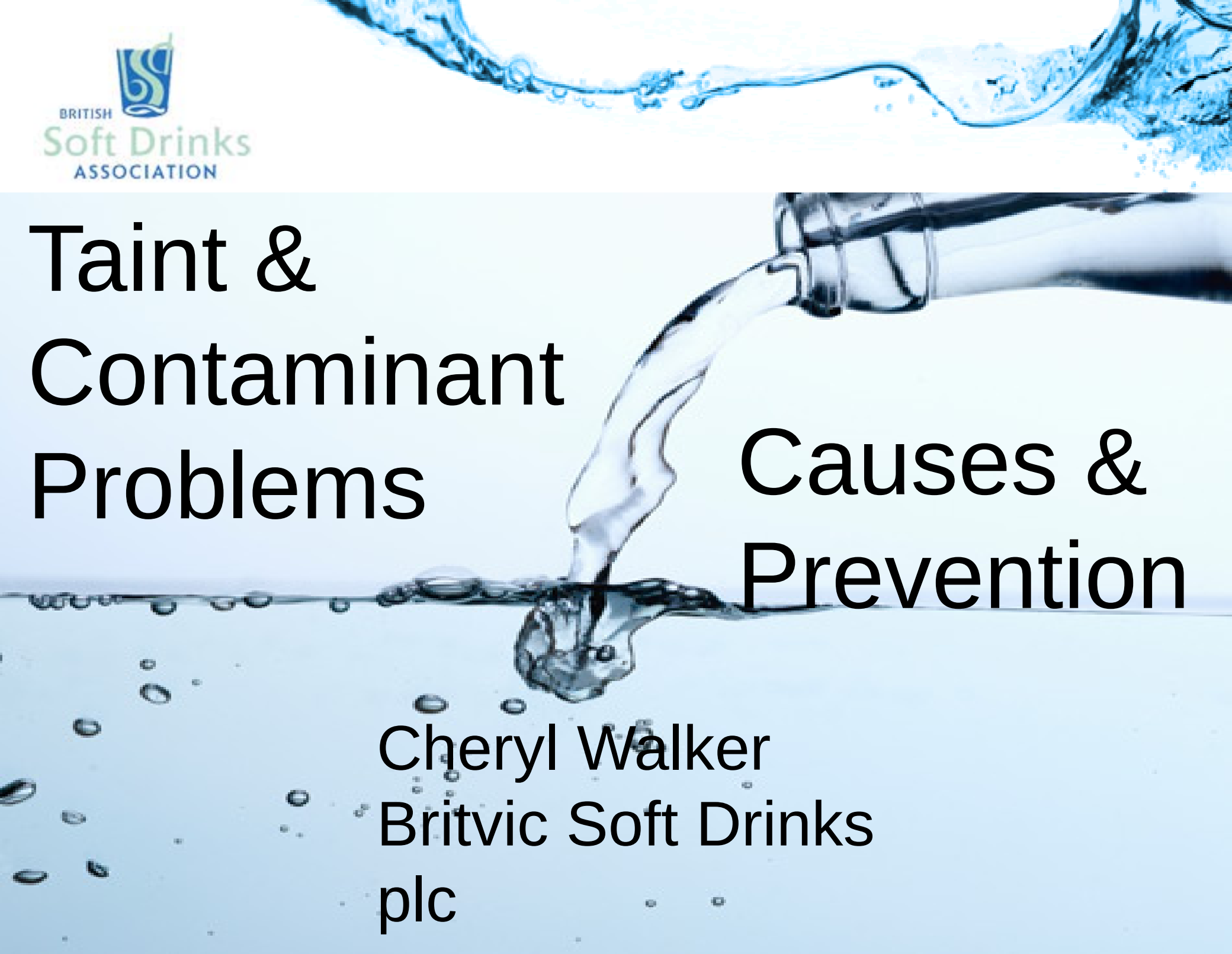


Taint & Contaminant Problems

Causes & Prevention

Cheryl Walker
Britvic Soft Drinks plc

Scope

- Taints & contaminants – what's the difference?
- Tasting
- Families of taints & their causes
- Prevention
- Conclusion

Taints

- **Taints** are off flavours or odours arising from changes within the water as extracted from source. These off flavours or odours are caused by reactions within the water due to the chemistry of the water or the interaction of the water with packaging, or post production storage conditions.
- Types of taint
  - Headspace
  - Within product

Contaminants

- Contaminant – this is a **substance** which is introduced to the product during production or storage and which may cause an off odour or flavour in product. **Contaminants** are materials that have entered the water during extraction, bottling or post production..

