Benefits of Using 4 µm Particle-Size Columns

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Executive Summary

Analytical chemists who wish to attain the optimal combination of chromatographic speed and resolution should consider 4 µm particle-size columns as a solution.

Keywords

IonPac, 4 µm particle-size columns, HPIC, Capillary IC, Ion Chromatography

Why consider 4 µm Particle-Size IC columns?

Chromatographic separations using packed columns benefit from a high number of theoretical plates per column. The number of theoretical plates can be increased by packing smaller particles into the columns. Typically ion chromatography columns use resin particles ranging from 7–9 µm in diameter. Recent developments in resin technology have allowed the use of 4 µm resin particles in ion exchange columns. The benefits of columns packed with smaller particles include:

- More efficient peaks
- Better resolution
- Faster run times
- Easier integration
- More reliable results

Figure 1. Thermo Scientific™ Dionex™ IonPac™ 4 µm particle-size IC columns

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In addition, the length of the column can be optimized for desired results. Shorter, 150 mm length columns can be used at higher flow rates to increase productivity without sacrificing performance. Longer, 250 mm length columns are utilized for higher resolution separations of complex sample matrices. As a result, these columns allow one to choose the optimum balance between resolution and throughput.

Figure 2 below shows the improved performance of a 4 µm particle-size column (top) compared to a 9 µm particle-size column (bottom). All other parameters are identical. All peaks generated using the 4 µm particle-size column are more efficient (taller and narrower) than those generated using the 9 µm particle-size column. As highlighted in the red boxes, the net result is improved resolution, allowing baseline separations for easier to integrate peaks and more reliable results.

Column:	See Chromatograms
Eluent Source:	Thermo Scientific Dionex EGC 500 KOH eluent generator cartridge
Eluent :	1 mM KOH (0–7 min),1–15 mM KOH (7–16 min), 15 to 30 mM KOH (16–25 min), 30 to 60 mM KOH (25-33 min)
Flow Rate:	1.5 mL/min
Inj. Volume:	10 µL
Temperature:	30 °C
Detection:	Suppressed Conductivity,Thermo Scientific™ Dionex™ ASRS™ Anion Self-Regenerating Suppressor 300 4 mm, Thermo Scientific™ Dionex™ AutoSuppression™ device, recycle mode

Peaks:	mg/L		mg/L		mg/L
1. Quinate	5.0	10. Valerate	5.0	20. Maleate	7.5
2. Fluoride	1.5	11. Monochloroacetate	5.0	21. Sulfate	7.5
3. Lactate	5.0	12. Bromate	5.0	22. Oxalate	7.5
4. Acetate	5.0	13. Chloride	2.5	23. Tungstate	10.0
5. Propionate	5.0	14. Nitrite	5.0	24. Phosphate	10.0
6. Formate	5.0	15. Triflouroacetate	5.0	25. Phthalate	10.0
7. Butyrate	5.0	16. Bromide	5.0	26. Citrate	10.0
8. Methylsulfonate	5.0	17. Nitrate	5.0	27. Chromate	10.0
9. Pyruvate	5.0	18. Carbonate	–	28. *cis*-Aconitate	–
		19. Malonate	7.5	29. *trans*-Aconitate	10.0

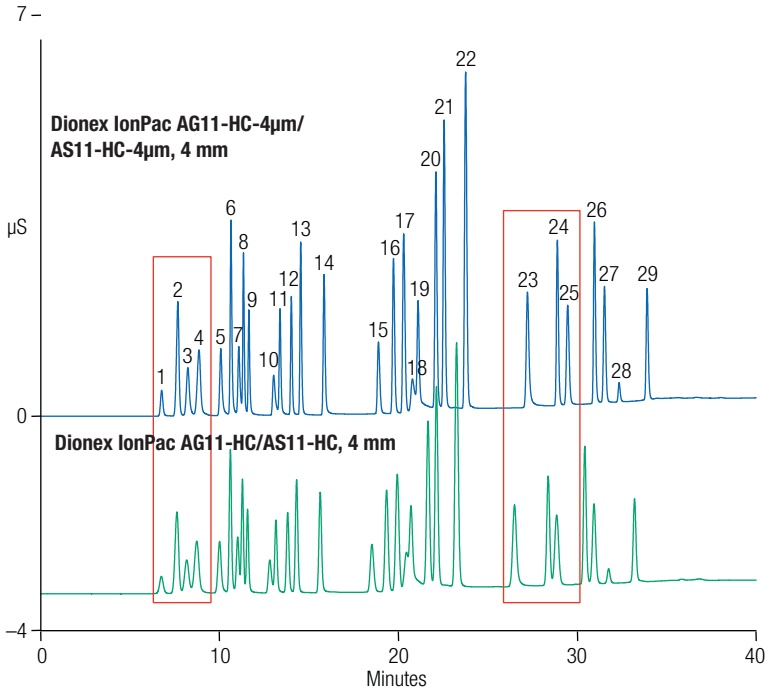

Figure 2. Particle-size comparison. Peak efficiencies were improved by 50–60% with 4 µm columns.

What solutions exist on the market?

