水處理與毒物風險實驗室

國立中山大學環境工程研究所

陳威翔副教授

副總務長兼環安中心副主任

氣膠科學研究中心副主任

Education 學歷

- 加州大學戴維斯分校環境工程博士
- 卡內基美隆大學環境工程碩士
- 國立中山大學特聘年輕學者

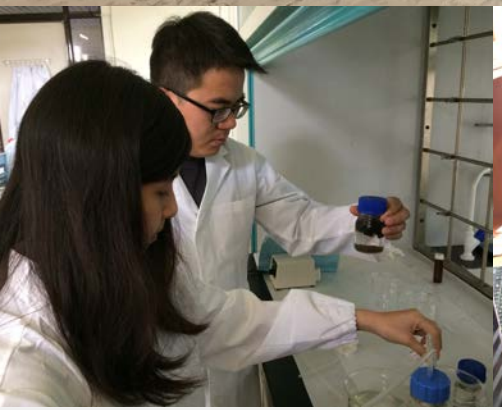
Experiences 經歷

- 國立中山大學環境工程研究所專任副教授
- 國立中山大學副總務長與環境保護暨安全衛生中心副主任
- 國立中山大學氣膠科學研究中心副主任
- 行政院環保署專責人員訓練班課程教師
- 中華民國環境工程學會學刊*Sustainable Environment Research*編輯委員、學會會刊編輯委員、水環境工程委員會委員、土壤與地下水環境委員會委員

關於我們

水處理與毒物風險實驗室

Water Treatment and Toxicological Risk (WTTR) Lab



研究成果（自2011年）

Projects and publication

學術榮譽

- 49次學術榮譽獎項、優秀論文獎、及各式學生獎學金（如106年度中華民國環境工程學會優秀青年工程師獎等）

研究計畫

- 執行8件科技部計畫、6件政府委託之產學計畫、14件非政府委託之產學計畫

研究計畫

- 40篇SCI論文、46篇研討會論文、3篇專書專章

研究計畫部分摘述

科技部

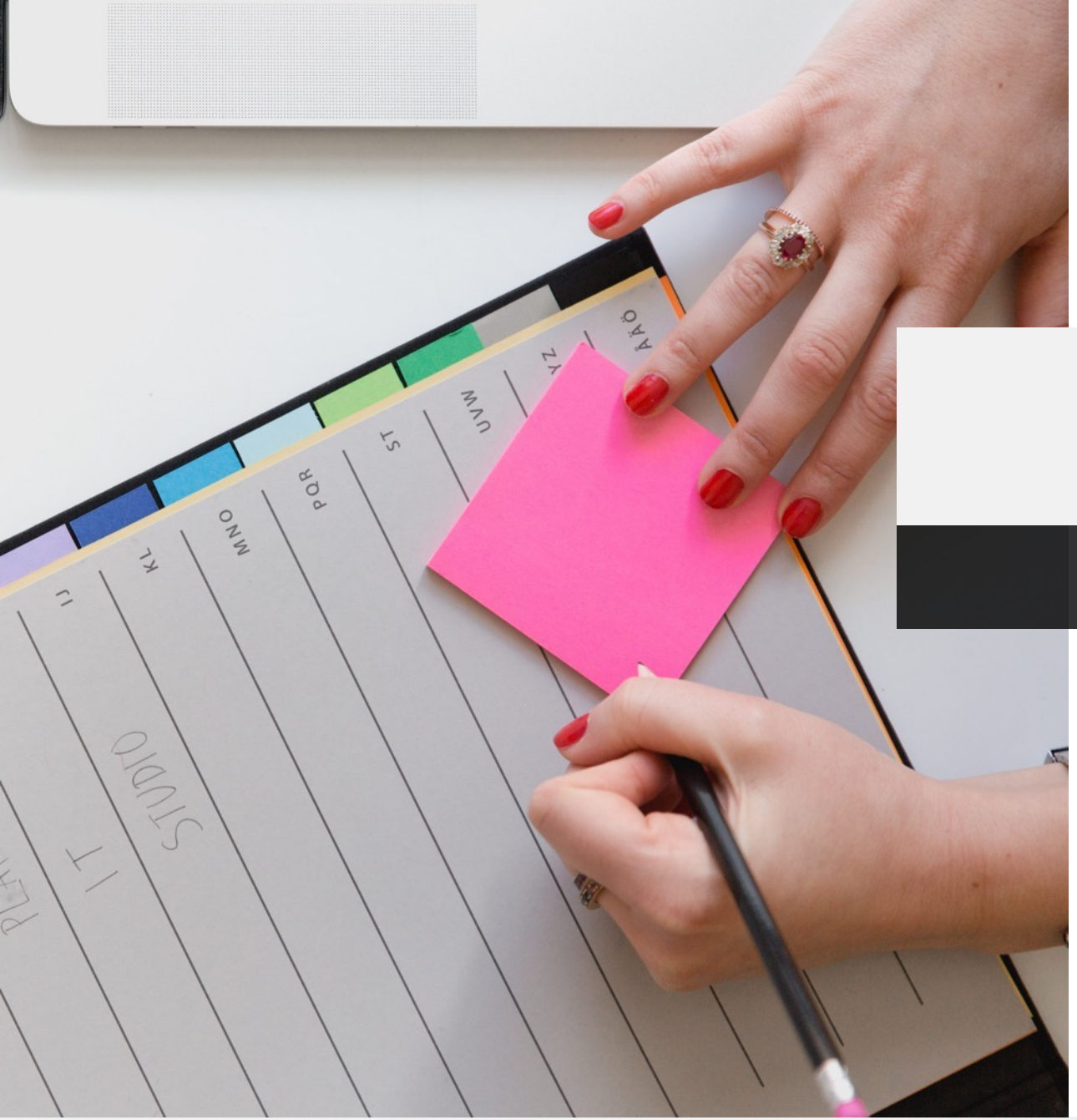
- 國內高使用量藥品生成含氮消毒副產物亞硝胺、鹵乙酰胺、鹵乙腈之潛勢與淨水處理環境宿命研究，MOST 107-2221-E-110-003-MY3
- 鋁集塵灰有效提取氧化鋁之技術開發與精進研究，MOST 106-2622-E-110-015-CC2
- 應用氧化石墨烯複合材料加速厭氧氨氧化以去除水中藥品及其衍生性致癌副產物生成潛勢，MOST 106-2621-M-110-003
- 探索研究計畫：改質氧化石墨烯搭配厭氧流體化生物膜與厭氧氨氧化處理含藥品類新興污染物之民生污水，MOST 105-2633-E-110-001
- 藥品及個人保健用品在消毒氧化過程中生成多種新興消毒副產物亞硝胺之研究，MOST 103-2221-E-110-007-MY2
- 淨水前處理與生物固形物中N-亞硝胺化合物之生成與宿命研究，NSC 101-2221-E-110-055-MY2

