Waters
THE SCIENCE OF WHAT'S POSSIBLE.®

SFE Bio-Botanical Extraction System

A supercritical fluid extraction system that rapidly extracts and fractionates botanical matrices

RAPIDLY EXTRACT AND FRACTIONATE LARGE QUANTITIES OF DESIRED COMPONENTS FROM A MULTITUDE OF MATRICES

The Waters® SFE Bio-Botanical Extraction System (BBES) functions as a bulk-scale, high-pressure separator for collecting extracted compounds. It provides extraction efficiency and selective fractionation of an extract in a single run. With the SFE BBES, you'll see increased consistency of final product, from run-to-run.

Because of the ability to run at increased pressure, extractions can happen faster – up to four times faster than in other systems – and at a decreased temperature, which means cleaner extracts due to less decarboxylation.

Extracting with carbon dioxide

By manipulating the pressure and temperature, CO_2 can selectively extract the desired material. The sample is placed in an extraction vessel and pressurized with CO_2 and, depending on the application, a small percentage of co-solvent, to extract the compounds of interest. These dissolved compounds are then transferred from the extraction vessel to a series of collection cyclones. The SFE BBES features either a 5-L extraction vessel (which can hold up to 4.5 lbs of material) or a 10-L extraction vessel (up to 9 lbs of material).

The automated back-pressure regulator (ABPR), located between the vessel and cyclones, allows for controlled pressurization of the compounds of interest and the CO_2. After exiting the ABPR, the system pressure is reduced, causing the CO_2 to lose its solvating power. When the manual back-pressure regulators (MBPR) are properly set, the extracted material precipitates out of the solution into the collection cyclones. The cyclones are arranged in consecutive order to enable a series of decreasing pressure steps to isolate the collected compounds – this allows for extract fractionation, giving you purer, cleaner fractions requiring less post process.

The condensed CO_2, now a gas, is sent to vent or a Recycler.

Get the highest product quality, and in less time

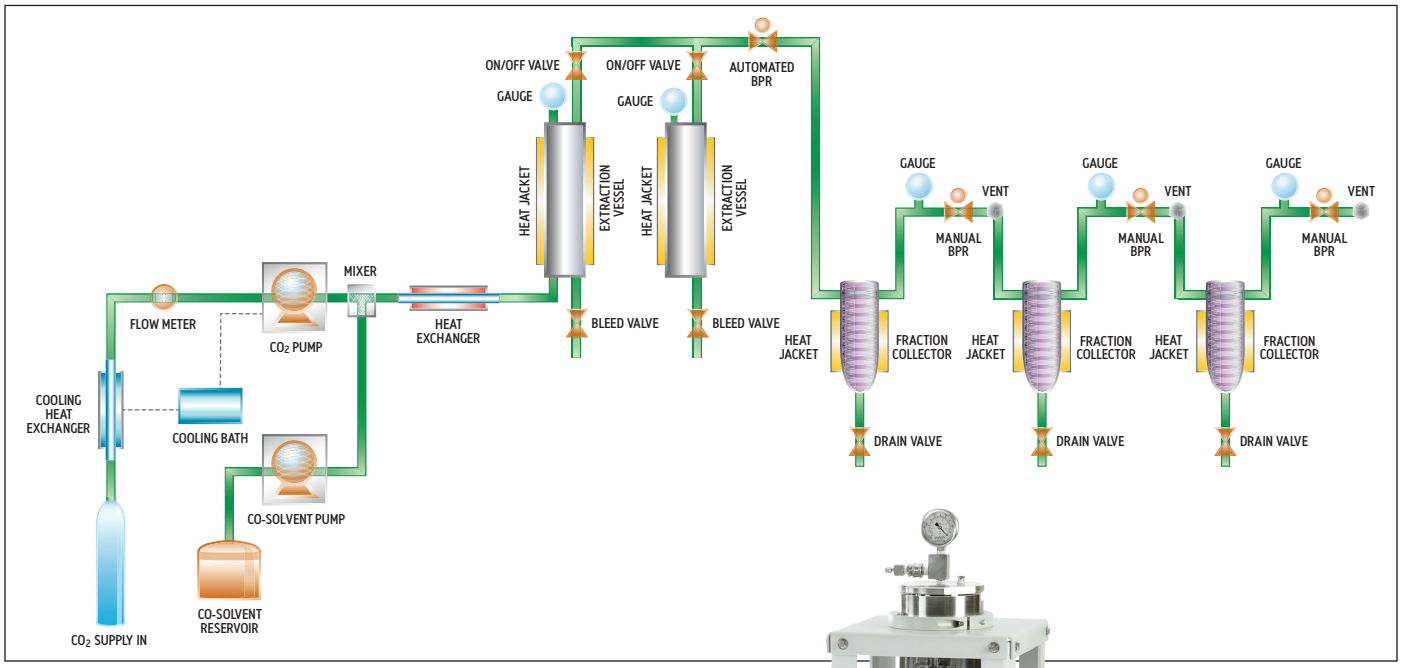
- Computer-controlled system, meaning less user-intervention
- Precise control of pressure, temperature, and time
- Up to 200 g/min flow, at 8700 psi
- Can perform sub-critical or super-critical extractions

