REGIONAL WATER QUALITY NEWSLETTER

DATE: Report for April 2010
Sampling conducted April 5-6, 2010
A Phoenix, Tempe, Glendale, Peoria, CAP, SRP – ASU Regional Water Quality Partnership

http://enpub.fulton.asu.edu/pwest/tasteandodor.htm

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SUMMARY: EVALUATION AND RECOMMENDATIONS

1. MIB plus geosmin levels above 10 ng/L in finished water lead to noticeable earthy-musty odors by customers. Currently MIB+geosmin levels are below 10 ng/L.
2. Dissolved organic carbon (DOC) concentrations in the reservoirs are ~ 3.5 mg/L (Lake Pleasant) and slightly higher 4.5 to 5 mg/L in the Salt River (Saguaro Lake). The Verde River has a of roughly 5.5 mg/L in Bartlett Lake reservoir.
3. The reservoirs are full and now water moving through the Verde River reservoirs should help to reduce DOC over the next month.
4. Articles on taste and odor from a special issue journal are provided, and one shows how chlorine residual masks earthy-musty odors in drinking water
5. Our final report on Pharmaceuticals in Arizona is now complete and will be uploaded later this week to our website: ***http://enpub.fulton.asu.edu/pwest/tasteandodor.htm***

Table 1a Summary of WTP Operations February 1, 2010

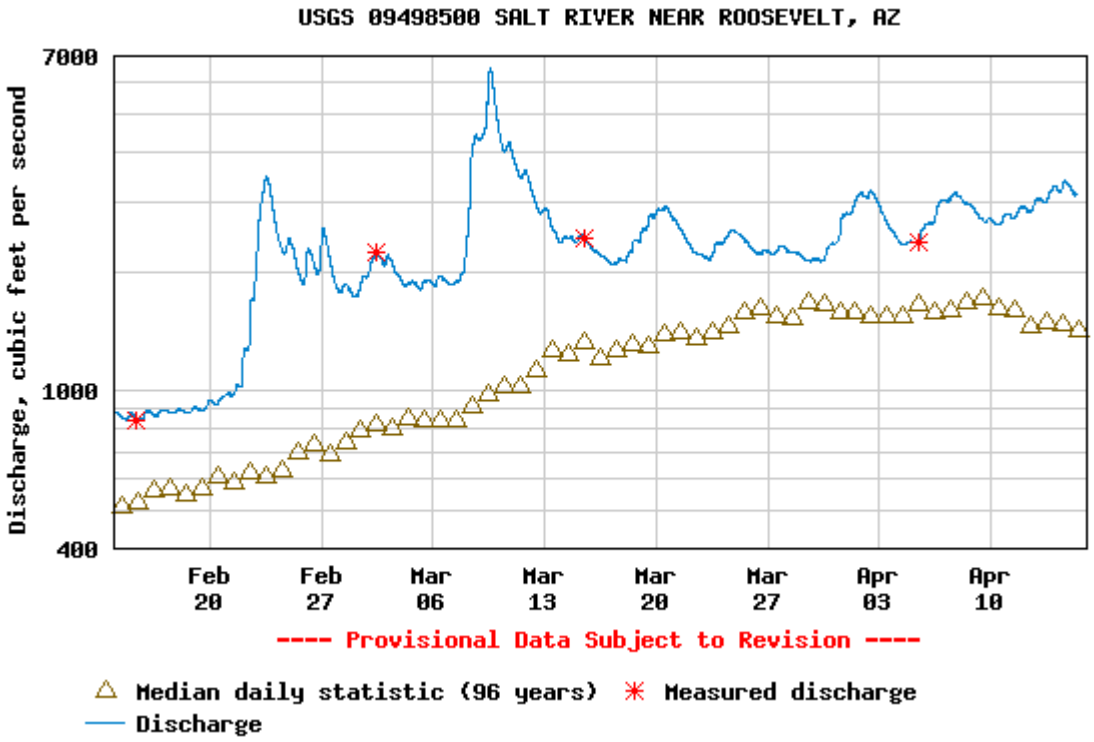
	Verde WTP	Union Hills	24th Street WTP	N.Tempe J.G. Martinez	Deer Valley	Glendale Cholla WTP [3]	Peoria Greenway WTP	Val Vista	South Tempe
	Verde River	CAP Canal	Arizona Canal					South Canal	
PAC Type and Dose		None	Calgon WPH 15 ppm	None		None		None	
Copper Sulfate		None	None	None		None		None	
PreOxidation		Stopped last week	None	None		None		None	
Alum Dose Alkalinity pH		10 ppm [1] 142 7.25	50 ppm 132/113 6.9	65 ppm 128 7.8		45 ppm 132 6.8		35 ppm [1] 90 6.9	22 ppm 114 7.4
Finished water DOC DOC removal[2]		2.7 mg/L 18%	2.8 mg/L 42%			3 mg/L 39%	3.6 mg/L 25%	2.9 mg/L 40%	3.2 mg/L 33%
Average turbidity over last 7 days		10 NTU	25-40 NTU	70 NTU		23 NTU		20 NTU	18 NTU
Notes from operators				Plant restarted on 4/6	Off-line				
Notes from operators									

