

SUMMARY 3 (starting at page 129)

(1)

Chapter 7. Drinking water

- p129 Surface water vs ground water ... finite resources
Municipal water treatment: 1st settling; aeration; coag.; disinfection
Aeration: removes easily oxidisable stuff
Coagulation: $Al(OH)_3$ or $Fe(OH)_3$ gelatinous ppt. ... removes small stuff
Disinfection: kills residual nasties
Using Cl_2 : $HOCl$ and ClO^- principal agents, pH dependent
 $HOCl$ better than ClO^- ; distinguish dose, residual, demand, free
p132 Cl_2 disadv.: taste/odour (aliphatics); chlorinating agent; by-products, eg. $CHCl_3$ (carcinogen?), ^{oxidised} hydrolysis to phosgene
Using ClO_2 : made in-situ; temporary expedient; effectiveness?
Using O_3 : elec. discharge in air; expensive; $[O]$ agent; no residual
Using NH_2Cl : domestic applications only
UV radn (254 nm); kill microorganisms; ^{large} ~~small~~ installations; no residual
Drinking water quality (text, see 7.9)

- p137 Metals in drinking water; Pb, Cd, Hg, As, and NO_3^- , F^-

Chapter 8. Sewage treatment

- p140 1st settling (adding coags); 2nd treatment, microbial $[O]$, aeration to reduce BOD \Rightarrow sludge. What to do with sludge?
3rd treatment ... remove specific contaminants ^{organic, BOD,} heavy metals, xs ions etc, phosphorus & eutrophication; detergents and tripolyphosphates (STP) hydrolyt to phosphates, e.g. PO_4^{3-} , can ppt. with Al^{3+} or Fe^{3+} , or biol. removal
Phosphates; soaps/detergents; surfactants \Rightarrow micelles with lipophilic core. Linear mds degraded better than branched.
Phosphates ... builders/ Ca^{2+} sequestration. Phosphate-free detergs. now used.
p144 Pharmaceuticals in treated sewage (inc. metabolites)
Industrial aq. wastes; biol. treatment best for organics, both aerobic & anaerobic. Recalcitrant & toxic compds. still a problem.
Advanced $[O]$ processes; usually involves OH^\cdot . UV- O_3 or UV- H_2O_2 ; Fenton chem.; semiconductor assisted $[O]$; electrochemical $[O]$; mediated EC $[O]$, e.g. $\rightarrow Ag^{2+}$

(2)

p147 Inorg. aq. wastes: air stripping (NH_3, VOCs); neutralisation (acids/bases)
breakpoint chlorination ($\text{NH}_3 + \text{HClO}$); $\text{ClO}^- \rightarrow \text{EO}$ /hydrolysis
Remediation of contaminated soil: various methods. Solidification
Remediation of ground water (often contains Cl -ethenes, form DNAPLs). In-situ permeable reactive barriers ($\text{Fe}(0)$ as reductant)

p151 Chapter 9. Chlorine and its compounds

Issue 1. Producing Cl_2 ; chloralkali process $\Rightarrow \text{Cl}_2, \text{NaOH}, \text{H}_2$
Old cells, flowing Hg cathode; new ones diaphragm based (no Hg)

Issue 2. Lipophilicity of chlorinated organics \Leftarrow POPs

p154 $K_{\text{part}} \approx K_{\text{ow}}$ ($\frac{\text{conc. of solute in octanol}}{\text{conc. of solute in water}}$); DDT/PCBs, $K_{\text{ow}} > 10^6$
Bioconcentration factor ($\frac{\text{conc. of tox. in aq. organism}}{\text{conc. of tox. in water}}$); BCF
 $\text{BCF} = K_{\text{ow}} \times \% \text{ by wt. of fat in organism}$; $K_{\text{ow}} > 1000$, likely to bioconc.
Biomagnification; water \rightarrow sediment \rightarrow plankton \rightarrow salmon \rightarrow gull \rightarrow .

