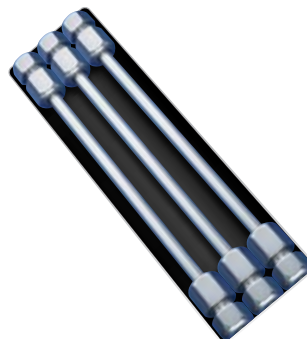




## ZIRCHROM ION EXCHANGERS

- Phases for Sugars and Proteins
- Wide Range of Ion Exchange Selectivity
- No Shrinking or Swelling –  
Use Any Organic Solvent
- Significantly Higher Efficiency than  
Polymeric Phases

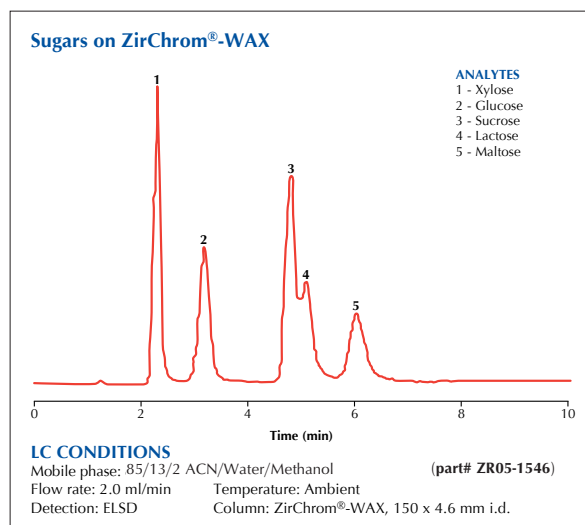
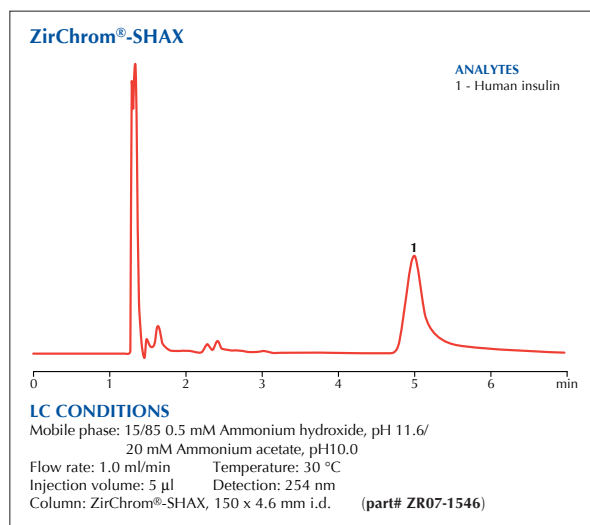


### Method Development with ZirChrom's Ion Exchange Phases

Each ZirChrom ion exchange phase is produced by coating ultra-stable zirconia particles with an extremely thin layer of an ionic polymer. This method creates phases with much higher efficiency and, oftentimes, higher capacity than pure polymeric phases. Also, ZirChrom's ion exchangers do not shrink or swell as a function of ionic strength or organic modifier content of the mobile phase.

ZirChrom's SAX and SHAX phases are thermally stable up to 80 °C, which causes different selectivity, allowing high speed separations with lower ionic strength mobile phases. This is very important in the preparation of RNA and DNA samples.

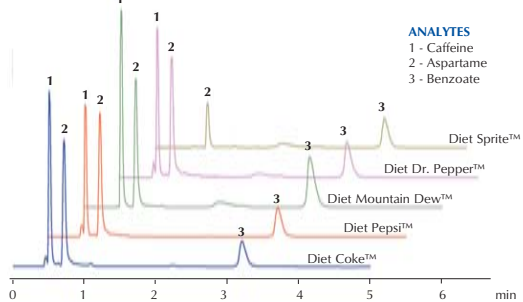
If desired, mixed-mode separation modes may be exploited to optimize separations, including Lewis acid-base interactions, hydrophobic interactions and ion-exchange interactions. These modes may be attenuated by adjusting the strong Lewis base content, organic content and ionic strength of the mobile phase, respectively.





