



This month's installment of "Column Watch" is the conclusion of a two part series in which Ron Majors examines the trends in columns and sample preparation at Pittcon 2006. In this installment, new gas chromatography columns, sample preparation products, and chromatography-sample prep hardware, accessories, and kits are featured.

Ronald E. Majors
Column Watch Editor

New Chromatography Columns and Accessories at the 2006 Pittcon Conference: Part II

Pittcon 2006 — the 57th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy — will return to the Orange County Convention Center in Orlando, Florida on March 12–17, 2006. This year's event will host more than 1000 instrument manufacturers and laboratory suppliers in more than 2300 booths. In addition to attending the exposition, the conferees will have the opportunity to listen to more than 2200 oral and poster presentations, which will include invited and award symposia, check out 50 seminar rooms, or attend one of 100 short courses.

Pittcon remains the most important yearly international analytical exhibition where companies introduce their latest instruments, instrument accessories, columns, sample preparation products, and other consumable products. Because many past attendees have purchased one or more new products within three months after attending the show, most exhibitors attempt to maximize their booth traffic to meet as many potential customers as possible.

The purpose of this report is to provide information about many of the new separation consumables and accessory products that were displayed at Pittcon 2006. In some cases, products that were introduced during 2005 but after Pittcon 2005 (1,2) have been included for reasons of completeness. The information is based upon manufacturers' responses to a

questionnaire mailed in December 2005. Because of space limitations and the fact that some manufacturers did not respond to the questionnaire, this report cannot be considered an exhaustive listing of all new products that will be introduced in Orlando. However, over the years, these Pittcon introduction summaries have provided a good source of information that would be difficult for one individual to gather during the four days of the exhibition. In addition, the products introduced have shown definite correlations to current research, development, and application activity in the separation sciences.

As in previous years, columns and other products recommended by their manufacturers primarily for biomolecule separations or sample preparation are denoted in the tables with the designation BIO. Some of these products can be used for general high performance liquid chromatography (HPLC) separations as well, but their main emphasis is for biological samples.

In last month's coverage, I described new columns for reversed-phase, normal- and bonded-phase, ion-exchange and ion, size-exclusion, and specialty chromatography (3). In this month's coverage, I look at gas chromatography (GC) columns, supercritical fluid chromatography (SFC) products, sample preparation products, and hardware, and accessories and kits for chromatography and sample preparation.

Companies Listed in This Column

Abel Industries, Wilmington, Delaware
 AccuStandard, New Haven, Connecticut
 Agela Technologies, Wilmington,
 Delaware
 Agilent Technologies, Inc., Wilmington,
 Delaware
 Argonaut/Biotage, Charlottesville, Virginia
 Astec, Whippany, New Jersey
 BIA Separation (Astec), Ljubljana,
 Slovenia
 Biotech AB, Lund, Sweden
 Brechbuhler AG, Schlieren, Switzerland
 Chata Biosystems, Fort Collins, Colorado
 Chiralizer Services, Newton, Pennsylvania
 Domnik Hunter, Charlotte, North Carolina
 DyChrom, Santa Clara, California
 GeneVac, Suffolk, United Kingdom
 Gerstel, Baltimore, Maryland
 Glygen, Columbia, Maryland
 Hamilton, Reno, Nevada
 Isolation Technologies, Hopedale,
 Massachusetts
 JG Finneran, Vineland, New Jersey
 Macherey-Nagel GmbH & Co. KG, Düren,
 Germany
 Merck KGaA, Darmstadt, Germany

MicroSolv Technology Corp., Long Branch,
 New Jersey
 Nalge Nunc, Rochester, New York
 New Objective, Woburn, Massachusetts
 OroChem, Lombard, Illinois
 Parker Balston, Tewksbury, Massachusetts
 Phenomenex, Torrance, California
 Polymer, Amherst, Massachusetts
 Quadrex Corp., Woodbridge, Connecticut
 Restek Corp., Bellefonte, Pennsylvania
 Selerity Technologies, Salt Lake City, Utah
 Sensirion AG, Zurich, Switzerland
 Sepax Technologies, Newark, Delaware
 SeQuant, Umea, Sweden
 SGE Inc., Austin, Texas
 Sigma Aldrich, St. Louis, Missouri
 Supelco, Bellefonte, Pennsylvania
 Thermo Electron Corp., Waltham,
 Massachusetts
 United Chemical Technologies, Bristol,
 Pennsylvania
 Upchurch Scientific, Oak Harbor,
 Washington
 Vapourtec/Biotage, Uppsala, Sweden
 Varian Inc., Palo Alto, California
 Wohleb Scientific, Ferndale, California
 Xenosep Technologies, Boonton, New
 Jersey

Gas Chromatography Columns

Although GC is considered to be a relatively mature separation technique, new GC columns continue to be introduced each year at Pittcon (Table I), 20 in all for this year. All columns were the wall-coated open tubular (WCOT) format with the exception of one — the Agilent (Santa Clara, California) GS-OXYPLOT, a specialty PLOT column for oxygenate analysis in the petrochemical industry according to the American Society for Testing Materials (ASTM) methods (4). This column has been optimized for this analysis and can be “dropped-in” with current oxygenate analysis with improved peak shape and better reproducibility compared with current columns.

In recent years, there has been a trend in the introduction of ultra low-bleed WCOT stationary phases that allowed better detection limits, less baseline drift during temperature programmed separations, and improved compatibility with gas chromatography–mass spectrometry (GC–MS) analyses. This year, almost every GC column had lower than normal

