Operation Manual
Shodex IC SI-37 4D

(Please read this operation manual carefully to achieve the best and consistent column performance for a long time.)

Important Handling Instructions

Caution!

· Please consult the Safety Data Sheet (SDS) of reagents and solvents used with the column and understand their proper handling methods to prevent potential health hazards or death from occurring.

· Please wear appropriate personal protective equipment such as lab goggles and gloves when handling organic solvents and acid and alkaline reagents. Avoid any direct physical contact to prevent chemical injuries.

Before Using the Column

(1) Please visually inspect the column package and the column surface for any damage.

(2) Please check the product name and serial number (Serial no. or S/N) written on the column package and adhesive label on the column body.

(3) Please download the Certificate of Analysis (CoA) for the purchased product. The CoA can be downloaded from Shodex website (https://www.shodex.com/download/). You will be asked to enter the serial number.

1. Introduction

Thank you for purchasing the Shodex product. Shodex IC SI-37 4D is a suppressor type ion chromatography column for anion analysis, using hydroxide eluents such as potassium hydroxide and sodium hydroxide. It is suitable for separation of standard anions including fluoride, chloride, nitrite, bromide, nitrate, sulfate, and phosphate, as well as halogen oxides including chlorite, bromate, and chlorate.

2. Column Components

Please refer to the Shodex website: https://www.shodex.com/en/da/07.html

3. Column Specifications

Product Code	Product Name	Column Size (mm)		Particle Size (μm)	Theoretical Plate Number (Per Column)
		I.D.	Length		
F6999371	**IC SI-37 4D**	4.0	150	3.5	≥ 14,000
F6709620	**IC SI-90G**	4.6	10	9	(Guard Column)

Base Material : Spherical porous particles of polyvinyl alcohol modified with quaternary ammonium
Column Housing : PEEK
Screw Type : Internally-threaded type No.10-32 UNF
Shipping Solvent : 10 mM Sodium Sulfate Solution (SI-37 4D)
1.8 mM Sodium Carbonate Solution + 1.7 mM Sodium Bicarbonate Solution (SI-90G)

4. Usable Conditions

Product Name	Flow Rate (mL/min)		Maximum Pressure (MPa/column)	pH Range	Temperature (°C)	
	Recommended	Maximum			Recommended	Range
IC SI-37 4D	0.5	0.9	20	3 - 13	30	20 - 60
IC SI-90G	-	-	-			

Usable solvents are listed below.

(1) In general, either potassium hydroxide or sodium hydroxide is used.

(2) The standard eluent is 23-mM potassium hydroxide. The higher the concentration of potassium hydroxide, the faster the elution of ions will be.

(3) Up to 100 % acetonitrile is usable.

Attention!

· Use the column within above stated flow rate, pressure, and temperature ranges. Using the column outside the given range may damage the column and lower its performance.

· Column pressure is influenced by the eluent composition, flow rate, and column temperature. When changing the eluent compositions, adjust the flow rate and column temperature so that the column pressure remains below the usable maximum pressure.

5. Eluent Preparation

(1) Use freshly generated ultrapure water (18.2 MΩ-cm) to prepare the eluent.

(2) The use of an eluent generation system is highly recommend for the preparation of potassium hydroxide or sodium hydroxide solution. If an eluent generation system is not available, dilute a reagent-special grade potassium hydroxide or sodium hydroxide solution with ultrapure water.

(3) Degas the eluent fully to prevent the formation of air bubbles.

(4) Presence of small debris or insoluble substances may result in deterioration of columns and/or they may appear as noise on chromatograms. Filter the eluent with a 0.45-μm disposable filter to prevent the problems from occurring.

Attention!

· Use of HPLC grade organic solvents of guaranteed quality, which can be used without problems in HPLC is recommended. If organic solvents with different grades are used together, make sure that their qualities are all suitable for the analysis prior to the use. Solvents left in opened bottles for a long time should not be used. The content may have been changed, absorbed moisture, or has been contaminated.

