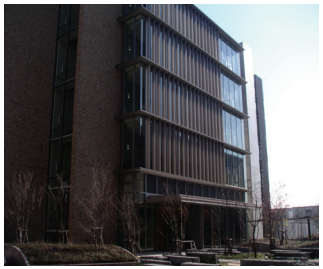
Exploring the cause of source water contamination using LC/MS/MS



Nov. 26, 2015, UT

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Water Management Field
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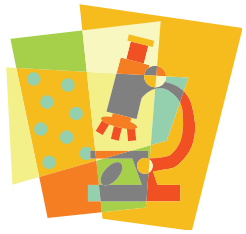
Research topics

Risk management and chemical analysis in water source and drinking water using LC/MS/MS



Research promotion

Collaboration of research and practice

Reflection to risk management

Development of analytical method for LC(IC)/MS/MS

- We have developed analytical methods, conduct first national survey and did risk assessment respectively on
  Bromate(IC, IC/MS/MS and LC/MS/MS),
  perchlorate(IC/MS/MS and LC/MS/MS),
  chlorate(IC), and
  NDMA(SPE-LC/MS/MS)
- Collect water quality accidents related to health issues
- Contribution to guidelines for water safety plans

Control of toxic disinfection by-products (DBPs)

Production of carcinogenic compound, bromate in ozonation as advanced water treatment

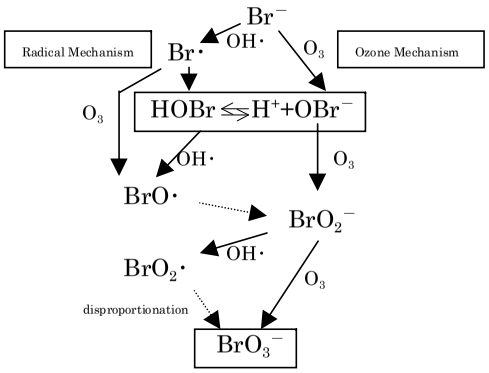
Development of analytical method of bromate

National survey

High concentration of bromate formation in cities of high bromide, treatment at high pH, high dose of ozone, and high temperature

Control method

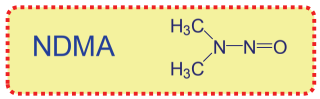
Bromate was introduced into WQ standard, controlled by pH and ozone dose.



Major information introduced in advanced water treatment systems

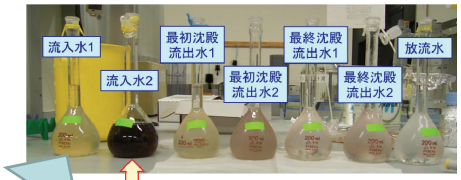
Identification of toxic NDMA (1/2)

NDMA



- 10^{-5} cancer potency (IRIS): 7 ng/L
- WHO GDWQ: 100 ng/L
- Japanese ref.: 100 ng/L

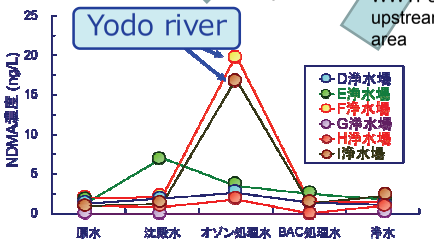
Development of analytical method for NDMA National survey

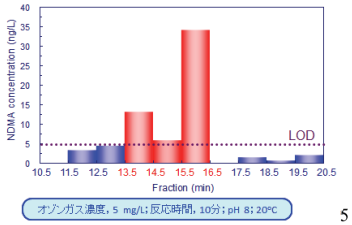


Looked for inflow of WWTPs in upstream area

Inflow

Fractionation and ozonation

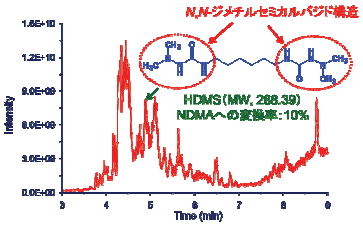




オゾンガス濃度，5 mg/L; 反応時間，10分; pH 8; 20°C

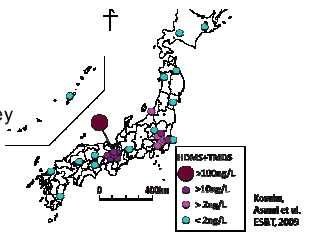
Identification of toxic NDMA (2/2)

