15
 D-38678 Clausthal-Zellerfeld, Germany

Course Program

Sunday, 25 September 2022

19:00 joint dinner in the restaurant of the hotel
"Zur Pixhaier Mühle" with introduction to "Montan
Region Harz"

Monday, 26 September 2022

08:30-10:00 plant-based extracts – products and processes,
fundamentals and theory, analytical basics

10:00-11:30 botanical fundamentals

11:30-12:30 lunch

12:30-18:00 applications and regulatory for agro-chemicals,
nutrition additives, flavours, cosmetics,
pharmaceuticals
unit operations: solid-liquid extraction with
pretreatment, disintegration distillation, liquid-liquid
extraction, supercritical/solvent extraction,
chromatography, membrane technology,
crystallization/precipitation

from 19:00 guided tour of the mining museum Clausthal-
Zellerfeld and traditional „Tscherper-meal“

Tuesday, 27 September 2022

08:30-10:00 introduction into process modelling and process
design, scale-up

10:00-11:30 experimental model parameter determination in
laboratory: solid extraction (maceration, percolation,
solvent choice, phase ratio, solubility, extraction
parameter, pretreatment, equipment choice)

11:30-12:30 lunch

12:30-14:00 experimental model parameter determination in the
lab: chromatography, distillation, liquid-liquid extrac-
tion, membrane technology and crystallization/
precipitation

15:00-18:00 transfer and guided-tour to Goslar/Kaiserpfalz

18:00-20:00 joint dinner

20:00-24:00 „Midnight Session“ – simulation tutorials
solid-liquid extraction, distillation, liquid-liquid-
extraction, membrane technology, chromatography
(batch and continuous), crystallization/precipitation

Wednesday, 28 September 2022

08:30-10:00 equipment and production technology

10:00-11:30 open requested topics

11:30-12:30 lunch

12:30-15:00 status and trends
conclusions and discussion

Subject to modifications.

General Information

Accommodation

Waldhotel „Zur Pixhaier Mühle“, An der Pixhaier Mühle 1, D-38678
Clausthal-Zellerfeld.

Possibility for lunch is in the University's mensa or restaurants nearby.
On Sunday, a shuttle will be offered from Göttingen main station (ICE) at
17:00 and 21:00 h and back on Wednesday after the end of the course. In
Clausthal a shuttle between hotel and institute and any activity will be
organized.

Registration

Please complete and return the enclosed form or contact:
Forschungsvereinigung der Arzneimittel-Hersteller e.V. (FAH)
Dottendorfer Straße 86
53129 Bonn
Tel.: 0049 / 228 / 1 84 86 990
Fax.: 0049 / 228 / 1 84 86 999
E-Mail: udo.larbig@fah-bonn.de
Internet: http://fah-bonn.de

Actual Corona-Pandemic rules will have to be applied and accepted at
registration. Actually, valid 2G (boostered) and daily self-tests as well as
FFP2-mask is standard.

Registration fee

2.895,- €
2.545,- € (FAH members)
(incl. course materials, certificate of attendance, beverages, transfers, bed
and breakfast in the hotel Pixhaier Mühle and dinner Sunday, Monday and
Tuesday)

The number of participants is limited.

Course language is German, materials may be English.

Deadline: 31 August 2022



Trainings Course

25th – 28th September 2022
Clausthal-Zellerfeld / Germany

Plant-based Extracts - Process Development and Production

Design and scale-up based on
laboratory experiments and
process simulation



TU Clausthal
Institute for Separation and Process Technology