Table I: Gas chromatography columns at Pittcon 2006

Product Name	Supplier	WCOT	Phase	Film Thickness (μm)	Internal Diameter (mm)
007-17MS	Quadrex	WCOT	50% phenyldimethylpolysiloxane	0.1–0.5	Various
007-35MS	Quadrex	WCOT	35% phenyldimethylpolysiloxane	0.1–0.5	Various
BPX90	SGE	WCOT	90% biscyanopropylpolysilphenylene	0.25–0.5	0.25, 0.32
ChiralDEX DP	Astec	WCOT	Dipropionyl cyclodextrin	0.125	Various
Factor Four VF-1301ms	Varian	WCOT	6% cyanopropylphenyldimethylpolysiloxane	0.15–1.50	0.15–0.53
Factor Four VF-1701ms	Varian	WCOT	14% cyanopropylphenyldimethylpolysiloxane	0.1–1.0	0.10–0.53
Factor Four VF-5ht	Varian	WCOT	5% phenyldimethylpolysiloxane	0.10	0.25, 0.32
Factor Four VF-624ms	Varian	WCOT	6% cyanopropylphenyldimethylpolysiloxane	0.84–3.0	0.15–0.53
GS-OXYPLOT	Agilent Technologies	PLOT	Proprietary	10	0.53
Optima 5ms Accent	Macherey-Nagel	WCOT	5% phenyldimethylpolysiloxane	0.2–1.0	0.2–0.32
Optima XLB	Macherey-Nagel	WCOT	5% phenyldimethylpolysiloxane	0.2–1.0	0.2–0.32
Rxi-1ms & -5ms capillary	Restek	WCOT	100% dimethylpolysiloxane; 5% phenyldimethylpolysiloxane	Various	Various
SLB-5ms	Supelco	WCOT	5% phenyldimethylpolysiloxane	0.2, 0.25, 0.32, 0.5, 1.0	0.20, 0.35, 0.32
SP-2560	Supelco	WCOT	Biscyanopropylpolysiloxane	0.14	0.18
Zebtron Guardian	Phenomenex	WCOT	ZB-1ms, ZB-5ms, ZB-5	0.25, 0.50, 1.0	Various
Zebtron ZB-1701P	Phenomenex	WCOT	14% cyanopropylphenyldimethylpolysiloxane	0.25, 1.0	Various
Zebtron ZB-1ms & -5ms	Phenomenex	WCOT	100% dimethylpolysiloxane; 5% phenyldimethylpolysiloxane	Various	Various
Zebtron ZB-WAXplus	Phenomenex	WCOT	Polyethyleneglycol (PEG)	Various	Various

bleed specifications. Figure 1 provides experimental data on two of these phases that demonstrates inertness (Figure 1a)

or low bleed (Figure 1b). For Figure 1a, the low tailing of pyridine is a good indication of the absence of basic active sites.

For Figure 1b, the bleed profiles for a regular 624 column and a new low-bleed column are compared. A column that

Length (m)	Comments
Various	Bonded phase capillary columns with low bleed characteristics for high sensitivity GC and GC-MS, similar to 007-35; recommended for midpolarity compounds such as drugs, pesticides, and so forth; also EPA confirmation column; upper temperature limits: 325/350 °C.
Various	Bonded phase capillary columns with low bleed characteristics for high sensitivity GC and GC-MS, similar to 007-35; recommended for midpolarity compounds such as drugs, and pesticides; also EPA confirmation column; upper temperature limits: 325/350 °C
15, 30, 60	Extremely high polarity phase with π - π selectivity recommended for polyunsaturated FAME analysis, <i>cis-trans</i> and positional isomers, petrochemical analysis, PAHs, PBDE resolution; good column for 2D GC applications since complete orthogonality; upper temperature limit: 280 °C.
Various	Broad-based chiral column which offers high efficiency and resolution at low retention times for polar racemates; recommended for chiral aromatic and aliphatic amines and many aliphatic and aromatic esters; good hydrolytic stability; complements G-TA and G-DM columns; upper temperature limits: 200/220 °C.
Various	Very low bleed phase equivalent to 6% cyanopropylphenyl-94% cyanopropylphenyl polydimethylsiloxane; recommended for semivolatile organic compounds, solvents, PCBs and pesticides; upper temperature limits: 280/300 °C.
Various	Recommended for EPA 508, 525, 608, 625 and 8140/1841 methods for semivolatile organic compounds as well as pesticides and PCBs; low bleed phase; upper temperature limits: 280/300 °C.
15, 30	Very low bleed phase with extended isothermal temperature limits to 400 °C; recommended for high boiling mixtures, long chain hydrocarbons, heavy PAHs, triglycerides, crown ethers, and so forth.
Various	Recommended for EPA Methods 524, 624, and 8260 for volatile organic compounds in water; also for USP 467 method for residual solvent in pharmaceutical preparations, low bleed phase; upper temperature limits: 280/300 °C.
10	Recommended for petrochem applications specifically for oxygenate analysis and related ASTM methods; suitable for "drop-in" column with current oxygenates analyses; improved peak shape and reproducibility compared to current columns; no new method development required; upper temperature limits: 350/350 °C.
25-60	Low bleed columns recommended for GC-ion trap and -quadruple MS; upper temperature limits: 340/360 °C.
25-60	Low bleed columns recommended based on sil-arylene phase; slightly different selectivity from typical 5% phenyldimethylpolysiloxane; upper temperature limits: 340/360 °C.
Various	A new line of fused silica capillary columns with lower bleed, better inertness, more reproducible retention and selectivity, and longer lifetime than current columns; upper temperature limits: 330/350 °C; general purpose columns.
15, 30, 60	New polymer synthesis and surface deactivation chemistry gives more inert, low bleed column for trace analysis; upper temperature limits: 340/360 °C; especially recommended for environmental analysis and GC-MS and GC-ECD.
75	Recommended for fast GC analysis of <i>cis-trans</i> fatty acid methyl esters with a 45% reduction in analysis time compared to traditional 100-m column; upper temperature limit: 250 °C.
Various	A deactivated integrated guard column that has the same phases and upper temperature limits of parent phase; integrated guard columns don't need press fit union (potential leaks); guard column extends analytical column lifetime and allows analyte focusing for low boilers; offered in 5- and 10-m lengths.
Various	Recommended for EPA Method 8081A for pesticide analysis (organochloro-, organophosphorous-, nitrogen-containing-, Arochlors, amines); upper temperature limits: 280/300 °C for 0.25- μ m film and 260/280 °C for 1.0- μ m film.
Various	A new line of fused-silica capillary columns with lower bleed (< 2-pA at 320 °C), better inertness, upper temperature limits: 330/350 °C; uses enhanced engineered self-crosslinking (ESC) bonding technology; 5 ms column employs Arylene Matrix Technology; general purpose columns.
Various	Bonded phase is solvent rinsable; can be used with aqueous solvent injection; recommended for a wide variety of alcohols, aldehydes, aromatics, solvents, glycols, and essential oils; upper temperature limits: 250/260 °C.

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has lower phase bleed will allow better detection and improved quantitation over a higher bleed column.