· Always use freshly prepared solvents. Solvents stored for a long time may have changed their compositions and may influence elution patterns and/or damage the column.

· If using a manually prepared eluent, keep the eluent in a solvent reservoir equipped with a trap cartridge that removes carbon dioxide.

Note

· Use of on-line degasser is recommended.

6. Sample Preparation

(1) Filter diluted sample solutions using disposable 0.45-μm filters to prevent the column from clogging or deteriorating.

(2) Suggested injection volume is less than 25 μL per column. When analyzing low concentration samples (< 0.1 mg/L), by increasing the injection volume to 100 - 200 μL may improve the detection.

(3) When a sample contains proteins, remove them prior to the sample injection. The use of an ultrafiltration membrane is recommended.

(4) When a sample contains hydrophobic impurities, remove the impurities prior to the sample injection. The use of a solid phase extraction is recommended.

Attention!

· When a sample is dissolved in a solvent other than the eluent and if the sample matrix contains components which do not dissolve in the eluent fully, precipitates may form and clog the column.

· Full column performance may not be achieved if a sample concentration is higher or sample injection volume is larger than it should be. It may lead to abnormal peak shapes, poor separations, and/or low reproducibility. In such cases, please adjust the sample concentration and/or the injection volume.

Note

· Use of a guard column is recommended to protect the analytical column.

7. Column Usage Procedure

7.1 HPLC System Preparation

Wash the entire HPLC system prior to column installation, including all flow-lines and sample loop by switching the valves, and then replace the washing solution with the eluent to be used. If desired new eluent has low miscibility/solubility to the eluent of previous analysis, first use the eluent that is miscible/soluble to both eluents, and then replace it with the desired eluent.

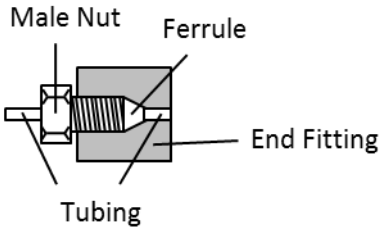
Attention!

- If the eluent left in the HPLC system is not compatible with the column to be used, it may damage the column.
- A drastic change in the eluent compositions may remove substances adsorbed on the HPLC system and they may enter and deteriorate the column.

7.2 Column Installation

(1) Connect the column to HPLC system by following the “flow direction arrow” (➞) indicated on the column adhesive label. If a guard column is used, position the guard column in front (before the inlet) of the analytical column.

(2) Make sure to insert the tubing all the way to the end fitting and secure it with the male nut. It is important that there is no extra space between the tubing and the column side of the end fitting. Presence of an extra space will let the sample to spread out and may result in wide peaks.



(3) Set the initial flow rate at less than 0.25 mL/min and start the system. If the column is to be heated during the analysis, keep the low flow rate until the column temperature reaches to the set temperature, and then gradually increase the flow rate to the desired.

(4) When using a new column for the first time, before connecting the column outflow to a suppressor, wash the column with the eluent at 0.25 mL/min flow rate for more than 40 minutes. This also applies to when reusing a column with which the eluent was replaced with shipping solvent.

Caution!

- Verify that there is no solvent leak. The solvent leak may cause electronic leakage, rust, and/or chemical injury.

Attention!

- Make sure not to let air bubbles enter the column while installing the column. The air bubbles may damage the column.
- When restarting the system after column installation or after holding the eluent flow, start the system at less than 0.25 mL/min flow rate. A rapid increase in pressure can damage the column.
- If the column was heated during the analysis, lower the flow rate to less than 0.25 mL/min at the end of analysis. Then, turn off the column oven to let the column temperature returns to room temperature before stopping the pump. This is to prevent creating an empty space in the column, which deteriorates the column. Since if the pump was stopped while the eluent inside the column is still hot, the eluent volume decreases and creates an empty space when the eluent temperature decreases.

