Jurgen Volz, 19 June 2006

kiwa
Partner for progress

How the drinking water industry deals with emerging pollutants

3 decades of experience in The Netherlands

NORMAN Workshop Emerging Environmental Pollutants, Stresa, Italy 19-20 June 2006

- **Kiwa Water Research: Joint R&D institute of Dutch drinking water supply sector (14 companies); has played a pivotal role in all stages of the process of coming to terms with EP's since ~1970**

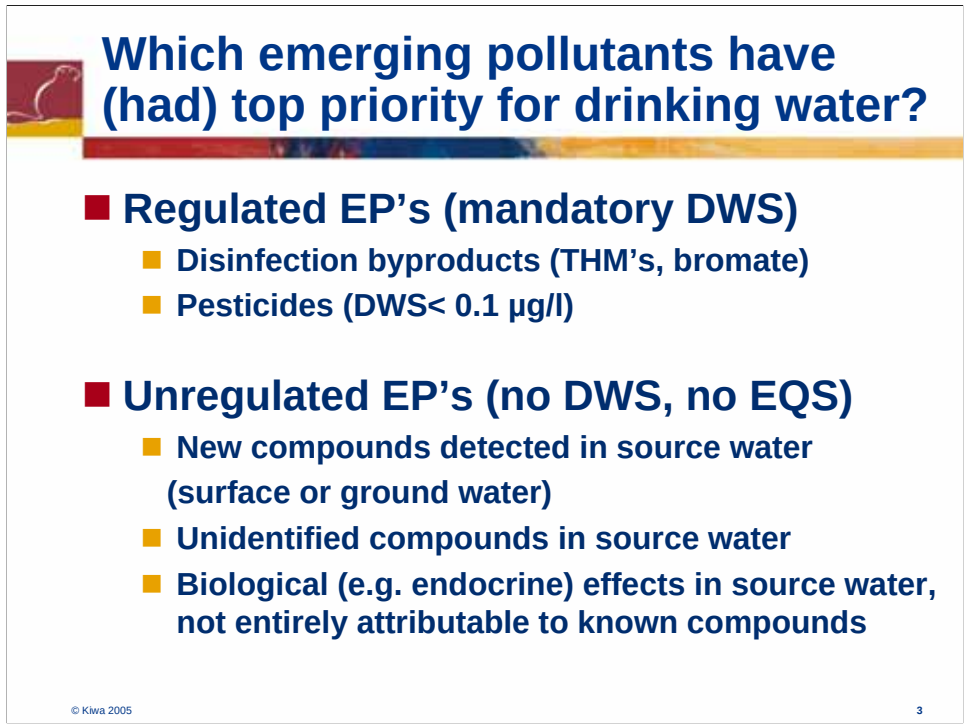
Why are drinking water companies concerned about emerging pollutants?

EU Drinking Water Directive (98/83/EC)

"drinking water is wholesome and clean if it:

- **(a) meets the minimum requirements set out in Annex I, Parts A and B, and**
- **(b) is free from any substances which constitute a potential danger to human health"**

- **A) Compliance with these mandatory Drinking Water Standards for appr. 35 chemical substances (e.g. arsenic & benzene) and several microbiological parameters is regularly checked by national health authorities, who must submit annual reports to the European Commission.**
- **B) No mandatory procedures to check (non)compliance, thus wait and see strategy possible (not in NL)**



- **Bromate: Real EP is bromide, practically only example of an inorganic EP**

- **Compliance with DWS is enforced by health authorities (only temporary derogations)**
- **If monitoring reveals non-compliance health authorities demand "better" (=more) treatment. Examples of treatment options for pesticide removal: Activated carbon or membrane filtration, advanced oxidation (O3 + UV + H2O2); Groundwater: sometimes no extra treatment option (closure of contaminated/problematic well(field)s) available**
- **Final solution for THM problem in Netherlands: termination of chlorine disinfection (2005); time frame >30 years!**
- **Source protection lowers risks (the more complicated treatment processes become the more vulnerable they get) and costs (additional costs for monitoring and treatment appear on consumers' bills!)**
- **Examples of (national) bans because of drinking water concerns: herbicides diuron & atrazine**

