



PMA

# Spice extraction KS 94 application

Supercritical extraction for spice production

KS 94/IBS with InterBus

Decentralized plant concept

Simple on-site operation

Recipes are processed with utmost precision

## KEY WORDS

**Supercritical extraction, spice extraction, natural substances, foodstuffs, cosmetics, pharmaceuticals, refining of raw materials, solubility of material blends, solvent removal from synthetic products.**

## DESCRIPTION

During the production of spice extracts – e.g. for alcoholic liquors – special care is taken to ensure that the aromatic compounds smell and taste the same as the original spices. By means of a special extraction plant built by Uhde Hochdrucktechnik, that uses supercritical fluids such as CO<sub>2</sub> as solvents, all the requirements for the extraction of natural flavours are met.

Depending on the extract, pressures up to 600 bar, and temperatures between 30 and 80 °C must be maintained precisely, and in accordance with the various recipes. Because the plant consists of widely separated equipment, the decision for a decentralized automation system has proved to be ideal.

## HIGH-PRESSURE EXTRACTION WITH SUPERCRITICAL GASES

Extraction involves the separation of material blends into their constituent parts by means of suitable solvents.

Because organic solvents have a low boiling point, and some of them are toxic, supercritical CO<sub>2</sub> gases are used for the extraction of natural substances. The low critical temperature of 31°C allows very gentle processing of the natural substances. Moreover, CO<sub>2</sub> is available in sufficient quantities and at a reasonable price. By varying the pressure and temperature, the dissolving power can be defined precisely.

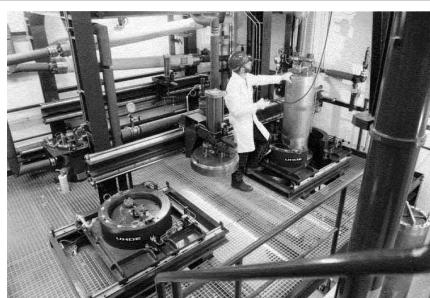


Fig. 1: Production plant for 2 x 200 liters

Thus high-pressure extraction can be applied equally well for solid and liquid raw materials, coupled with gentle treatment of temperature-sensitive natural substances.

In addition, fewer production stages are required to yield extremely pure extracts. The extraction of solid substances is performed in a batch process, whilst liquid substances can be extracted continuously in counterflow columns. Liquefied CO<sub>2</sub> from a storage tank is compressed to the extraction pressure by a pump, and heated to the required temperature in a heat exchanger before it enters the extraction column.

As it passes through the extractor, the substances to be extracted are dissolved in the CO<sub>2</sub>, which is then passed to the separator. By varying the pressure and/or temperature, the dissolving power of the CO<sub>2</sub> is reduced in the separator, so that the extracts are precipitated.

To obtain extract fractions of different qualities, precipitation can be performed in several stages. The gaseous CO<sub>2</sub> from the separator is liquefied in a cooled condenser, and collected in a vessel, from where it is returned to the process. By using several extractors for solid raw material, semi-continuous processing is possible.

This process is also used for the extraction of spices, hops, herbs, and flowers for the foodstuffs industry, cosmetics, and pharmaceuticals, as well as the refining of raw materials. This includes the decaffeination of coffee and tea, removal of pesticides from raw plant extracts, removal of cholesterol from animal products, or the removal of solvents from synthetic products.

builds and supplies a wide range of equipment for high-pressure extraction plants. The product range includes autoclaves, reactors, heat exchangers, high-pressure pumps, fittings, machined parts, flanges, and pipes. Furthermore, special ball valves for operating pressures up to 500 bar are supplied with any type of actuator.



Fig. 2: Production plant with 3 extractors

Since 20 years, Uhde has been building complete pilot and full-scale plants worldwide for high-pressure extraction with supercritical gases. The standard scope of delivery includes initial planning, design of the processing stages, all safety aspects, manufacturing, installation, and commissioning, plus training of operating personnel. The degree of automation depends on the process requirements, plant safety, and customer-specific demands.

## IMPLEMENTATION

An InterBus network is used to connect the 15 stand-alone KS 94 process controllers (supplied by PMA), various I/O modules (from Phoenix Contact), plus numerous field transmitters and actuators (frequency converters, etc.) to the central supervisory computer. The supervisory computer is a PC with WIZCON, and the entire InterBus network comprises a total of 52 nodes.

An important feature of the universal KS 94-IBS controllers is the standard interface for a direct link to the InterBus network. Highly appreciated by the operating personnel is the simple on-site operation, and the excellent readability of the „day & night“ display. The powerful control algorithm of these decentralized controllers relieves the central PC from the high working load usually involved with real-time computation.

This is the main reason for the reliability and high availability of the fully automatic plant. Another advantage of the selected InterBus structure lies in the communication facilities between the controllers and the numerous input/output modules in the field. This considerably reduces the wiring costs, problems with EMC are minimized, and maintenance is much simpler.

Via the WIZCON operating display on the central PC, the operator is able to upload the set-point profiles into the controllers, as required for the individual recipes. In addition, the operating status of each controller can be monitored continuously. The results achieved with pilot and production scale plants in Switzerland were so good, that further plants have been built and are being planned according to this concept, e.g. in the USA and in China.

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