

APPLICATIONS

Investigation of Methanol Loss from Solvent Reservoirs and Its Potential Mitigation by the Use of SecurityCAPTM

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Zeshan loves to collect watches and the Back to the Future Trilogy. He has twin boys which drive him crazy! He is an Apple[®] fanboy for life and he likes being in the lab more than anywhere else.

Abstract

Losses of volatile solvents into the atmosphere can result in poor laboratory air quality and create health and safety risks for laboratory staff. As there are cost implications due to the wasted solvent loss, there is also a potential for variability in chromatography as the mobile phase may become contaminated.

Introduction

Providing a safe working environment for employees is of prime concern for employers. Generally, little consideration is given to the solvents typically used in reversed phase HPLC/UHPLC systems, like methanol, in terms of solvent volatility. Non-airtight container caps and unsecured solvent delivery tubing allow solvent vapors and gasses into the laboratory creating exposure risks for laboratory workers and visitors. Unsealed containers can also allow dust or other airborne particles into the container which can contaminate the mobile phase, create mystery ghost peaks, block system filters or even the HPLC/UHPLC column itself. Solvent reservoirs are often placed on top of HPLC/UHPLC systems to allow gravity to assist in providing flow to the pump head. Such positioning together with unsecured solvent container closures increase the risk of splashing or spillage of solvents further creating a safety risk.

As laboratories often have multiple systems, each with their own solvent reservoirs, any solvent vapor and gas build up should be within OSHA guidelines. In this tech note we investigate the use of a variety of different solvent bottle closures on the rate of evaporative loss of methanol, calculated by weight. Below are the OSHA and NIOSH Permissible Exposure Limits.

Standard Set by	Exposure Limit	Health Effect Codes – Health Effects and Target Organs
Occupational Safety and Health Administration (OSHA)	200 ppm (260 mg/m ³) TWA	HE3—accumulation in blood and tissues
National Institute for Occupational Safety and Health (NIOSH)	200 ppm (260 mg/m ³) TWA 250 ppm (325 mg/m ³) STEL skin	HE3—visual disturbances, optic neuropathy HE7—headache, drowsiness, dizziness Target organs – brain, central nervous system HE16—eye, skin and respiratory irritation dermatitis

TWA-Time weighted average
STEL-Short term exposure limit

Experimental Conditions

Solvent bottles were each filled with 1 liter of methanol, equipped with a variety of closures, and placed in a fume hood for 10 days. They were weighed at the beginning and end of this period. Each closure/cap style was equipped with HPLC Teflon[®] tubing to simulate real world usage. The laboratory temperature during this time was an average 25° C. Results:

Bottle	Initial Solvent Weight (g)	Solvent Weight After 10 Days (g)	% Difference
SecurityCAP	1350.6	1349.9	0.05
Fully Closed Cap	1351.8	1351.7	0.007
3-Port Cap	1348.7	1321.1	2.0
No Cap	1348.4	973.1	27.8
Aluminium Foil Cap	1349.0	1336.8	0.9



Results and Discussion

The first important point to note is that solvent losses occur in all cases, even with the control (fully capped bottle). This indicates the necessity to store all solvents in an appropriate facility when not in use. The other cap options we have included in this study are designed to illustrate likely losses from commonly used solvent bottle cap solutions. These range from no cap, through aluminium foil used to help prevent ingress of airborne particulates, and standard caps with holes ports to accommodate solvent delivery tubing.

The greatest losses are seen for the solvent reservoir with no cap, which is in line with expectations. The magnitude of the loss, at 27.8% is extremely significant. A three port cap was found to lose 2% of the solvent over 10 days. The fact that the Teflon® tubing is not secured to the cap, allowing for vapor leakage has a significant loss. The use of aluminium foil as a reservoir closure resulted in close to 1% loss of solvent while the solvent bottles using SecurityCAP™ reduced methanol loss to 0.05%.

The performance improvements seen with SecurityCAP solvent/eluent products are due to an integrated one-way air valve and filter along with secure tubing seals that protects lab air quality from hazardous solvent vapors and gases that can escape from unsecure solvent containers. The SecurityCAP solvent filter also incorporates

a PTFE membrane that captures dust, dirt, and other contaminants in the air and prevents them from entering the solvent/eluent container, protecting solvents from contamination. This protects both the chromatography results and HPLC/UHPLC systems.

An added benefit of the SecurityCAP is that should the solvent reservoir be accidentally tipped during installation or during transportation, the cap is completely leak free, preventing accidental spillage or leakage. Also the tubing which delivers solvent to the HPLC pump is securely held in place, preventing it from moving above the solvent level, which would allow air to be drawn into the system.