Total Ion Chromatogram (fraction no.13)

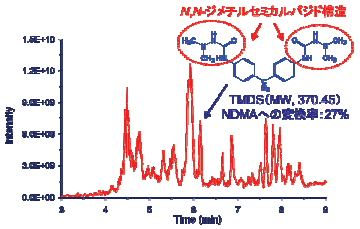


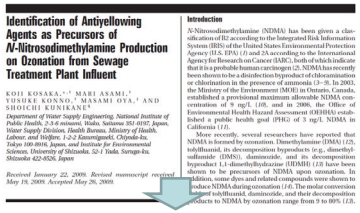
National survey

National survey of HDMS and TMDS concentrations



Total Ion Chromatogram (fraction no.15)

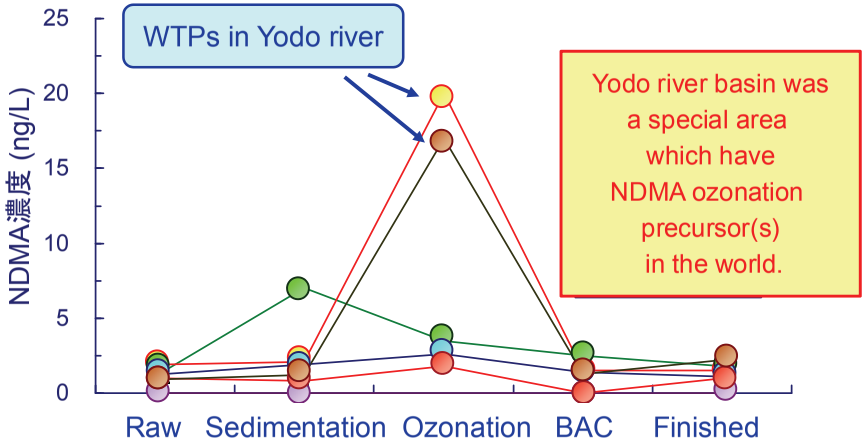




Identification of Antiyellowing Agents as Precursors of *N*-Nitrosodimethylamine Production on Ozonation from Sewage Treatment Plant Influent

Candidates for "Troubling substances for water treatment"

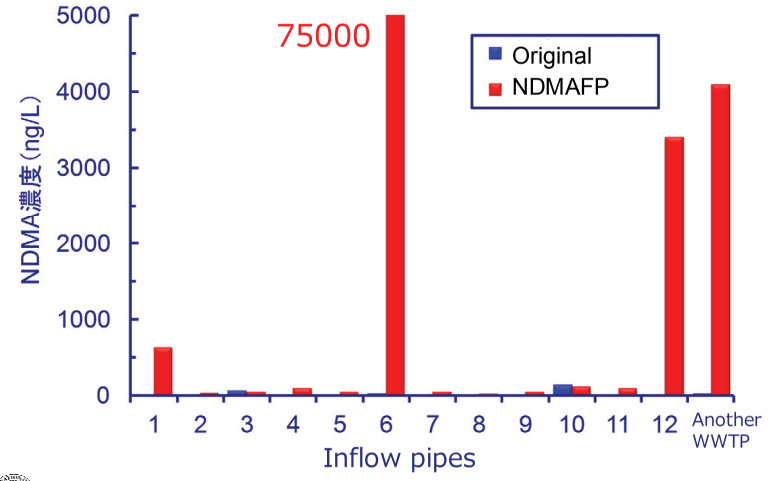
NDMA behavior in ozonation and AC process



