

SPE-03 plus Eight Channel Cleanup Station

An multi functional sample preparation platform

About PromoChrom

PromoChrom Technologies focus on development of sample preparation solutions for trace analysis. Since year 2005, PromoChrom have developed SPE-01 cleanup station, SPE-03 cleanup station, SPE-04 online/offline SPE, LC-04SP valve system and SPE-06 mini SPE. Each of the instruments are targeting specific applications. SPE-01 has been used for cleanup in analysis of pesticide residues and extractable petroleum pollutants in soil. SPE-03 has been used for water quality monitoring. LC-04SP has been used to build multi dimensional HPLC.

In 2011, PromoChrom developed flow-path-integration technique for liquid handling. The technique is based on ideas from integrated circuit and lab on a chip manufacturing. It combines various switching valves into one liquid handling module. The technique simplifies the structure of our instruments considerably, making the instruments more affordable and more reliable.

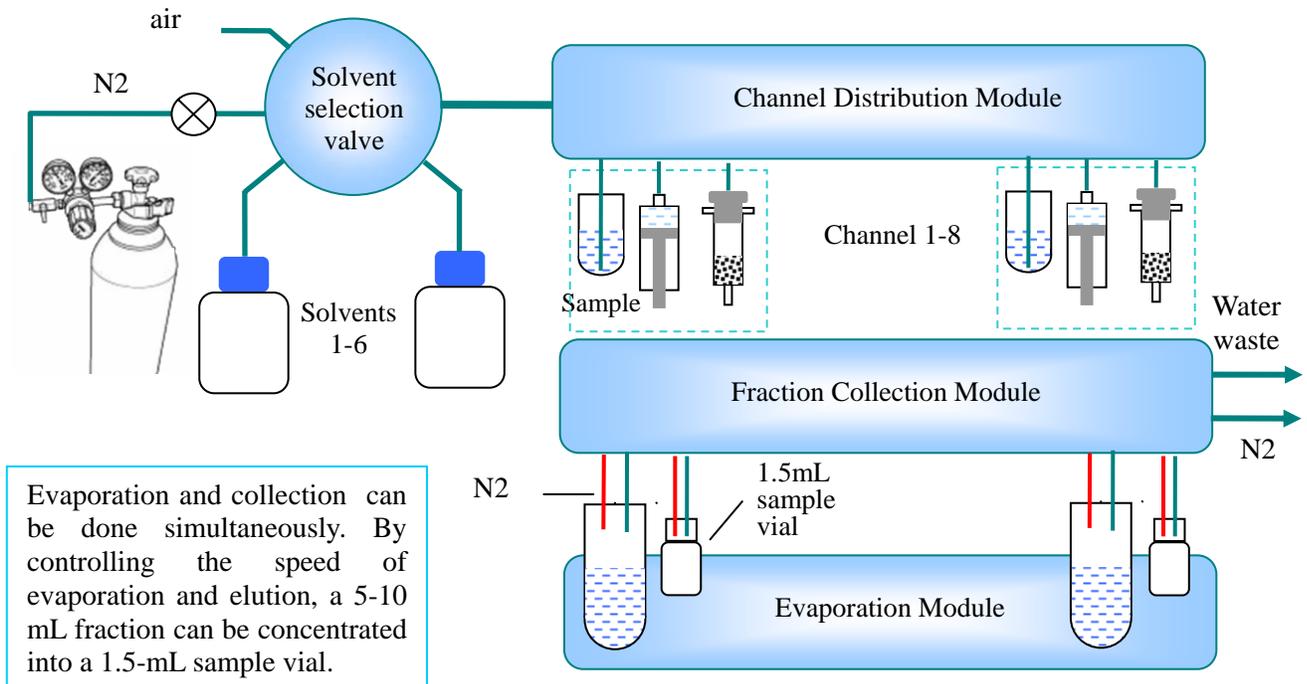
SPE-03 plus eight-channel cleanup station is designed for parallel extraction of multiple samples. It can automatically fulfill all the necessary actions for solid phase extraction, and can be used for extraction of large volume water samples, as well as small volume samples (such as soil extracts, forensic samples, and food samples). In addition to conventional cleanup, SPE-03 plus can also perform heat assisted extraction of solid samples and concentration of sample extracts and collected fractions.

Thanks to the flow-path-integration technique, the weight and dimension of SPE-03 are much smaller than other multi channel SPE instruments.