政府委託

- 經濟部加工出口區管理處-107至109年度楠梓園區空氣品質調查分析及輔導計畫，經濟部加工出口區，
- 106年嘉義市細懸浮微粒及有害空氣污染物調查暨焚化廠周界健康風險評估計畫，嘉義市政府環境保護局
- 使用中車輛污染調查研究計畫，子計畫二：PAHs 致癌性及免疫毒性分析及健康風險評估，環保署/科技部空污防制科研合作計畫
- 新世代碳質複合材料技術開發，工業技術研究院
- 104年度高雄市小港區固定污染源排放調查及健康風險減量計畫，高雄市政府環境保護局
- 工業區污水處理廠溫室氣體排放係數、生成機制及控制技術之研究，國科會與環保署合作代辦計畫

非政府委託

- 有藥切割研磨廢水回收處理研究，財團法人日月光文教基金會，
- 料堆水霧抑塵技術與效率量化，中國鋼鐵股份有限公司，
- 中鋼煤料料堆與燃燒煙氣PM2.5之健康影響潛勢量化比較，中國鋼鐵股份有限公司，
- 台灣檢驗科技股份有限公司委託暨外包合約(拷潭與翁公園淨水場)，台灣檢驗科技股份有限公司，
- 切割研磨廢水矽渣回收收集技術操作最佳化測試，財團法人日月光文教基金會
- Assessment of and suggestions for environmental protection/education in the fields of water, air, and soil pollution in Southern Taiwan，Our Fellow Man Alliance (NGO)
- 成功淨水廠水質分析及提升操作效能委託專業服務案，台灣自來水股份有限公司第七區管理處
- 台南市化工業廢水與高雄市重點河川中揮發性有機物之逸散與環境宿命調查，環佑實業有限公司



