

## Polymer & Solvent

Industry	Applications	Typical samples	Solvent	Analysis temp	Column(s)	Standards
Petrochemical	Bottles, bags, pipes, car fenders, molded cases	Polyolefins, polyethylene, polypropylene	Trichlorobenzene	140 to 180 °C	PLgel Olexis PLgel MIXED-A PLgel MIXED-B	Polystyrene
Agrochemical (environmental)	Seed treatment, biopesticides, insecticides, slow release agents, dispersants	Ionic polymers, chitosan, polyethylene glycol, polyacrylic acid, polyvinyl pyrrolidone	Water (pH adjusted), buffers	Ambient to 40 °C	PL aquagel-OH	Polyethylene glycol/oxide
	Water treatment, agrochemical additive	Lignin	DMSO + 0.1% LiBr	50 to 80 °C	PLgel MIXED-A PLgel MIXED-B	Polyethylene glycol/oxide
Food	Thickeners and stabilizers	Starches	DMSO + 0.1% LiBr	50 to 80 °C	PLgel MIXED-A PLgel MIXED-B	Polyethylene glycol/oxide
	Thickeners, slow release energy agents, gelling agents, baking aids	Low MW cellulose, polysaccharides, dextran, pectin, guar gum	Water (pH adjusted), buffers	Ambient to 40 °C	PL aquagel-OH	Polyethylene glycol/oxide
Paints	Paints, adhesives, binders, art materials	Alkyd, epoxy, acrylic polymers, polyurethane	Tetrahydrofuran	Ambient to 40 °C	PLgel MIXED-C PLgel MIXED-D PLgel MIXED-E	Polystyrene, polymethylmethacrylate
Resins	Adhesives, molded products, electrical and heat insulators	Phenol and urea formaldehyde, melamine, cellulose derivatives	DMSO + 0.1% LiBr, DMF or NMP	50 to 80 °C	PLgel MIXED-B PLgel MIXED-C	Polymethylmethacrylate or polyethylene glycol/oxide
Synthetic fibers	Fibers, toothbrush bristles, tubing, fishing line, low strength machine parts	Polyesters, polyamides, nylons	Hexafluoroisopropanol	40 °C	PL HFPgel	Polymethylmethacrylate
Pharmaceutical (drug delivery)	Hydrophilic controlled, targeted, localized drug release	Polyvinyl pyrrolidone, polylactic acid, polyglycolic acid, polystyrene sulfonic acid	Water (pH adjusted), buffers	Ambient to 40 °C	PL aquagel-OH	Polyethylene glycol/oxide
	Hydrophobic controlled, targeted, localized drug release	Polydimethyl siloxane, polyurethane, ethylene vinyl acetate	Tetrahydrofuran	Ambient to 40 °C	PLgel MIXED-C PLgel MIXED-D PLgel MIXED-E	Polystyrene, polymethylmethacrylate
Medical polymers	Artificial joints, contact lenses, tubing, implants	Polyethylene*, polyurethane, silicones, polylactide/glycolide and copolymers	Tetrahydrofuran	Ambient to 40 °C	PLgel MIXED-C PLgel MIXED-D	Polystyrene, polymethylmethacrylate
Plastics manufacturing	Plumbing pipes, guttering, plastic tableware, compact discs, glazing, automotive applications	Polyvinyl chloride, polycarbonate, ABS, polymethylmethacrylate, polystyrene	Tetrahydrofuran	Ambient to 40 °C	PLgel MIXED-B PLgel MIXED-C PLgel MIXED-D	Polystyrene, polymethylmethacrylate
	Tires, fuel hoses, insulating materials, lubricating agents, heat resistant tiles	Natural and synthetic rubber, polydimethyl siloxane, polyethylene wax	Toluene	Ambient to 80 °C	PLgel MIXED-B PLgel MIXED-C	Polystyrene
Specialty polymers	Non-stick coatings, engineering polymers, detergents, high strength and chemical resistant applications	Polyphenylene sulfide, PTFE, PEEK, liquid crystal polymers, polyethyleneimine	Special conditions required for each - contact Agilent technical support <a href="http://www.agilent.com/chem/techsupport">www.agilent.com/chem/techsupport</a>			

\* Refer to "Synthetic fibers" for analysis. \*\* Refer to "Petrochemical" for analysis

