

國立臺北大學自然資源與環境管理研究所  
102 學年度第一學期『環境工程科學概論』(在職專班)

課程講義(14)：水處理技術概要  
Introduction to Water Treatment Technologies

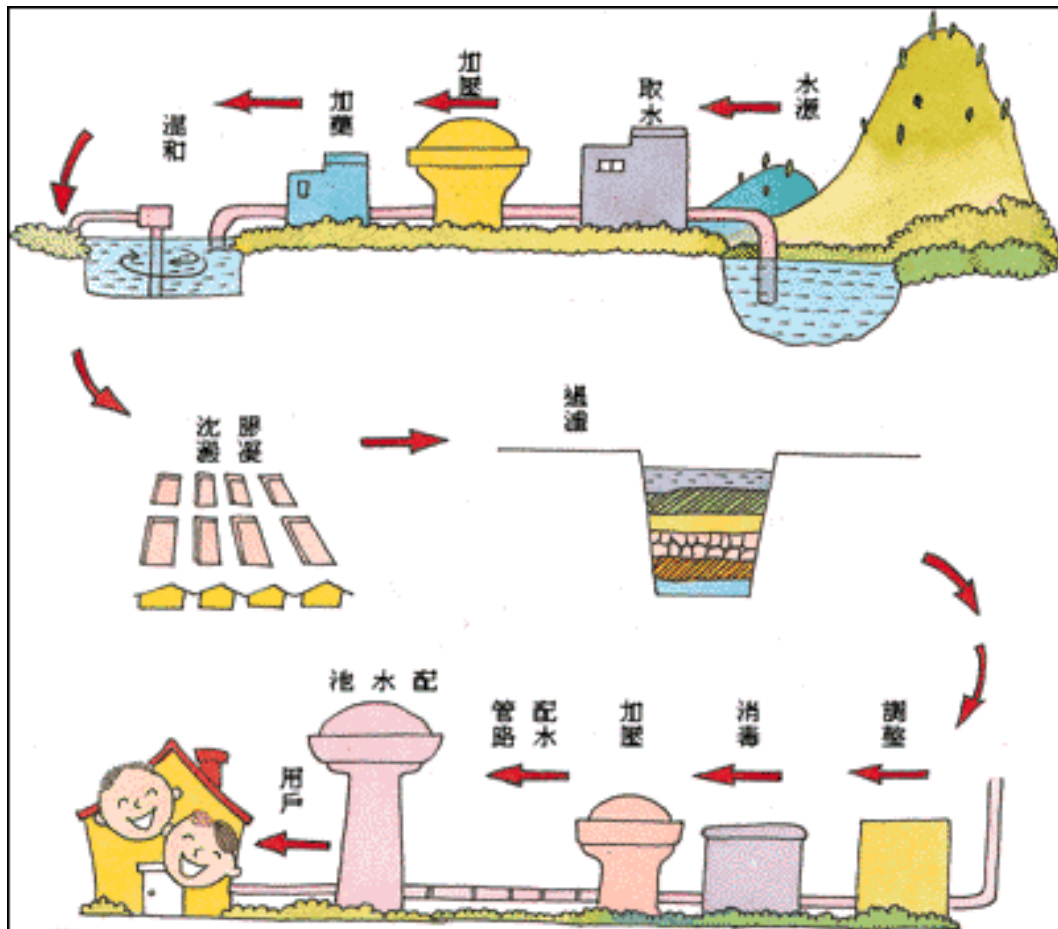
● INTRODUCTION

- Tap Water vs. Drinking Water =>自來水、飲用水
  - ⇒ Infrastructure vs. Environmental Protection => Public Utility
  - ⇒ 社區自設公共給水設備、簡易自來水
- Drinking Water Quality 飲用水水質 vs. Tap Water Quality Standard
  - ⇒ [Taiwan's Drinking Water Quality 飲用水水質標準](#)
    1. Bacterial standards 細菌性標準
    2. Physical standards 物理性標準
    3. Chemical standards 化學性標準：
      - A. Substances that impact health 影響健康物質
      - B. Substances with the potential to impact health 可能影響健康物質
      - C. Esthetic influential substances 影響適飲性物質
      - D. Limits on residual chlorine 有效餘氯含量
      - E. Limit range for pH index 氫離子濃度指數
  - ⇒ [自來水水質標準](#)
  - ⇒ 大高雄地區自來水後續改善工程計畫
- The U.S. Environmental Protection Agency (EPA) sets two types of standards:
  - ⇒ Primary standards are set to provide the maximum feasible protection to public health. They regulate contaminant levels based on toxicity and adverse health effects. The goal of standard setting is to identify maximum contaminant levels (MCLs) which prevent adverse health effects.
  - ⇒ Secondary standards regulate contaminant levels based on aesthetics such as color and odor, which do not pose a risk to health. These secondary maximum contaminant levels (SMCLs) are guidelines, not enforceable limits. They identify acceptable concentrations of contaminants which cause unpleasant tastes, odors, or colors in the water. SMCLs are for contaminants that will not cause adverse health effects.
- Drinking Water Regulations in Other Countries