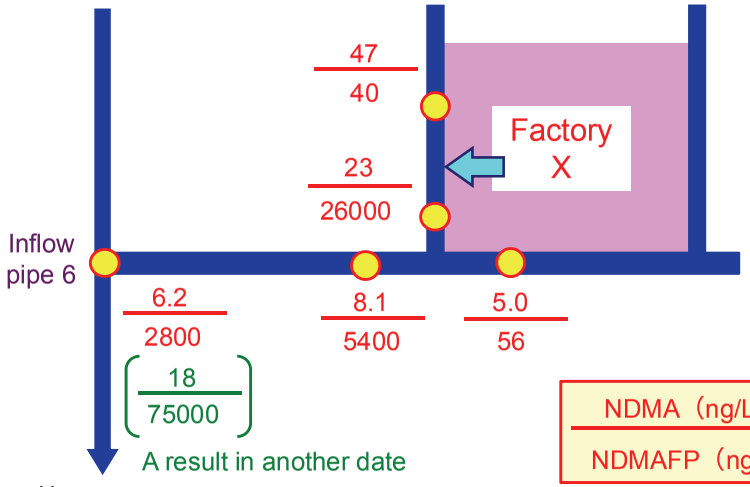
Yodo river basin was a special area which have NDMA ozonation precursor(s) in the world.

 Asami et al. (2009) Sci. Total Environ. 3540. 7

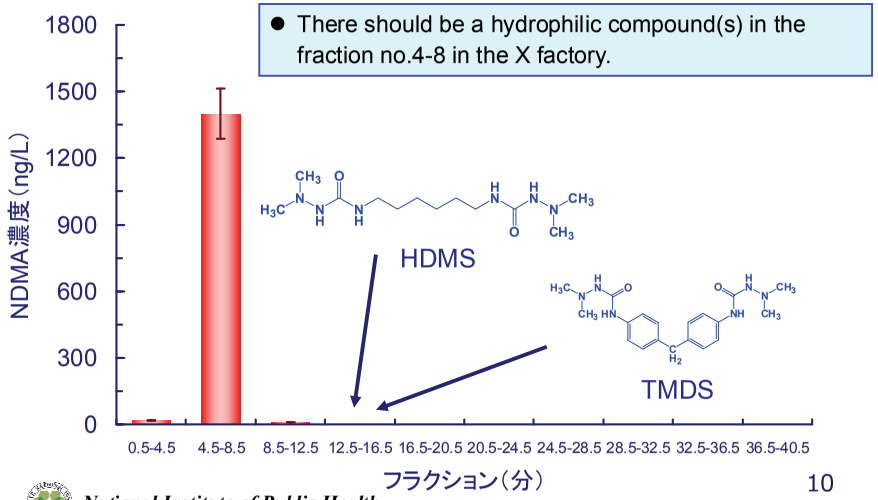
NDMA and its formation potentials (NDMAFP) at inflow pipes of the A Waste water treatment plant



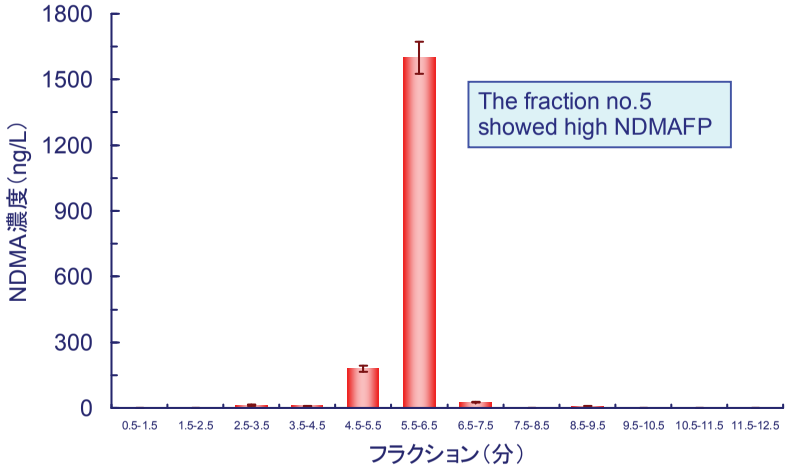
NDMA and NDMAFP at inflow pipes in upstream