Conclusion

The SecurityCAP, featured in this technical note, provides the best option of those tested for reducing methanol loss from HPLC/ UHPLC solvent reservoirs used for chromatography. It also prevents the ingress of airborne particulates and contaminants due to the air filter incorporated in the design. The use of SecurityCAPs reduces employee solvent exposure, both airborne and through accidental spillage.

SecurityCAP™ Ordering Information



Starter Kits

SecurityCAP Mobile Phase (Eluent) Safety Starter Kits

Part No.	Description
AC2-1245	2-port GL45 Cap and 6-month Safety Filter
AC2-4245	2-port GL45 Caps (x4) and 6-month Safety Filters (x4)
AC2-4240	2-port Merck S40 Caps (x4) and 6-month Safety Filters (x4)
AC2-1345	3-port GL45 Cap and 6-month Safety Filter
AC2-4345	3-port GL45 Caps (x4) and 6-month Safety Filters (x4)
AC2-4445	4-port GL45 Cap (x1) and 2-port Caps (3x) and 6-month Safety Filters (x4)
AC2-1445	4-port GL45 Cap and 6-month Safety Filter
AC2-1545	5-port GL45 Cap and 6-month Safety Filter
AC2-1561	5-port S60/S61 Cap and 6-month Safety Filter

Replacement Filters

SecurityCAP Mobile Phase Safety Filters

Part No.	Description	Unit
AC2-0161	6-month Capacity, ¼ in.-28 Threads	ea
AC2-0961	6-month Capacity, ¼ in.-28 Threads	10/pk

Fittings and Accessories

SecurityCAP Fittings

Part No.	Description	Unit
AC3-1101	for ¼ in. or 2.0 mm OD Tubing, ¼ in.-28 Threads (POM), blue	ea
AC3-1201	for 2.3-2.6 mm OD Tubing, ¼ in.-28 Threads (POM), white	ea
AC3-2101	for ¼ in. OD Tubing, ¼ in.-28 Threads (POM), black	ea

SecurityCAP Connectors

Part No.	Description	Unit
AC3-1001	Barbed Connector, for 5-8 mm ID Tubing (PTFE), white	ea
AC3-1301	Y-connector, for 6-8 mm ID Tubing (POM), white	ea

POM = polyoxymethylene

PTFE = polytetrafluoroethylene (Teflon®)

SecurityCAP Waste Safety Compatibility Table

Supplier	Phenomenex SecurityCAP Filters	
	ea	3/pk
SCAT[®] Safety Waste Caps	AC1-0162	AC1-0362
AIT[®] SmartCaps[™]	AC1-0162	AC1-0362
Agilent[®] InfinityLab Stay Safe Caps	AC1-0162	AC1-0362
VICI[®] Waste Caps	AC1-0161	AC1-0361
Canary-Safe[™] Safety Caps	AC1-0162	AC1-0362
DURAN[®] DG Safety Caps	AC1-0162	AC1-0362



SecurityCAP Waste Safety Filters

Part No.	Description	Unit
AC1-0161	6-month Exhaust Filter for SecurityCAP, 1/4 in.-28 Threads	ea
AC1-0361	6-month Exhaust Filter for SecurityCAP, 1/4 in.-28 Threads	3/pk
AC1-0162	6-month Exhaust Filter for Wide-port Caps, GL14 Threads	ea
AC1-0362	6-month Exhaust Filter for Wide-port Caps, GL14 Threads	3/pk



SecurityCAP Adapter

Part No.	Description	Unit
AC2-1138	Cap Thread Adapter, PTFE, GPI/GL 38 Female to GL45 Male	ea

SecurityCAP Sealing Plug

Part No.	Description	Unit
AC3-2001	1/4 in.-28 Threads (POM), white	ea



SecurityCAP Waste Safety Starter Kits

Part No.	Description	Unit
AC1-1245	2-port GL/DIN45 Cap and 6-month Exhaust Filter and Barbed Connector	ea
AC1-1545	5-port GL/DIN45 Cap and 6-month Exhaust Filter	ea
AC1-1551	5-port DIN51 Cap and 6-month Exhaust Filter	ea
AC1-1561	5-port S61 Cap and 6-month Exhaust Filter	ea



If Phenomenex products in this technical note do not provide at least an equivalent separation as compared to other products of the same phase and dimensions, return the product with comparative data within 45 days for a FULL REFUND.



APPLICATIONS

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