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Chemical Stability of Varispenser® and Top Buret™

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Abstract

Trace analysis, e.g. in food quality control, puts highest demands on the chemical inertness of the instruments used in this kind of assay. Even when applying aggressive chemicals, no residues are allowed to be released from the instruments used. This publication shows that the Varispenser is suitable for trace analysis. Moreover, an overview of the chemical application field of Varispenser and Top Buret is given.

Introduction

Bottle-top dispensers are used in the lab for dispensing a wide range of different liquids and solvents from glass or stainless steel containers. These dispensers have to meet various requirements. For example, they should not give off any substances which may disturb trace analysis, have cytotoxic properties, distort optical tests or influence chromatographic methods and residue analysis. Even after prolonged contact with a solvent, the materials of a bottle-top dispenser should neither be affected nor bind the solvent non-specifically. This means that there are very high demands on the chemical resistance of bottle-top dispensers. Accordingly, the bottle-top dispensers Varispenser and Varispenser plus as well as the Top Buret from Eppendorf are made of materials which are particularly resistant to chemicals. Only parts made of the chemical resistant materials PFA, PTFE, FEP, ETFE, borosilicate glass 3.3 and Pt-Ir (abbreviations: see tab. 1) come into contact with the solvents. The adapter rings for the screw connection are made of PP or PTFE.
A residue analysis of foods places high demands on the purity of solvents and inertness of the lab equipment used. To detect, for example, even smallest traces of pesticides, contamination caused by lab equipment has to be avoided under all circumstances. A series of experiments was performed to test the suitability of the Varispenser for food analysis by determining whether the Varispenser is inert to the solvents commonly used in this field.

Table 1: Abbreviations and chemical names of Varispenser and Top Buret materials

Abbreviation	Chemical name
ETFE	ethylene/tetrafluoroethylene-copolymer
FEP	tetrafluoroethylene/perfluoropropylene-copolymer
FKM	poly(vinylidene fluoride-co-hexafluoropropylene)
PE	polyethylene
PFA	perfluoroalkoxy-copolymer
PP	polypropylene
PTFE	poly(tetrafluoroethylene)
PVDF	poly(vinylidene fluoride)
Pt-Ir	platinum-iridium

The following pages include an example of the use of a Varispenser for residue analysis in the lab of a food manufacturer. Furthermore, a list of the chemical stability of the Varispenser and recommendations for the chemical application field of Top Buret are given. An overview of the materials of the Varispenser and Top Buret is given as well.

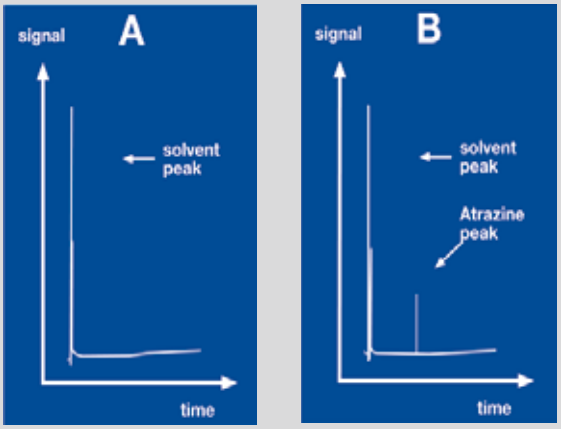
Materials and Methods

The chemical stability of the Varispenser was verified at the main lab “Residual Analysis” of the Hipp plant, Pfaffenhofen, Germany. A residue analysis of the pesticide atrazine was performed whereat the Varispenser was used to dispense ultrapure solvents. Two experiments were performed:

Test A
100 ml of the solvent acetonitrile (CH_3CN) were drawn from a larger supply with a Varispenser, evaporated in a rotation evaporator and then dissolved in 1 mL of the solvent i-octane (2,2,4-trimethylpentane). The sample was examined using gas chromatography.