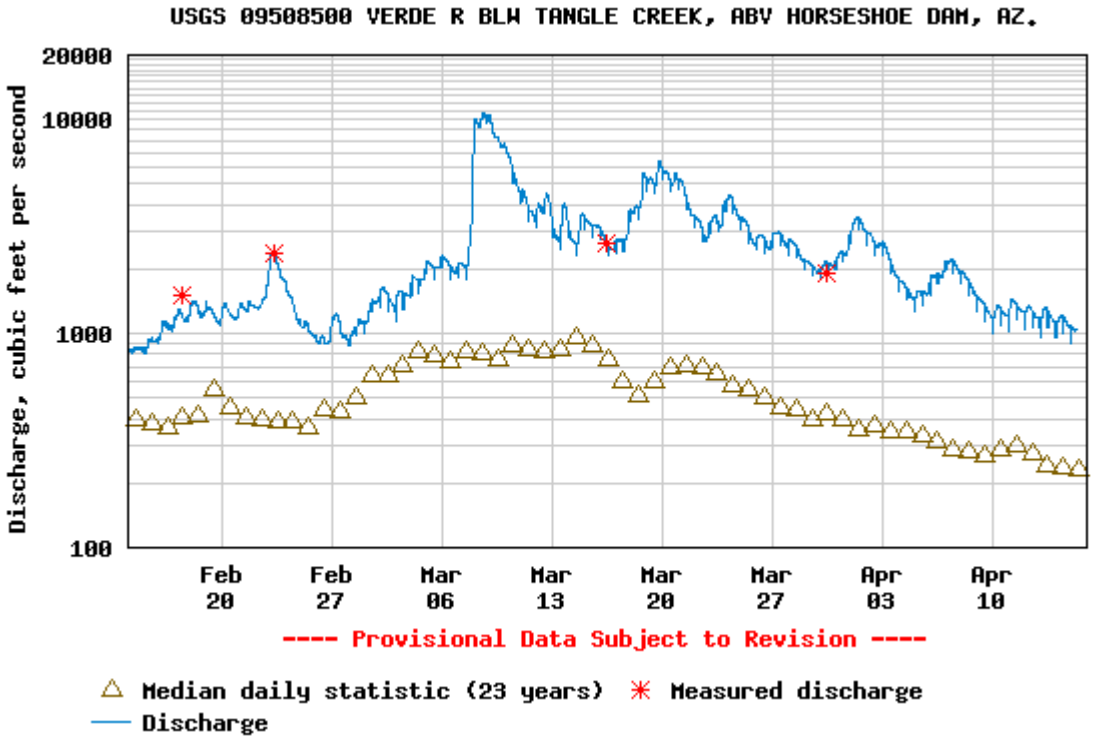
[1] Ferric chloride instead of alum; plus ppm sulfuric acid; [2] Calculated based upon influent and filtered water DOC (note that DOC and not TOC is used in this calculation); [3] Sample from finished water includes a blend of surface and ground water sources sometimes

Table 1 - SRP/CAP OPERATIONS - Values in cfs, for April 6, 2010

System	SRP Diversions	CAP
Arizona Canal	662	0
South Canal	532	0
Pumping	42	0
Total	1236	0

