

國立臺北大學自然資源與環境管理研究所

106 學年度第一學期『環境工程科學概論』

課程講義(04)：物質與能量平衡；環境化學概要
Conservation of Mass and Energy; Environmental Chemistry

- INTRODUCTION – UNIFYING THEORIES
 - Conservation of Matter => Chemical Reactions
 - Conservation of Energy => Laws of Thermodynamics
 - Conservation of Matter and Energy => The Theory of Relativity
- MATERIAL BALANCE
 - Control Volume, Control Mass, and System
 - Steady State vs. Transit or Dynamic => Rate of Change
(Accumulation Rate) = (Input Rate) – (Output Rate) ± (Transformation Rate)
 - Steady-State Conservative Systems => Non-conservative Pollutants
 - Batch Systems with Non-Conservative Pollutants
- ENERGY BALANCE
 - First Law of Thermodynamics
 - ⇒ Thermal Unit of Energy; Specific Heat Capacity
 - ⇒ Latent Heat, Overheated Stream, Subcritical and Supercritical
 - ⇒ Pressurized Water Reactors (vs. Boiling Water Reactors)
 - Second Law of Thermodynamics
 - ⇒ Energy: Heat, Kinetic Energy, Potential, Electricity, etc.
 - ⇒ Work, Unusable Energy, Entropy and Disorder/Randomness
 - ⇒ Thermal Efficiency: Carnot Engine
 - ⇒ Thermal Power Plants: Coal, Oil and Natural Gas; Steam Generator and Internal combustion; Combined Cycle and IGCC
 - Conductive and Convective Heat Transfer
 - Radiant Heat Transfer
 - ⇒ Solar Energy: Heat vs. Photovoltaic
 - ⇒ Electromagnetic Spectrum: Wavelength vs. Frequency
 - Heat Engine vs. Heat Pump
- UNIT OF MEASUREMENT
 - Basic Units: Length, Mass, Time, and Temperature
 - International System of Units (SI) vs. Imperial System (U.S. customary units)
 - Extended Units: Concentration, Dose, ppm(m), ppb(v), Energy, “Equivalent”
 - ⇒ Units for Air Pollutants: ppm(v), ppb(v), $\mu\text{g}/\text{m}^3$, iTEQ
 - ⇒ Units for Water Pollutants: mg/L, ppm(m), $\mu\text{-mho}/\text{cm}$
 - ⇒ Units for Soil Contaminants: mg/kg, meq/100g (CEC)
 - ⇒ pH, kg CO₂-eq, kWh, kOLE...

- INTRODUCTION TO ENVIRONMENTAL CHEMISTRY
 - “Chemistry is the study of matter”
 - Chemical Kinetics, Chemical Reaction, and Chemical Equilibrium
 - Inorganic Chemicals and Organic Chemicals
 - Important Elements
 - ⇒ Carbon, Oxygen, Hydrogen, Nitrogen, Sulfur, and Phosphorus
 - ⇒ Halogen: Fluorine, Chlorine, Bromine
 - ⇒ Heavy Metals: Lead (Pb) 鉛、Arsenic (As) 砷、Cadmium (Cd) 鎘、Mercury (Hg) 汞、Chromium (Cr) 鉻、Other Metals (Atomic Weight > 40)
 - ⇒ RoHS Directive => Pb, Cd, Hg, Cr⁺⁶, 2 Flame Retardants (Polybrominated biphenyls, PBB; Polybrominated diphenyl ether, PBDE)
 - ⇒ Rare Earth Elements (REE) => Epitaxy (GIS); Silicon crystal => Wafer
 - ⇒ CFC, HFC => Greenhouse gases vs. Ozone depletion substance
 - ⇒ GWP (Global Warming Potential) vs. ODP (Ozone Depletion Potential)

- BASIC CHEMICAL CONCEPTS
 - Atoms, Elements, and the Periodic Table => Isotopes
 - Chemical Bond and Intermolecular Forces
 - Mole, Molar Units (Molarity), and Activity Units
 - Chemical Reactions and Stoichiometry
 - ⇒ Balancing Chemical Reactions
 - ⇒ Types of Chemical Reactions: Precipitation-Dissolution Reaction, Complexation Reaction, Oxidation-Reduction (Redox) Reactions
 - Chemical Equilibrium
 - ⇒ Precipitation (K_{sp}), Partial Pressure and Molar Rate (Molarity), and pH

- ORGANIC CHEMISTRY
 - Alkane, Alkene, and Alkynes => 甲烷、乙烯、丙炔
 - Aryl (Aromatic) Compounds
 - ⇒ BTX (Benzene-Toluene-Xylene) and PAH (Polycyclic aromatic hydrocarbon)
 - ⇒ PCB: Polychlorinated biphenyl; PCDDs: Polychlorinated dibenzo-p-dioxins
 - ⇒ DDT: di-chloro-diphenyl-tri-chloro-ethane 二氯二苯基三氯乙烷
 - Phenol：壬基苯酚 (Nonyl Phenol, NP)；雙酚 A (Bisphenol A, BPA)
 - Toxic Chemicals => Hazardous Chemicals

- HOMEWORK ASSIGNMENT #1 (Due 2017/10/17)：

依據《行政院環境保護署毒物及化學物質局組織法》(2016/12/23)，環保署設有毒物及化學物質局。請查詢相關文件，以定義「毒物」及「化學物質」。該局於 2017/09/26 [公告 13 種食安疑慮物質為毒化物](#)，請定義說明「毒性化學物質」(毒化物、毒物)，並比較 4 類毒性化學物質之分類，以說明第四類毒性化學物質之管制方式。上述 13 種化學物質中，有那些係屬「有機化合物」？