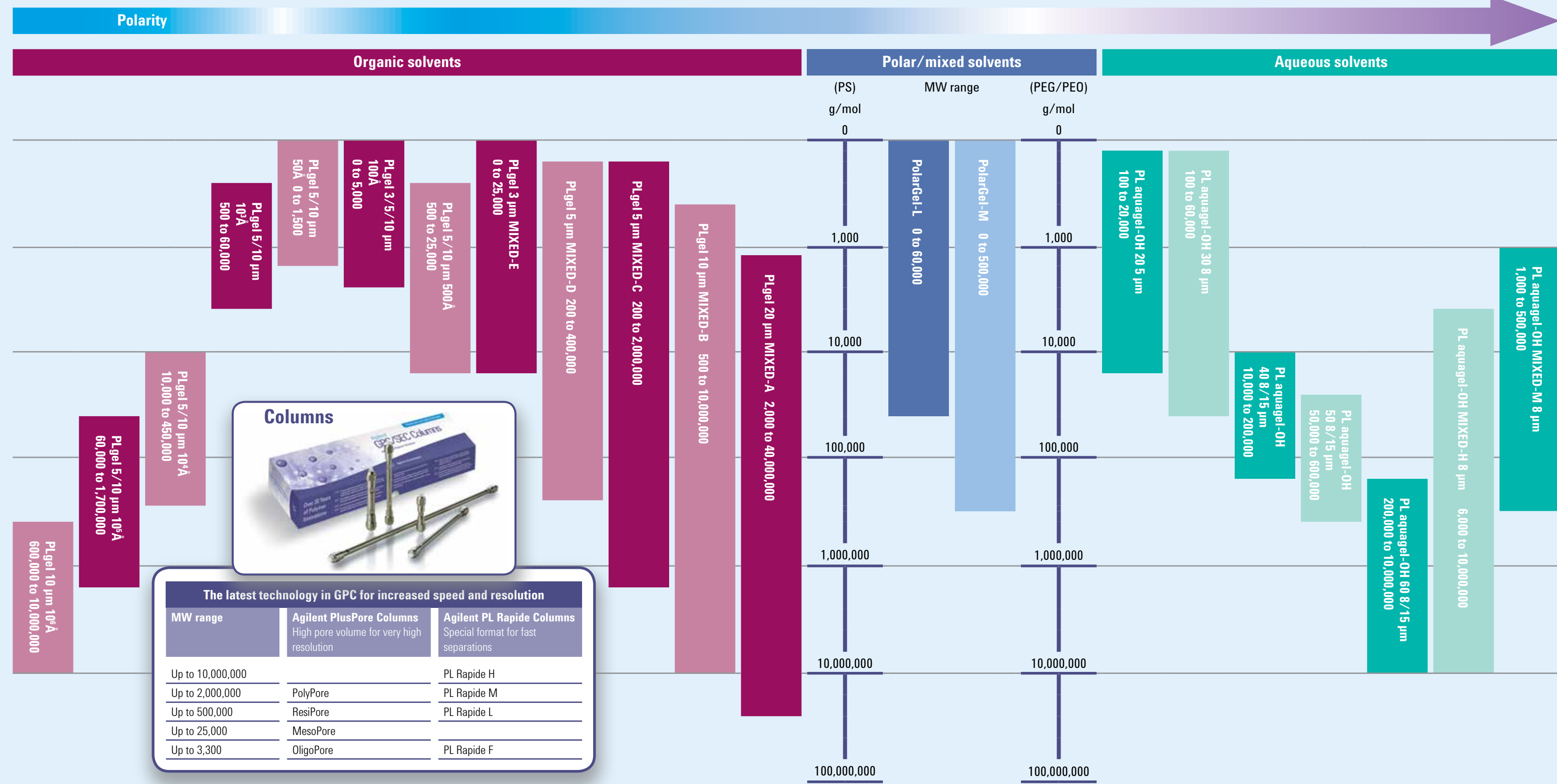
## Troubleshooting

Symptom	Cause	Solution
Peak tailing	Excessive dead volumes	Minimize tubing length Tighten injection seal Check connector fitting
Peak broadening	Column degradation	Replace or repair column
	Column interaction	Use mobile phase additives
	Shear degradation	Check age of standards Modify dissolution process (no excessive shaking)
Exclusion	Large dead volume	Minimize tubing/check fittings
	Eluent too viscous	Heat column oven
	Detector cell too large	If possible use smaller cell volume
Baseline drift/noise	Column/detector contamination	Flush column/detector to waste Clean eluent Use better quality solvents
	Bubbles in detector	De-gas solvent
Ghost/negative peaks	Temperature variations	Use column heater/insulate tubing
	Carryover from previous injection	Wait for previous run to finish
Split peaks	dn/dc of polymer less than solvent	Ensure injection valve is flushed clean Reverse signal polarity of RI Change eluent to get true peak
	Negative/baseline 'noise' peaks at total permeation due to RI differences between sample injection and eluent	Cannot be avoided, but reduced by preparing sample in mobile phase
