Industrial Solutions
Process Technologies

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Industrial Solutions

Extract, clean, impregnate using supercritical fluids

thyssenkrupp

engineering. tomorrow. together.

Uhde – a specialist in high-pressure technology

Supercritical fluids can replace conventional solvents such as methanol, ethanol, methylene chloride etc. Since some of these solvents are toxic, efforts are now being made to avoid their use. An alternative to these solvents is provided especially by supercritical CO_2. Substances dissolve at a much higher rate in supercritical fluids than would normally be expected at a given vapour pressure. CO_2 has proven to be particularly well suited for the extraction of natural substances.
The low critical temperature of 31 °C allows gentle treatment of natural substances. Moreover, CO_2 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
- supercritical drying of aerogels

Reaction
- improvement of reactions
- new products by novel reactions for the chemical and pharmaceutical industries




Worldwide high-pressure experience

- Uhde High Pressure Technologies plants
  Main references

The company of Uhde High Pressure Technologies 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. Uhde High Pressure Technologies has comprehensive knowledge in the development of CO_2 plants. That is why we have maximum requirements on process engineering, design, materials and components.

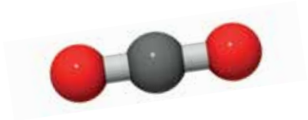
A unique high manufacturing vertical integration that is convincing

Being a generalist and developer of complete plants Uhde High Pressure Technologies combines the eye for the bigger picture with the know-how for each detail being used in CO_2 plants: with a unique high manufacturing vertical integration we recommend ourselves as a highly specialized provider for vessels, quick-acting closure systems, heat exchangers, instruments, valves, prefabricated pipes and fittings, which are designed and fabricated according to the latest state-of-the-art concerning design and materials.

Tailor-made solutions for ready-to-use plants

In summary: From process design and planning of the plant and the manufacturing of individual structural elements and components up to the construction and assembly of ready-to-use plants Uhde High Pressure Technologies offers tailor-made solutions from one source. With our customer-oriented and reliable service our clients can rely on maximum safety and economic efficiency.

Support in process realisation and scale-up



Uhde High Pressure Technologies is able to assist in the course from initial process idea to commissioning of a complete production-scale supercritical fluid plant. For this purpose Uhde High Pressure Technologies' engineers are able to provide all kinds of engineering work.

Specialized engineering work for every project step

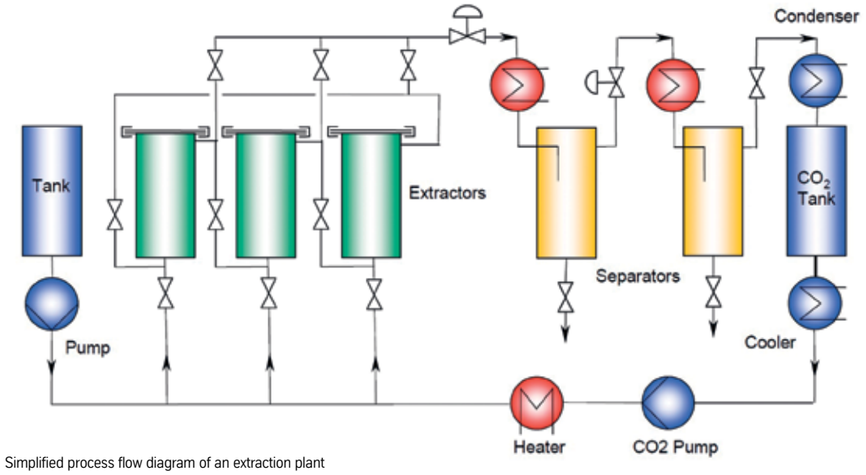
Uhde High Pressure Technologies possesses valuable process and product know-how and a large product databank containing verified data for supercritical fluid processes. Based on this data it is possible for Uhde High Pressure Technologies to evaluate a process idea of a customer and to support with a feasibility study.