## ION EXCHANGE CHROMATOGRAPHY

### "Green" Analysis of Diet Soft Drinks on ZirChrom®-SAX



#### LC CONDITIONS

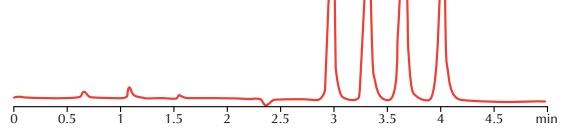
Mobile phase: 10mM Ammonium phosphate, 5mM Ammonium carbonate, pH 6.6  
Flow rate: 1.0 ml/min Temperature: 50 °C  
Injection volume: 5 µl Detection: 210 nm  
Column: ZirChrom®-SAX, 100 x 3.0 mm i.d. (part# ZR06-1030)

### Organic Acids

#### ZirChrom®-SAX

#### ANALYTES

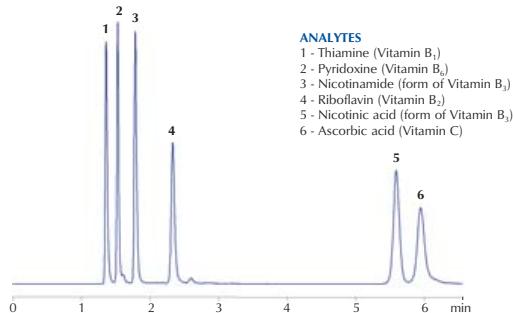
- 1 - Acetic acid
- 2 - Propionic acid
- 3 - Formic acid
- 4 - Butyric acid



#### LC CONDITIONS

Mobile phase: 5 mM Ammonium phosphate, pH 6.0 Pressure drop: 140 bar  
Flow rate: 1.5 ml/min Temperature: 50 °C Column: ZirChrom®-SAX,  
Injection volume: 5 µl Detection: 210 nm 150 x 4.6 mm i.d.  
(part# ZR06-1546)

### Water Soluble Vitamins on ZirChrom®-SAX



#### LC CONDITIONS

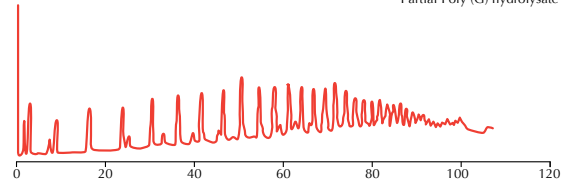
Mobile phase: 50 mM Ammonium dihydrogenphosphate, pH 4.5  
Flow rate: 1.0 ml/min Temperature: 30 °C  
Injection volume: 5 µl Detection: 254 nm  
Column: ZirChrom®-SAX, 150 x 4.6 mm i.d. (part# ZR06-1546)

### Oligonucleotides

#### ZirChrom®-SAX

#### ANALYTES

Partial Poly (G) hydrolysate



#### LC CONDITIONS

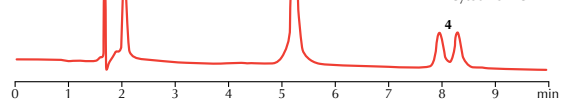
Mobile phase: (A) 20 mM Potassium phosphate dibasic at pH 7.0,  
200 mM Sodium chloride  
(B) 200 mM Potassium phosphate dibasic at pH 7.0,  
2.0 M Sodium chloride; Gradient: 10 to 90% B over 180 min.  
Flow rate: 1.0 ml/min Temperature: 100 °C Column: ZirChrom®-SAX,  
Injection volume: 25 µl Detection: 260 nm 150 x 4.6 mm i.d.  
(part# ZR06-1546)

### Protein Separations

#### ZirChrom®-PEZ

#### ANALYTES

- 1 - Water
- 2 - Myoglobin
- 3 - Lysozyme
- 4 - Oxidized and reduced forms of Cytochrom C



#### LC CONDITIONS

Mobile phase: Gradient elution with 25 to 100% B over 10 min, where A is  
2 mM EDTPA, 50 mM NaCl, 20 mM MES, pH 5.5, and B is  
2 mM EDTPA, 1.0 M NaCl, 20 mM MES, pH 5.5  
Flow rate: 1.0 ml/min Temperature: 30 °C Column: ZirChrom®-PEZ,  
Injection Volume: 10 µl Detection 280 nm 150 x 4.6 mm i.d.  
(part# ZR08-1546)