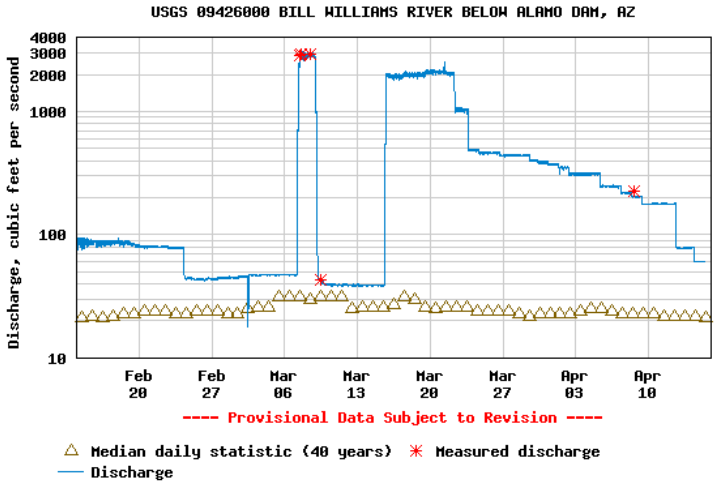
- **SRP is releasing water from both Verde and Salt River Systems**. Salt River release from Saguaro Lake: 1531 cfs; Verde River release from Bartlett Lake: 2175 cfs.
- **Water is being released over Granite Reef Dam at 2400 cfs because the SRP reservoirs are at >98% of full capacity**.
- **Runoff in the Salt and Verde Rivers are above the long**-term average. The rivers are approaching their seasonal high flow period over the next 1-2 weeks.
- **The elevated turbidity levels observed recently are not necessarily due to recent rainfall, but instead high flow into and through the Verde River and its reservoirs**.

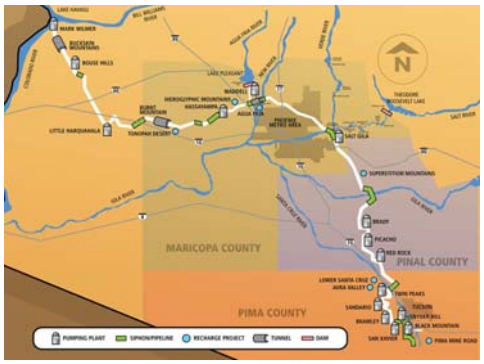



USGS 09508500 VERDE R BLW TANGLE CREEK, ABV HORSESHOE DAM, AZ.
Discharge, cubic feet per second
20000
10000
1000
100
Feb 20
Feb 27
Mar 06
Mar 13
Mar 20
Mar 27
Apr 03
Apr 10
---- Provisional Data Subject to Revision ----
Median daily statistic (23 years)
Measured discharge
Discharge

High flow conditions are also present in the CAP system.

- The Bill Williams River flows into the Colorado just above the CAP intake and has plans to release high flows Sunday March 7th and again in mid-march
- Consquently the turbidity in the CAP canal has been slightly higher (4 to 8 NTU) than usual, but is far below the 20 to 60 NTU in the SRP system now.





The water quality changes through the CAP canal may be monitored on the CAP website, at http://www.cap-az.com/water_quality

Taste and Odor Data

Data have been collected as usual. ALL sampling locations have MIB < 2 ng/L and Geosmin < 4 ng/L. Specific data is available upon request.

MIB plus geosmin levels above 10 ng/L in finished water lead to noticeable earthy-musty odors by customers. Currently MIB+geosmin levels are below 10 ng/L.

Organic Matter in Water Treatment Plants

Table 2 - Water Treatment Plants – April 06, 2010

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN		DOC removal (%)
24th Street WTP Inlet	**4.81**	**0.157**	**3.26**	**0.56**		
24th Street WTP Treated	**2.80**	**0.056**	**1.98**	**0.48**		**42**
Deer Valley Inlet	**4.76**	**0.154**	**3.24**	**0.64**		
Deer Valley WTP Treated						
Val Vista Inlet	**4.75**	**0.144**	**3.03**	**0.50**		
Val Vista WTP Treated –East						
Val Vista WTP Treated -West	**2.88**	**0.058**	**2.03**	**0.39**		**40**
Union Hills Inlet	**3.28**	**0.071**	**2.17**	**0.53**		
Union Hills Treated	**2.70**	**0.034**	**1.25**	**0.50**		**18**
Tempe North Inlet						
Tempe North Plant Treated						
Tempe South WTP	**4.78**	**0.148**	**3.09**	**0.48**		
Tempe South Plant Treated	**3.18**	**0.063**	**1.99**	**0.41**		**33**
Greenway WTP Inlet	**4.77**	**0.150**	**3.14**	**0.59**		
Greenway WTP Treated	**3.57**	**0.043**	**1.20**	**0.54**		**25**
Glendale WTP Inlet	**4.90**	**0.154**	**3.13**	**0.65**		
Glendale WTP Treated	**3.01**	**0.063**	**2.08**	**0.47**		**39**

DOC = Dissolved organic carbon
UV254 = ultraviolet absorbance at 254 nm (an indicator of aromatic carbon content)
SUVA = UV254/DOC
TDN = Total dissolved nitrogen (mgN/L)

Organics in Canals

The CAP system has lower DOC and SUVA than the SRP system.