Furthermore, extraction experiments can be conducted by Uhde High Pressure Technologies to verify the behavior of customer's feedstock. A close cooperation with industry and research institutes allows carrying out experiments in lab-scale up to production-scale depending on the desired information and processed feedstock. This also includes state-of-the-art analysis of the processed products and extracts to gain valuable information on product quality, properties and yield. Uhde High Pressure Technologies' experienced high-pressure engineers can provide several kinds of additional engineering work including:

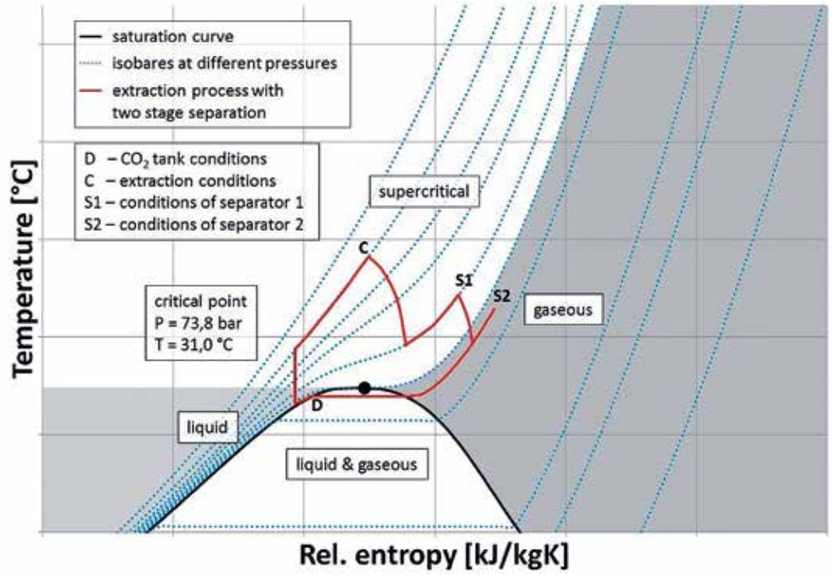
- process development for high-pressure processes (e.g. thermodynamic considerations, development of PFDs, pre-engineering studies)
- process engineering for different high-pressure components like heat exchangers, separators and valves
- layout design work as information for space requirements of a plant
- design engineering work of components/ systems in compliance with corresponding applicable regulations
- simulations (e.g. CFD analysis to verify process design)
- upscaling engineering work as well as process intensification work with regard to a production-scale plant
- assistance for relocation of a complete plant

Additional fields of activity

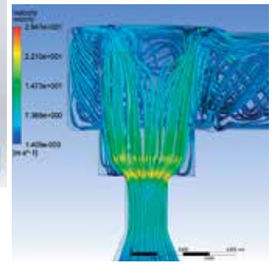
Apart from the engineering work, Uhde High Pressure Technologies is also able to carry out all needed steps until final fabrication of the plant including assistance in commissioning and training of the operating personnel. The sizes of supplied plants cover lab-scale plants as well as pilot-scale plants up to production-scale plants with high-pressure vessels up to several cubic meters. Uhde High Pressure Technologies' engineered high-pressure installations are designed for manual up to fully automated operation, depending on process requirements, operational safety and customer specification.