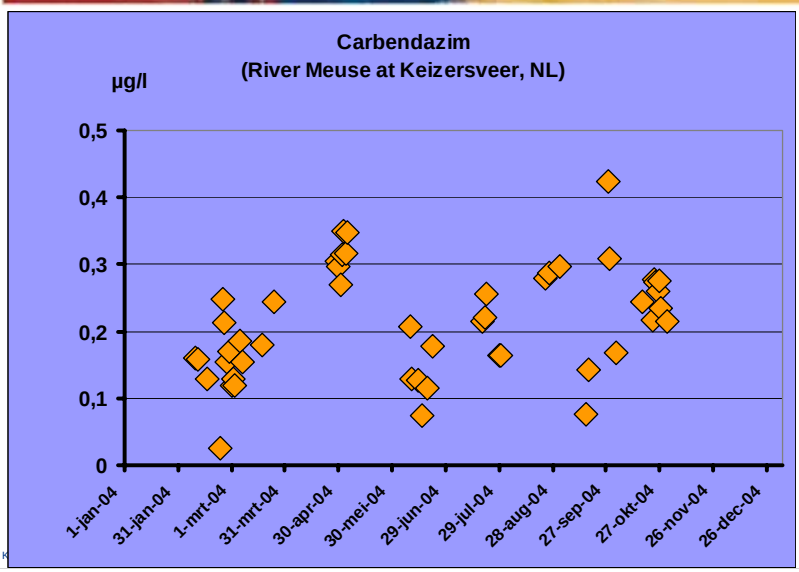
EP monitoring routine in NL

Example: Meuse water intake monitoring

- A total of 330 organic compounds was monitored in 2004
- 180 (55 %) of these were pesticides (including metabolites)
- Another 60 (18%) were regulated EP's (e.g. PAH, PCB, aromatic amines)

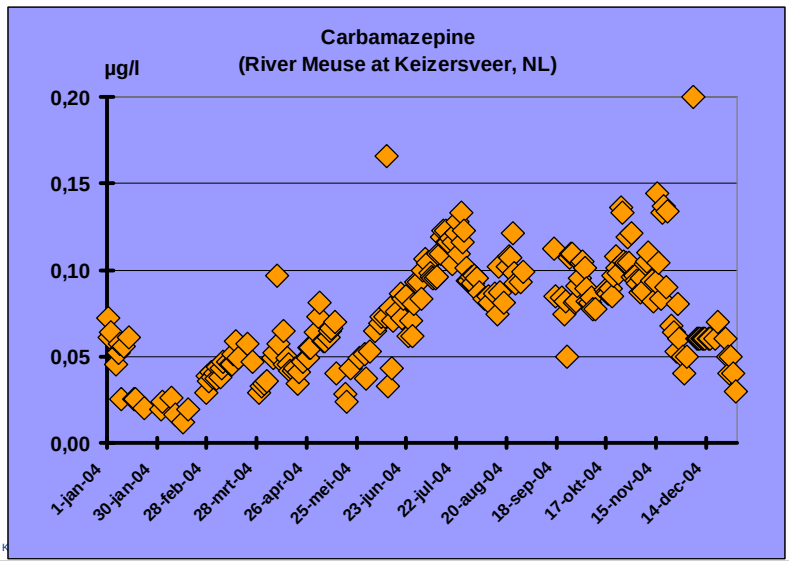
- Keizersveer: Water intake for 2 million drinking water consumers (e.g. Rotterdam)
- **Monitoring frequency 13-365 times/year**
- **Total monitoring costs € 150,000/year**

Results of daily routine monitoring (HPLC-DAD) Example no.1



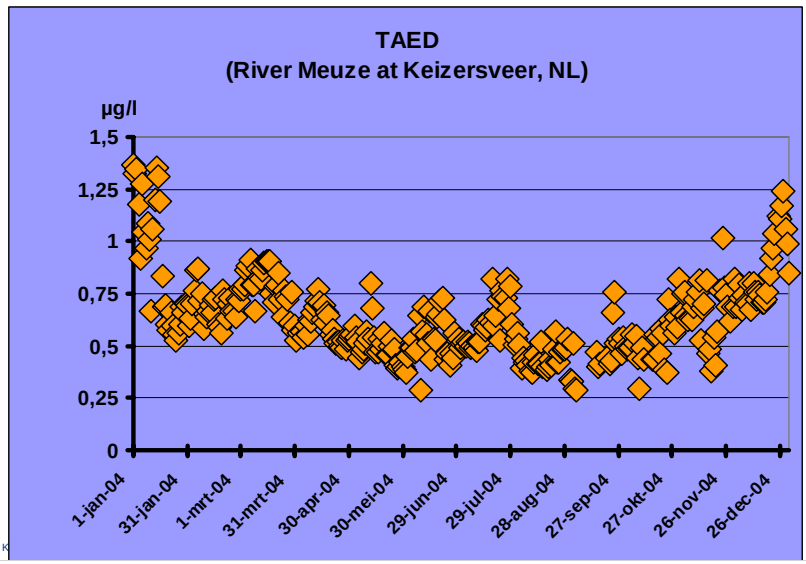
- **Fungicide carbendazim, DWS 0.1 micrograms/L, frequently exceeded in Meuse water**

Results of daily routine monitoring (HPLC-DAD) Example no.2



Traces (20-200 nanograms/L) of the pharmaceutical drug carbamazepine were found in almost every water sample

Results of daily routine monitoring (HPLC-DAD) Example no.3



TAED, a common bleaching agent in detergents, was also present in almost every sample, concentration range 0.2-1.5 micrograms/L

- **Until now there is no systematic monitoring for these EP's in the Netherlands (or elsewhere)!**
- **The last two substances are unregulated EP's, so how do we deal with them?**

Risk assessment of EP's Example: carbamazepine

- Highest concentration in Dutch drinking water 23 ng/L
- Equivalent with lifetime exposure of 1.2 milligrammes
- Normal therapeutic dose is 400 milligrammes/day!