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Waddell Canal	**3.33**	**0.073**	**2.20**	**0.52**
Union Hills Inlet	**3.28**	**0.071**	**2.17**	**0.53**
CAP Canal at Cross-connect				
Salt River @ Blue Pt Bridge	**4.64**	**0.125**	**2.70**	**0.36**
Verde River @ Beeline	**4.96**	**0.183**	**3.68**	**0.65**
AZ Canal above CAP Cross-connect	**4.74**	**0.149**	**3.14**	**0.47**
AZ Canal below CAP Cross-connect	**4.81**	**0.148**	**3.07**	**0.52**
AZ Canal at Highway 87	**4.79**	**0.150**	**3.13**	**0.44**
AZ Canal at Pima Rd.	**4.76**	**0.154**	**3.24**	**0.46**
AZ Canal at 56th St.	**4.77**	**0.153**	**3.20**	**0.51**
AZ Canal - Inlet to 24th Street WTP	**4.81**	**0.157**	**3.26**	**0.56**
AZ Canal - Central Avenue	**4.85**	**0.157**	**3.25**	**0.53**
AZ Canal - Inlet to Deer Valley WTP	**4.76**	**0.154**	**3.24**	**0.64**
AZ Canal - Inlet to Glendale WTP	**4.90**	**0.154**	**3.13**	**0.65**
AZ Canal - Inlet to Greenway WTP	**4.77**	**0.150**	**3.14**	**0.59**
South Canal below CAP Cross-connect	**4.64**	**0.144**	**3.11**	**0.43**
South Canal at Val Vista WTP	**4.75**	**0.144**	**3.03**	**0.50**
Head of the Tempe Canal	**4.76**	**0.147**	**3.08**	**0.49**
Tempe Canal - Inlet to Tempe's South Plant	**4.78**	**0.148**	**3.09**	**0.48**
Chandler WTP – Inlet				

Table 4 - Reservoir Samples – April 06, 2010

Reservoir sampling will be conducted only monthly. CAP is sampling Lake Pleasant on slightly different days than the other reservoirs.

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Lake Pleasant (March 2010)	Eplimnion	**3.40**	**0.07**	**2.15**	**0.59**
Lake Pleasant (March 2010)	Hypolimnion	**3.55**	**0.08**	**2.27**	**0.60**
Verde River @ Beeline		**4.96**	**0.18**	**3.68**	**0.65**
Bartlett Reservoir	Epilimnion	**5.11**	**0.18**	**3.47**	**0.35**
Bartlett Reservoir	Epi-near dock				
Bartlett Reservoir	Hypolimnion	**5.49**	**0.18**	**3.28**	**0.62**
Salt River @ BluePt Bridge		**4.64**	**0.13**	**2.70**	**0.36**
Saguaro Lake	Epilimnion	**4.92**	**0.13**	**2.56**	**0.39**
Saguaro Lake	Epi - Duplicate	**4.80**	**0.13**	**2.61**	**0.37**
Saguaro Lake	Epi-near doc				
Saguaro Lake	Hypolimnion	**4.75**	**0.13**	**2.72**	**0.53**
Verde River at Tangle	Feb-10	**4.22**	**0.15**	**3.62**	**0.38**
Havasu	Mar-10	**5.98**	**0.19**	**3.21**	**0.74**

The Journal of Water Supply: Research and Technology – AQUA
Had a special issue on taste and odors: http://www.iwaponline.com/jws/toc.htm
in December 2009

A few of the titles and abstracts were selected for your information – along with a few key graphs.