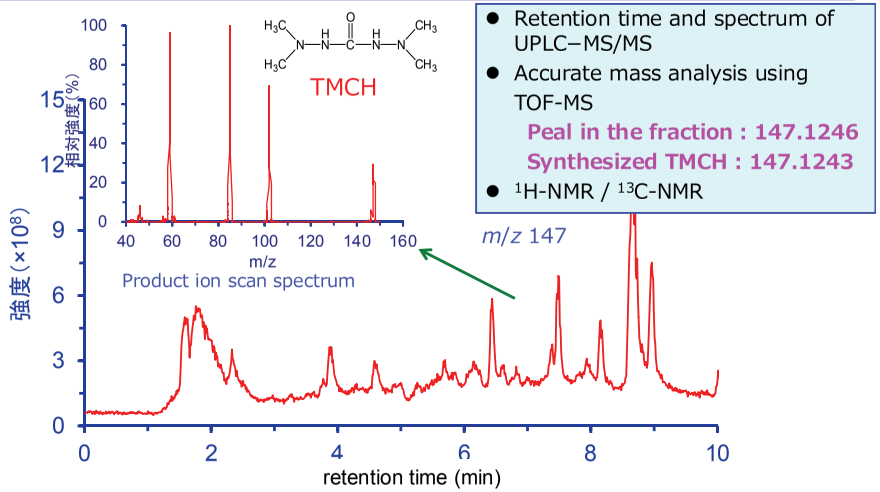
Ozonation NDMAFP Another component in the fraction no.4-8 in the discharge form the factory X.



The fraction no.5 showed high “Ozonation NDMAFP” in the discharge from the factory A.

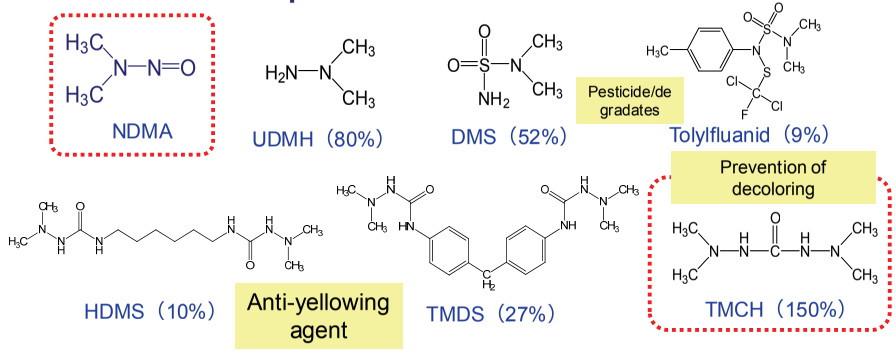


UPLC–MS of Total Ion Chromatogram fraction no.5



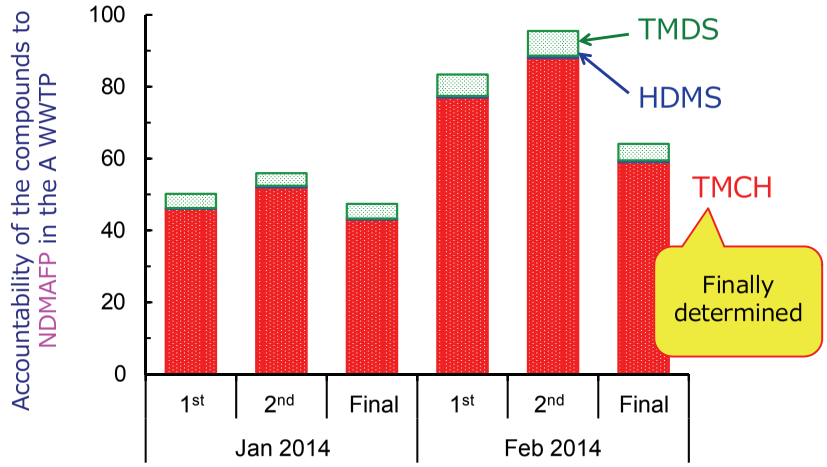
Identification of TMCH（1,1,5,5-tetramethyl carbonohydrazid)

