Time Saving Benefit of the Column Switching Valve in the EcoSEC® GPC System

Introduction

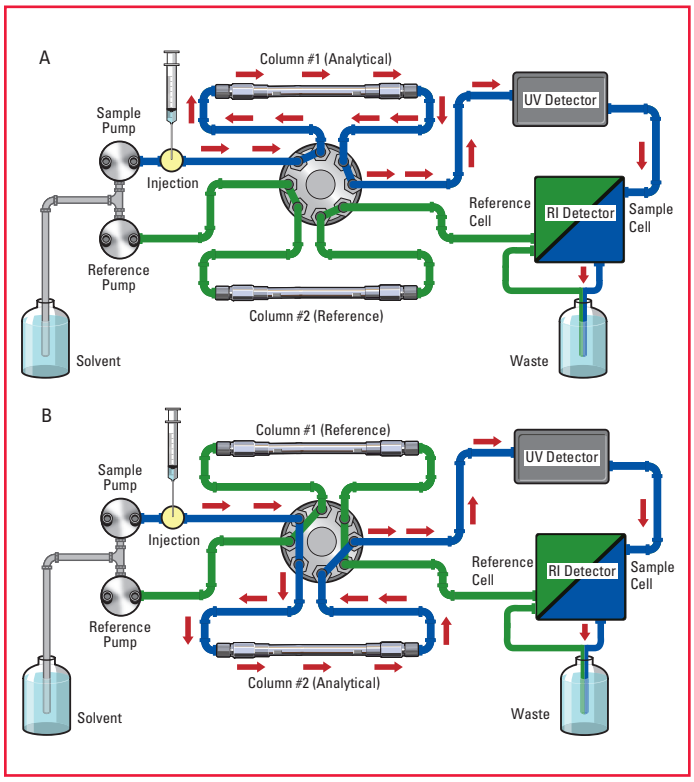
Column selection in gel permeation chromatography (GPC) is based largely on the required molar mass range of the separation and the nature of the sample-solvent combination. Large variations in molar mass ranges among polymer samples require the use of different types of GPC columns. Polymers with narrow molar mass ranges should be analyzed using GPC columns with a specific and focused separation range in order to achieved optimal resolution. On the other hand, polymers with large or unknown molar mass ranges should be analyzed using GPC columns with broad separation ranges.

Typically a GPC laboratory will manually uninstall and reinstall column sets onto one GPC system as experimental procedures dictate. Within one laboratory this could mean column sets are changed multiple times a day or numerous times over a month, quarter, or year. Manually switching columns on any GPC requires stopping the flow of the system, opening the temperature controlled column compartment to disconnect one column set and then connect the new column set, gradually increasing the system flow to the desired system flow rate and then waiting for the temperature controlled column compartment to re-equilibrate. The amount of man power time required to perform this task is minimal but the amount of time required to re-equilibrate a GPC System can take hours or even days depending on the stability and number of detectors within the GPC experimental set-up. The EcoSEC GPC System has an optional column switching valve that is designed to eliminate the need for system re-equilibration when column sets are changed.

Column Switching Valve

The dual flow design of the EcoSEC GPC System allows for two different column sets of the same physical dimensions, flow rate ranges, and solvent compatibilities to be ready for use at the push of a button when the optional column switching valve is installed. The two pumps within the EcoSEC GPC System work in such a way that the sample pump delivers sample and solvent through the analytical column to the sample side of the RI detector flow cell while the reference pump continuously flows solvent via a reference column to the reference side of the RI detector flow cell. When the column switching valve is used, the reference column is replaced with a second set of analytical columns. By having the column switching valve and two sets of analytical columns installed on the EcoSEC GPC System, an analysis can be performed on column set 1 while simultaneously equilibrating column set 2, *Figure 1A*. The column switching valve can then be used to switch column sets (without opening the doors of the EcoSEC GPC System) thus making column set 2 the set where analysis is performed and column set 1 the set in the flow path to the reference side of the RI detector flow cell, *Figure 1B*. The push of a button switches between equilibrated column sets allowing for easy use of two sets of GPC columns varying in molar mass ranges.

