VOC-Pak™ Point-of-Use Polisher

Final purification step at the ultrapure water point-of-delivery efficiently removes Volatile Organic Compounds (VOCs)

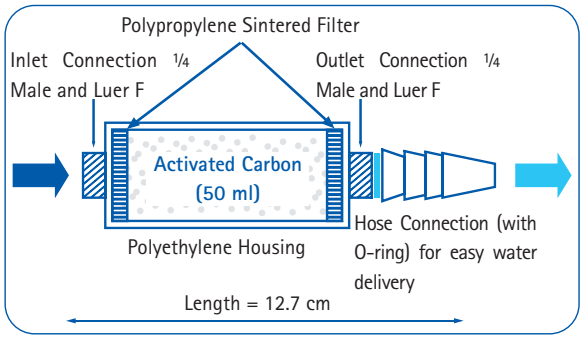
VOCs are industrial contaminants that may cause health safety issues and therefore should be detected in the environment. VOCs are routinely analyzed in water, soil, soil gas and air.
Specifications for VOCs in drinking water have been established by different regulatory agencies in many countries. A table showing the Maximum Allowable Concentration (MAC) for some of the different VOCs monitored in the United States, Europe, Japan and China, as well as by the World Health Organization (WHO), is available on the Merck Millipore web site: www.millipore.com/labwater

Benefits

- The VOC-Pak™ polisher is easily connected to the outlet of all Merck Millipore Type I water purification systems (Milli-Q®, Direct-Q®, Synergy® and Simplicity® systems)
- The final purification step provides VOC-free ultrapure water at high flow rate—when you need it
- Delivers a minimum of 300 l of VOC-free ultrapure water
- Validated for efficient removal of VOCs
- Each VOC-Pak™ cartridge is delivered with a Certificate of Quality

VOC-Pak™ POLISHER DESIGN

The VOC-Pak™ cartridge is designed to assure scientists performing VOC analysis that the ultrapure water they use to rinse glassware, produce standard solutions or dilute samples is VOC-free.



The purification media used to achieve this goal is a specific activated carbon selected after tests performed on media from many suppliers.

Table 1:
Results of the VOC-Pak™ challenge test for a processed volume of 350 l

VOC tested	Challenge (ppb) (*)	Quantification limit (ppb) (**)	Concentration after VOC-Pak™ (ppb) (***)
benzene	0.97	< 0.05	< 0.05
bromodichloromethane	1.56	< 0.05	< 0.05
bromoform	1.58	< 0.50)	< 0.50
carbon tetrachloride	1.06	< 0.05	< 0.05
chlorobenzene	0.94	< 0.05	< 0.05
chloroform	1.07	< 0.05	< 0.05
dibromochloromethane	1.01	< 0.10	< 0.10
1,2-dichlorobenzene	1.01	< 0.05	< 0.05
1,4-dichlorobenzene	1.53	< 0.05	< 0.05
1,2-dichloroethane	1.08	< 0.05	< 0.05
1,1-dichloroethene	0.87	< 0.05	< 0.05
cis-1,2-dichloroethene	0.95	< 0.05	< 0.05
trans-1,2-dichloroethene	1.53	< 0.05	< 0.05
1,2-dichloropropane	0.86	< 0.05	< 0.05
cis-1,3-dichloropropene	0.97	< 0.04	< 0.04
trans-1,3-dichloro-propene	0.91	< 0.05	< 0.05
ethylbenzene	1.09	< 0.05	< 0.05
tetrachloroethene	1.44	< 0.05	< 0.05
toluene	0.96	< 0.10	< 0.10
1,1,1-trichloroethane	0.94	< 0.10	< 0.10
1,1,2-trichloroethane	0.93	< 0.05	< 0.05
trichloroethene	1.02	< 0.05	< 0.05
o-xylene	0.79	< 0.05	< 0.05
m-xylene	1.02	< 0.05	< 0.05
p-xylene	0.94	< 0.05	< 0.05

(*) Challenge = VOC concentration in feed water upstream of VOC-Pak™ cartridge
(**) Quantification limit: limit of quantification of the VOC measured by GC
(***) Concentration of VOC below the VOC-Pak™ cartridge for a feed water concentration of 1 ppb

VOC-Pak™ POLISHER OPERATION

The VOC-Pak™ cartridge is easy to use: simply connect the VOC-Pak™ unit to the outlet of the Merck Millipore ultrapure water system and flush 5 l of water. You are now ready to deliver at least 300 l of VOC-free ultrapure water.

VOC-Pak™ POLISHER SPECIFICATIONS

The VOC-Pak™ cartridge is designed to producewater in which the VOC concentration is below the analytical quantification limit (**) for the VOCs listed in Table 1, provided that the VOC concentration in feed water does not exceed 1 ppb (1 µg/l), and the Total Oxidizable Carbon (TOC) of the ultrapure water entering the VOC-Pak™ cartridge is below 5 ppb.

In order to warrant this water quality, the VOC-Pak™ cartridge was qualified by a challenge test: the VOC-Pak™ cartridge was fed by ultrapure water containing a 1 ppb (1 µg/l) concentration of the VOC to be eliminated.

