High Pressure Solutions for Supercritical Fluids
Extract – Clean – Impregnate

Uhde High Pressure Technologies
Supercritical fluids can replace conventional solvents such as methanol, ethanol, methylene chloride etc. Because some of the conventional solvents are toxic, efforts are now being made to avoid their use. An alternative to these solvents is provided especially by supercritical CO₂. Substances dissolve at a much higher rate in supercritical fluids than would normally be expected at a given vapour pressure. CO₂ has proven to be especially well suited for the extraction of natural substances. The low critical temperature of 31 °C allows particularly gentle treatment of natural substances. Moreover, CO₂ is not only readily available, but may also be obtained at relatively low prices. Supercritical fluids are applied to:

**Extraction**
- of valuable substances
  - From spices, herbs and other plant material
  - For food, cosmetics and the pharmaceutical industry

**Upgrading of raw materials**
- Decaffeination of coffee and tea
- Removal of pesticides from plant raw materials and extracts

**Purification**
- Binder removal from structural components
- Solvent recovery from synthesis products
- Removal of contaminants from soil

**Cleaning**
- Parts
- Wafers
- Textiles

**Impregnation and coating**
- Dyeing of textiles
- Coating of sensitive substances in order to improve properties

**Other processes**
- Particle generation
  - Microparticles and nanoparticles for the pharmaceutical industry with improved properties

**Reaction**
- Improvement of reactions
- New products by novel reactions for the chemical and pharmaceutical industries
EXTRACT – CLEAN – IMPREGNATE
The company of Uhde High Pressure Technologies (HPT) can substantiate its claim to be a market leader and excellent specialist in high-pressure technology by innovative applications, processes and products in most different areas day by day. Our comprehensive knowledge is also transferred into the development of CO₂ plants putting maximum requirements on process engineering, design, materials and components.

**A unique high manufacturing content that is convincing**
Being a generalist and developer of complete plants Uhde HPT combines the eye for the bigger picture with the know-how for each detail being used in CO₂ plants: with a unique high manufacturing content we recommend ourselves as a highly specialized provider for heat exchangers, instruments, valves, prefabricated pipes and fittings, which are designed and fabricated by us according to the latest state of the art concerning materials, alloys and construction.

**Tailor-made solutions for ready-for-use plants**
In short: from process design and planning of the plant via the manufacture of individual structural elements and components up to the construction and assembly of ready-to-use plants Uhde HPT being the manufacturer of CO₂ plants offers tailor-made solutions from one source. With our customer-oriented and reliable service our clients can rely on maximum safety and economic efficiency far beyond the initial commissioning.
Production size extraction plant
Uhde HPT manufactures a broad range of components for high-pressure installations. These products include autoclaves, reactors with rotary agitators, tubular reactors, heat exchangers, high-pressure pumps, valves and fittings, flanges and piping, which are used in a wide variety of high-pressure processes. Thanks to a combination of proven designs, high quality and meticulous precision all these products have been found to provide excellent service. With its longstanding experience in the design and construction of industrial plants Uhde is in the position to engineer and manufacture complete pilot and industrial-scale installations for high-pressure extraction using supercritical gases. Uhde, moreover, attaches considerable importance to operational safety.

The process engineering for a high-pressure extraction system is based either on test results or on customer specifications. On the process-development side, Uhde HPT works in close cooperation with both industry and research institutes. Using the latest analysis techniques it is possible to assess the product yield and, therefore, the closely linked factor of process economy at an early stage. Uhde HPT engineered high-pressure installations being designed for either manual or fully automated operation, the level of automation depending on process requirements, operational safety and customer specifications. The range of services offered by Uhde HPT includes process development, design and the construction of systems in compliance with all applicable regulations, installation and commissioning as well as the training of the operating personnel.
Mechanical engineering
Comprehensive competence in the design and construction of extraction plants

With their team of well trained and experienced designers Uhde HPT can accept orders for the complete design of plants as well as the design and calculation of the most important equipment components like e.g. tanks, heat exchangers, pumps, valves and pipes.

In such situations we exploit possibilities given by modern 3D design software and perform stability calculations for structural elements by means of the finite-element method. All design and construction works are done on the basis of internationally used standards, codes and regulations.
Manufacturing and process control
Quality from the choice of materials to production

Material – quality from the beginning
Already at the time when raw steel is purchased we pay attention to the best possible grade, because impurities can cause flaws like crack formations. Therefore, we only use steel grades of maximum quality that we purchase from renowned steelworks.

Manufacturing
The equipment such as high-pressure tanks, heat exchangers, valves etc. to be used in the plants is manufactured in the Uhde HPT workshops and accompanied by continuous quality control. Manufacturing is only completed when equipment has been accepted by authorities such as TÜV or Lloyd’s and the meeting of regulations and specifications has been certified.

