Instructions for Use

SeQuant® SAMS™ Suppressor

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Unpacking

Before starting the installation, please check that the delivery is complete. Apart from the suppressor, you should also find a 5 mL plastic syringe for back-pressure testing, and fittings for connection of the PEEK end after the column, and fittings for connection to the regeneration flow stream.

Installation

Back-pressure Check. Excessive back-pressure may cause breakage of the membrane inside the suppressor. Therefore, the back-pressure at the point in the system where the suppressor is inserted must therefore be checked ***before*** the suppressor is attached to the system.

Check the detector back-pressure before installing the suppressor!

Maximum pressure on the suppressor is 1 MPa (10 bar/140 psi). The syringe supplied can be used to carry out a quick diagnostic test to ensure that the flow is not restricted, by forcing 5 mL water through the downstream flow

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components. If the entire syringe volume (5 mL) can be pressed through the detector assembly by hand in 30 seconds, without excessive force, the back-pressure is acceptable. In case of doubt, the pressure must be measured at the point of insertion using the maximum flow rate at which the suppressor will be used. If the pressure exceeds the maximum allowable, take appropriate measures, such as substituting excessively narrow tubing, to bring the pressure within acceptable limits before installing the suppressor.

Installing a Pressure Relief Valve. A pressure relief valve is available as an optional accessory to protect the suppressor membrane in case of unexpected pressure escalations that may be caused by detector clogging, pinched tubes, etc. This valve should be installed between the column and the suppressor, and opens if the system pressure increases above 0.7 MPa (7 bar/100 psi). Follow the instructions that are included with the pressure relief valve if this option is being installed.

Connecting the Inner Flow. Install the suppressor downstream the separation column. Omit for now connecting the suppressor outlet. Note that the eluent channel flow direction is marked on the suppressor. It has been tested only in that direction, and may be damaged if the flow direction is reversed.

Use the minimum tightening force required to establish leak-free connections downstream the suppressor! Ferrules may otherwise pinch the connecting tubing by radial compression, which can lead to a gradually increasing back-pressure and eventual membrane rupture.

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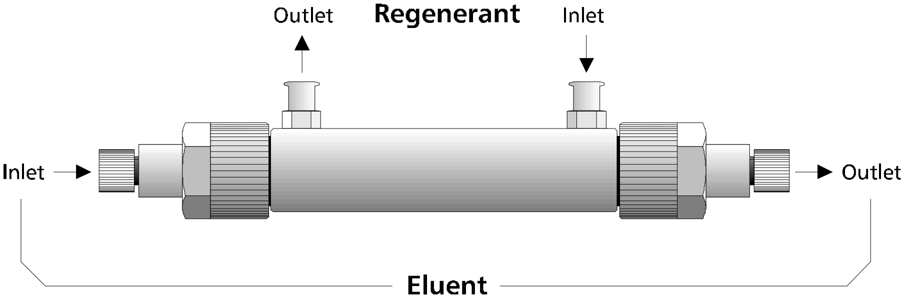

Connecting the Regeneration flow. The Regeneration (outer channel) flow should be connected counter-current to the Eluent (inner channel) flow (see Figure). When a SeQuant® CARS™ - Continuous Auto Regeneration System - is being installed, connect the *Regeneration Inlet* with CARS™ pump outlet and the *Regeneration Outlet* with CARS™ Cartridge inlet.

Priming the Suppressor. Pump eluent at a flow rate of 0.5 mL/min and ensure a flow from the suppressor outlet. Then connect the conductivity detector and ensure a flow from the detector outlet. Finally the flow rate may be increased to the intended operational flow rate.

Maximum eluent flow rate is 2.0 mL/min!

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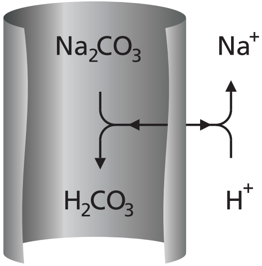
Operation



The suppressor contains an ion exchange membrane and is used for *suppression* of eluent background conductivity in the analysis of anions. Eluent cations (typically sodium ions) are replaced with protons (H^+) from the regeneration solution by an ion-exchange process over the membrane. The eluent anions are thereby converted to their non-conducting corresponding weak acid and the background conductivity is significantly reduced (e.g., $CO_3^{2-} + H^+ \rightarrow HCO_3^- + H^+ \rightarrow H_2CO_3$).

However, while using a carbonate eluent some background conductivity will anyway remain due to some back-dissociation of the non-conducting carbonic acid to hydrogen carbonate. The background conductivity while using a carbonate eluent is therefore typically 10-25 µS/cm and this range is an indicator on a proper operation.

Ion exchange membranes rely on a phenomenon called ion exclusion to allow ions of only one polarity to penetrate the membrane. The exclusion process is most efficient at relatively low ionic concentrations. Therefore, if the suppression (ion mass flow) is insufficient, the best way to minimise "forbidden ion penetration" and to improve the suppression efficiency is to increase the *flow* of regeneration rather than its *concentration*.

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Chemical compatibility. The wetted polymeric materials used in the suppressor are PTFE, PVDF, and PEEK. These materials are, just like the membrane, stable to acids and bases. The membrane will not *dissolve* in any organic solvent, but exposure to non-aqueous solutions alters the membrane irreversibly, since the membrane must be a hydrogel in order to function efficiently. A warning is issued against the use of aqueous solutions of alcohols, acetonitrile, or any other low-molecular water-soluble organic solvent. Such solutions will swell the membrane excessively with drastic irreversible decrease in ion-exchange selectivity and pressure resistance.