They may not result in an off taste or aroma!

What's the difference?

- Taints develop within the water due to the natural chemistry of the water interacting with it's environment either as the result of heightened levels of organic material (NOM) or unstable elements (Sulphur, Iron).

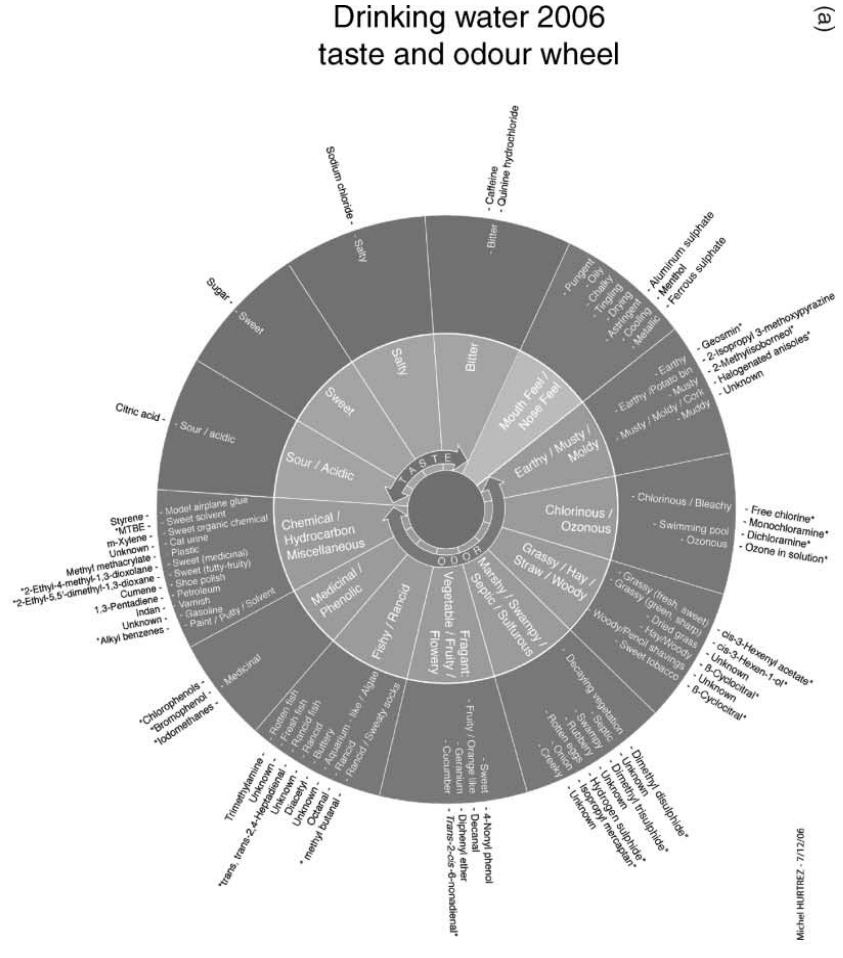
- Contaminants enter the water at any point of production – they are an additional material to the natural composition of the water. Examples include the presence of plasticisers leached from packaging.

Sensory summary

- Water has a very subtle taste
- Panels have to be specifically trained on water