	Sample loading too large	Reduce loading/loop size
Increased retention times	Blocked/partially blocked frit	Replace frit - use 2 μm inline filter to stop clogging
	Void in column	Replace column
	Partially blocked injection valve	Replace rotor seal
High pressure	Flow rate reducing	Check for bubbles in pump head De-gas solvent
	Interaction with packing	Use modifiers/additives
	Sample adsorption	Change eluent polarity
Pressure fluctuation	Column/frit blockage	Replace frit - use 2 μm inline filter to stop clogging Filter samples Use guard column Reverse flow on column to clear blockage
	Detector blockage	Flush with solvent
	Solvent viscosity/freezing	Heat columns, ensure solvent bottles are not cold
Pressure fluctuation	Build-up of particulates	Filter samples
	Check valve is dirty	Replace/clean check valve
	Air in pump/system	Purge pump/de-gas solvent
	Insufficient flow to pump	Clean mobile phase inlet Elevate reservoir above pump head

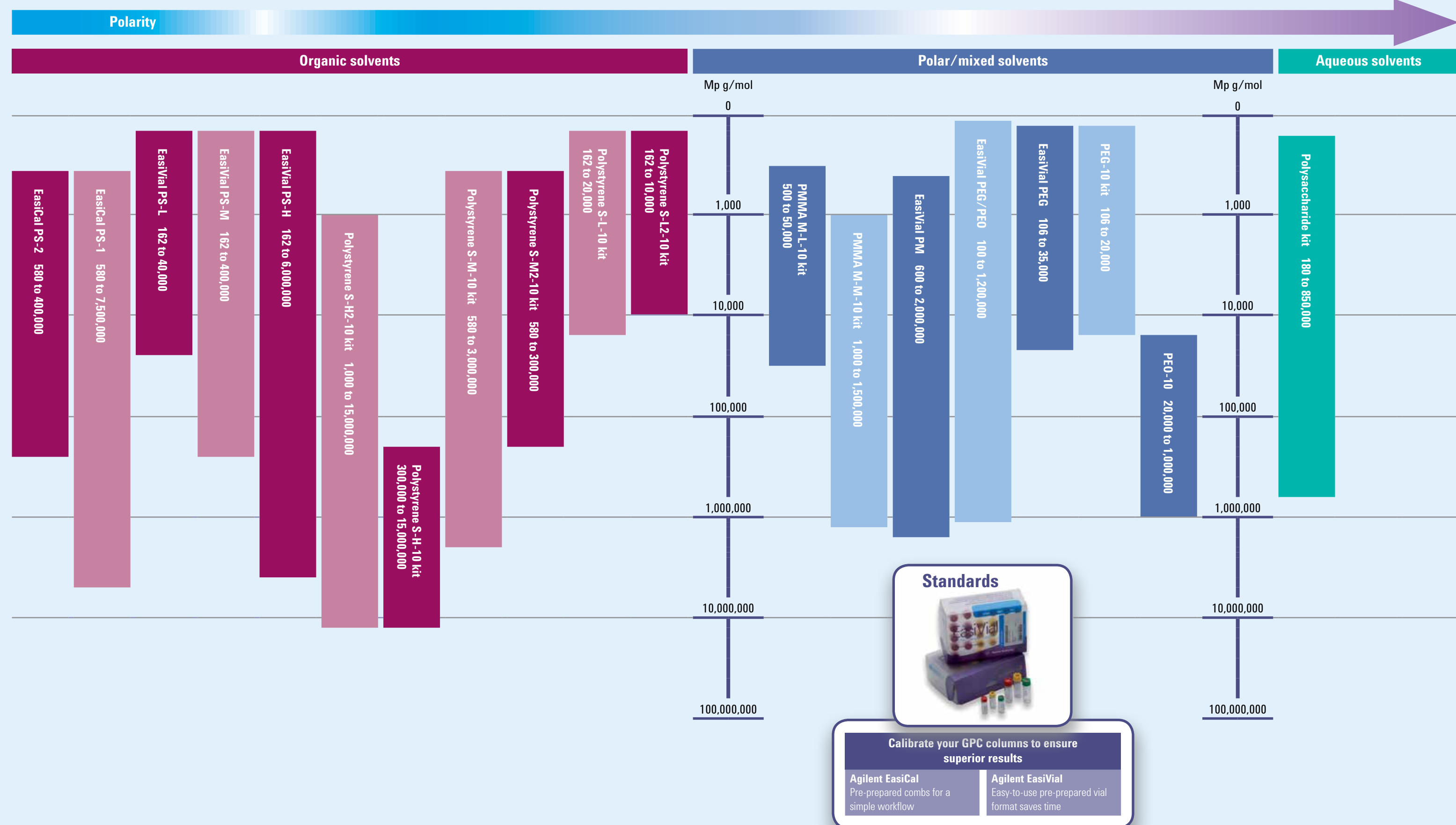
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## Column choices