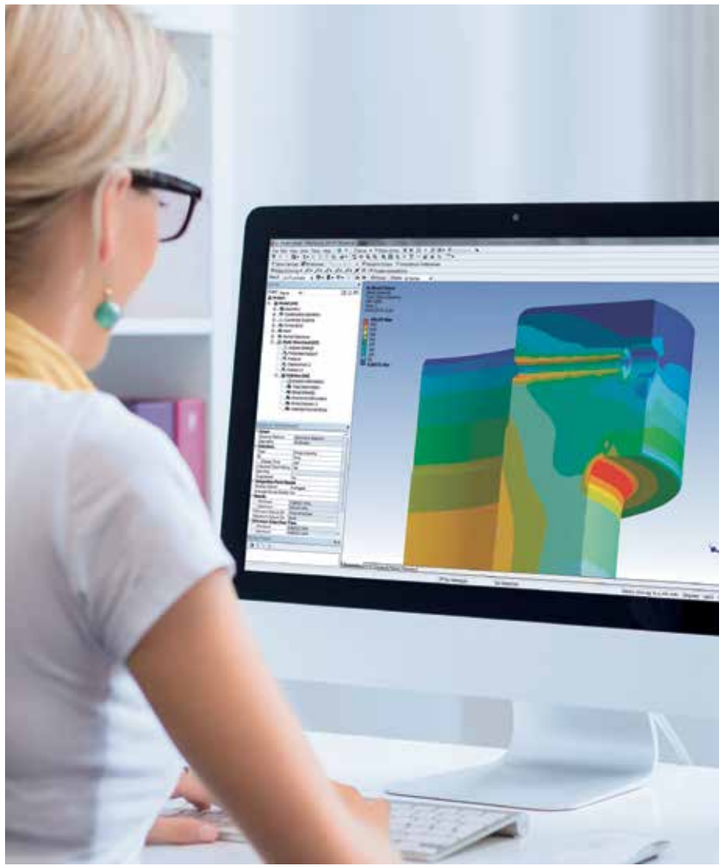
Simplified process flow diagram of an extraction plant



Multi-purpose CO_2 and propane extraction plant

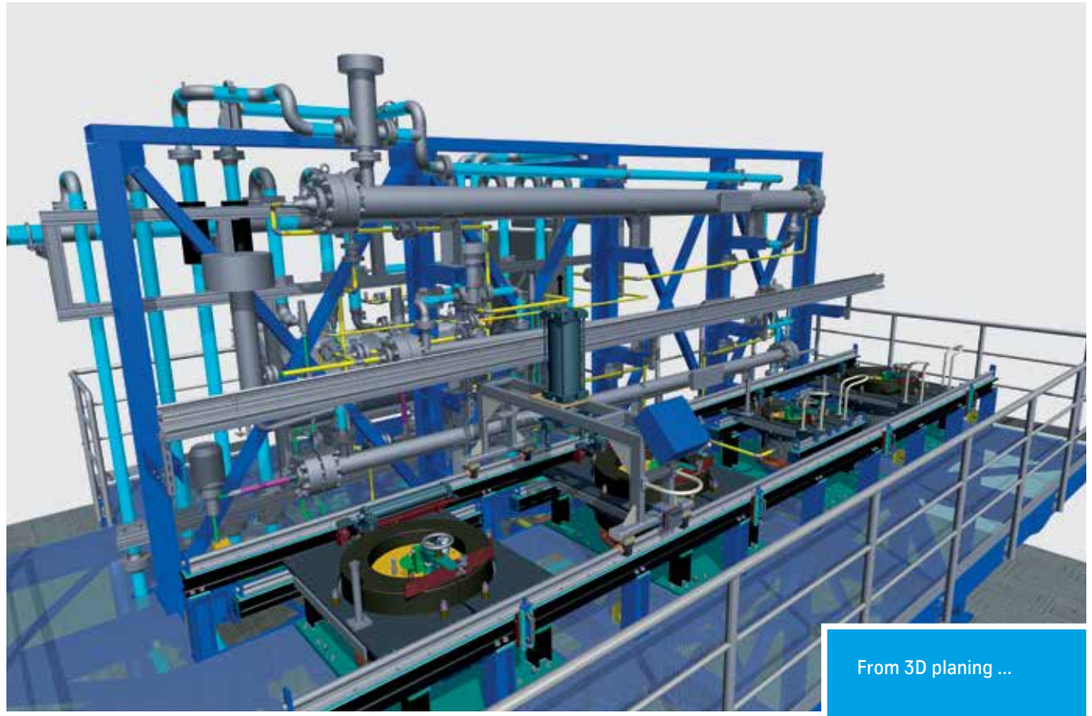


Comprehensive competence in the design and construction of extraction plants



With a team of well trained and experienced designers Uhde High Pressure Technologies 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. vessels, heat exchangers, pumps, valves and pipes. Fabrication of the plant as pre-installed modules allows a shorter site installation time.