All of the general-purpose GC capillary columns displayed at Pittcon 2006 were crosslinked phases. Crosslinked,

chemically bonded, or immobilized phases are more stable, have lower bleed,

Table II: Sample preparation products at Pittcon 2006

Product Name	Supplier	Product Type	Model(s)	Base Material	Functional Group
ArrayCote 96-Well Plates	Nalge Nunc	96-well plates	Affinity	Glass plate	Aminopropyl, aldehyde, and epoxy
Celerity Deluxe	Orochem Technologies	SPE cartridge/96-well plate	Reversed phase	DVB Polymer	DVB
ChromaBond Mixed Mode SPE	Macherey-Nagel	SPE cartridge /96-well plates	Mixed mode	Silica	C8/-NR3+
Cleanert PEP	Agela Technologies	SPE cartridge, disk and 96-well plate	Polar enhanced reversed phase	Silica	Amide
Generik SPE	Sepax Technologies	SPE cartridge, 96-well plate	Reversed phase, ion exchange, mixed mode	Silica and polymeric versions	See comments
HyperSep SPE	Thermo Electron	SPE cartridges, 96-well plates	Reversed phase, normal phase, ion exchange	Silica, carbon	See comments
HyperSep Tip & SpinTip	Thermo Electron	SPE pipette tips	Reversed phase, HILIC, affinity, mixed mode, adsorption	Silica, carbon	See comments
ILE Caps	Wohleb Scientific	SPE cap	Reversed phase		Methyl-, phenyl-, and fluoro-polysiloxane
Isolute SLE	Argonaut/Biotage	96-well plate	Supported liquid extraction (SLE)	Modified diatomaceous earth	Not applicable
Lab-in-a-Film	Glygen	SPE film	See comments	Polypropylene film	See comments
Lab-in-a-Plate	Glygen	Well plate	See comments	Polystyrene, polypropylene	See comments
MARS HU-PL7	Agilent Technologies	Immuno-depletion column	Affinity	Proprietary	Antibodies and affinity ligands
MIP4SPE	MIP Technologies	Cartridge	Molecular imprint	Polymer	Chloramphenicol imprint
OMIX 96-well plates	Varian	SPE 96-well plate	Reversed phase, ion exchange	Monolith	C4, C18, MP1
OMIX Tip for Tomtec Quadra	Varian	SPE pipette tip	Reversed phase	Monolith	C18
PL-Thiourea-, Thiol- and Guanidine-MP Scavengers	Polymer Laboratories	Scavenger cartridge	Metal scavenging	Macroporous (MP) PS-DVB	Thiourea, thiol, guanidine
ProteoPrep 20	Sigma Aldrich	Spin column	Affinity	Unspecified	Immunoaffinity ligands, antibodies
PRP-Derivative	Hamilton	SPE	Reversed phase	Polymeric	Proprietary
PRP-Plus	Hamilton	SPE	Reversed phase	Polymeric	C18

Dimensions	Comments
Standard 96-well plate	Can be used for construction of arrays; plates are derivatized with one of the three functionalities that can be linked to reactive groups in proteins (antibodies) or DNA for binding; 16 well slides also available. BIO
1- and 2-mL well plate; 1-, 3-, and 6-mL cartridges	Polymeric packing with pH range 1–14; hydrophilic, hydrophobic, and mixed retention mechanism; recommended for polar drugs and unspecified metabolites in biological fluid (for example, serum); smaller bed mass and lower elution volumes than silica-based beds; narrow particle size distribution for homogeneous flow; extractables checked by GC testing; custom cartridges available.
50 mg to 70 g, 1–70 mL	Mixed-mode phase recommended for THC and derivatives from urine, blood, serum, plasma; also for acidic analytes from biological fluids; average particle size: 45- μ m; pore size: 60 Å.
30 mg/1 mL to 2 g/10mL	Balanced adsorption for polar and nonpolar analytes; 100% water compatible; can run dry; recommended for extraction of polar compounds in drug discovery and metabolite research drugs of abuse, environmental, and natural product samples; particle size: 30–50 μ m; pore size: 90 Å.
Cartridges: 1–75 mL	Family of SPE products with following functionality: C4, C8, C18, CN, NH ₂ , Silica, SAX, SCX, C8, and C18/amino, C8 and C18/SCX, C8 and C18/SAX, and PS-DVB; particle size: 50- μ m average.
Cartridges: 50 mg to 10 g; plates: 10–100 mg/well	Family of SPE products with following functionality: C8, C18, phenyl, silica, graphitized carbon, SAX, SCX, C8/SCX, C8/SAX, Florisil, aminopropyl; 96-well plates available in fixed and flexible configuration — the latter has removable wells for method development and customized configurations; particle size: 40–60 μ m except for carbon (30 μ m); pore size: 60 Å except carbon (250 Å).
1–10 μ L, 10–200 μ L	Packing materials are attached to the inner surface of tip without using polymers or glue; tips have a wide variety of stationary phases including C4, C8, C18, graphitized carbon, trypsin, titanium dioxide, carbon/C18, and ion-exchange phases; used for peptide and protein purifications of microliter volumes; applications include desalting, purification, MALDI-MS. BIO
10- and 24-mm cap	ILE = immobilized liquid extraction; product provides two step sample preparation; extraction cap has a sorptive coating placed on the inside; cap is placed on sample bottle containing aqueous sample and bottle is agitated and analytes are attracted to coating; cap containing sorbed analyte is placed on small back extraction vial containing organic solvent (<200- μ L); vial is agitated and sample is extracted into organic solvent; efficient extraction, surface area allow phase ratio equal to/better than stir-bar sorptive extraction; two cap sizes cover 1-mL to 1-L samples
Standard fixed well plate; 200 mg/well	Well plate constructed of high purity polypropylene with polyethylene frits; designed for automated extraction of acidic, basic and neutral drugs and metabolites from biological fluids; liquid sample deposited in well and organic solvent added for extraction; saves time over conventional liquid–liquid extraction.
Microtiter plate	Concept similar to Lab-in-a-Plate but in a film format; intended for small sample volumes (0.5–5 μ L); film can be attached to any 96-well plate to be used for sample collection in an autosampler or a liquid handling device. BIO
96-, 384-, and 1536-well plates	Chromatographic media are attached to bottom of microtiter plate; sample is dispensed or aspirated with any micropipette or liquid handling system; binding capacity 5–10 times higher than normal ELISA plates (for example, 96-well, 2 μ g, sample volume 25–250 μ L), bonded phases for adsorption, reversed, phase, size exclusion, ion exchange, IMAC, affinity, avidin, lectins, enzymes, and so forth. BIO
See comments	MARS (multiple affinity removal system) used for high abundance protein fractionation in human plasma (will work for other fluids such as CSF, serum, and synovial); removed seven high abundance proteins providing higher loading for downstream applications and removing interfering proteins in the analysis of low abundance proteins; available in spin tube (0.45 mL) and LC column configurations (50 and 100 mm \times 4.6 and 100 mm \times 10 mm); high capacity and robust for over 200 injections; BIO.
25 mg 10-mL volume	Separation principle based upon molecular imprinting (“lock and key”); behaves like an affinity type column 50 μ m beads; provides high selectivity for chloramphenicol extraction; possible class extraction; provides low detection limits zero bleed characteristics.
<4 mg/well	Flexible well design with removable flow-through wells; allows customized arrangements or for method development plate; C18 for general purpose extraction, C4 for very large or nonpolar analytes, MP1 mixed-mode cation exchanger for basic compounds; useful for small samples.
Pipette tip size	Designed to fit Tomtec Quadra robotic liquid handling system; SPE medium is located inside of the tip; no vacuum processing required so reproducibility is enhanced; recommended for pharmaceutical bioanalysis.
500 mg/6 mL	Recommended for removal of metal species from analytical samples, both aqueous and organic; higher loading capacity than most silica-based metal scavengers; selfindicating tube capacity and 45- μ m monodispersed particles for stable bed packing.
Unspecified	Plasma immunodepletion kit that removes 20 of the most abundant proteins from human plasma or serum for further proteomics studies; 97–98% of the total protein mass in human plasma or serum removed leaving 1–2% of low abundant proteins to study. BIO
Not specified	Derivatized spherical polymeric packing with particles from 3 to 75 μ m; 100-Å pores; available in bulk, cartridges, and 96-well plate configuration; recommended for purifying oligonucleotides. BIO
Not specified	Derivatized spherical polymeric packing with particles from 3 to 75 μ m; 100-Å pore size; available in bulk, cartridges, and 96-well plate configuration.