## Calibrations & standards



## Transfer guide

Organic columns	Column supplied in ethylbenzene	
Transfer to low viscosity solvents e.g. THF, Chloroform, Dichloromethane	Transfer to medium viscosity solvents e.g. Toluene, DMF, DMSO	Transfer to high viscosity solvents e.g. TCB, m-Cresol, NMP
Flush column with acetone at 0.5 mL/min for two column volumes	Flush column with acetone at 0.5 mL/min for two column volumes	Set column oven to 50 °C, flow at 0.1 mL/min
Flush with new eluent at 0.5 mL/min for two column volumes	Flush with new eluent at 0.2 mL/min for two column volumes	Flush column direct with new eluent** at 50 °C at 0.1 mL/min for two column volumes
Increase column temperature to 30 to 40 °C* as required for analysis at 1 °C/min	Increase column temperature to 50 to 60 °C* as required for analysis at 1 °C/min	Increase column temperature to 100 to 220 °C* as required for analysis at 1 °C/min
Operate column in new eluent at required flow rate	Operate column in new eluent at required flow rate	Operate column in new eluent at required flow rate

\*Always ensure operating temperature is at least 10 °C below boiling point of solvent.

\*\*Always ensure miscibility. If unsure, use acetone at room temperature.

Polar columns	Column supplied in water containing 0.02% Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	
Transfer to aqueous e.g. Water, Buffer	Transfer to mixed solvent systems e.g. Water/THF*, Water/methanol*	Transfer to polar organic e.g. DMF, DMSO
Flush column with pure water at 1.0 mL/min for two column volumes	Flush column with pure water at 1.0 mL/min for two column volumes	Flush column with pure water at 1.0 mL/min for two column volumes
Flush with new buffer at 1.0 mL/min for two column volumes	Flush with new, pre-mixed eluent at 0.2 mL/min for two column volumes	Flush with acetone at 0.5 mL/min for two column volumes
Operate column in new eluent at 50 °C maximum, using required flow rate	Increase column temperature* as required for analysis at 1 °C/min	Flush with new eluent at 0.2 mL/min for two column volumes
Operate column in new eluent at required flow rate	Operate column in new eluent at required flow rate	Increase column temperature to 50 to 60 °C* as required for analysis at 1 °C/min
		Operate column in new eluent at required flow rate

\*Always ensure operating temperature is at least 10 °C below boiling point of solvent.

Aqueous columns	Column supplied in water containing 0.02% Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	
Transfer to aqueous e.g. Water, Buffer	Transfer to mixed solvent systems e.g. Water/methanol*	
Flush column with pure water at 1.0 mL/min for two column volumes	Flush column with pure water at 1.0 mL/min for two column volumes	
Flush with new buffer at 1.0 mL/min for two column volumes	Flush with new, pre-mixed eluent at 0.2 mL/min for two column volumes	
Operate column in new eluent at 50 °C maximum, using required flow rate	Increase column temperature** as required for analysis at 1 °C/min	
Operate column in new eluent at required flow rate	Operate column in new eluent at required flow rate	

\*Maximum of 50% organic solvent.

\*\*Always ensure operating temperature is at least 10 °C below boiling point of solvent.

## Advanced GPC