Test B
In order to detect minute amounts of pesticides, the background in the chromatogram must consistently be as low as possible. For testing the suitability of the Varispenser in trace analyses a specific amount of the herbicide atrazine (50 pg/mL)* was added to a sample treated as in Test A as a comparative standard for pesticides. Again, the sample was analyzed by gas chromatography.

*EG drinking water limit: 100 pg/mL



Test A: 100 mL acetonitrile evaporated, dissolved in 1 mL octane, 0.5 µL injected.
Test B: Like test A, except 50 pg/mL atrazine added as pesticide reference.

Figure 1: Chromatograms of trace analyses using Varispenser

Results and Conclusion

As shown in fig. 1A no other peak could be found in addition to the solvent (acetonitrile) peak after performing Test A. Therefore, at these conditions no substances had been released from the Varispenser.
The chromatogram of Test B (see fig. 1B) shows a clear atrazine peak without any ghost bands. This demonstrates that no traces of substances have been released into the solvent by the Varispenser. Thus, the system is suitable to detect even minute amounts of substances like pesticides.

Quotation from Mr. Lembacher, main lab “Residual Analysis” of the Hipp plant:
“The chromatograms recorded show that the dispenser is extremely inert. Fears about interference by plasticizers – even during long-term use – were totally unfounded.”

Appendix

The following tables show the recommended chemical application area of Top Buret (Tab. 2) and a list of materials Top Buret and Varispenser are made of (Tab. 3). Also, the chemical stability of the Varispenser is displayed (Tab. 4).

Table 2: Recommended application area of the Top Buret

The Top Buret is suitable for dispensing of titration media up to a maximum concentration of 2 mol/L.

A	Acetic acid	**N**	Nitric acid	**S**	Silver nitrate solution
	Alcoholic potassium hydroxide solution	**O**	Oxalic acid solution		Sodium arsenite solution
	Ammonium iron (II) sulfate solution	**P**	Perchloric acid		Sodium carbonate solution
	Ammonium thiocyanate solution		Potassium bromate solution		Sodium chloride solution
B	Barium chloride solution		Potassium bromide bromate solution		Sodium hydroxide solution
	Bromide bromate solution		Potassium dichromate solution		Sodium nitrite solution
C	Cerium (IV) sulfate solution		Potassium hydroxide solution		Sodium thiosulfate solution
E	EDTA solution (ethylenediamine tetraacetic acid)		Potassium iodate solution		Sulphuric acid
H	Hydrochloric acid		Potassium permanganate solution	**T**	Tetra-n-butylammonium
I	Iodine solution		Potassium thiocyanate solution		hydroxide solution
	Iron (II) sulfate solution			**Z**	Zinc sulfate solution

These informations are valid for usage, only. Storage might lead to crystal formation. Please rinse device daily when chemical is subject to crystallization. The recommendations are carefully checked and correspond to the current state of knowledge. If you need statements for chemicals which are not given in the list, please do not hesitate to contact us.

Table 3: Materials of Varispenser, Varispenser plus and Top Buret

Part	Varispenser	Varispenser plus	Top Buret
Direct contact to dipensing fluid			
Valve head	PFA	PFA	PFA
Telescopic intake tube	FEP/ETFE/PTFE	FEP/ETFE/PTFE	FEP/ETFE/PTFE
Intake valve/valve ball	ETFE/borosilicate glass 3.3	ETFE/borosilicate glass 3.3	–
Dosing unit (piston-/cylinder-unit with intake valve)	–	–	PFA/Pt-Ir/PTFE/ borosilicate glass 3.3
Cylinder	ETFE/borosilicate glass 3.3	ETFE/borosilicate glass 3.3	see dosing unit
Piston head	PFA	PFA	see dosing unit
Discharge valve incl. recirculation valve	–	PFA/PTFE/Pt-Ir/ borosilicate glass 3.3	PFA/PTFE/Pt-Ir/ borosilicate glass 3.3
Discharge valve	PFA/Pt-Ir/ borosilicate glass 3.3	–	–
Discharge tube	FEP	FEP	FEP
Indirect contact to dipensing fluid			
Valve head casing	PP	PP	PP
Piston rod	ETFE	ETFE	see dosing unit
Piston seat	PP	PP	–
Cylinder casing	PP	PP	–
Protective cylinder sleeve	PP	PP	–
Discharge tube support	PP	PP	PP
Discharge tube closure cap	PVDF	PVDF	PVDF
Ventilation cover	PP	PP	PP
Volume adjustment knob	–	PP	–
Hand wheels	–	–	PP
O-ring for valve cock protection	–	FKM	FKM
Volume setting knob	PP	PP	–
Discharge valve toggle	–	PP	PP
Drying tube (optional)	PP	PP	PP
Thread adapter	PP	PP	PP
Casing	–	–	PP
Display	–	–	Polyester