Table II: Sample preparation products at Pittcon 2006 continued

Product Name	Supplier	Product Type	Model(s)	Base Material	Functional Group
slgGnAI	BIA Separation	Spin column	Affinity	Methacrylate monolith	anti-IgG and anti-HAS ligands
Supelclean ENVI-Carb II/PSA	Supelco	SPE	Reversed phase-anion	Carbon/silica	Carbon, ethylenediamine-N-propyl (PSA)
Xenosep Oil and Grease SPE Filters	Xenosep Technologies	SPE filter disk	Reversed phase	Glass fiber mat	C18
Xenosep SPE Filters	Xerosep Technologies	SPE filter disk	Reversed phase	Glass fiber mat	C18
Zic-tip	SeQuant	SPE pipette tip	HILIC	Silica	Tetraalkylammonium,

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and usually operate at higher temperatures than coated phases. Another advantage of the bonded phases is their ability to be solvent-rinsed. If a column becomes contaminated by high boilers, inorganic compounds, and other non-volatile impurities that might cause drifting baselines, bleed, and other undesirable occurrences, it can be disconnected, washed (outlet to inlet direction) with various solvents, and placed back into the gas chromatograph for further use. Capillary columns with internal diameters ranging from 0.10 mm (small bore) to 0.53 mm (large bore or megabore) were the most popular sizes.

High-polarity capillary GC columns always have been tricky to construct

because the high-polarity phases are difficult to stick to the fused-silica inner wall. SGE (Austin, Texas) introduced an extremely polar column coated with 90% biscyanopropylpolysiphenylene phase that offers a completely orthogonal approach to the popular nonpolar polysiloxane phases for two-dimensional (2-D) GC. The phase shows strong π - π selectivity for polyunsaturated fatty acid methyl esters and various types of isomers.

Applications-specific columns are always popular introductions at the Exposition. In addition to the oxygenate column, columns for volatile enantiomers, *cis-trans* fatty acids, pesticides, semivolatile, and volatile organic compounds, and PCBs were among those classes of compounds mentioned. Most

of the application-specific columns are pretested and are shipped with test chromatograms.

Sample Preparation Products

As indicated in Table II, Pittcon 2006 was another productive year, with 23 new sample preparation products or families of products displayed. Not counted were sample preparation accessories (Table III) that will be covered later. Among the more popular introductions were products that deal with increasingly smaller amounts of available sample. Cartridges, disks, pipette-tips, well plates, and spin tubes were among the formats introduced.

In the past several years, the 96-well plate design for SPE and filtration has proliferated, driven by the needs of high-throughput sample preparation automation requirements. Compared with last year (2), this year numerous sample preparation plate products were again in evidence. Most of them were solid-phase extraction (SPE) plates or variations of SPE-plates. For example, Glygen (Columbia, Maryland) introduced their lab-on-a-plate well plates where the SPE medium was affixed to the inner surface of the well and rather than a flow-through design, one performs a liquid-solid extraction in a conventional well. Nalge-NUNC's (Rochester, New York) ArrayCote product was of similar design but the wells within a glass plate were functionalized with reactive ligands that could be derivatized to form in-situ affinity phases.

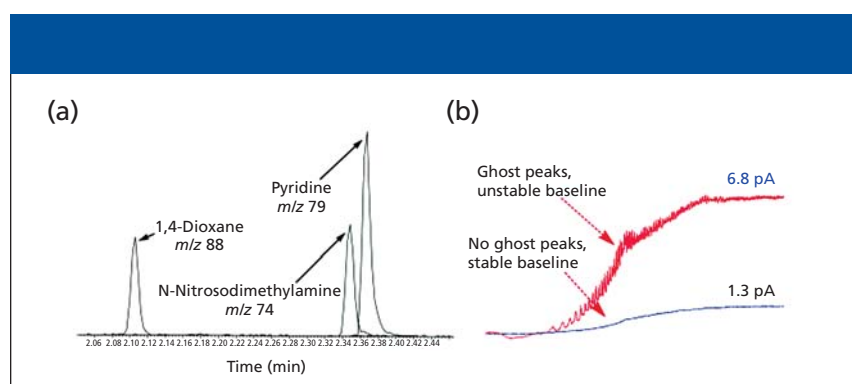


Figure 1: Demonstration of the inertness and low bleed of modern GC columns. Shown are (a) separation of basic analytes on a Restek Rxi-5ms column and (b) a bleed profiles for a Varian VF-624ms column (lower) and a competitor's column (upper). Conditions in (a): injection: 0.5 ng on column, splitless; temperature program: hold at 40 °C for 0.5 min, then increased at 24 °C/min. Conditions in (b): temperature program: 100–260 °C at 10 °C/min; detection: flame ionization. (Courtesy of [a] Restek and [b] Varian.)

Dimensions	Comments
Spin column size	Used for depletion of albumin and IgG from human serum for low abundance protein investigations in proteomics studies; 10 min for depletion step; sample dilution 1:1 resulting in increased productivity; can use 20 mL of serum or plasma; cleaned up sample can be applied directly to 2D gel electrophoresis; kit has buffers for binding/elution experiments. BIO
300–600 mg/6 mL	Cartridge with dual layer technology; graphitized nonporous carbon in upper layer, PSA in lower layer, separated by polyethylene frit; this combination is recommended for cleanup of multiresidue pesticide analysis in agricultural products; carbon has strong affinity for planar molecules and pigments; PSA has affinity for organic acids, polar pigments, and sugars; cleanup decreases background level and reduces matrix signal intensity.
47- and 90-mm disks	Recommended for EPA Method 1664 Oil and Grease; triple layer construction: coarse prefilter, intermediate prefilter, adsorbent layer (glass fiber with bonded C18); layered design prevents plugging by sample particulates and hexadecane:stearic acid standard; can be used at fast flow rates for rapid sample throughput
33-, 47-, and 90-mm	Three products: Semi-Volatile Organics; Chlorinated pesticides and PCBs; Phthalate Esters. Recommended for EPA Methods 525.2, 608, and 8061A, respectively; triple-layer construction as oil and grease product; each lot tested for suitability for EPA methods; can be run at fast flow rates.
Pipette tip size	Recommended for the extraction of hydrophilic biomolecules such as glycopeptides; tips are packed or sulfonic wall-coated with hydrophilic ZIL-HILIC chromatographic particles; sample volumes for 2–200 μ L (mini tips) to 2–100 μ L (microtips).BIO

Argonaut Technologies, now part of Biotope (Charlottesville, Virginia), displayed their flow-through supported liquid extraction plates. Here, the wells are filled with high-purity diatomaceous earth that serves as a support for an extractable aqueous sample, such as blood plasma. Under proper conditions, organic solvent is passed through the wells and a liquid–liquid extraction takes place. The organic solvent containing the extracted analytes is collected in a well plate for further treatment.