Food safe flavour analogues

Descriptors

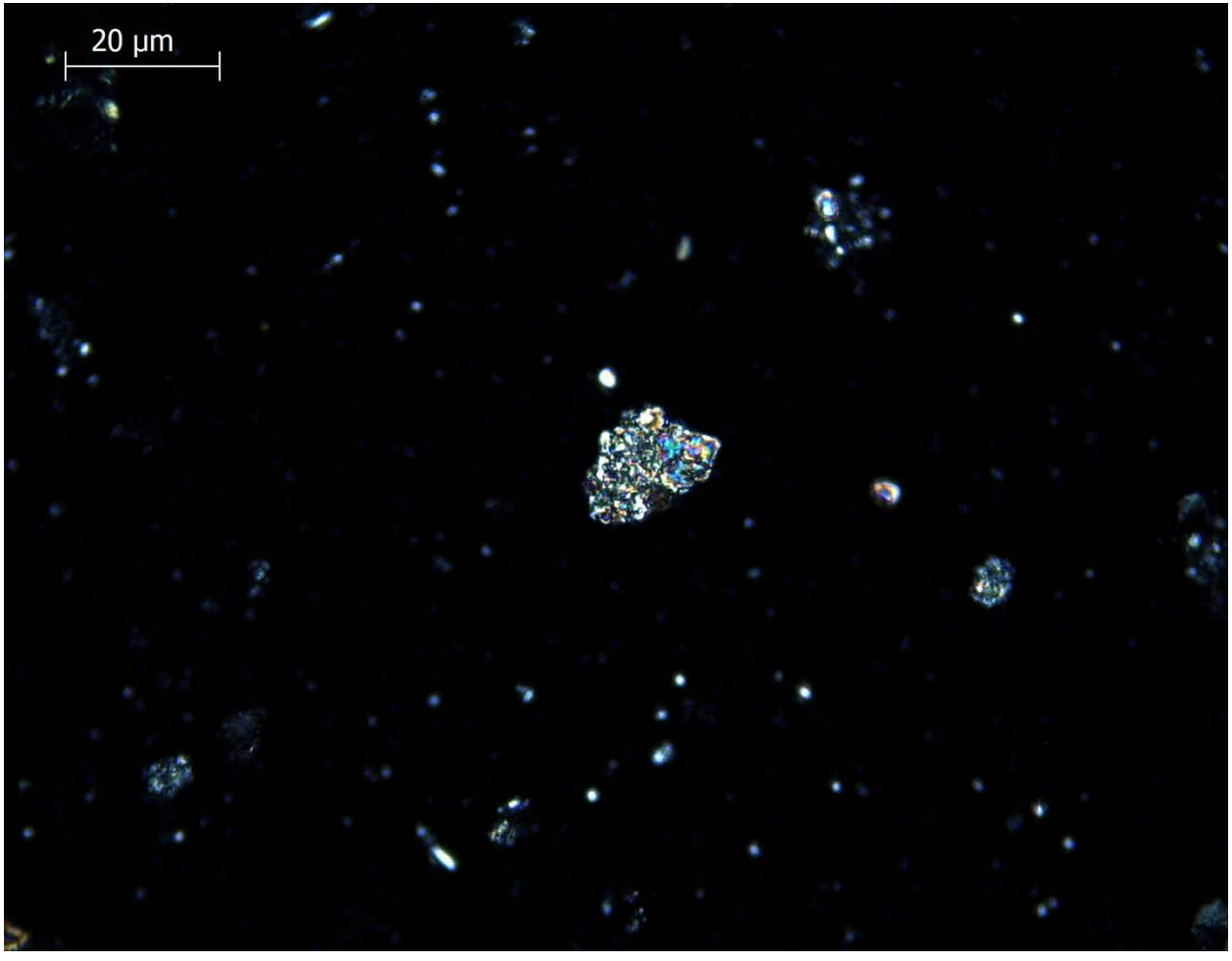


The drinking water taste and odour wheel (Suffet et al., 1999) and (b) the wastewater odour wheel for evaluating wastewater treatment odours (Burlingame et al., 2004)

Contaminants

Sand grains from a sand filter

Calcite particles in mineral water



Naturally occurring particles – from groundwater – sometimes reported as foreign bodies in bottled water.

Off Smells & Tastes

- Drains, cabbagey – sulphur – **line issue**
- Musty/Mouldy – MIB (2-methylisoborneol) or TCA (Trichloroanisole)– **water issue**
- PET bottles– **Packaging & Shelf life issue (still)**
  - acetaldehyde – sweet
  - Styrene - plastic
  - Sulphur – selenite in water reacting with PET
- PET & Glass bottles – Carbonates - **Product**
  - Sulphur taint - from Carbon dioxide

Odour Thresholds

Chemical	Size of panel	Geometric mean odour threshold concentration (ug/l^{-1})	Lowest concentration at which an odour was detected (ug/l^{-1})
Geosmin	10	0.0038	0.0013 (4 testers))
2-isobutyl-3-methoxypyrazine	8	0.001	<0.00005 (1 tester)
2-isopropyl-3-methoxypyrazine	6	0.0002	<0.00003 (2 testers)
2-methyl-isoborneol	10	0.015	0.0063 (2 testers)

Sources of taints and contamination

- Borehole
- Wellhead
- Filters
- Production Line
- Post production storage
- Packaging