Technical specifications subject to change! For explanations of abbreviations refer to the table on page 1.

Table 4: Chemical stability of the Varispenser and Varispenser plus

For each chemical, 2 numbers are given. The numbers on the left display the stability at a test temperature of +20 °C, the numbers on the right the stability at +50 °C. Salts were tested as almost saturated solutions.
All data are recommendations without guarantee. **1** = usable, **2** = limited usage, **3** = not usable

Materials	PFA	PTFE	borosilicate glass 3.3	Varispenser can be used	PP Adapter rings	
Chemicals						
A						
Acetaldehyde	1 1	1 1	1 1	**1 1**	1 3	*1
Acetic acid 50 %	1 1	1 1	1 1	**1 1**	1 1	
Acetone *4	1 1	1 1	1 1	**1 1**	1 1	
Acetonitrile *4	1 1	1 1	1 1	**1 1**	2 3	*1
Acrylonitrile	1 1	1 1	1 1	**1 1**	2 3	*1
Adipic acid	1 1	1 1	1 1	**1 1**	1 1	
Allyl alcohol	1 1	1 1	1 1	**1 1**	1 1	
Aluminium chloride solution	1 1	1 1	1 1	**1 1**	1 1	
Aluminum hydroxide	1 1	1 1	1 1	**1 1**	1 1	
Amino acids	1 1	1 1	1 1	**1 1**	1 1	
Ammonium chloride solution	1 1	1 1	1 1	**1 1**	1 1	
Ammonium hydroxide 25 %	1 1	1 1	1 1	**1 1**	1 1	
n-Amyl acetate	1 1	1 1	1 1	**1 1**	2 3	*1
Amyl alcohol	1 1	1 1	1 1	**1 1**	1 1	
Amyl chloride	1 1	1 1	1 1	**1 1**	3 3	*1
Aniline	1 1	1 1	1 1	**1 1**	1 1	
B						
Barium chloride ($BaCl_2$)	1 1	1 1	1 1	**1 1**	1 1	
Benzaldehyde	1 2	1 1	1 1	**1 2**	1 1	
Benzene	1 1	1 1	1 1	**1 1**	1 2	*1
Benzine	1 1	1 1	1 1	**1 1**	2 2	*1
Benzyl alcohol	1 1	1 1	1 1	**1 1**	3 3	*1
Boric acid	1 1	1 1	1 1	**1 1**	1 1	
n-Butanol	1 1	1 1	1 1	**1 1**	1 1	
n-Butyl acetate	1 1	1 1	1 1	**1 1**	2 2	*1