1. Working principle of SPE-03

The following diagram illustrates the working principle of SPE-03:

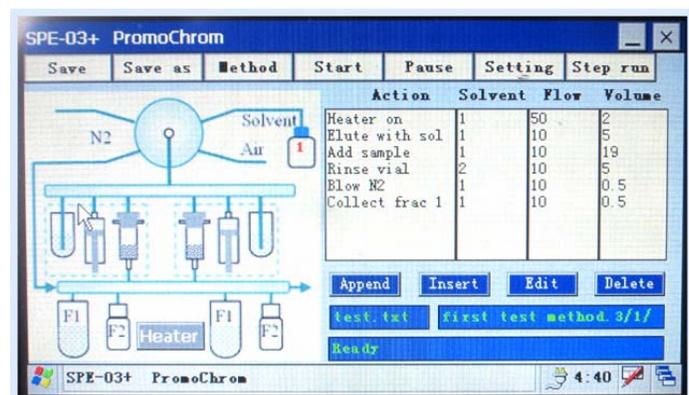


As shown in the above diagram, the major components of SPE-03 plus are a stream selection valve, a channel distribution module, and an optional evaporation module. It does not need other stream selection valves or 3-way solenoid valves.

2. Features

2.1 Easy operation

SPE-03 plus uses an industry mini computer with touch screen for the control. The graphical user interface gives a clear real time display of the instrument status. Commands in a method are simple and very easy to understand. Help tips are provide to make method creation easy and fast. Most operations can be done using just a few clicks.



2.2 Accommodation of a wide variety of samples

SPE-03 plus can be used for both large volume water samples and small volume solid sample extracts. It provides two sets of tubing to minimize dead volume for different samples. In addition to conventional solid phase extraction and column cleanup, SPE-03 plus can also perform extraction of solid samples with assistance of heat. For a very dirty or sticky samples, a pause command may be placed in a method after column conditioning, so that samples can be added directly on top of the columns.

2.3 Small footprint and simple structure

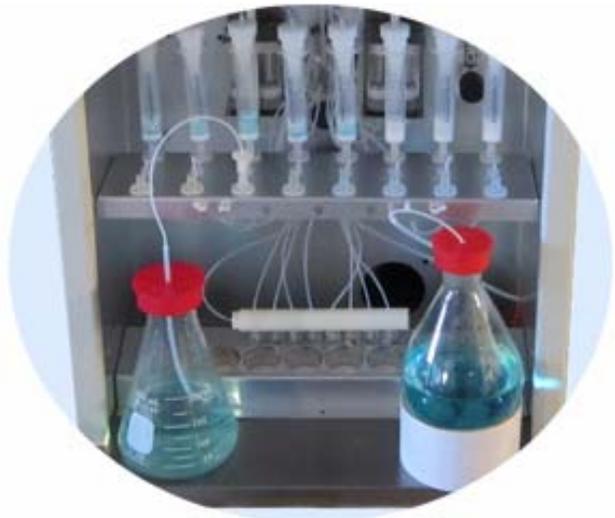
Normal automated SPE instruments involves many switching valves and complex tubing connections. A multi channel SPE is normally heavy and of large size. The tubing connection is also complex, making maintenance difficult. Thanks to the flow-path-integration technique, the weight and dimension of SPE-03 plus are around half of other multi channel SPE instruments.

As the instrument does not need an extra computer and the solvent bottles are placed on the top, a large laboratory space are saved.

2.4 Use of various SPE columns and containers for fractions

SPE-03 plus adopts an innovative adapter to deal with variations in diameter of SPE columns. The adapters can be easily adjusted when different type columns are used. Its wide flow rate range makes it also suitable for disk extractions.

The instrument can also use containers of different shape for sample and fraction collection. These containers can be capped during while the instrument is processing sample. It minimizes solvent evaporation. Thus the work can be carried out without using a fume hood.



2.5 Automatic wash of sample tubing and container

To prevent cross contamination, function for cleaning of sample tubing is built into the methods. Two solvents may be used to wash the tubing and containers. The rinsate may be left inside the container or added back to the columns.

3. Instrument Functions

3.1 Solid phase extraction and column cleanup

SPE-03 plus can automatically fulfill all the steps of solid phase extraction and column cleanup. The following table lists the commands available in a SPE-03 plus's method.

Commands	Relevant parameters	Remarks
Add sample	Flow rate and volume	
Elute with sol.	Solvent type, flow rate, volume	Elute SPE columns using selected solvents
Blow air	Flow rate and volume	Use air to purge SPE column
Blow N2	Duration	Use nitrogen to dry SPE column
Collect frac	Solvent type, flow rate, volume	Collect fraction to selected position
Rinse vial	Solvent type, flow rate, volume	Rinse sample container with selected solvent, add the rinsate back to SPE column.
Clean vial	Solvent type, flow rate, volume	Wash sample tubing and container, then use air to purge the sample tubing.
Heater on	Temperature and duration	Start heating
Evaporate frac	Duration	Blow nitrogen to fraction for concentration
Collect-evap F2	Solvent type, flow rate, volume	Collection and blow nitrogen simultaneously
Pause		Pause an automated run to allow manual attention
3 way valve	On /off	To separate chlorinated solvents from other solvents
Trigger	Logic 1 or 0	To trigger other devices, such as an HPLC

3.2 Online evaporation (optional)

The concentration in SPE-03 plus follows normal practice in trace analysis. The fraction is first evaporated to near dry and then the syringe pump is used to add back a precise volume of suitable solvent. Evaporation and collection can also be done simultaneously. By controlling the speed of evaporation and elution, a 5-10 mL fraction can be concentrated into a 1.5-mL sample vial. The liquid level in the sample vial can be maintained very low through out the collection process.