NDMA formation from TMCH and other reported substances

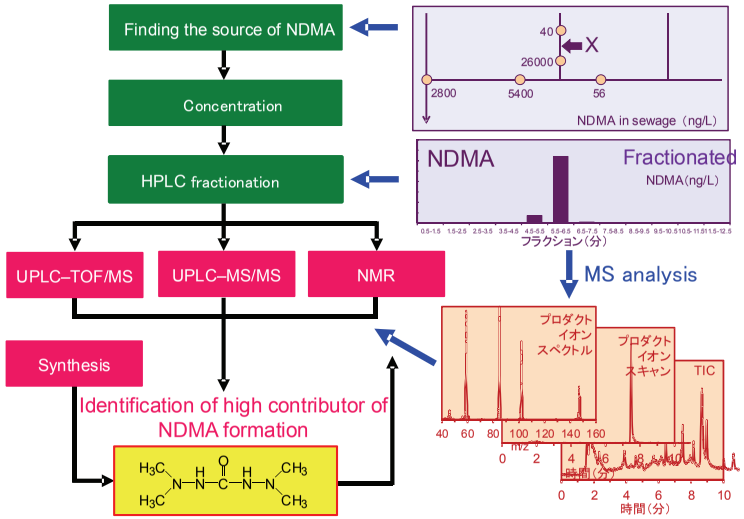


- TMCH-a special chemical in paper and printing industry
- Tolylfluanid, a pesticide prohibited in EU water source, because DMS, its degradation by-product was found in high production
- HDMS, TMDS-close to TMCH, previously found by our team

Accountability of the chemicals to NDMAFP in the A WWTP



MS analysis and identification of NDMAFP



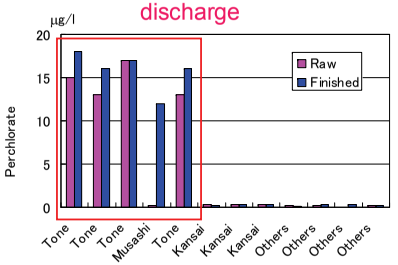
Analysis and control of perchlorate (ClO_4^-)

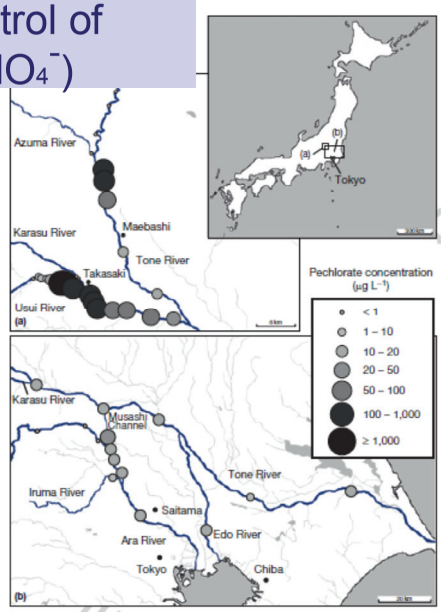
Perchlorate is a hydrophilic contaminant used for rocket fuel, air bags and fireworks.

Found at rather higher concentration in Tokyo metropolitan area

Looked for the sources

Requested the reduction of discharge





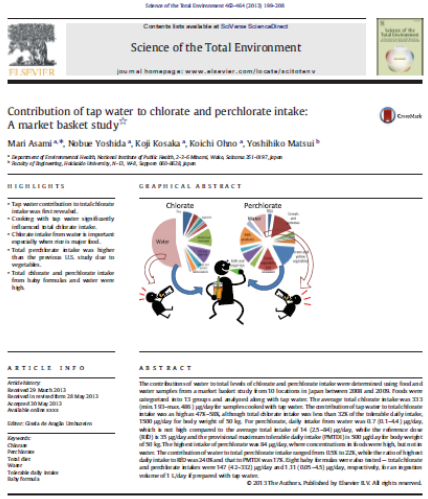
Exposure analysis of hydrophilic chemicals in water and foods

Data of chlorate and perchlorate in food was not available due to difficulties in analysis