Other variations of SPE plates were those of Varian (Palo Alto, California), whose 96-well plate had removable flow-through wells that enable users to customize the plate configuration. Such flexibility is useful in method development

where several SPE phases can be present in a single plate so that phase scouting can be performed.

Several companies introduced SPE pipette tip–based products that can be used with *xyz* automated liquid-handling systems. The SPE stationary phase was packed, bonded, or affixed to the tip by various means. For example, in the Thermo Electron (Waltham, Massachusetts) tips, packing was affixed on the inner surface so that flow through the opening was not impeded. In Varian's OMIX, a monolithic packing is used to cut down flow resistance. The opening of the pipette tip is quite small and if the packing is restricted or the small packed bed is plugged with sample particulates, flow can be erratic and nonreproducible

results can occur. Other formats for SPE introduced were disk and spin tubes. An example of one of the SPE pipette-tip based products from SeQuant (Umea, Sweden) is depicted in Figure 2. One version, the Zic-tip mini (Figure 2a), has a packed bed containing a zwitterionic hydrophilic interaction chromatography (HILIC) chromatographic resin. The other version, the Zic-tip micro (Figure 2b), has the same packing coated on the inner walls of the pipette tip. Both are used for the extraction of hydrophilic biomolecules, such as glycopeptides, from microliter volumes of biological solutions using typical extraction–elution steps.

One area of special focus in sample preparation was the high-abundance protein-removal products from Agilent Technologies, BIA Separations (Ljubljana, Slovenia) and Sigma Aldrich (Bellefonte, Pennsylvania). These kits and columns are used in proteomics research where investigators are interested in the presence or absence of low-abundance proteins that can be indicative of disease states. The high-abundance proteins, which constitute 90+% of the proteins in human serum, can mask the lower abundance proteins in 2-D gel or HPLC separations. By removing them, there is a better chance to see the smaller ones. By the use of antibodies to the high-abundance proteins like albumin, IgG and so on, they can be removed or greatly reduced.

Specialized SPE application chemistries also were introduced. Poly-

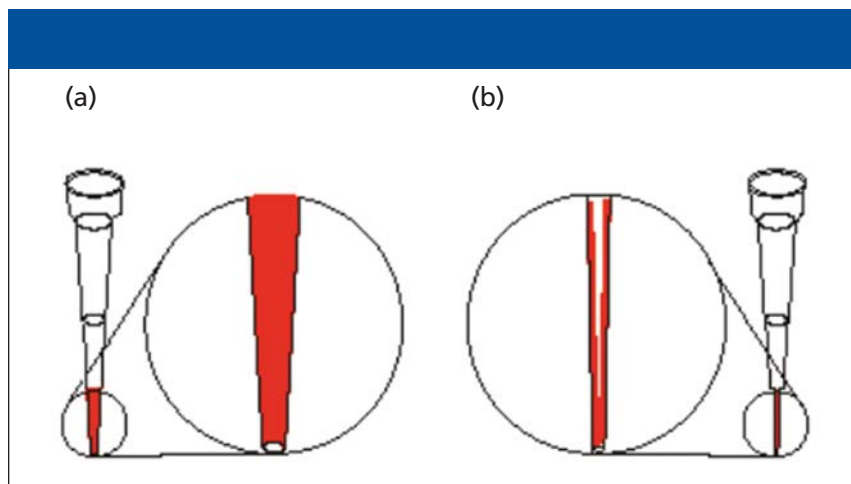


Figure 2: Schematic illustrations of (a) the packed bed in a ZIC-tip mini pipette tip and (b) the wall coating in a ZIC-tip micro pipette tip, which are designed for HILIC SPE. (Courtesy of SeQuant AB.)

Table III: Chromatography and Sample Preparation Accessories at Pittcon 2006

Product Name	Supplier	Application Area	Product Type
2D Column Switching System	Chiralizer Services	LC	Column switching system
2D Proteomics HPLC Kit	SeQuant AB	LC	Application kit
Accel-X MDV	Isolation Technologies	LC	LC Column hardware
Allergen Chemical Reference Standards	AccuStandard	GC	GC Standards
Caloratherm Mobile Phase Temperature Control	Selerity Technologies	LC	In-line mobile phase heater/cooler
Chem + Mix Solution Preparation System	Chata Biosystems	LC, general laboratory	Automated solution preparation
CR-100 Miniature Electronic Cooler	Abel Industries	General laboratory	Benchttop electronic cooler
Dura-Cap FS Capillary Hardware	Isolation Technologies	LC	Capillary LC hardware
EZ-2 and EZ-2 Plus Personal Evaporator	GeneVac	Sample prep	Centrifugal evaporator
Finnpipette/Finntip Pipettors	Thermo Electron	Sample prep	Handheld pipettor
FluoroLiner	SGE	GC	Injection port glass liner
H2PD Hydrogen Gas Generator	Parker Balston	GC	H2 gas generator
H-Bank Hydrogen Storage System	Quadrex	GC	Portable hydrogen source
Interlocked Vial/Insert System	J.G. Finneran	GC, LC, CE-CEC	Vial insert
Iso-Bar Column Hardware	Isolation Technologies	LC	LC column hardware
JCI-21 Portable Pyrolyzer	DyChrom	GC, GC-MS	Cure point pyrolyzer
MRV Vials, Bottles, & Caps	MicroSolv Technologies	LC, GC, CE-CEC	Low volume vials