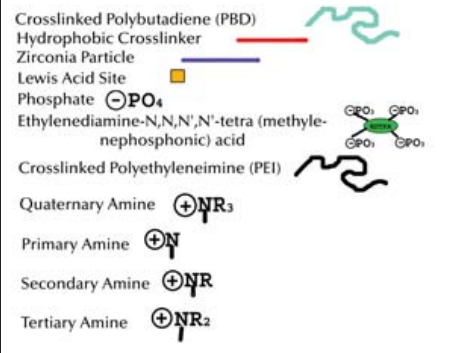
\*NOTE: The high temperature specification for ZirChrom®-SAX is 80 °C. Routine column use above the high temperature specification will significantly shorten column lifetime.



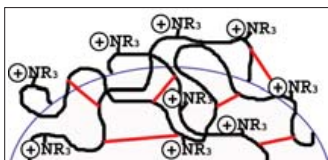


## ION EXCHANGE CHROMATOGRAPHY

### Legend for Surface Chemistry Diagrams

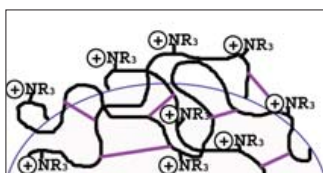


### ZirChrom®-SAX (Stable from pH 1-12, and to 80 °C)



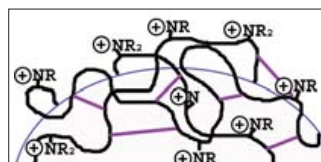
- Cross-linked polyethyleneimine-coated zirconia for strong anion-exchange
- Useful for inorganic and organic anions
- Ideal for the separation of water-soluble vitamins
- Useful for the separation of bio-molecules such as nucleotides, nucleosides, oligonucleotides, oligodeoxynucleotides, amino acids, and peptides

### ZirChrom®-SHAX (Stable from pH 1-12, and to 80 °C)



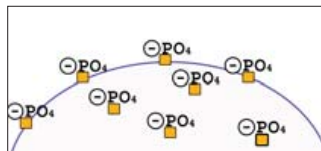
- Quaternized polyethyleneimine-coated zirconia for strong hydrophilic anion-exchange.
- ZirChrom-SHAX has all the advantages of ZirChrom-SAX except that the surface is much more hydrophilic making it useful for anion-exchange of proteins

### ZirChrom®-WAX (Stable from pH 3-9, and to 50 °C)



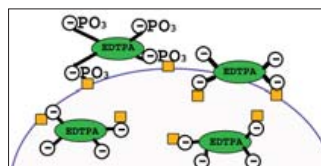
- Cross-linked polyethyleneimine-coated zirconia for weak anion-exchange
- Efficient weak anion-exchanger useful for inorganic and organic anions
- Useful for the separation of bio-molecules such as nucleotides, nucleosides, oligonucleotides, oligodeoxynucleotides, amino acids, peptides, and proteins
- Extremely stable amino phase for normal phase separation of carbohydrates

### ZirChrom®-WCX (Stable from pH 1-10, and to 50 °C)



- Phosphate-coated zirconia for weak cation-exchange
- Useful for protein chromatography in the cation-exchange mode

### ZirChrom®-PEZ (Stable from pH 1-10, and to 50 °C with mobile phase additive)



- EDTPA-coated zirconia for cation-exchange
- Useful for protein chromatography in the cation-exchange mode
- Excellent phase for monoclonal antibody separations

PACKING	MODE	PART
ZirChrom®-WCX	Weak Cation-Exchange	ZR04
ZirChrom®-WAX	Weak Anion-Exchange	ZR05
ZirChrom®-SAX	Strong Anion-Exchange	ZR06
ZirChrom®-SHAX	Strong Hydrophilic Anion-Exchange	ZR07
ZirChrom®-PEZ	Cation-Exchange for Proteins	ZR08

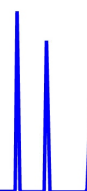
Microbore, Semi-Prep and Prep Formats Available—see Page 24