Dionex IonPac 4 µm particle-size IC columns are currently available in three separation chemistries. The new Dionex IonPac AS11-HC-4µm anion-exchange column is a high-capacity, high-efficiency column that provides excellent resolution of 40 organic acids and inorganic anions in a single run using a hydroxide gradient as shown in Figure 3. Complex sample matrices such as chemical wastewater effluents and fermentation broth solutions can be analyzed using this high-resolution column. The smaller resin particles used in this column produce a backpressure over 3000 psi at standard flow rates. As a result, a high-pressure IC system, such as the Thermo Scientific™ Dionex™ ICS-5000⁺ HPIC™ or the Dionex ICS-4000 Capillary HPIC must be used to operate this column under standard conditions.

Column:	Dionex IonPac AG11-HC-4µm/ AS11-HC-4µm (0.4 × 250 mm)	Flow Rate:	15 µL/min
		Inj. Volume:	0.4 µL
Eluent Source:	Dionex EGC-KOH (Capillary)	Temperature:	30 °C
Eluent:	1 mM KOH (0.01 min, 1–5 mM KOH (0.01–15 min), 5–55 mM KOH (15–40 min)	Detection:	Suppressed Conductivity, Thermo Scientific™ Dionex™ ACES™ 300 Anion Capillary Electrolytic Suppressor, recycle mode

Peaks:

1. Quinate	11. Isovalerate	21. Nitrate	31. Fumarate
2. Fluoride	12. Valerate	22. Citramalate	32. Tungstate
3. Lactate	13. Monochloroacetate	23. Malate	33. Phosphate
4. Acetate	14. Bromate	24. Carbonate	34. Phthalate
5. 2-Hydroxybutyrate	15. Chloride	25. Malonate	35. Arsenate
6. Propionate	16. 2-Oxovalerate	26. Citraconitate	36. Citrate
7. Formate	17. Nitrite	27. Maleate	37. Chromate
8. Butyrate	18. Ethylphosphate	28. Sulfate	38. Isocitrate
9. Methylsulfonate	19. Trifluoroacetate	29. *alpha*-Ketoglutarate	39. *cis*-Aconitate
10. Pyruvate	20. Bromide	30. Oxalate	40. *trans*-Aconitate

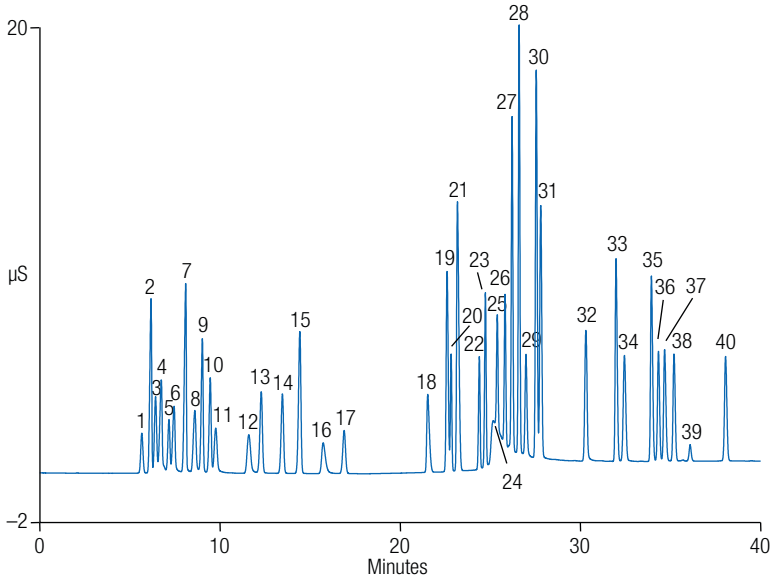

Figure 3. Forty inorganic anions and organic acids separated in less than 40 minutes on a Dionex IonPac AS11-HC-4µm (0.4 × 250 mm) column.

The Dionex IonPac AS18-4µm anion-exchange column is a high-capacity, high-efficiency column that provides excellent resolution of inorganic anions in environmental matrices. Figure 4 shows a municipal drinking water sample analyzed at increasing flow rates without a loss of resolution. This column is the hydroxide-selective column of choice for compliance monitoring of inorganic anions in drinking water and wastewater samples in accordance with US EPA Methods 300.0 (A) and 300.1. This shorter length column (150 mm) allows the use of faster flow rates for increased productivity without sacrificing performance. The smaller resin particles used in the Dionex IonPac AS18-4µm column produce increased back pressure as well. While some capillary applications may operate under 3000 psi at the standard flow rate, in order to obtain fast run times using elevated flow rates, a high-pressure IC system (such as the Dionex ICS-5000⁺ HPIC or Dionex ICS-4000 Capillary HPIC systems) will be required.