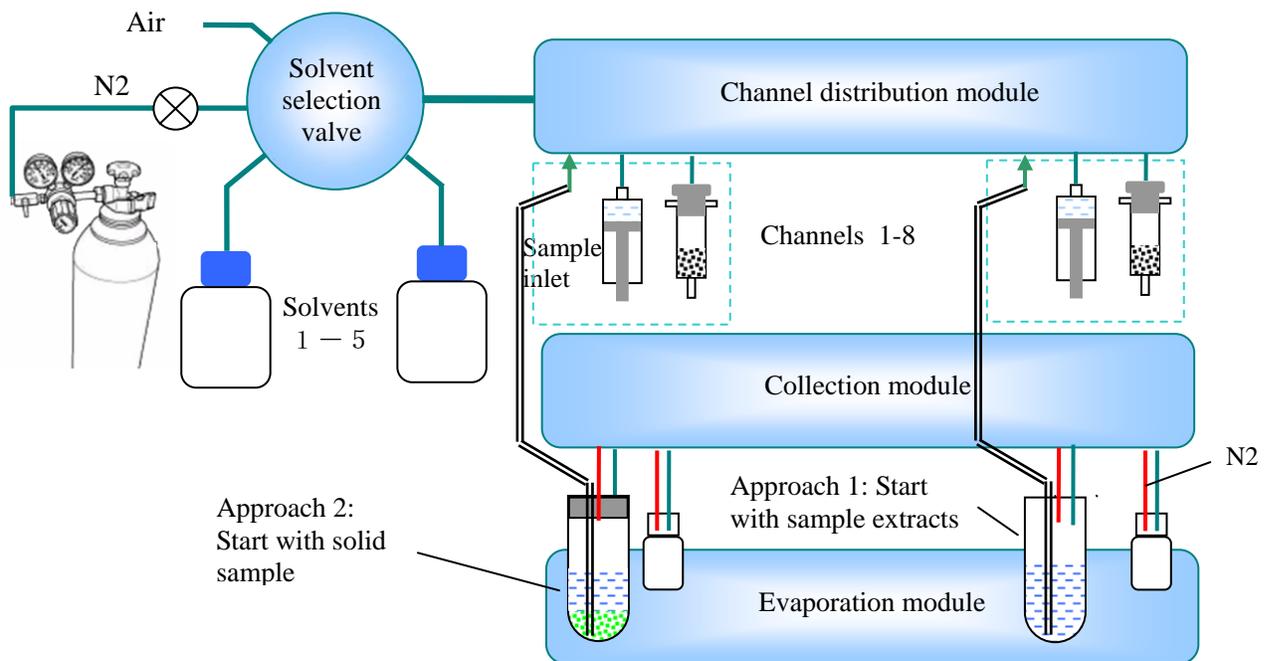
3.3 Column blockage detection and smart handling

The system can detect the blockage of SPE column and reduce the flow rate accordingly. If blockage still occur, the instrument will pause to wait for human attendance.

3.4 Heat assisted extraction of solid samples combined with column cleanup

Sample preparation for solid samples in trace analysis normally involves four steps: 1) Sample extraction, 2) evaporation and solvent change of the extracts, 3) column cleanup, 4) fraction evaporation and solvent change again prior to GC or HPLC analysis.

In addition to evaporation of fraction, the evaporation module can also evaporate sample extracts before loading it to column and can even carry out heat assisted sample extraction. Below is the set up of the instrument for such application:



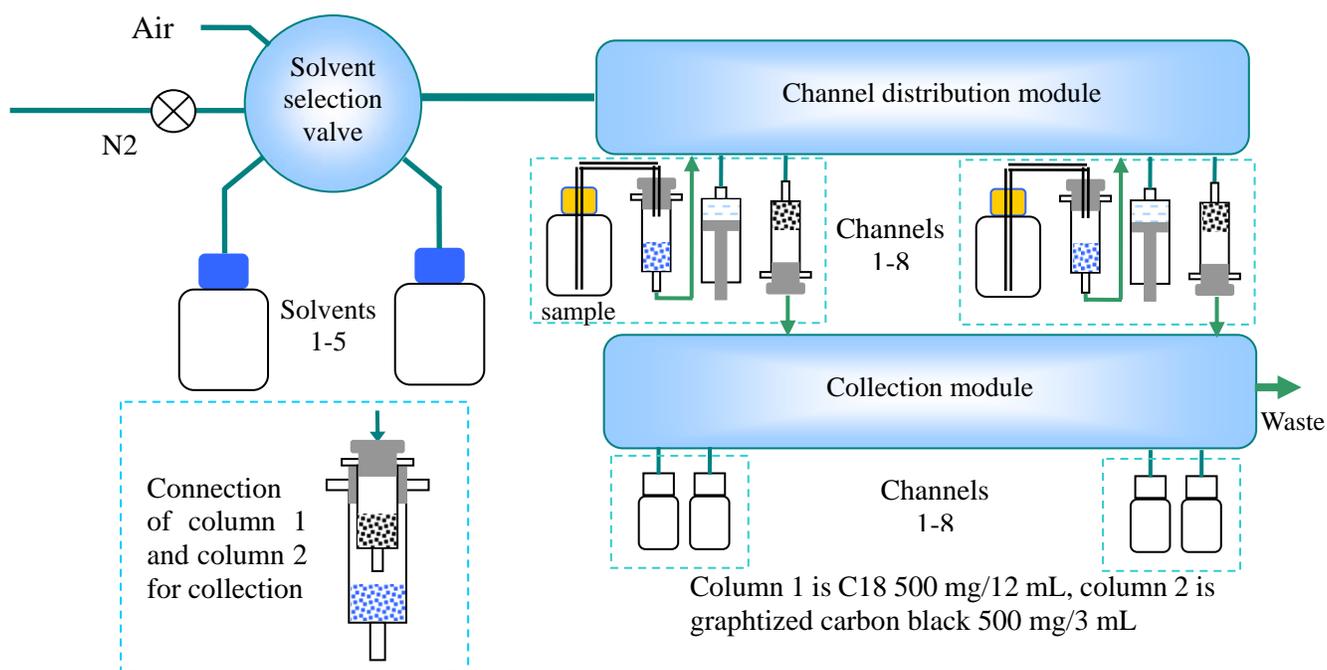
Approach 1 starts from evaporation of sample extracts, whereas approach 2 starts from the extraction of solid samples. The extraction time for solid samples can be reduced from over 12 hours to 30 minutes by applying heat and stir with air purge.

3.5 Sample loading by vacuum with well controlled flow rate

Manual solid phase extraction normally use a vacuum pump and a manifold to introduce samples onto SPE columns. The major problem of this approach is fluctuation of flow rate that can cause poor reproducibility. However, use of vacuum for sample loading does have its advantages. Firstly samples are introduced directly from sample container to the column top, there is little adsorption or contamination from the tubing or pumps. Secondly, particles and other sticky materials in sample have little interference.

To make good use of the advantage and avoid the disadvantage of this manual approach, a sample loading mode based on the drawing force of syringe pumps is integrated into SPE-03 plus. In this mode, the loading flow rate is well controlled by the drawing speed of the pump, which is settable by users.

Based on this loading mode, a method for simultaneous extraction of pollutants with very different properties is developed. It uses a C18 column (column 1) to trap compounds of low polarity and a graphitized carbon black column (column 2) to trap compounds of mid and high polarity. The difference of this approach with other two-column-in-series methods is that the column 1 is placed in the inlet of loading pump and column 2 is placed in the outlet of the pump. Water sample is first drawn into column 1, and then pushed into column 2. Among the advantages of this arrangement over the conventional two column methods are: 1) much lower resistance in liquid delivery and more tolerance to blockage on columns; 2) Particles and sticky compounds (such as benzo pyrene and PCBs) are retained by column 1. They will not cause damage to the syringe pump and valves. It also avoid cross contamination. The following diagram shows the set up of the instrument:



Details of this method is available in the instrument user manual.

4. Specifications

Sample capacity	8 per batch
Volume of sample	0.5 to 5000 mL
Material of wetted parts	Teflon, 316 stainless steel, Pyrex glass
System control	Touch screen computer
Method functions	Pre condition, load sample, elution with 5 solvents, wash of sample line, drying with nitrogen, fraction collection.
Waste handle	Collect organic waste and aqueous waste separately
Pump flow rate	0.5 to 60 mL/min
Pressure limit of pump	6 bar
Pump reproducibility (C.V.%)	<1.5
Power consumption	< 3.0 A at 24 VDC
Evaporation temperature	Ambient to 90 °C
Minimum evaporation volume	0.5 mL
Weight	16 Kg
Dimension (cm)	34 x 34 x 45 (width x depth x height)

4. Order information

Part No.	Description	Price (US\$)
SPE-03-08	SPE-03+ mainframe, 24V power supply, and user manual.	
SPE3-MOD-001	Evaporation module	



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