Water source

- Groundwater -microbiological
- Chemical - SO2
- Soil metabolites
- Surface water – algal
- Haloanisoles
- pollutants

Examples

- Sporadic taints – when the concentration of naturally present compounds increases to detectible levels.
- Often result from soil saturation, they are unpredictable and may only affect 1 or 2 bottles in a case; or a few minutes filling time.
- Compounds formed by the geology and microflora of the wellfield and catchment

Microbial Taints

Table 3.1 Summary of some of the main microbially mediated taste and odour sources

Source	Taste and odour descriptor	Compound
Actinomycetes, cyanobacteria	Earthy	Geosmin
Actinomycetes, cyanobacteria	Musty	2-methylisoborneol
Actinomycetes	Mouldy, musty	2-isopropyl-3-methoxypyrazine
Actinomycetes	Woody, earthy	Cadin-4-ene-1-ol
Green algae	Cucumber	Trans-2 and cis-6-nonadienal
Pseudomonas sp.	Swampy, fishy	Dimethyl polysulphides (dimethyl trisulphide)
Sulphate reducing bacteria (Clostridia)	Rotten eggs	Hydrogen sulphide

Taken from DWI Report 2001

Taints of particular interest

Substance	Reason for concern	$\log_{10} K_{ow}$ (1)	solubility g/100ml	taste/ odour threshold ng l^{-1} *	Henry's Law Constant atm m^{-3} $mole^{-1}$ +
Geosmin	taste/odour - naturally occurring	3.57	0.015	10	$3.1\ 10^{-6}$
2-Methyl-isoborneol	taste/odour - naturally occurring	3.27	0.032	29	$8.9\ 10^{-6}$
2-Isopropyl-3-methoxypyrazine	taste/odour - naturally occurring	2.37	0.069	2	$3.1\ 10^{-6}$
2,3,6-Trichloroisoanisole	taste/odour –	4.01	0.003	7	$1.3\ 10^{-4}$
2-ethyl-5,5'-dimethyl-1,3-dioxane	Chemical industry by-product	1.96	0.17	<10	$9\ 10^{-5}$
2-butoxyethanol	as above	0.57	6.4	<10	$9.8\ 10^{-8}$

Taints - Families

TASTE OR ODOR	SOURCE
Earthy	Geosmin
Musty	MIB, isopropylmethoxypyrazine (IPMP), isobutylmethoxypyrazine (IBMP)
Turpentine, oily	Methyl tertiary butyl ether (MTBE)
Fishy/rancid	2,4-Heptadienal, decandienal, octanal
Chlorinous	Chlorine
Medicinal	Chlorophenols, iodoform
Oily, gas-like, paint	Hydrocarbons, volatile organic compounds (VOCs)
Metallic	Iron, copper, zinc, manganese
Grassy	Green algae

Issues caused by Water Storage

Off-Taste problem	Source	Organoleptic chemical	Reference
"acidic and resinous" taste in drinking water	Fibre glass reinforced polyester resin in water tower	Styrene	Rigal and Danjou (1997)
"medicinal" taste in drinking water	Use of unapproved PVC reinforcement netting in approved cementitious reservoir repair material	Chlorophenols formed from lime-hydrolysed triphenylphosphate in presence of chlorine	Rigal and Danjou (1997)

Production Line

- Pipework - biofilms
- Jointing/welding compounds
- Dead legs
- Connections – valves – one way & otherwise
- Sample points

Preventative measures

- Avoid plastic pipework
- Make sure that any welding or sealing compounds used are fit for purpose
- Keep pipework runs short
- Carry out sensory after any engineering work is carried out.

Gases

- Ingredient gases – naturally carbonated waters
- CO2
- Blowers – air
- Top gas- N2 - from tanker/transfer lines