The effect of water source and chlorine and chloramine odorants in drinking water on earthy and musty odour intensity

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ABSTRACT

Water utilities and laboratory studies have indicated that chlorine or chloramines can mask earthy or musty odours. However, there have been conflicting results. Sensory testing was completed on finished waters from five water utilities and a control to determine whether earthy and musty odours, caused by geosmin and 2-methyl isoborneol (MIB), at concentrations found in drinking water, are dependent on the background water matrix or chlorine (<1 mg l^{-1} as Cl) or chloramines (2–4 mg l^{-1} as Cl) concentrations found in finished drinking waters. Finished and dechlorinated water samples were spiked with geosmin and MIB and analysed by Flavor Profile Analysis to determine odour intensity and solid phase microextraction/GC-MS to determine actual geosmin and MIB concentrations. The participating utilities for this project represent a wide range of background matrices in terms of both total organic carbon and total dissolved solids. Background water quality did not significantly affect the intensity of earthy and musty odours. Dechlorination and dechloramination increased the intensity of the earthy odour of geosmin (20.1–61.9 ng l^{-1}). However, dechlorination and dechloramination did not significantly affect the musty odour of MIB (18.6 ng l^{-1}). This may be due to the statistical power of the method used at the low MIB concentration.

Keywords: chloramines; chlorine; earthy odours; geosmin; masking odours; methyl isoborneol; musty odours

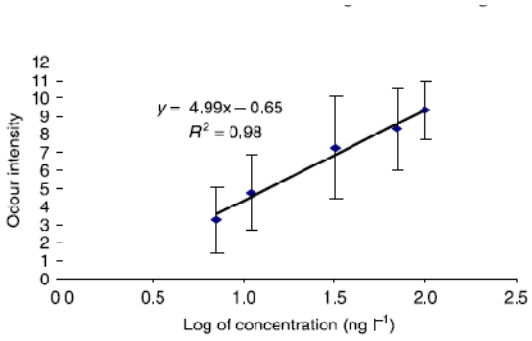

Figure 1 | Weber-Fechner curves developed in this study for MIB at 45°C.

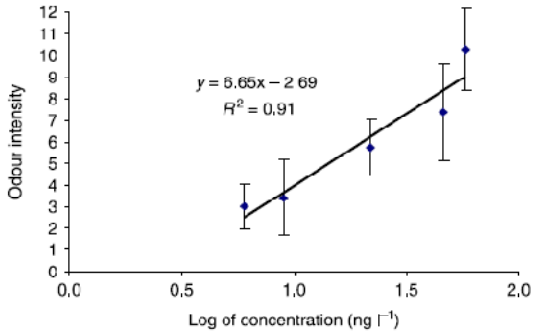

Figure 2 | Weber-Fechner curves developed in this study for geosmin at 45°C.