Suggested Applications	Comments
2D LC-LC	A multidimensional HPLC column selection system for direct "in line" heartcutting or sample peak fractionation; modular benchtop unit uses two or three separate HPLC columns.
Protein tryptic digests	Kit includes two orthogonal HPLC columns (reversed phase and HILIC), six vials with three high purity tryptic digest standards and CD containing full chromatographic documentation of the standards. BIO
Microbore LC	Modular HPLC hardware platform the AccelOX MDV (minimal dead volume) is designed for high-throughput HPLC; system has lower dead volume and reduced back pressure (~20% less) than other hardware; combined improved surface finish, low dead volume fittings and new frit composition; especially useful for the more efficient sub-3- μ m packings.
Cosmetics industry	Certified reference standards for ensuring compliance with EU Directive (76/768/EEC), the new SNIFF (Safe Notification and Information Fragrances Act), FDA regulations; Cosmetic Ingredients Review Panel and International Fragrance Assoc.; recommended for QA-QC of soaps, cosmetics, perfumes-colognes, hair products, and other grooming products.
Controls mobile phase temperature	Using Peltier cooling or heating, low thermal mass unit provides temperature control of incoming mobile phase to prevent thermal mismatch between column temperature and incoming mobile phase temperature; unit can be placed precolumn or postcolumn for detector stabilization; improves chromatographic efficiency and peak shape.
Preparation of solutions	A PC-controlled system that automates the preparation and pH adjustment of chemical solutions such as HPLC mobile phases, buffers, standards, etc.; for method development where small volumes are required; instrument offers precision mixing, provides complete GLP/GMP capabilities including audit trail and multilevel security access
Thermally sensitive compounds	Cooling block that accommodates vials, tubes, bottles or flasks fits into a large cooling reservoir; temperature: ambient to -10°C or below; cool down rate: ambient to 0°C <4 min; to -10°C in less than 30 min; temperature variation: $\pm 1^{\circ}\text{C}$; digital thermal controller with digital display; also recommended for cryogenic reactions, microlyophilizations incubations, concentration, digestion of biological samples below 18°C ; custom systems available.
Columns and connections	Encapsulates a fused-silica capillary in a PEEK housing to provide performance and durability; eliminates bending, breaking, and bed disruption during packing process or operation; incorporates integrated end fitting and frit that provides zero dead volume connection; proprietary frit design; dimensions: 75–500 μm i.d. and 5–25 cm length.
Fast solvent evaporation	Small bench space required; can process more samples per unit time than rotary evaporator; has smart evaporation software that stops run once samples are dry; sample protection system prevents bumping and overheating; has solvent-resistant PTFE diaphragm pump and visible glass condenser trap and solvent drain valve; accommodates wide variety of vessels including roundbottom flasks.
Precision liquid pipetting	Single- and multichannel pipettes available in range of volumes; features include fast volume settings, soft-touch tip ejection; advanced fine adjustment; both manual (Focus) and digital versions available; Novus 1200 and Finntip are programmable liquid dispensers; allowing drawing of pure liquids and dispensing of mixed liquids; adjustable aspiration and dispensing speeds.
Inert liner for GC systems	Injection port liner with a perfluorinated glass surface that provides full chemical passivation and negligible acidic bleed associated with coated products.
GC carrier gas/FID fuel gas	Generates 99.9999+ pure hydrogen gas from deionized water; eliminates explosive hydrogen cylinder from lab; uses no desiccants; incorporates electron beam cell technology for demanding applications; inherently maintenance free.
Field applications	A portable hydrogen storage device with fittings for easy attachment to GC or other standard fittings; rechargeable with high purity hydrogen; materials of construction: SS outer shell, inner metal hydride; recommended for portable GC for FID-FPD or where hydrogen supply is a problem; 50–500 L capacity; 99.9999% high purity output; small size: about size of standard carrier gas filter (50 L) to lunch box size (500 L).
Vials for small volume samples	A 300- μL insert permanently interlocked into a variety of vials; vial and insert are fused together to eliminate insert movement which could cause needle breakage; flange of insert helps to further eliminate chance of needle misguidance; available for 2-mL vials (screw and crimp, clear and amber) in 100 pack quantities.
LC packed columns	Construction combines highly polished internal surface finish, low dead volume fittings, and new frit design all for UHPLC; columns can operate to 40,000 psi; stainless steel encapsulated frit and reduced volume end fittings allows use of packing materials less than 3- μm ; column dimensions: 2.0–15 cm \times 2.1, 3.0, and 4.6 mm.
See comments	Pyrolyzer is interfaced easily with GC using a special needle connection; needle fits any standard septum injector; recommended for polymer characterization, thermal extraction of volatiles, and detection of outgas from solids; polymer characterization performed by placing sample (for example, rubber, resin, or plastic) into the pyrolyzer and injecting through the GC septum; solid-phase microextraction (SPME) can be easily performed.
General purpose vial system	Vials can be used for derivatizations, maximum recovery of precious samples, and storage; new larger sizes; available silanized or unsilanized.

Table III: Chromatography and Sample Preparation Accessories at Pittcon 2006 continued

Product Name	Supplier	Application Area	Product Type
Nano Flow Sensor	Upchurch Scientific	CE-CEC	Flow sensor for nano flow rates
PAT Frits	Biotech AB	LC	Frits for HPLC columns
PBDE Chemical Reference Standard	AccuStandard	GC, LC-MS	Reference standards
PicoClear Sample Trap	New Objective	LC	Sample trap enrichment
PicoClear Union	New Objective	LC, CE-CEC	Union
Positive Pressure Manifold	United Chemical Technologies	Sample prep	SPE manifold system
SFC 3000 Digital EOM Mass Flow Controller	Sensirion AG	GC	Mass flow controller
SilTite Integrated Guard Column	SGE	GC	Capillary guard column
SPE Option for MPS rinse	Gerstel	Sample prep	Automated SPE device
Thermogreen LB-2 Molded Septa	Supelco	GC	GC septa
Ultimate Union Kit	Agilent Technologies	GC	GC union
Vapourtec V-10 Rapid Solvent Evaporator	Vapourtec/Biotage	Sample prep	Solvent evaporator system
VarioSplit	Brechtbuehler AG	GC	Flow splitter
Xenosep Filtration/SPE	Xenosep Technologies	Sample prep	Glassware
Zero Air Generator	domnick hunter	GC	Air generator