Figure 1. A.) Flow path with column set 1 as the analytical column and column set 2 as the reference column, B.) Flow path with column set 2 as the analytical column and column set 1 as the reference column.

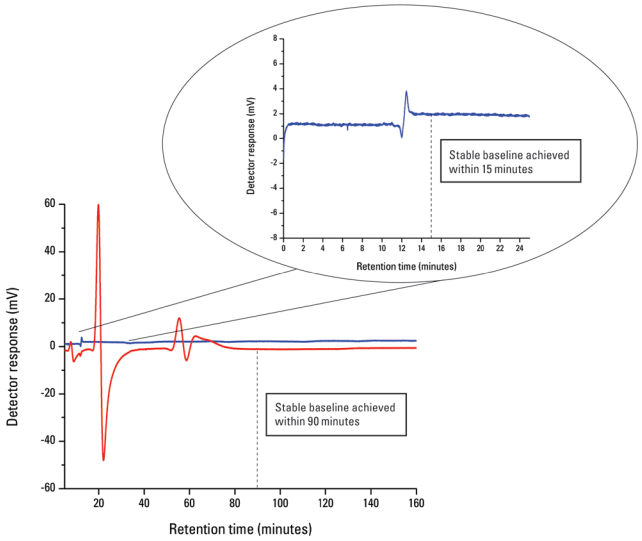


Time Saving Benefit

Equilibration of the EcoSEC GPC System when starting the system from cold takes between 80 to 90 minutes at a flow rate of 0.35 mL/min; this is the same amount of time needed to re-equilibrate the system after manually changing the columns and having the temperature controlled ovens opened. After 90 minutes the RI baseline drift is 1×10^{-7} RIU/h or less. The red baseline trace in *Figure 2* shows manual acquisition of the of the RI baseline from the start-up of the EcoSEC GPC System to 160 minutes after start-up. It should be noted that while the baseline initially appears to be stable after 50 minutes, a large spike in the RI baseline is always observed between 60 and 70 minutes. Once the spike in the RI baseline occurs, another 10 to 20 minutes is needed to have a completely stable RI baseline. The 80 to 90 minute time frame needed for the EcoSEC GPC System to obtain a stable RI baseline is much less than other systems, which can take anywhere from several hours to several days depending on the nature of the detector, solvent, and system.

The column switching valve allows for switching between column sets while the temperature controlled ovens of the EcoSEC GPC System remain closed and for the switching to and from already equilibrated column sets, thus a stable RI baseline is rapidly established. The use of the column switching valve to switch between two analytical column sets decreases the equilibration time of the EcoSEC GPC System to 15 minutes. The blue trace in *Figure 2* shows that once the columns are switched using the column switching valve and the flow rate is resumed to the initial flow rate (0.35 mL/min) a stable RI baseline begins almost immediately. The RI baseline does appear stable immediately following the column switch but a small spike is observed at about 12 minutes after the column switch occurs, making the RI baseline slightly unstable until about 15 minutes. As seen in *Figure 2* the RI baseline remains stable and does not drift more than 1×10^{-7} RIU/h after the 15 minute waiting period. *The amount of time saved when using the column switching valve to change between different analytical column sets can save a user over an hour of wait time and allow for multiple polymers needing columns of different ranges to be run more efficiently.*

Figure 2. Overlay of refractive index detector signals during equilibration following a column change using manual switching (red) and then column switching valve (blue).



TOSOH BIOSCIENCE

TOSOH BIOSCIENCE LLC
3604 Horizon Drive, Suite 100
King of Prussia, PA 19406
Tel: 800-366-4875
email: info.tbl@tosoh.com
www.tosohbioscience.com

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