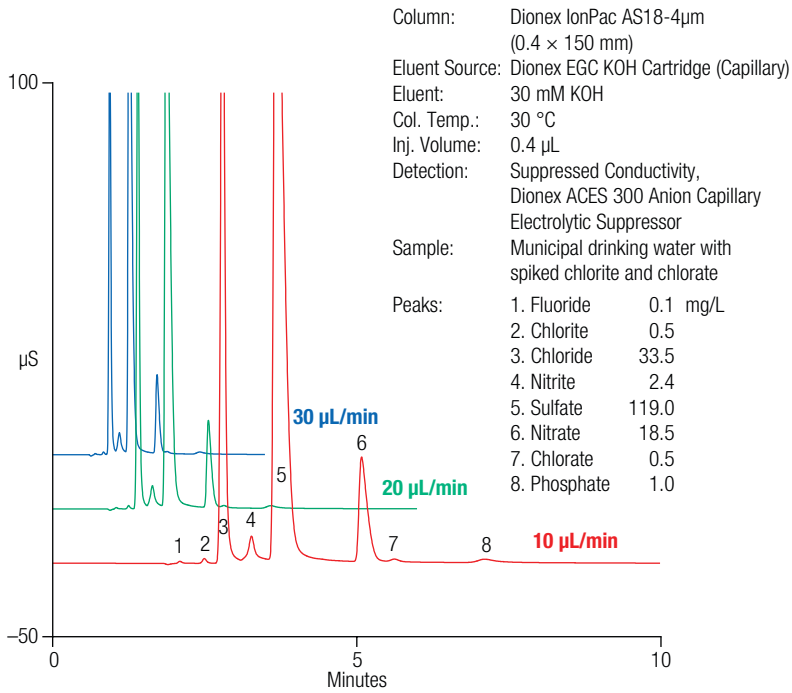

Figure 4. Inorganic anions separated at increasing flow rates while maintaining excellent peak efficiencies.

The Dionex IonPac CS19-4µm cation-exchange column is a high-capacity, high-resolution column that provides excellent resolution of common cations, small polar amines and polyvalent amines in complex matrices. A fast separation of six common cations plus biogenic amines using an elevated flow rate with a gradient eluent is shown in Figure 5. The Dionex IonPac CS19-4µm column is ideal for the analysis of power plant waters treated with ammonium, morpholine, or ethanolamine; as well as chemical additives, chemical process solutions, scrubber solutions, personal care products and food samples. Not surprisingly, the smaller resin particles used in the Dionex IonPac CS19-4µm column produce increased backpressure as well. While some capillary applications may operate under 3000 psi at the standard flow rate, to take advantage of faster runs using higher flow rates a high-pressure IC system (such as the Dionex ICS-5000⁺ HPIC or Dionex ICS-4000 HPIC systems) is necessary.

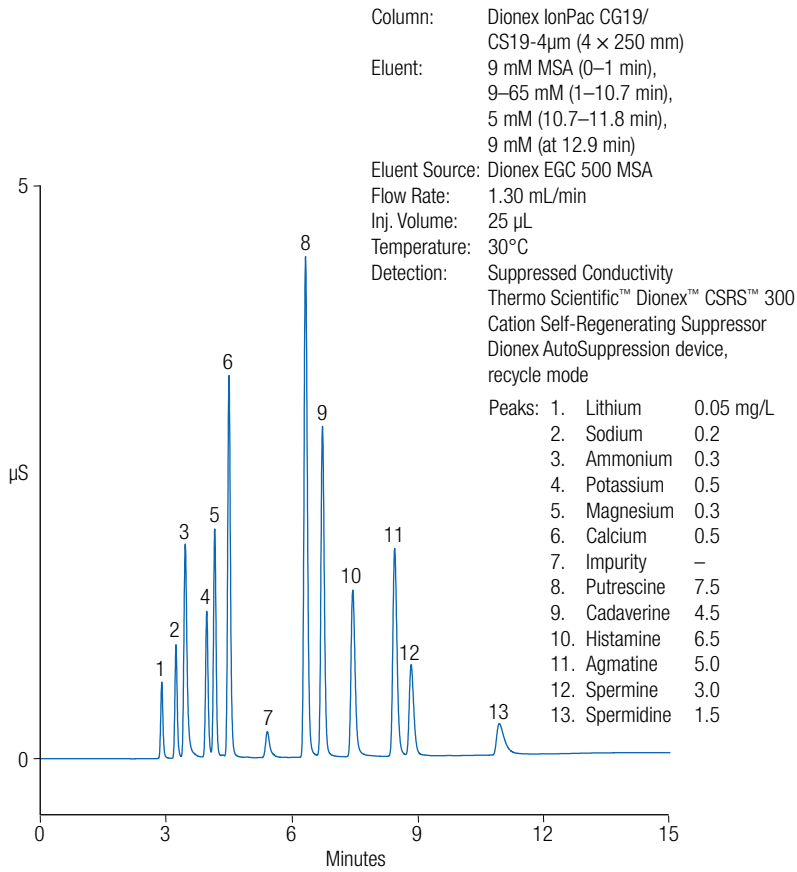

Figure 5. Fast separation of six common cations plus biogenic amines.

Dionex IonPac 4 µm particle-size columns are ideal for the analytical chemist who wishes to attain the optimal combination of chromatographic speed and resolution.

Reference

- http://www.dionex.com/en-us/products/columns/ic-rfic/lp-111741.html

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