Conclusion

Trace levels of carbamazepine in drinking water pose no threat to human health

- 2x0.023x365x70=1175 microgrammes=1.2 milligrammes
- Preliminary Dutch DWS is 50 microgrammes/L

How to deal with ‘unknown’ EP’s

- Broad screening methods yield ‘unknown' peaks
- If detected in source water, check potable water
- Identify and quantify compound
- Assess toxicity and treatment behaviour
- If necessary, monitor compound on routine basis

- **Broad spectrum screening methods include HPLC-UV, HPLC-DAD, GC-MS etc.**
- **In following this logical strategy we encounter practical difficulties (e.g. total lack of toxicological data)**
- **Also: even the first step (identification) is by no means easy**

Identification of ‘unknown’ polar compounds in water by Kiwa WR

- **KIWA: state-of-the-art LTQ Orbitrap MS-MS system commissioned in May 2006 (€500,000) which is capable to analyze more than 100 target compounds in a single run**
- **But: Even the most sophisticated analytical equipment cannot reveal the full picture (too many unidentified organic EP’s), hence we need biomonitoring systems which target the <u>combined toxicity of all compounds in our complicated source water matrix</u>**

How to deal with unknown EP's
Early Warning Systems in the Netherlands

- State monitoring stations at Dutch frontier:
  - Rhine
  - Meuse
- Early warning systems (biomonitors) at abstraction points for drinking water supply

- **EWS particularly important in case of accidental pollution (e.g. toxic spills – Sandoz 1986)**

Common biomonitors in the Netherlands

Daphnia

Algae

Mussels

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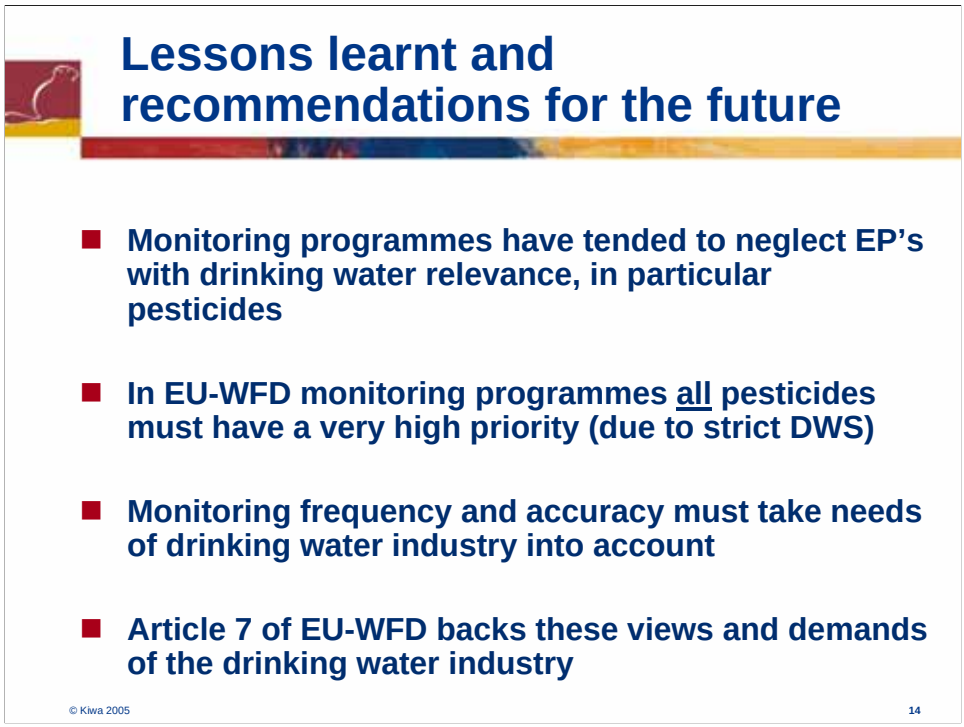
- **Alarm signals of biomonitors usually trigger a river water intake stop**
- **Only on very rare occasions is it possible to isolate and identify a single compound which has caused an alarm: 2004, Daphnia alarm, Keizersveer, caused by a previously unknown compound identified by Kiwa WR as 3-cyclohexyl-1,1-dimethylureum**



- **National monitoring programmes are mainly focused on EP's which pose a threat to the environment (aquatic ecosystem). This has forced drinking water companies to do much of the monitoring themselves**
- **The drinking water standard is stricter than the environmental quality standard for most pesticides. Example glyphosate: EQS-NL 70 micrograms/L, EU-DWS 0.1, US-DWS 700!**

EU-WFD, Article 7, Paragraph 3

"Member states shall ensure the necessary protection for the bodies of water identified with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water."

- **If taken seriously this provision means that the EQS for pesticides in surface waters (at the point of compliance) must be the same as the EQS for groundwater, namely 0.1 microgrammes/L**
- **Thank you**