p156 Kinetic of uptake and depuration
$$\text{BCF} = \frac{c(\text{fish, ss})}{c(\text{aq})} = \frac{k_1}{k_2 + k_3} \equiv \frac{k(\text{uptake})}{k(\text{depuration})}$$

Issue 3. Chlorinated solvents: air/water pollution; chlorinated alkanes/
-alkenes (MC, TCE, PERC etc). Stratospheric concern, O_3 depletion
Water contamination, especially TCE, PERC

p158 Issue 4 Long range transport of POPs. Global distillation
~~Global~~ Different compositions at diff. latitudes. Issues of volatility/mobility
UN's "dirty dozen" and world-wide banning/usage.

p161 PBDEs; fire retardants; emerging problem; detected in Arctic, persistent, lipophilic
209 possible congeners; tox decreases as #Br's increases.

p162 Issue 5 Toxic organochlorine aromatics; PCBs, PCDDs (dioxins), PCDFs (furans)
DDT \approx Rachel Carson; main product p,p'; o,p'-DDT weakly estrogenic
PCBs, N.A. ban 1976, 209 congeners, Aroclor 1254, still problematic, persistent, lipophilic. Analysis GC-MS. Regulations, toxicity... complicated (various congeners)

p165 Destruction: incineration... but, poss. dioxin formation; storage problematic. Reaction w/ active metals e.g. Na; formation ArCl^-
Alterations in PCB congener distribus; grasshopper effects & microbial EO
PCB contaminated sites... various.

p167 Dioxins ... general term & specifically for toxic 2,3,7,8-tetraCl version ^③
PCDDs/PCDFs never manufactured, trace by-products (TCDD)
75 congeners → 135

Historical background; herbicide 2,4,5-T from triCl phenol. TCDD formed as byproduct. Various accidents, defoliant uses highlighted toxicity

p170 Tox. issues ... extreme lethality, but varies across species. Toxic effects
Mechanism: binding to Ah receptor (intracellular protein)
Similar compounds: Toxic equivalency factors (TEF) and toxic equivalence, TEQ ($= \sum (c_i \times TEF_i)$), compared to TCDD.

Environmental sources: mainly incineration

Human health; meat/dairy major sources; levels for adverse effects

p174 Endocrine disrupting compds ... interfere with hormone action
Estrogen/androgen mimics most widely ~~studied~~ studied ... act as hormone agonists or antagonists. Operate at minute concs (μM)
Steroid hormones, 4 ring skeleton; estradiol, testosterone, imp. in fetal develop.

Mechanism: binding to steroid hormone receptor (intracellular)

ER receptors α & β ; estrogen mimics ... size, shape, polar groups (esp. OH) (H-bonding)

p178 ER binding, relative binding affinities (RBA) vs 17 β -estradiol (=1)
Various endocrine disruptors, e.g. o,p'-DDT, dieldrin, PCBs, nonyl phenol etc.

p181 Effects linked to endocrine disruptors ... transference → fetus/eggs
Pulp & paper industry and downstream endocrine effects.

p185 Chapter 10 Metals in the Environment.

Mercury, toxicity esp. alkylHg compds. Biol. alkylation via cobalamin

Neurotoxins/renal toxins; cumulative .. binds to S compounds. Exposure.

Mercury in the environment, fish, etc; problem today, incineration

p191 Lead. Uses and toxicity. Pb in gasoline, TEL additive ⇒ roadside dust.
MTBE and its problems; ethanol → aldehydes. Lead-acid batteries.

p196 Arsenic Shellfish & exposure; rapid excretion. As in water; guidelines; As III vs As V and solubilization in wells (tied up with Fe³⁺).

Metabolites, LD₅₀, uptake, inhalation, effects → biomarkers.

AMD low, low pH, solubilisation of metals, Fe(OH)₃ downstream.

Huge problem, remediation ... possibly ... but ...

Electroplating ... some applications, CN⁻ in soln.; chromates also FIN