Materials	PFA	PTFE	borosilicate glass 3.3	Varispenser can be used	PP Adapter rings	
Chemicals						
C						
Calcium chloride	1 1	1 1	1 1	**1 1**	1 1	
Chloroacetic acid	1 1	1 1	1 1	**1 1**	1 1	
Chromic acid 10 %	1 1	1 1	1 1	**1 1**	1 1	
Chromic acid 50 % *2	1 1	1 1	1 1	**1 1**	2 2	*1
Chromic sulfuric acid, concentrated *2	1 1	1 1	1 1	**1 1**	3 3	*1
Cresol	1 1	1 1	1 1	**1 1**	1 2	*1
Cupric sulphate	1 1	1 1	1 1	**1 1**	1 1	
D/E						
Dibutyl phthalate	1 1	1 1	1 1	**1 1**	1 2	*1
Dichlorobenzene	1 1	1 1	1 1	**1 1**	2 3	*1
Dichlorethane (Ethyl dichloride) *4	1 1	1 1	1 1	**1 1**	2 3	*1
Dichlormethane (Methylene chloride) *4	1 1	1 1	1 1	**1 1**	2 3	*1
Diethylene glycol	1 1	1 1	1 1	**1 1**	1 1	
Diethyl ether	1 1	1 1	1 1	**1 1**	2 3	*1
Dimethylformamide	1 1	1 1	1 1	**1 1**	1 3	*1
1.4-Dioxan	1 1	1 1	1 1	**1 1**	2 2	*1
Ethanol 100 % (Ethyl alcohol)	1 1	1 1	1 1	**1 1**	1 1	
Ethyl acetate	1 1	1 1	1 1	**1 1**	1 1	
F/G						
Formaldehyde 40 %	1 1	1 1	1 1	**1 1**	1 1	
Formic acid 98–100 % *5	1 1	1 1	1 1	**1 1**	1 1	
Fuel oil	1 1	1 1	1 1	**1 1**	1 1	
Glycerol *3	1 1	1 1	1 1	**1 1**	1 1	
Glycol	1 1	1 1	1 1	**1 1**	1 1	

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Chemicals	PFA	PTFE	Varispenser can be used borosilicate glass 3.3	PP Adapter rings		
H/I/J						
Hexane	1 1	1 1	1 1	**1 1**	2 3	*1
Hydrochloric acid 35 % *4	1 1	1 1	1 1	**1 1**	1 1	
Hydrochloric acid 37 % *4	1 1	1 1	1 1	**1 1**	1 3	*1
Iodine-potassium iodide sol.	1 1	1 1	1 1	**1 1**	1 1	
Isobutanol (Isobutyl alcohol)	1 1	1 1	1 1	**1 1**	1 1	
Isopropanol (Isopropyl alcohol)	1 1	1 1	1 1	**1 1**	1 1	
L/M/N						
Lactic acid (Salts: Lactates)	1 1	1 1	1 1	**1 1**	1 1	
Magnesium chloride (MgCl)	1 1	1 1	1 1	**1 1**	1 1	
Mercury (I) chloride	1 1	1 1	1 1	**1 1**	1 1	
Methanol (Methyl alcohol) *4	1 1	1 1	1 1	**1 1**	1 1	
Methyl propyl ketone	1 1	1 1	1 1	**1 1**	1 2	*1
Nitric acid 30 %	1 1	1 1	1 1	**1 1**	1 1	
Nitrobenzene	1 1	1 1	1 1	**1 1**	3 3	*1
O/P						
Octane/Iso octane	1 1	1 1	1 1	**1 1**	3 3	*1
Oil of turpentine	1 1	1 1	1 1	**1 1**	3 3	*1
Oxalic acid	1 1	1 1	1 1	**1 1**	1 1	
Pentane (n-/Iso-) *4	1 1	1 1	1 1	**1 1**	3 3	*1
Perchloric acid 10 %	1 2	1 1	1 1	**1 2**	1 3	*1
Phenol (saturted aqueous solution)	1 1	1 1	1 1	**1 1**	1 1	
Phosphoric acid 85 %	1 1	1 1	2 3	**2 3**	1 1	
Potassium chloride	1 1	1 1	1 1	**1 1**	1 1	
Potassium hydroxide 50 %	1 1	1 1	1 2	**1 2**	1 1	
Potassium permanganate	1 1	1 1	1 1	**1 1**	1 1	
Propanol	1 1	1 1	1 1	**1 1**	1 1	
Propylene glycol	1 1	1 1	1 1	**1 1**	1 1	
Propylene oxide	1 1	1 1	1 1	**1 1**	1 1	
Pyridine	1 1	1 1	1 1	**1 1**	2 2	*1