SFE Bio-Botanical Extraction System.

Benefits of using carbon dioxide

Waters SFE systems extract chemical compounds using supercritical CO_2 instead of an organic solvent or a hydrocarbon. The supercritical fluid state occurs when a fluid is above its critical temperature (Tc) and critical pressure (Pc). This supercritical state allows CO_2 to take on the properties of a gas (high diffusivity, low surface tension), while maintaining the solvating power of a liquid. Manipulating the temperature and pressure of CO_2 alters the solvent power and allows the materials of interest to be selectively extracted.

The biggest advantage of SFE is that it leaves no traces in the product. After extraction, the CO_2 is either depressurized and vented, or recycled for further extraction use. Any residual trace of CO_2 in the product dissipates into the atmosphere within a few hours. As a tunable solvent, CO_2 is non-toxic, non-flammable, and physiologically compatible.



Schematic of the SFE BBES.

SFE Bio-Botanical Vessel.

SFE BBES system components

The system consists of a CO_2 pump, a mass flow meter, one or two extraction vessels, an automated back pressure regulator, two heat exchangers, and three fraction collection vessels. Options include a co-solvent pump and mixer, and a CO_2 Recycler.

CO_2 pump – Ideal for high pressure, supercritical fluids, and pulseless flow applications.

Co-solvent pump – Pumps a co-solvent as a percentage of the carbon dioxide flow rate up to its maximum flow rate and pressure rating. Adding a co-solvent like food grade ethanol allows one to extract polar compounds.

Cooling heat exchanger – Cool and liquefy CO_2 before it enters the pump for maximum efficiency.

Flow meter – Located on the inlet of the carbon dioxide pump, the pump, for flow control, uses measured liquefied CO_2 mass output from the flow meter.

Heat exchanger – Located upstream from the vessel to ensure that the fluid is heated prior to entering the vessel.

Extraction vessels – Caps with spring-loaded seal enhances safety, and lend to automation for efficient loading and unloading of large vessels. There can be up to two in a system.

Automated BPR – Motor-driven and temperature-controlled to compensate for cooling during depressurization. A built-in pressure sensor provides closed loop feedback for control and pressure alarm monitoring.

Collection vessels with manual BPR – The mixed fluid is introduced into the high pressure collection vessels, efficiently separated, and collected at the bottom of the vessels. There are three in a system, allowing for efficient collection of different extracts by varying pressure between collection vessels with the MBPR's.

Recycler – Reclaims vented CO_2 from extraction process. This system consists of storage vessel with level sensor for CO_2 storage, level sensor module to display level, condensing heat exchanger, condensing cooling bath, and valves. The system also features a pressure relief valve that can be piped to vent to relieve pressure in case of over-pressurization or overfill conditions.

Software – Uses intuitive ChromScope™ Software to automate the system, including pressure, temperature, flow rate, and extraction time. Methods can be saved to be run again or used in 'manual' mode.

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