Uhde High Pressure Technologies exploits all possibilities given by modern 3D design software and performs stability and strength 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.



From 3D planing ...

... to construction of a modular-concept plant

Fabrication quality from selection of materials to production

Material – quality from the beginning

Already at the time when raw steel is purchased Uhde High Pressure Technologies pays attention to the best possible grade, because impurities can cause flaws like crack formations. Therefore, Uhde High Pressure Technologies only uses steel grades of maximum quality being purchased 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 High Pressure Technologies workshops and accompanied by continuous quality control. Manufacturing is only completed when equipment has been accepted by authorities such as TÜV or Lloyds and the compliance with regulations and specifications has been certified.

Safety in each manufacturing phase

Uhde High Pressure Technologies inspects surfaces, bores, materials, volumes and wall thicknesses in the course of manufacture and thus achieve uninterrupted quality assurance in compliance with national and international standards. To ensure that the manufactured components meet all requirements concerning hardness, pressure, tightness, flexibility and precision, different kinds of tests are carried out including impulse, ultrasonic and microscopic tests, but also destruction and corrosion tests at independent test laboratories.

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 visualisation 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, the devices are designed explosion proof. An efficient field-bus system links the field devices to the PLC system via 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 the corresponding 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.

Components for supercritical fluids – all from one source

Uhde High Pressure Technologies' comprehensive performance spectrum for the implementation of CO_2 plants allows the manufacturing of almost all components, guaranteeing continuous maximum quality to its clients and licence partners.

Particle formation plants

Apart from normal extraction plants Uhde High Pressure Technologies provides plants for a variety of purposes such as particle formation, drying, deoiling, etc. In the left picture a 2 l, 400 bar particle formation vessel is shown which is used for pharmaceutical products.

Production-scale plants with high requirements

Uhde High Pressure Technologies is able to fulfil cGMP requirements that are mandatory for plants for pharmaceutical purposes. In the left picture a 2 l, 500 bar production-scale plant for pharmaceutical products is shown.

Equipment for the extraction of natural products

Uhde High Pressure Technologies is able to provide equipment for extraction purposes in a large variety of sizes and pressures. On the left, a vertically installed extraction vessel with a volume of 800 l and a pressure up to 880 bar for the extraction of natural substances is presented. Furthermore, it is equipped with a heating jacket for temperatures up to 130 °C.

Closure systems for quick access to vessel's inside

In extraction processes it is important to reduce the time for product exchange to a minimum. Thus, Uhde High Pressure Technologies provides quick acting closure systems for quick access to the vessel. The segmental ring closure system presented in the left picture is used for extraction vessels with large diameters.

Closure systems for production-scale plants

For production-scale plants with moderate diameters the clamp closure system is used to allow a quick product exchange. 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.

Plants for pharmaceutical applications

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

Plants for medical purposes

Uhde High Pressure Technologies 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) is shown.

A reliable service partner for your success

Installation- and maintenance service by Uhde specialists

Services

In addition to the supply of plants, Uhde High Pressure Technologies offers several services connected to 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 with the decision of installing a production plan, even in an early stage of development.

Equipment and plant design and engineering

Equipment and plants are designed and engineered in compliance with all relevant regulations and standards. For the pharmaceutical industry this includes e.g. 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 can be completely pre-assembled in our workshops and delivered in one or more modules or installed at client's site. Installation is carried out either by the customer's personnel under supervision of Uhde experts or completely by Uhde personnel.

Commissioning and start-up

After completion of the installation the plant is commissioned and started up under supervision of Uhde experts. In addition, Uhde High Pressure Technologies can offer specialists to assist its customer during the first steps of the production after the commissioning.

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.