Note

- It is recommended to set the pump limiter to avoid exceeding the maximum pressure.

7.3 Solvent Exchange

To replace the solvent, start the system at less than 0.25 mL/min flow rate. Recommended solvent volume to introduce at each step is 3 to 5 times of the column volume.

7.4 Column Cleaning

Problems in peak shapes and elution time changes or elevated column pressure are often caused by the deposition of insoluble or adsorbing components from the sample/flow-line inside the column. These problems may be resolved by cleaning the column.

If a guard column is used with an analytical column(s), first remove the guard column and check the performance of the analytical column alone. If the problem is solved, most likely the cause was from the guard column. In this case, clean the guard column.

If the problem remains even after removing the guard column, clean both guard and analytical columns. Make sure to clean the guard and the analytical columns separately. In case multiple number of analytical columns are used together, wash them separately. During the column cleaning, disconnect the detector and collect the washing solution directly from the column outlet into a waste container (i.e., do not let the solution go through the detector).

If the column performance does not improve (recover) after performing the column cleaning, please replace the column with a new one.

<Cleaning method>

(1) Insoluble components that block the column inlet may be removed by reversing the flow direction, i.e., introducing the eluent from the column outlet, with flow rate at less than half of the recommended flow rate.

(2) Follow below cleaning steps for adsorbing components. For an efficient cleaning, reverse the flow direction. Set the flow rate at 0.25 mL/min.

Method 1: Adsorption of hydrophilic compounds

Washing Solution		Cleaning Time
1	H_2O	20 min
2	100 mM KOH or NaOH aq. solution	70 min
3	H_2O	20 min
4	Eluent (Reverse the column flow to normal direction)	70 min

Method 2: Adsorption of hydrophobic compounds

Washing Solution		Cleaning Time
1	H_2O	20 min
2	H_2O/CH_3CN = 95/5	15 min
3	CH_3CN	70 min
4	H_2O	40 min
5	Eluent (Reverse the column flow to normal direction)	70 min

Attention!

- Keeping the washing solution in the column for a long time will lead to column deterioration. Please replace the washing solution with the eluent immediately after cleaning.
- Strong alkaline solvents such as 100-mM aqueous sodium hydroxide solution can damage the detector cell. Do not connect the detector while regenerating the column and collect elute directly from the column outlet to the waste container.

8. Column Storage

If preferred to store the column with the eluent used, remove the column from the system, securely tighten the end caps and store the column in a refrigerator. Alternatively, if preferred to store the column at a room temperature, replace the in-column solvent with the shipping solvent. Then, remove the column from the system, securely tighten the end caps and store the column at a location with stable temperature (a cool and dark space is recommended). Refer to section 7.3 Solvent Exchange for how to replace the eluent.

Attention!

- Never allow inside the column to dry. It can damage the column.
- When replacing the in-column solvent with shipping solvent, detach the suppressor before introducing the shipping solvent to the column.
- When reusing the column stored in a refrigerator, first wait for the column temperature to be ambient, and then remove the end caps and install the column on the system.

9. Column Inspection

Please refer to the inspection method described in the CoA. At Shodex, “half width method” is adopted for the calculation of plate count and “asymmetry factor (Fas)” is adopted for the calculation of peak symmetry. Please refer to the Shodex website for the detail: https://www.shodex.com/en/da/07.html

Attention!

· Plate count and Fas values change significantly depend on samples and/or analysis conditions being used. To check the initial column condition, please make sure to use the same sample and the analysis condition mentioned in the CoA.

10. Additional Warnings

(1) Do not remove end fittings.

(2) Do not make a strong impact on the column. Do not drop or hit the column on a hard surface.

(3) Please follow a proper waste disposal method specified by your local regulations.

Please refer to the Shodex website (https://www.shodex.com/) for product details and their applications. For additional assistance, contact the distributor from whom you purchased the column or contact your regional Shodex support office (https://www.shodex.com/en/support_office/list).