Suggested Applications	Comments
NanoLC, MS infusion, lab-on-a-chip	Monitors liquid flow rate from 1.000 to 8.000 nL/min with high precision and accuracy; calibrateable for any solvent; other suggested applications: feedstream to postcolumn reactor; pump calibration; system troubleshooting; uses proprietary MEMS-based thermal anemometry technology.
Where inert flow system required	PAT stands for PEEK alloyed with Teflon; formed by compressing PEEK and PTFE particles under controlled conditions to form porous sheets; exhibits low protein binding and chemical resistance; especially recommended for biological samples where stainless steel frits may have problems; pressure rating: <5000 psi; 0.8- and 1.59-mm thicknesses can be used without supporting rings. BIO
Environmental	Certified reference standards for PBDEs and metabolites; standards consist of 160 pure congeners and over 35 metabolites for EPA and EU regulations; can be useful for identifying and quantitating these compounds in the environment drinking water and other matrices.
Proteomics and other sample enrichment	Trap can be supplied with the company's chemistries or customer-specified chemistry; available in 50-, 75-, 100-, and 150- μ m i.d. and 360- μ m o.d. dimensions; materials of construction: aluminum, fluoropolymer, and PEEK; PicoClear construction allows instant visual verification of good connection as well as visual inspection during run (looking for contaminants).
Joining capillaries	A clear (see-through) union designed to connect fused-silica tubing and columns or as an inline filter with unpacked IntegraFrit column; allows immediate visual confirmation of good connection that does not damage fused-silica tubing; true zero dead volume; high pressure operation to greater than 4000 psi.; compatible with 360- μ m o.d. fused-silica and polymer tubing; inert fluoropolymer core; other materials of construction are aluminum and PEEK.
General SPE	Manifold with 48 positions each individually regulated; four pressure-controlled banks of 12 positions with flow indicator on each bank; uses different gas pressures for column extraction and drying; accommodates cartridges of 1-, 3-, 6-, 10-, and 15-mL sizes; includes waste reservoir that can be emptied between each waste step if desired.
Controlling flow in GC	Small digital mass flow controller for OEM applications; CMOSens Technology used to control carrier gases and flame gases for GC; various interfaces, pressure capabilities, temperature ranges, dynamic ranges, and so forth; wetted materials silicon nitride, PEEK, SS, PTFE.
See comments	A voidless, low thermal mass and permanent union allows mixed chemistry-mixed inside diameter column sets for GC; permits greater flexibility than when integrated guard column produced from a single capillary; suggested applications; retention gaps, guard columns, postcolumn restrictors, integrated column sets; columns can be supplied with guards on both ends; range of phase chemistries and column inner diameters can be supplied on request.
Automated SPE	MPS = multipurpose sampler; dedicated SPE accessory combined with sample introduction system for LC-MS and GC-MS systems, modular configuration; flexible and elution capabilities; based on standard 3-mL cartridges; software controlled; integrated with Agilent ChemStation software.
For capillary inlet	Molded injection port septa for GC; septa have better fit in injection pore and have recessed hole to reduce needle coring.
Connecting two capillary tubes	Recommended for connection for capillary columns, guard columns, and retention caps in GC; reusable mechanical seal-based using microfluidic technology; not sealing- or press fit-based; no need to retighten after temperature cycling; one size fits fused-silica tubing-columns with 100-530 μ m i.d.; available in deactivated and nondeactivated versions; ferrule release hole prevents stuck ferrules; kit has union and all hardware for connections.
Solvent evaporation	High speed automated evaporation; up to 40X faster (for example, a 10-mL water-based sample dried in 8 min at 35 °C; no bumping; automated end-of-run detection; compounds dried in vial of choice; scaleable; can also fit large volumes into small vials by using automatic multiple injections.
Splits flow for multiple detectors	Splitter allows one to dynamically change the split ratio to two or more detectors with no hardware modification; software controlled.
SPE, filtration	Glassware designed for low volume laboratories for cost-effective and easy-to-use SPE and filtration (33 and 47 mm); unique design increases effective filtration area of a 47-mm diameter filter by 71%; won't leak solvent or vacuum during SPE extraction operation.
FID-FPD air supply	Generator produces a continuous flow of zero grade (hydrocarbon-free) air with an ultra low residual methane content of <0.1 ppm from an existing compressed air supply; six models with flow rates ranging from 1.0 to 20 L/min; interchangeable top panel allows for direct mounting of company's hydrogen generator for all-in-one flame gas solution.

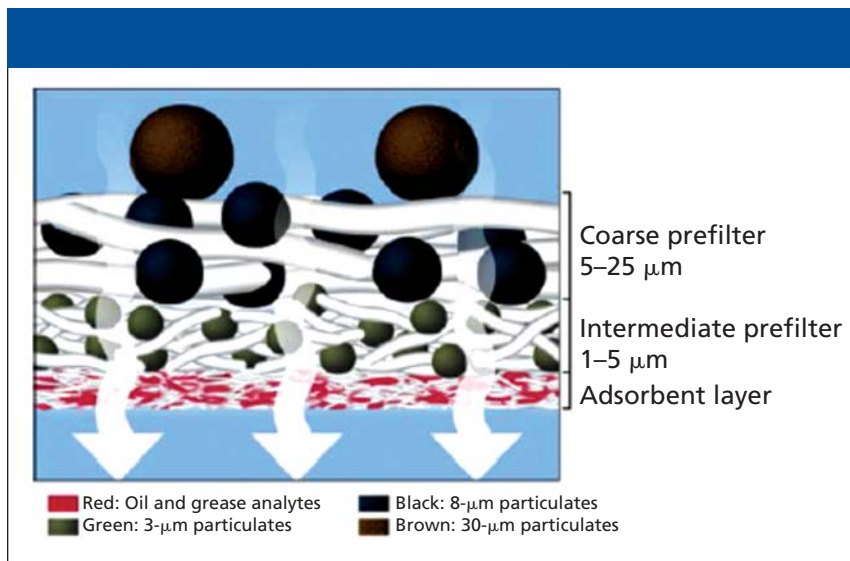


Figure 3: Illustration of a triple-layer SPE filter. (Courtesy of Xenosep Technologies.)

meric packings can be used under a wide variety of experimental conditions. Polymeric SPE products were displayed by Hamilton (Reno, Nevada), Polymer Labs (Amherst, Massachusetts), BIA Separations, OroChem Technologies (Lombard, Illinois), and Sepax Technologies (Newark, Delaware). Molecular-

imprinted phases are quite popular in Europe, less so in the United States. These phases are very selective due to the presence of molecular imprints of a specific template on the surface of a polymer. Molecular-imprinted phases are prepared by adding a target template molecule to the monomer reaction mix-

ture and forming a polymer around the template. The template is extracted away, leaving behind its imprint on the surface. When a mixture of compounds containing the target molecule is introduced to the molecular-imprinted phase, usually packed into a column or cartridge, there is a stronger affinity for the target molecule by the imprinted site. This is viewed by some as a "lock and key" mechanism. So the process very much resembles affinity attraction. Usually molecular-imprinted phases are customized synthesized but MIP Technologies (Lund, Sweden) has uncovered at least one high-volume application and has developed a molecular-imprinted phase exclusively for chloramphenicol, an antibiotic drug often used in cattle and poultry but banned in many countries. For this molecular-imprinted phase, detection limits well below the minimum performance limit are achieved. Glycopeptide sample preparation by HILIC SPE and a mixed-mode THC phase were some other specialized chemistries shown at Pittcon.