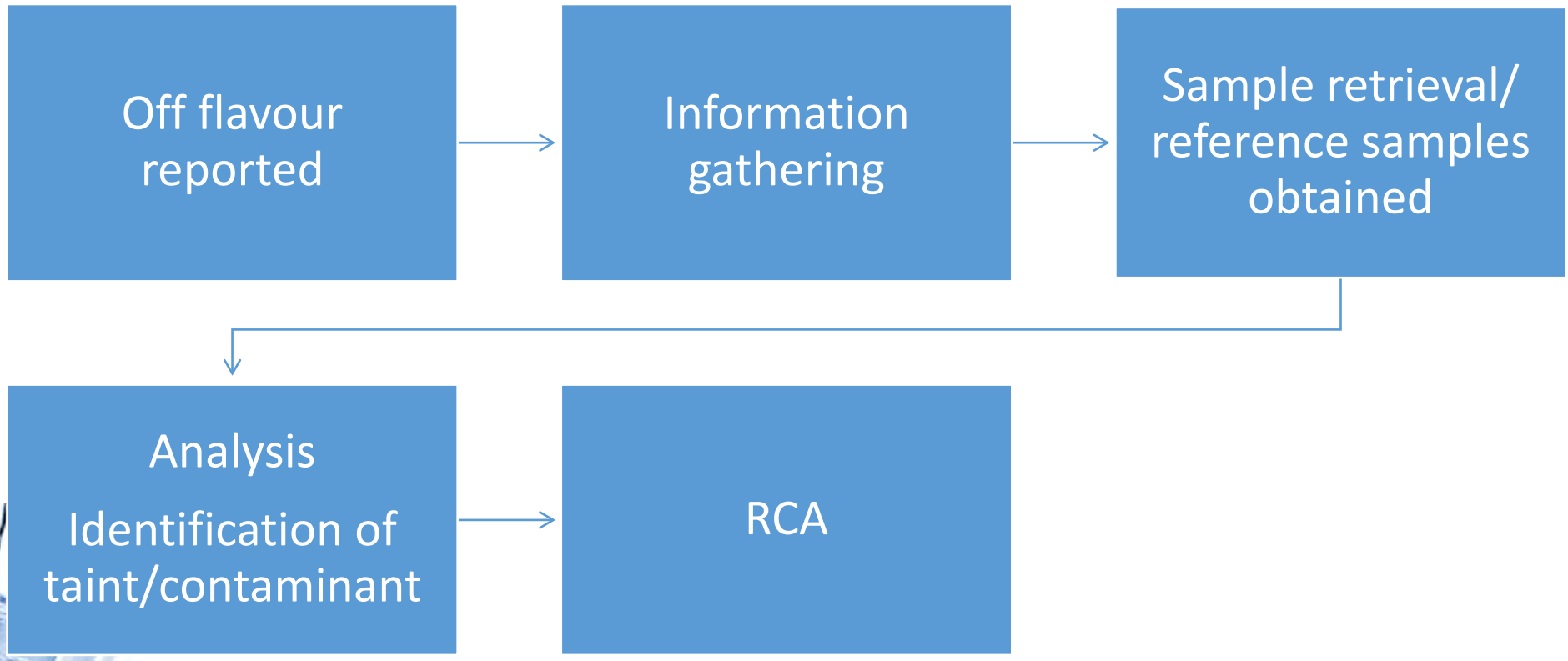
Sampling CO_2

- CO_2 is collected into the sampling device to form a snow pellet.
- It is then checked for off odour due to sulphur or hydrocarbon compounds
- Image & process taken from EIGA tanker driver manual http://www.eiga.eu

Snow cap sampling device

- This is an alternate device used to check compressed gas deliveries.
- Again a pellet is captured and then checked for off odours.
- Courtesy B. Watson of A G Barr

Taint Identification Process



Post Process taints

- Light struck – prolonged exposure can cause tainting
- Poor storage off flavours adsorbed through packaging if product stored near other products with strong
- Packaging – selenite in PET; acetaldehyde formation over shelf life
- Algae

Summary

- Taints and contaminants can arise at any point in the abstraction, bottling and storage of bottled water.
- Good well, source and risk management reduce the likelihood.
- Sporadic taints can arise at any time but it is possible to identify periods of high risk and increase sampling to mitigate the risk

Some Useful References

- **For descriptors:** Food Taints and Off-Flavours
  M.J. Saxby 2nd edition, Springer
  ISBN978-0-7514-0263-6 Softcover ISBN978-1-4613-5899-2

Useful specialised websites (www.odour.org.uk; www.flavornet.org).

- Technology of Bottled Water edited by Nicholas Dege
- Flavour Development, Analysis and Perception in Food and Beverages
  edited by J K Parker, Stephen Elmore, Lisa Methven
- Investigations into Off-flavours in PET bottled Mineral Water due to Sunlight Exposure
  Fraunhofer Institute for Process Engineering and Packaging (IVV), Giggenhauser Straße 35, 85354 Freising, Germany,

BRITISH Soft Drinks ASSOCIATION

Thank You