Graphs below show how chlorine “masks” earthy-musty odors

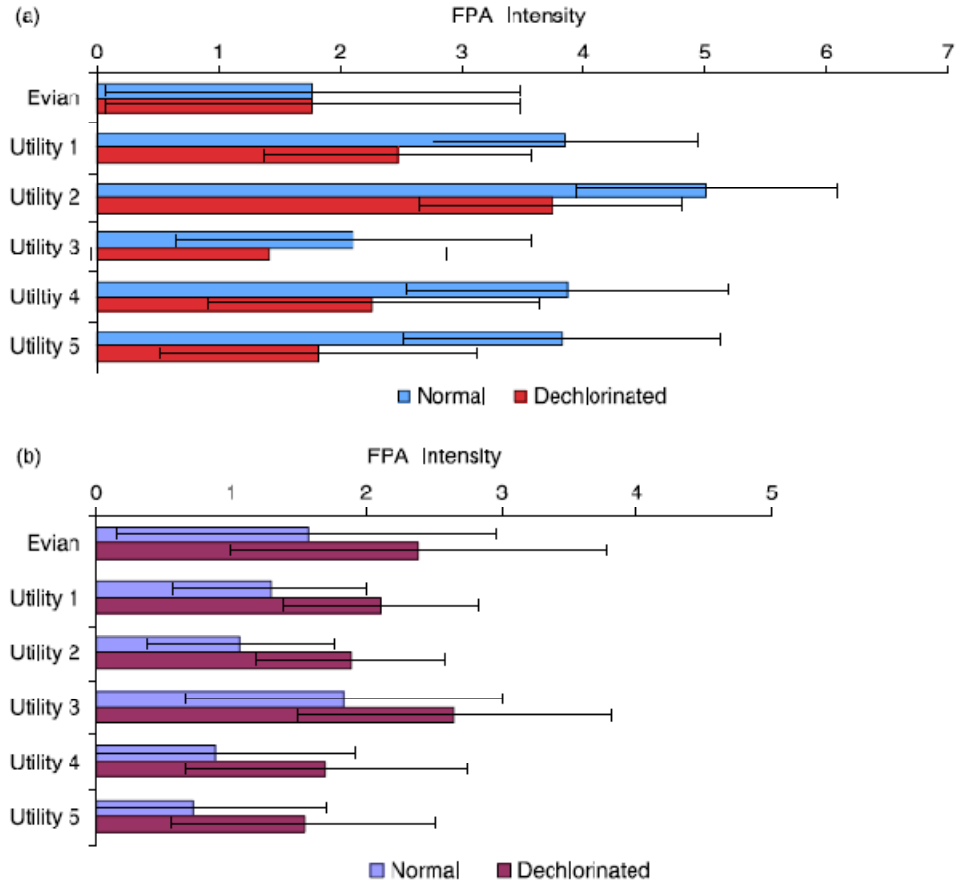

Figure 3 | (a) Chlorine odour intensity; and (b) earthy odour intensity for different water sources; the error bars represent ±2 standard errors.

European reassessment of MIB and geosmin perception in drinking water

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ABSTRACT

Earthy-musty flavors are a prevalent customer complaint for drinking water utilities. Sensory analysis can be used as an inexpensive early warning system to signal a taste and odor (T&O) event and to define the water quality objectives the treatment process has to achieve. T&O threshold concentrations of both 2-methylisoborneol (MIB) and trans-1, 10-dimethyl-trans-9-decalol (geosmin) were reassessed using a French and a Spanish panel, using a flavor-by-mouth protocol. Results of the 2 panels were found consistent and lower than those reported in the literature. Additional sensory testing experiments were performed to investigate the resulting perception when the two compounds (geosmin and MIB) are both present in solution and to clarify the effect of chlorine on both geosmin and MIB (masking or confusion in the perception).

Keywords: chlorine; drinking water; earthy musty; taste and odor

Effect of chlorination on the cell integrity of two noxious cyanobacteria and their releases of odorants

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ABSTRACT

The effect of chlorination on cell integrity and release of metabolites of two noxious cyanobacteria, a b-cyclocitral producer—Microcystis aeruginosa—and a geosmin producer—Anabaena circinalis—was investigated. Photos from a scanning electron microscope revealed that Microcystis cell surfaces were deformed after chlorination, and filamentary Anabaena cells were ruptured at the junction of vegetative cell units. Chlorination experiments indicated that both cyanobacteria are susceptible to attack by chlorine. A first-order decay model was used to simulate the cell-rupture kinetics during chlorination. Using laboratory cultures, the observed rate constants are 670–1,100 M^{-1} s^{-1} for M. aeruginosa, which are 1.3–5.0 times as large as those for A. circinalis. For unfiltered Microcystis-laden reservoir waters, a broader range of rate constants, 70–590 M^{-1} s^{-1}, were obtained. The rate constant was reduced in more eutrophic water, due probably to the competition of chlorine with other cyanobacteria in water. Geosmin was rapidly released into water immediately after the Anabaena cells were ruptured. However, a portion of geosmin remained cell-bound. For Microcystis, the total b-cyclocitral concentration decreased quickly during chlorination in most cases. It is speculated that the enzymes leading to the formation of b-cyclocitral were inhibited by chlorine, thus causing a sudden reduction of b-cyclocitral in the system.

Keywords: Anabaena; b-cyclocitral; cell rupture; chlorination; geosmin; Microcystis

The impact of private networks on off-flavour episodes in tap water

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ABSTRACT

Complaints registered by Veolia water agencies underlined the design and operating parameters in the private network can cause taste and odour (T&O) episodes. Three experiments were performed to elucidate the impact of the private network. Firstly, a lab-scale pilot study was designed involving four different pipes, consisting of copper, polyvinyl chloride, stainless steel and galvanized steel in which several residence times were simulated. The study was then conducted on a real private network. Finally, laboratory static experiments on tap seals were carried out. To evaluate T&O potential of drinking water samples, sensory analyses by a taste panel were performed. To detect and to quantify the molecules involved, stir bar sorptive extraction coupled with gas chromatography/mass spectrometry analyses was applied. The results showed that the residence time had a significant influence on the appearance of organic and metallic compounds. An audit of the private network identified two main critical points—corrosion and leaching—both of which are influenced by the hydraulic system. Finally, static experiments conducted on seals revealed a large quantity of polycyclic aromatic hydrocarbons leaching into water and a chemical or plastic taste according to the panel. These results suggest a huge potential impact of the private network on water quality if operating conditions are not optimal.

Keywords: PAHs; private network; sanitary fittings; SBSE-GC/MS; tap water; taste and odour