● WATER SUPPLY ENGINEERING

- 自來水工程、給水工程、上水道工程
  - ⇒ 集水工程 Collection Works
  - ⇒ 輸水工程 Transmission Works
  - ⇒ 抽水工程 Pumping Works
  - ⇒ 淨水工程 Purification Works
  - ⇒ 配水工程 Distribution Works

□ 中水道工程：雨水收集利用、建築物污水回收再利用



自來水到我家：取水、導水、淨水、送(配)水  
([http://www.water.gov.tw/05know/kno\\_b\\_main.asp?bull\\_id=495](http://www.water.gov.tw/05know/kno_b_main.asp?bull_id=495))

● WATER TREATMENT ENGINEERING (PURIFICATION WORKS)

□ Water Treatment Units

- ⇒ Gas Transfer; Ion Transfer; Solid Transfer
- ⇒ Solute Stabilization => Desalination
- ⇒ Sanitation, Hygiene and Aesthetical Considerations (Potability)

□ Water Treatment Components (Steps)

- ⇒ Gridding and Screening
- ⇒ Coagulation (混凝) and Flocculation (膠凝) => PAC
- ⇒ Sedimentation => Primary and Secondary (even Tertiary sedimentation)
- ⇒ Filtration and Disinfection => THM (Tri-Halogen Methane)

□ Advanced Water Treatment: Potability and other Aesthetical Considerations

- ⇒ Ion Exchange
- ⇒ Reverse Osmosis (RO)
- ⇒ Ultra-filtration: Membrane
- ⇒ UV & O<sub>3</sub>

- SEWAGE ENGINEERING

- Sewage Systems or Sewers: Sanitary Wastewater and Stormwater Runoff
- Combined vs. Separate Sewage Systems
- Pipelines vs. Channels: Pipe Flow vs. Open Channel (Open Surface) Flow
- Sewage Engineering (Works):  
Collection and Treatment of Wastewater as well as Disposal of Sludge
- Sludge and Bio-solid: Integrated Wastewater Treatment Plant; Cogeneration of Heat and Power, Water Reclamation (Recovery) Center => Newwater
- Treatment of Industrial Wastewater => Obligation of Private Sector

- WASTEWATER TREATMENT ENGINEERING

- Wastewater Treatment Units
  - ⇒ Physical and Physico-Chemical Mechanisms
  - ⇒ Biological Mechanisms
  - ⇒ Chemical Mechanisms
- Classification of Wastewater Treatment Plants
  - ⇒ Primary Treatment 一級處理
  - ⇒ Secondary (Biological) Treatment 二級 (生物) 處理
  - ⇒ Tertiary (Advanced) Treatment 三級 (高級) 處理
- Biological Treatment
  - ⇒ Suspend Growth Treatment: Activated Sludge (活性污泥)、Membrane Bioreactors (MBR)、Aerated Lagoons and Oxidation Ponds (氧化塘)
  - ⇒ Attached Growth Treatment: Trickle Filters(滴濾池)、Rotating Biological Contactor (RBC 生物旋轉盤)
  - ⇒ Hybrid Systems 組合生物處理法—A/O、兩級 A/O、A2/O、UNITANK
  - ⇒ Constructed Wetland (人工濕地) and Ecological Engineering
  - ⇒ Anaerobic Treatment to Retain Biomass and Water Reclamation
- Sludge Treatment
  - ⇒ Anaerobic Digestion; Dewatering and Drying => Water Content; Disposal
- Advanced Wastewater Treatment and Water Reuse
  - ⇒ Nitrogen and Phosphorus Removals; Removal of Heavy Metals
  - ⇒ Removal of Dissolved Solid and Sea Water Desalination

大高雄地區淨水廠現況

([http://depweb.ksepb.gov.tw/2/drinkingwater/management\\_4.htm](http://depweb.ksepb.gov.tw/2/drinkingwater/management_4.htm))

大高雄地區自來水主要由澄清湖、拷潭、翁公園、坪頂、鳳山及大崗山(含嶺口淨水場及北嶺加壓站)等淨水場供應高雄市的民生飲用水。為提升大高雄地區自來水在口

感、味覺等適飲性之品質，自來水公司乃辦理「澄清湖、拷潭、翁公園及鳳山淨水場增設高級淨水處理設備工程」、「原水取水口上移至高屏溪攔河堰工程」以及經濟部水利處執行之「南化水庫與高屏溪攔河堰聯通管路工程計畫」。圖 1 為大高雄淨水場位置示意圖。其水源主要取自高屏溪攔河堰，經台灣省自來水公司淨化處理後，處理水水質已能符合「飲用水水質標準」，為進一步提昇水質及充裕水量，先後完成「高雄地區自來水水質改善工程」，包括辦理澄清湖、拷潭、翁公園、坪頂及鳳山水庫水質改善曝氣工程、原水除藻、除臭色、抽換管線等工程。