More traditional markets also are

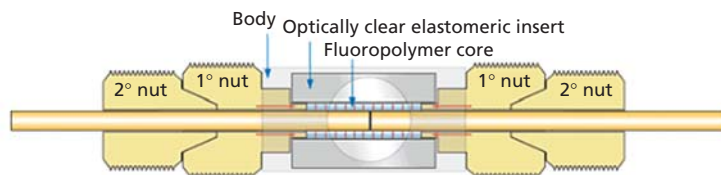


Figure 4: PicoClear union for LC and CEC connections. (Courtesy of New Objective.)

addressed. Environmental and food samples often contain low concentrations of contaminants that have to be analyzed and enrichment is often required. SPE is a technique often used for this purpose. New products addressing U.S. EPA methods were introduced by Xenosep Technologies (Boonton, New Jersey) (oil and grease, semivolatiles, chlorinated pesticides, PCBs, and phthalate ester) and Supelco (multiresidue pesticides). The Xenosep Technologies new triple layer SPE filter has been designed for use with EPA Method 1664A. This method is designated for oil and grease analysis and recently the EPA has allowed the use of SPE if equivalency the more accepted hexane extraction method is proven. One of the problems in using SPE devices such as cartridges or disks is that occurrence of plugging due to the presence of particulates, particularly in untreated effluents and in-process wastes. The Xenosep SPE filter (Figure 3) has a coarse layer (traps particles 5–25 μm) followed by an intermediate prefilter layer (traps particles 1–5 μm) followed by the SPE adsorbent layer, which retains the oil and grease compounds. This triple layer concept enables filtration much faster filtration (in a matter of seconds) and provides improved SPE recovery and precision performance.

Chromatography and Sample Preparation Accessories

Table III lists a record-breaking 31 new hardware products and accessories for HPLC, GC, capillary electrophoresis (CE), capillary electrochromatography (CEC), and sample preparation. This year, I have extended the columns and sample preparation accessories to include kits that are designated to solve specific applications problems. All of the products introduced were practical devices

designed to make the chromatographer's life easier. I will cover each area individually.

General laboratory products: An automated system for preparation of chemical solutions including HPLC mobile phases including pH adjustment of buffers should make life easier in the laboratory. New vials, caps, and septa including a integrated vial insert system was introduced. Reference standards are always appreciated. A convenient small laboratory cooler that can be used for a variety of cryogenic experiments and sub-ambient storage of samples was displayed.

HPLC, LC-MS, CE-CEC products: Column switching is having a comeback driven by the needs to tackle complex samples such as tryptic protein digests. Systems, trapping columns, and orthogonal column sets were introduced. With the miniaturization in HPLC with shorter and smaller diameter columns as well as high-pressure requirements for longer columns and smaller particles,

new lower dead volume and higher pressure rating hardware designs are becoming available so that performance is not compromised. A “see-through” union for low-volume connections for fused silica tubing shows promise. Figure 4 shows the PicoClear Union from New Objective (Woburn, Massachusetts). Unlike fused-silica unions used in nanoLC and CE-CEC that use frusto-conical compression, the absence of mechanical twisting with the PicoClear Union eliminates fused silica grinding and compression and reduces the subsequent likelihood of contamination. Through visual inspection, PicoClear Technology eliminates any question that a connection is leak-free and uncontaminated. Because high-temperature LC is becoming of increasing interest, a standalone mobile phase preheater or post column cooler should aid column performance and detector baseline stability. A new nanoliter flow sensor should help to ensure stable reagent addition or pump flow direct or split-flow output is constant.

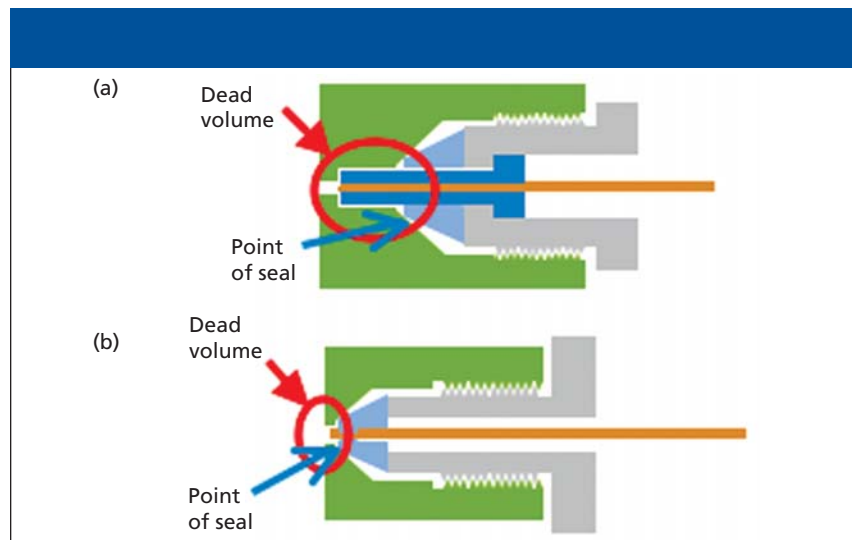


Figure 5: Schematics of (a) current stainless steel GC connector and (b) Agilent's Ultimate Union GC column connector. (Courtesy of Agilent Technologies.)

GC-SFC products: A large number of convenience products were shown at Pittcon. Gas generators can replace inconvenient and dangerous gas cylinders. New hydrogen and zero air generators were introduced. Gas cylinders in the field are a hassle so that a hydrogen storage system that can operate for long periods of time might be a boon for field GC testing. Improved septa and inert inlet liners are always appreciated. Guard columns, either integrated or external, help to slow down column deterioration. Leak-free unions that do away with press-fit should help those interested in connecting capillary columns, retention or guard columns together. Figure 5 compares a typical GC union stainless steel hardware design with the Ultimate Union Design (Agilent Technologies, Santa Clara, California). In the latter union, the seal is made at the contact of the ferrule (light blue) and the metal fitting (green). The amount of dead (or unswept) volume is limited to a very small space near the tip of the column while the conventional union allows the sample to migrate into long unswept cracks and crevices causing peak tailing. A variable flow splitter for feeding GC column outlet flow to multiple detectors should prove valuable.

Sample preparation products: The use of vacuum systems for SPE sometimes creates problems with uneven flow and the possibility of drying out cartridges. A positive pressure manifold with individual flow regulators should help out. A low-volume SPE glassware system which is cost effective might prove helpful to sample prep chemists. The automation of solvent evaporation should prove to be a time saving and more reproducible operation and a couple of units for controlled evaporation were introduced.

Acknowledgment

I would like to thank the manufacturers and distributors that kindly furnished the requested information in advance of Pittcon 2006, thus, allowing a timely report on new product introductions. For those manufacturers who would like to be considered for inclusion into Pittcon 2007 coverage, please send the name of the primary company contact, the mailing address, fax number, and e-

mail address to Patrick Kempf, Managing Editor, LCGC North America, c/o Advanstar Communications, 485 Rte. 1 South, Bldg. F, Iselin, NJ 08830, Attn.: Pittcon 2007 "Column Watch."

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