Developed analytical method using isotope and LC/MS/MS

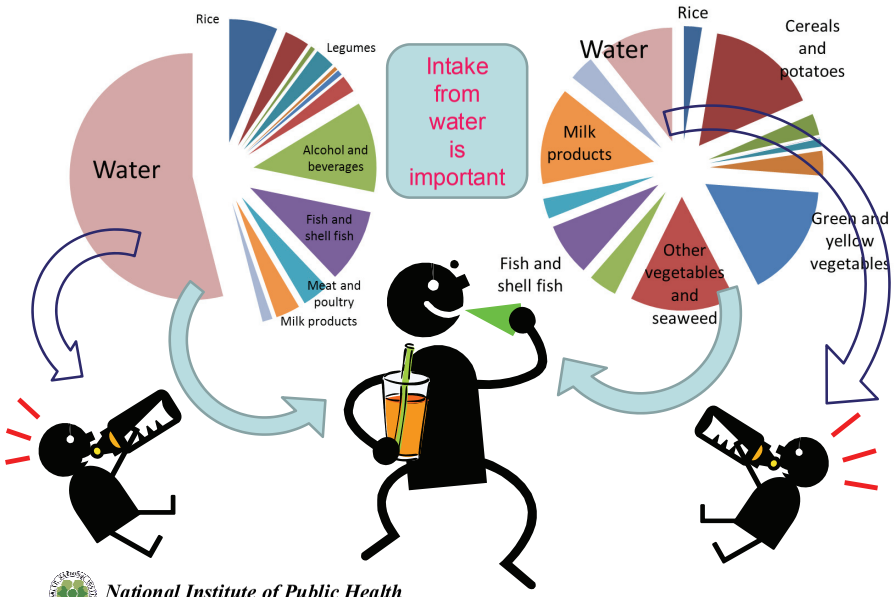
Exposure (intake) survey for chlorate and perchlorate for each food groups using market –basket method

High contribution of water supply



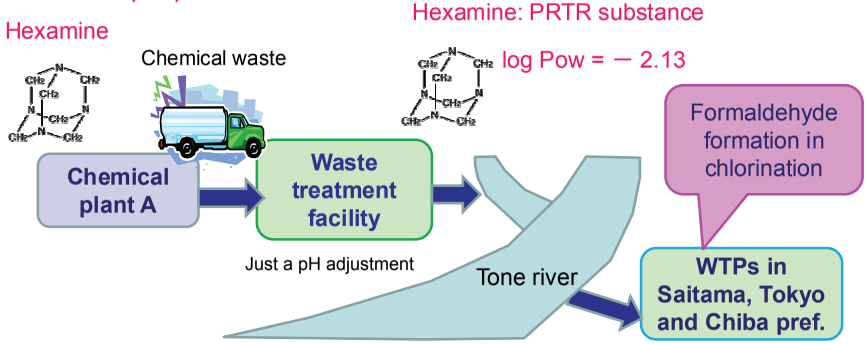
Total intake of chlorate

Total intake of perchlorate

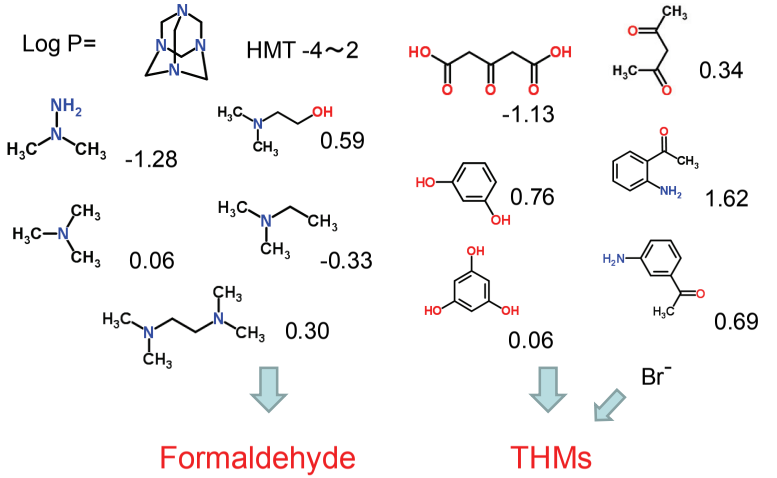


Accidental discharge of a formaldehyde precursor into the Tone river in 2012

Formaldehyde was detected above the WQ standard, in the upstream of Tone river. The chemical "Hexamine" was discharged into the Tone river, which was just a 60 tons. It caused water suspension for 850 thousand people.