The concentration of the VOC was measured by Gas Chromatography (GC) downstream of the VOC-Pak™ cartridge after passage of 50, 100, 150, 200, 250, 300 and 350 l in order to determine the breakthrough point of the different VOCs. The results are displayed in Table 1 for a processed volume of 350 l.

Q-POD® dispenser fitted with a VOC-Pak™ cartridge

Analysis of the VOCs in ultrapure water was performed according to Merck Millipore procedure 84214SO, using an Eclipse 4660 Purge-and-Trap sample concentrator from OI Corporation™ (College Station, Texas) and a GC-MS system (GC model 6890N and MS model 5975B) from Agilent Technologies®, Inc., Santa Clara, California. A copy of the complete qualification report with description of the analytical procedure is available upon request.

Additionally, each lot of VOC-Pak™ cartridges is analyzed to ensure that the following VOCs (Table 2) are below the analytical quantification limit in water produced by a VOC-Pak™ fed with ultrapure water from a Merck Millipore Milli-Q® system (resistivity at 18.2 MΩ.cm at 25 °C and TOC < 5 ppb).

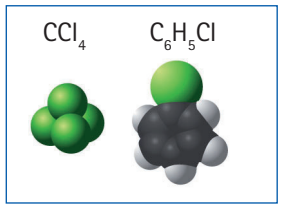
Table 2:

Quantification limits (ppb) of VOCs analyzed in each lot of VOC-Pak™ cartridges

Compound	QL* (ppb)
benzene	< 0.05
bromobenzene	< 0.10
bromochloromethane	< 0.05
bromodichloromethane	< 0.05
bromoform	< 0.50
bromomethane	< 0.20
n-butylbenzene	< 0.05
sec-butylbenzene	< 0.50
tert-butylbenzene	< 0.05
carbon tetrachloride	< 0.05
chlorobenzene	< 0.05
chloroethane	< 1.00
chloroform	< 0.05
2-chlorotoluene	< 0.05
4-chlorotoluene	< 0.10
dibromochloromethane	< 0.10
1,2-dibromo-3-chloropropane (DBCP)	< 0.05
1,2-dibromoethane	< 0.05
dibromomethane	< 0.10
1,2-dichlorobenzene	< 0.05
1,3-dichlorobenzene	< 0.05
1,4-dichlorobenzene	< 0.05
1,1-dichloroethane	< 0.05
1,2-dichloroethane	< 0.05
1,1-dichloroethene	< 0.05
cis-1,2-dichloroethene	< 0.05
trans-1,2-dichloroethene	< 0.05
1,2-dichloropropane	< 0.05
1,3-dichloropropane	< 0.10

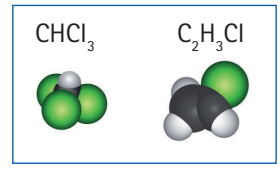
Compound	QL* (ppb)
2,2-dichloropropane	< 0.05
1,1-dichloropropene	< 0.05
cis-1,3-dichloropropene	< 0.05
trans-1,3-dichloropropene	< 0.05
ethylbenzene	< 0.05
hexachlorobutadiene	< 0.05
isopropylbenzene	< 0.05
4-isopropyltoluene	< 0.05
methylene chloride (dichloromethane)	< 0.10
naphtalene	< 0.10
n-propylbenzene	< 0.50
styrene	< 0.10
1,1,1,2-tetrachloroethane	< 0.05
1,1,2,2-tetrachloroethane	< 0.10
tetrachloroethene	< 0.05
toluene	< 0.10
1,2,3-trichlorobenzene	< 0.05
1,2,4-trichlorobenzene	< 0.05
1,1,1-trichloroethane	< 0.10
1,1,2-trichloroethane	< 0.05
trichloroethene	< 0.05
trichloromonofluoromethane	< 0.10
1,2,3-trichloropropane	< 0.05
1,2,4-trimethylbenzene	< 0.05
1,3,5-trimethylbenzene	< 0.10
o-xylene	< 0.05
m-xylene	< 0.05
p-xylene	< 0.05
vinyl chloride	< 0.20

***QL = Quantification Limit – expressed in ppb (µg/l)**



Molecules removed by the VOC-Pak™ cartridge include carbon tetrachloride (CCl_4) and chlorobenzene (C_6H_5Cl).

Milli-Q® water purification system fitted with a VOC-Pak™ cartridge



Molecules removed by the VOC-Pak™ cartridge include chloroform ($CHCl_3$) and vinyl chloride (C_2H_3Cl).

Direct-Q® 3 water purification system with VOC-Pak™ cartridge

Ordering information

Description	Catalogue No.
VOC-Pak™ cartridge (1/pk) delivered hermetically sealed, with a Certificate of Quality	VOCPAK001
Cartridge installation and Conditioning Kit including the following reusable parts: • Polyethylene 1/4 Gaz F-Hose barb connection with O-ring • Polyethylene 1/4 Gaz F – 1/4 Gaz F connectors for connection to Millipak® final filter	EDSKIT001

For more information, please visit our website:
www.millipore.com/labwater

Lit. No. PB1632EN00 01/12