Multiply charged metal ions, such as aluminum and some transition metal ions (notably iron) may bind irreversibly to the membrane. Pump heads, check valves, and injectors with liquid-exposed stainless steel parts may leak trivalent iron and chromium to the eluent. It is recommended that steel part are passivated (consult instrument manuals).

The membrane is, like all cation exchange materials, subject to fouling if the material is brought into contact with highly hydrophobic cations, or cationic polyelectrolytes. Ions of this type will adhere to the membrane practically irreversibly by a mechanism involving both ion exchange and hydrophobic interaction. Such adsorption will eventually lead to partial, or even total loss of, cation transport capability. Examples of ions that are incompatible with the membrane due to this reason are tetraalkylammonium ions, polyamines, and cationic surfactants.

The membrane may be irreversibly damaged if organic solvents, multiply charged metal ions, hydrophobic cations, or polycations are allowed to enter either flow channel!

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Fouled Membrane Rescue Procedure. If the cation transport capability decreases, and metal ion fouling is suspected as the cause, an operation can be launched to attempt to wash the membrane. In that case, prepare an aqueous solution consisting of:

0.1 M Magnesium sulfate,
0.1 M Disodium EDTA, and
0.2 M Sodium hydroxide

Warning – alkaline!
Use protective eye-glasses
and clothing

First, flush the outer channel of the suppressor with 50-100 mL of this solution, until the solution exiting from the outer channel has a pH above 11. Fill thereafter the inner channel of the suppressor with the solution, and let it stand overnight. Please note that most high-pressure pumps are incompatible with such strong salt solutions. The solution should therefore be delivered to the inner channel by other means, one alternative being *careful* use of the syringe supplied to test back-pressure. The success of this operation varies and depends on the type of fouling agent and the degree of deterioration. It normally takes quite a while to attain a stable baseline after this treatment.

Storage. The membrane possesses an exceptional chemical stability and resistance towards biological breakdown. However, to minimise the risk for microbiological growth during prolonged storage periods (> 30 days) the suppressor may be disconnected and stored in cold place, but <u>not</u> frozen.

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Specifications

SeQuant® SAMS™ Suppressor	Eluent[2]	Conductivity (µS/cm)[1]	
		typical	*maximum*
SAMS™ Standard (1.50609.0001)	NaOH	1-2	3
SAMS™ Gradient (1.50610.0001)	NaOH	1-3	5

1) The performance of the combination of SAMS™ and CARS™, while using carbonate free 10 mM sodium hydroxide as eluent at 2 mL/min and the CARS™ in normal operation i.e., 80% flow on pump and the regeneration solution ULB™-P diluted 1+4 with ultrapure laboratory water, and a non-exhausted Cartridge.
2) With sodium carbonate eluents the system is capable to achieve theoretical background conductivities ± 3 µS/cm.

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Operational range

Parameter	Limit	Unit
Eluent flow rate[1)]	2.0	mL/min
Inner channel pressure[1)]	1	MPa
Outer channel pressure	50	kPa
Temperature	50	°C
pH	1-13	

1) Limited by the higher of these values.

These limits are absolute, and should not be exceeded!

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Troubleshooting

Symptom	Possible Cause and Suggested Action
High background conductivity	• The eluent contains a strong acid salt as an impurity. *Prepare a new eluent, possibly from a new stock. Avoid contamination by sodium chloride.* • Regeneration acid concentration too high. *Decrease the concentration (Not likely reason for problem while using CARS™)* • Impurities in laboratory water *Check conductivity in the water.* • The CARS™ Cartridge has been exhausted • Ruptured membrane in suppressor. *Disconnect the regeneration tubings, while the eluent flow is running. If a flow of eluent can be seen at the regeneration side, the membrane has been ruptured.* ***Note:*** *Investigate and correct the reason before installing a new suppressor.*

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Troubleshooting

Symptom	Possible Cause and Suggested Action
Noisy baseline	• Eluent flow is not stable • Inhibition by hydrophobic cations. *Try rescue operation described above.* • The CARS™ Cartridge is exhausted.
Excessive "water dip"	• Improper selection of eluent salt. *Change eluent to an anion of a weaker acid. Use a salt with a monovalent cation for highest transport rate.* • The regeneration solution is too concentrated. *Change to a lower reagent concentration and use higher flow, if necessary. Switch to an acid with low "forbidden ion penetration", such as the ULB™-P solution.*
Peak splitting	• The suppressor (or column) is worn out. *Wash the column or replace units.*

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Ordering Information

Product	Part No
SeQuant® SAMS™ Standard Suppressor	1.50609.0001
SeQuant® SAMS™ Gradient Suppressor	1.50610.0001
SeQuant® CARS™ Continuous Auto Regeneration System	1.50611.0001
SeQuant® CARS™ Cartridge Small (0.5 L, capacity 0.9 eq)	1.50613.0001
SeQuant® CARS™ Cartridge Large (0.75 L, capacity 1.3 eq)	1.50614.0001
SeQuant® SAMS™ Installation Kit	1.50619.0001
SeQuant® ULB™-P Regeneration Solution (100 mL to be diluted 1+4)	1.50616.0100
SeQuant® Pressure Relief Valve (100 psi)	1.50618.0001
Certipur® single or multi element NIST traceable IC standards	Contact a Merck Millipore dealer

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A Practical Guide to Ion Chromatography

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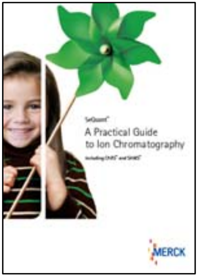

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