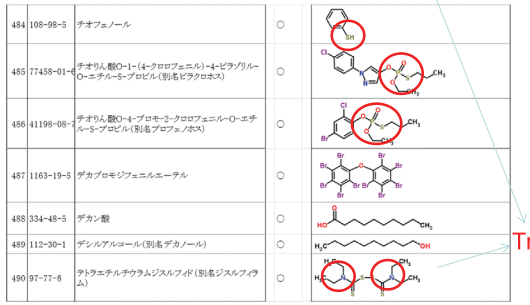


Submitted a list of troubling chemicals forming DBPs in water treatment



Establishing a database

Log Pow Log Dow Henry's law constant



Activated carbon adsorption

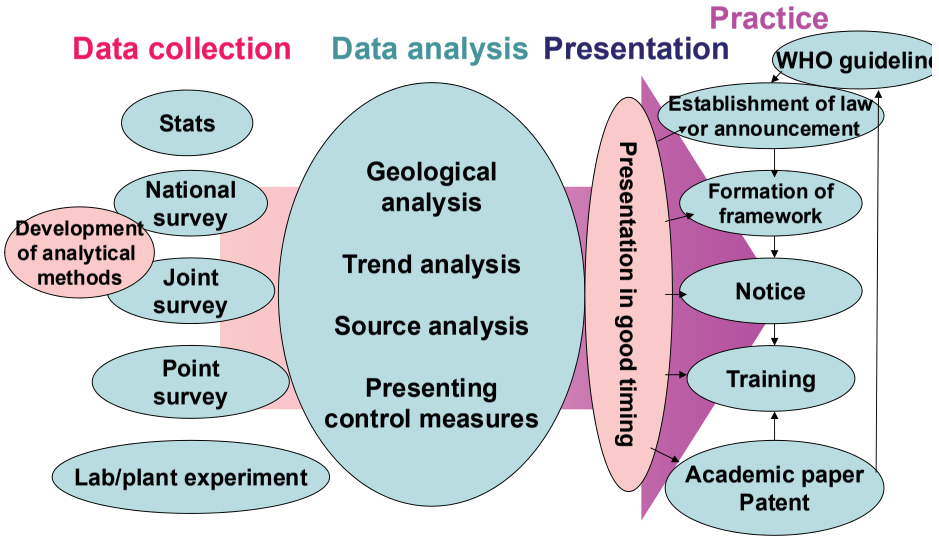
Treatability → Degradation in chlorination

Other info.

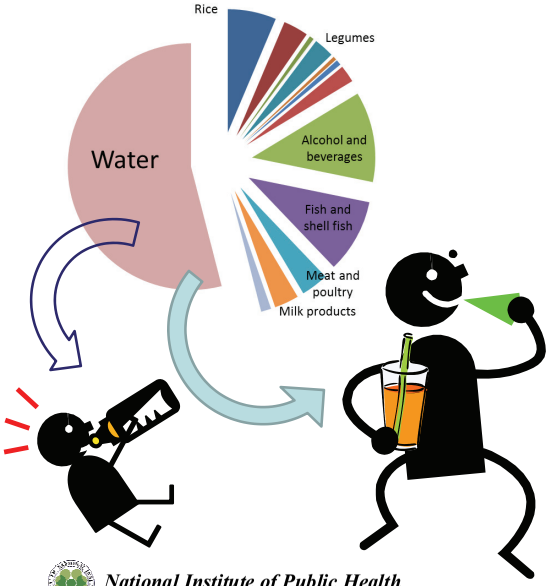
Production, Detection, Toxicity

Common data base for chemicals

Research design for promotion of practice



Total intake of chlorate



Source identification is important!!

Sometimes water is the main route of exposure of hydrophilic chemicals.

Thank you !

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For your reference

- Kosaka K, Asami M, Ohkubo K, Iwamoto T, Tanaka Y, Koshino H, Echigo S, Akiba M. Identification of a New N-Nitrosodimethylamine Precursor in Sewage Containing Industrial Effluents. Environ. Sci. Technol. 2014;48 (19):11243–50.
- Asami M, Yoshida N, Kosaka K, Ohno K, Matsui Y. Contribution of tap water to chlorate and perchlorate intake:a market basket study, Science of the Total Environment. 2013;463:199-208.
- Asami M, Kosaka K, and Kunikane S, Bromate, Chlorate, Chlorite and Perchlorate in Sodium Hypochlorite Solution Used in Water Supply, J. Water Supply: Research and Technology AQUA.2009;58(2)107-115.
- Kosaka K, Asami M, Konno Y, Oya M, Kunikane S. Identification of antiyellowing agents as precursors of N-nitrosodimethylamine production on ozonation from sewage treatment plant influent. Environmental Science & Technology 2009; 43(14): 5236-41.