Safety in each manufacturing phase
We inspect surfaces, bores, material volumes and wall thicknesses in the course of manufacture already and thus achieve uninterrupted quality assurance in compliance with national and international standards. Impulse, ultrasonic and microscopic tests, but also destruction and corrosion tests in independent test laboratories assure that the components manufactured by us meet all requirements concerning hardness, pressure, tightness, flexibility and precision.

Process automation
The measuring, control and automation systems especially matching the prevailing plant topology allow the simple and faultless operation of the plant. The complete operating system comprises all the necessary field devices such as sensors and actuators, local panels, PLC system as well as a central-computer-based operation and viewing system. The field devices are designed with process connections that are suitable for food or are hygienic according to their use. If combustible media are used, they have an explosion-proof design. An efficient field-bus system links the field devices to the PLC system via so-called remote I/Os. The PLC system contains the complete plant software including the registration of actual values, controls, sequences, interlocks as well as motor and valve controls. It is linked to the computer system via a plant bus, usually industrial Ethernet. In order to improve availability the computer system may have a redundant structure with a master computer and a back-up computer. The plant structure is displayed clearly on the computer screens in a form similar to P&I diagrams. Messages and requests for data input are displayed in plain language. The system contains extensive diagnostic functions in order to guide the operator to the affected component in the case of a fault.
HP Components for Supercritical Fluids – all from one source
Reactors, valve technology, pumps, tanks, steel constructions

Our comprehensive performance spectrum for the implementation of CO₂ plants allows us the manufacture of almost all components; we guarantee continuous maximum quality to our clients and licence partners.

Particle formation plants for pharmaceutics
Apart from 'normal' extraction plants Uhde HPT provides plants for a variety of purposes such as particle formation, drying, deoiling, etc. In picture a 2L, a 400-bar particle formation tank is shown which is used for pharmaceutical products.

Production-scale plant with high requirements
Uhde HPT is able to fulfil cGMP requirements that are mandatory for plants for pharmaceutical purposes. In picture a 2L, a 500-bar lab-scale size plant for pharmaceutical products is shown.
Equipment for the extraction of natural products
Uhde HPT is able to provide equipment for extraction purposes in a large variety of sizes and pressures. On the left, a vertically installed extraction tank with a volume of 800 l and a pressure range of up to 880 bar is presented for the extraction of natural substances. Furthermore, it is equipped with a heating jacket for temperatures of up to 130 °C.

Closure systems for quick access to tanks
In extraction processes it is important to reduce the time for product exchange to a minimum. Thus, Uhde HPT provides fast acting closure systems for quick access to the tank. The segmental ring closure system presented in the left picture is used for extraction tanks with large diameters.

Closure systems for production-size plants
For production-size plants with moderate diameters the clamp closure system is used to allow quick product exchanges. A cover carriage and clamp closure system for an extraction plant for natural substances (200 l, 1,000 bar) operated via a panel can be seen in the left picture.

Plant for pharmaceutical application
Uhde HPT is able to provide high-pressure plants for the pharmaceutical industry with sizes of up to 500 l and above. Even special arrangements like horizontally installed tanks can be fabricated. The picture shows an extraction tank used in a plant for pharmaceutical purposes (horizontal installation, 500 l, 300 bar).

Plants for medical purposes
Uhde HPT is able to provide ready-to-use plants in a variety of scales from lab scale up to production scale and for a variety of applications. In the left picture a 6 l, 350 bar extraction plant for medical purposes (production-scale size) is shown.
From the idea to the turnkey solution
A reliable partner for your success

Effective and efficient service ensures the productivity of your plant. We provide specialised services for the full life cycle of the plant or equipment, from the installation until the decommissioning, including necessary and useful expansions and modifications.

**Services**
In addition to the supply of plants, Uhde offers several services connected with supercritical fluids and their application.

**Process development**
In cooperation with experienced institutes and companies processes are developed from the first tests to application at production scale. Process development is accompanied by economic evaluation in order to help the customer to take his decision in favour of installing a production plant, even in an early state of development.

**Equipment and plant design and engineering**
Equipment and plants are designed and engineered in compliance with all the relevant regulations and standards. For the pharmaceutical industry these include DQ, IQ and OQ according to cGMP and GAMP guidelines, regulations from FDA, EMEA or similar organizations.

**Assembly and installation**
Depending on the size of the plant it is completely assembled in our workshops or installed at the client’s. Installation is carried out either by the customer’s personnel under the supervision of the Uhde HPT experts or completely by Uhde HPT personnel.

**Start-up and commissioning**
Upon completion of the installation the plant is started up and commissioned under the supervision of Uhde HPT experts. Assistance for production after commissioning can be offered by Uhde experts.

**Training of plant operators and maintenance personnel**
During the manufacturing phase, the client’s personnel is trained by Uhde HPT experts at our offices and workshops. Training is continued during the installation and start-up of the plant.