Chemicals	PFA	PTFE	Varispenser can be used borosilicate glass 3.3	PP Adapter rings		
S						
Salicylaldehyde	1 1	1 1	1 1	**1 1**	1 1	
Salicylic acid	1 1	1 1	1 1	**1 1**	1 1	
Scintillation cocktail	1 1	1 1	1 1	**1 1**	2 3	*1
Silver acetate	1 1	1 1	1 1	**1 1**	1 1	
Silver nitrate	1 1	1 1	1 1	**1 1**	1 1	
Sodium acetate	1 1	1 1	1 1	**1 1**	1 1	
Sodium dichromate	1 1	1 1	1 1	**1 1**	1 1	
Sodium hydroxide 30 %	1 1	1 1	1 2	**1 2**	1 1	
Sulphuric acid 60 %	1 1	1 1	1 1	**1 1**	1 1	
Sulphuric acid 98 %	1 1	1 1	1 1	**1 1**	3 3	*1
T/U						
Tartaric acid	1 1	1 1	1 1	**1 1**	1 1	
Tenside (Tween®-, Triton® X-, Brij®-dilutions) *6	1 1	1 1	1 1	**1 1**	1 1	
Toluene	1 1	1 1	1 1	**1 1**	2 3	*1
Trichloroacetic acid 10 %	1 1	1 1	1 1	**1 1**	1 1	*1
Triethylene glycol	1 1	1 1	1 1	**1 1**	1 1	
Tripropylenglycol	1 1	1 1	1 1	**1 1**	1 1	
Urea	1 1	1 1	1 1	**1 1**	1 1	
X						
Xylene	1 1	1 1	1 1	**1 1**	3 3	*1
Z						
Zinc chloride 10 %	1 1	1 1	1 1	**1 1**	1 1	
Zinc sulphate 10 %	1 1	1 1	1 1	**1 1**	1 1	

*1 PTFE adapter available
*2 Pt-Ir can be easily loosened from the spring
*3 Liquid with high viscosity
*4 Liquid with high vapor pressure; gases leak (observe safety regulations)
*5 Intensive cleaning is necessary after use
*6 May lead to foam formation

Acknowledgement:

We thank Mr. Lembacher, main lab “Residual Analysis” of the Hipp plant, Pfaffenhofen, Germany, for his creative and helpful input into this analysis.

Ordering information

Description	Order no. Varispenser® plus	Order no. Varispenser®
Varispenser®, Bottletop dispenser, for external bottle threads of 32 mm (sizes 1, 2, 3) and 45 mm (sizes 4, 5, 6), complete with telescopic tube, tool and three adapters. Quality certificate. **Varispenser® plus**, same as Varispenser, plus recirculation valve, valve toggle and media-specific fine adjustment.		
Size 1, 0.5–2.5 ml, outer ø 28, 40, 45 mm	4961 000.012	4960 000.019
Size 2, 1–5 ml, outer ø 28, 40, 45 mm	4961 000.020	4960 000.027
Size 3, 2–10 ml, outer ø 28, 40, 45 mm	4961 000.039	4960 000.035
Size 4, 5–25 ml, outer ø 32, 38, 40 mm	4961 000.047	4960 000.043
Size 5, 10–50 ml, outer ø 32, 38, 40 mm	4961 000.055	4960 000.051
Size 6, 20–100 ml, outer ø 32, 38, 40 mm	4961 000.063	4960 000.060

Article	Description	Order no.
Top Buret™, Bottletop burette with recirculation valve, valve toggle, telescopic filling tube, adjustable discharge tube, three adapters for 40/38/32 mm bottle threads, 2 x 1.5 V microbatteries. Quality certificate.		
Top Buret™ M	2,500 µl per rotation of handwheel	4965 000.017
Top Buret™ H	5,000 µl per rotation of handwheel	4965 000.025

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