ZirChrom®

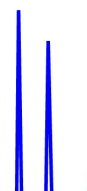
Technical  
Bulletin #246



... For Peak Performance

## Ion Exchange Phase Column Selection Guide

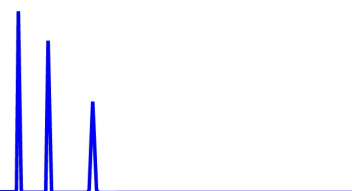
CURRENT PROBLEM/CONCERN	COLUMN	SUGGESTED CONDITIONS
<b>Improve Selectivity</b>		
Need improved selectivity for proteins.	ZirChrom®-PEZ ZirChrom®-WCX ZirChrom®-WAX	Use at pH below protein pI with EDTPA, MES, and NaCl. Use at neutral pH with up to 500mM phosphate. Employ pH and ionic strength (salt) elution gradients.
Need improved selectivity for organic anions including nucleic acids.	ZirChrom®-SAX	Use at neutral pH with phosphate and NaCl.
Need improved selectivity for organic cations.	ZirChrom®-WCX ZirChrom®-PEZ	Use at low to neutral pH with phosphate. Use at low to neutral pH with TFA and EDTPA.
Need improved selectivity for sugars.	ZirChrom®-WAX	Acetonitrile / buffer (100mM NH <sub>4</sub> HCO <sub>3</sub> pH 9).
<b>Change Retention</b>		
Need more retention for proteins or organic cations.	ZirChrom®-WCX	Adjust pH, lower ionic strength.
Need less retention for proteins or organic cations.	ZirChrom®-PEZ	Adjust pH, increase ionic strength.
Need more retention for organic anions, nucleic acids, & oligonucleotides.	ZirChrom®-SAX	Lower phosphate and ionic strength.
Need less retention for organic anions including nucleic acids.	ZirChrom®-WAX	Increase phosphate and ionic strength.
<b>Improve Dynamic pH Range Stability</b>		
Need more pH range stability for proteins or organic cations.	ZirChrom®-WCX ZirChrom®-PEZ	Stable from pH 1 to pH 10.
Need more pH range stability for organic anions including nucleic acids.	ZirChrom®-SAX	Stable from pH 1 to pH 12.
<b>Change Selectivity from Current Phase</b>		
If analytes do not separate on silica based anion phase.	ZirChrom®-SAX	For different selectivity.
If analytes do not separate on polymer based anion phase.	ZirChrom®-SHAX ZirChrom®-WAX	For different selectivity.
If analytes do not separate on polymer based cation phase.	ZirChrom®-WCX ZirChrom®-PEZ	For different selectivity.
<b>Improve Efficiency / Productivity</b>		
If separations are taking too long.	All Columns	Employ maximum operating temperature, increase flow.
If resolution is not adequate.	All Columns	Employ and optimize pH and ionic strength gradients.





ZirChrom®

Technical  
Bulletin #245



... For Peak Performance

## Characteristics of ZirChrom Ion Exchange Phases

Type	Characteristic	WCX	SHAX	SAX	WAX	PEZ
Physical	High pH Stability	Fair	Excellent	Excellent	Fair	Fair
	Low pH Stability	Excellent	Excellent	Excellent	Fair	Excellent
	High Temp Stability	Very Good	Very Good	Very Good	Fair	Very Good
	Charge Density / Retentivity	Highest	High	Highest	Moderate	Moderate
Similarity to Other Ion Exchangers	Silica Based Anion	NA	Close	Different	Close	NA
	Polymer Based Anion	NA	Different	Close	Different	NA
	Polymer Based Sulfonic Acid Cation	Different	NA	NA	NA	Different
	Polymer Based Carboxylic Acid Cation	Different	NA	NA	NA	Different
Selectivity	For Protein Purification	Good	Fair	Poor	Fair	Excellent
	Nucleic Acid	NA	Good	Best	Good	NA
	Organic Anion	NA	Good	Good	Good	NA
	Organic Cation	Good	NA	NA	NA	Good
	Inorganic Anion	NA	Good	Good	Good	NA