在改善大高雄地區自來水品質方面，台灣省自來水股份有限公司於 92 年 10 月底辦理完成「大高雄地區自來水後續改善工程計畫（原水取水口上移至高屏溪攔河堰工程、增設高級淨水處理場設備）」，於澄清湖淨水場增設可去除異味、降低「總硬度」之前臭氧、後臭氧、活性碳吸附設備、結晶軟化等高級處理設備，其澄清湖淨水場高級處理及各單元功能說明流程圖如圖 2 所示；於 96 年 9 月完成拷潭及翁公園等二座淨水場增設薄膜處理等高級處理設備，其拷潭及翁公園淨水場高級處理及各單元功能說明流程圖如圖 3 所示；於 96 年 12 月亦完成鳳山淨水場增設結晶軟化與生物活性碳濾床等高級處理設備，鳳山淨水場民生用水高級處理及各單元功能說明流程圖如圖 4 所示。



圖 1 大高雄淨水場位置示意圖

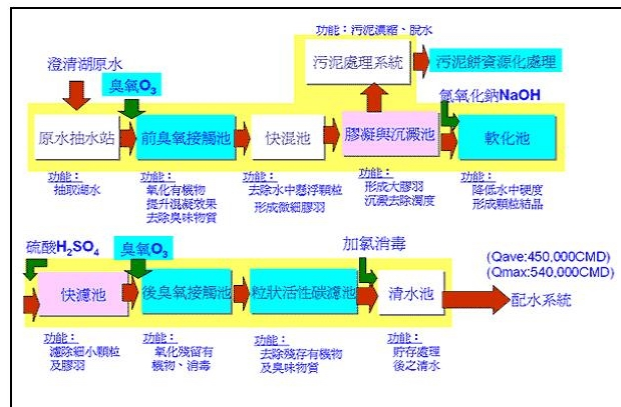


圖 2 澄清湖淨水場高級處理流程

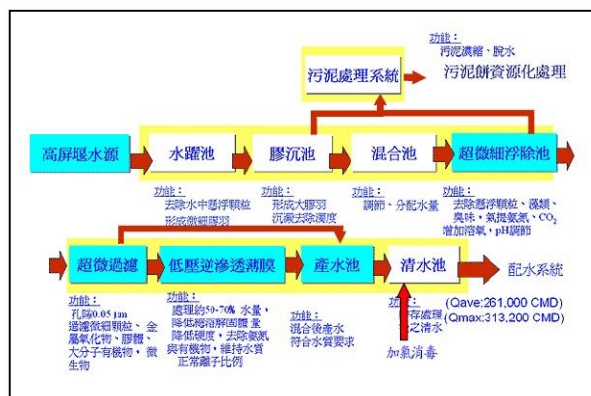


圖 3 拷潭及翁公園淨水場高級處理流程

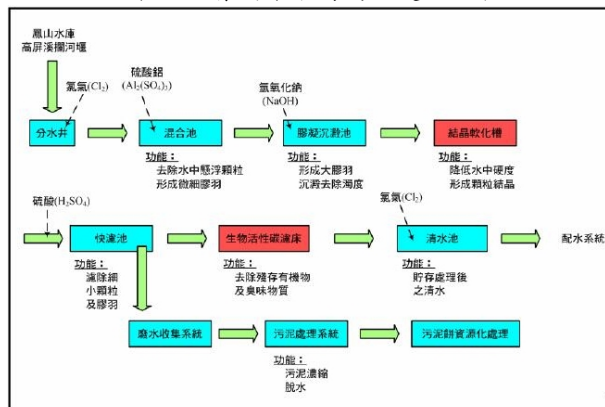


圖 4 鳳山淨水場民生用水高級處理流程

**高雄市自來水供水區域現況：**高雄市包含左營區、楠梓區、鼓山區、前鎮區、小港區、苓雅區、旗津區、鹽埕區、新興區、前金區、三民區、鳳山區、岡山區、鳥松區等 38 個行政區。其中，澄清湖淨水場：供應高雄市三民、左營、新興、鼓山、苓雅及鹽埕等行政區；拷潭及翁公園淨水場：供應高雄市小港、旗津、苓雅及前鎮等行政區；坪頂淨水場：供應高雄市左營與楠梓等行政區；鳳山淨水場：供應高雄市前鎮、小港及旗津等行政區。=> 高雄市每日民生用水量 127 萬立方公尺。