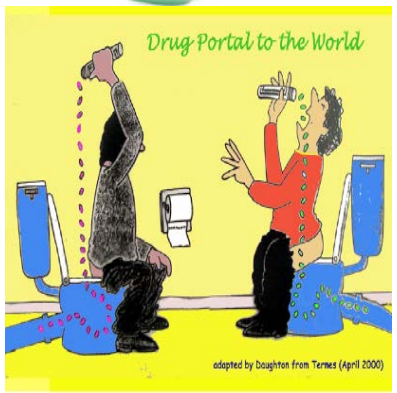
研究技術與專長

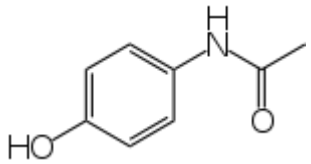
Research focuses and experiences

- 新興污染物生成與流佈
- 物理化學或生物水處理技術
- 健康風險評估

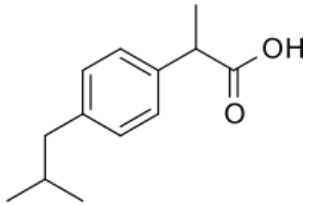
新興污染物生成與流佈

原生性污染物泛指本身可能對環境或健康造成負面影響之物質（如藥品、農藥等）





Acetaminophen



Ibuprofen

排名	藥物名稱	ton	用途
1	METFORMIN	582.5	糖尿病藥物
2	ACETAMINOPHEN	163.74	其他止痛劑及解熱劑
3	PIRACETAM	85.56	呼吸及大腦興奮劑
4	ACETYLSALICYLIC ACID	57.25	鎮痛藥、解熱藥和消炎藥
5	ACETYLCYSTEINE	43.28	祛痰藥物
6	AMOXICILLIN	35	抗生素
7	VALSARTAN	31.67	抗高血壓類藥物
8	VALPROIC ACID	23.58	癲癇及躁鬱症的藥物
9	PENTOXIFYLLINE	23.5	增進血液循環藥物
10	CIMETIDINE	20.69	抑制胃酸分泌藥物
11	CHLORZOXAZONE	19.41	骨骼肌鬆弛劑
12	IBUPROFEN	15.9	非類固醇類抗發炎劑
13	MEFENAMIC ACID	15.16	消炎止痛藥
14	THEOPHYLLINE	12.89	呼吸道平滑肌鬆弛劑
15	SILYMARIN	12.71	腸胃藥物
16	MEPHENOXALONE	11.2	肌肉鬆弛劑
17	FENOFIBRATE	9.97	降血脂藥
18	RANITIDINE	9.66	抑制胃酸分泌藥物
19	LOSARTAN	8.24	高血壓用藥。
20	ACARBOSE	8.19	糖尿病用藥

新興污染物生成與流佈

藥品的大量使用與不當棄置，除了本身造成環境危害，
也衍生具有更高毒性之有害副產物。

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to the detection of trace amounts of another possible human carcinogen, *N*-nitroso-*N*-methyl-4-aminobutyric acid (NMBA). According to the company, NMBA is a "possible process impurit

PROCESS CHEMISTRY

A side reaction may have led to impurities found in valsartan heart drugs

Multiple manufacturers have been involved in drug recalls over the past eight months

by Tien Nguyen

FEBRUARY 19, 2019

Credit: Shutterstock

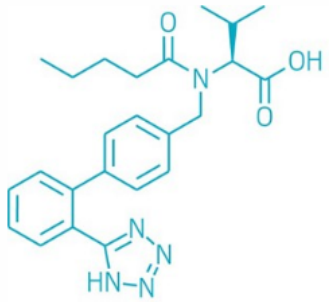
Dozens of companies have recalled valsartan products due to the presence of possibly carcinogenic impurities.

MOST POPULAR IN PHARMACEUTICALS

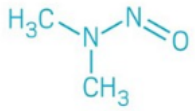
- Drug hunters explore allostery's advantages
- Psychedelic microdoses ease rat symptoms of depression and PTSD
- A side reaction may have led to impurities found in valsartan heart drugs
- Small molecule mimics flu-blocking antibodies
- Psychedelic microdoses ease rat symptoms of depression and PTSD

Over the past eight months, **more than a dozen pharmaceutical distributors** around the world have voluntarily recalled hundreds of batches of generic versions of the drug valsartan and related products losartan and irbesartan, which are commonly prescribed to treat high blood pressure and heart failure. The most recent recall occurred earlier this month. **According to the Agency for Healthcare Research and Quality**, about 1.6 million people purchased valsartan in the US in 2016.

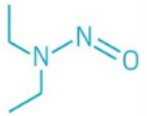
The recalled products contained active pharmaceutical ingredients (APIs) with trace amounts of either *N*-nitrosodimethylamine (NDMA) or *N*-nitrosodiethylamine (NDEA), which are both probable human carcinogens. Testing by companies and the US Food and Drug Administration has revealed that the impurities came from multiple API manufacturers, facilities that synthesize the biologically relevant compounds—valsartan and related sartan molecules—and then sell them to companies that make the final tablets that reach consumers. Based on information about how one of these API manufacturers produces the compound and reports from that company, experts think that these impurities were made through a side reaction of one step in the compound's synthesis.



Valsartan



NDMA



NDEA

Emerging Contaminant - N-Nitroso-dimethylamine (NDMA)

April 2008

FACT SHEET

At a Glance

- Classified as a B2 carcinogen - reasonably anticipated to be a human carcinogen.
- Formerly used in the production of rocket fuel, antioxidants, and softeners for copolymers. Currently used only for research purposes.
- Unintended byproduct of chlorination of wastewater at wastewater treatment plants that use chloramines for disinfection, causing significant concern as a drinking water contaminant.
- Highly mobile in soil, with potential to leach into ground water.
- Oral route is the primary human

Introduction

An "emerging contaminant" is a chemical or material that is characterized by a perceived, potential, or real threat to human health or the environment or a lack of published health standards. A contaminant may also be "emerging" because a new source or a new pathway to humans has been discovered or a new detection method or treatment technology has been developed (DoD 2006). This fact sheet, developed by the U.S. Environmental Protection Agency (EPA) Federal Facilities Restoration and Reuse Office (FFRRO), provides a brief summary for N-Nitrosodimethylamine (NDMA), including physical and chemical properties; environmental and health impacts; existing federal and state guidelines; detection and treatment methods; and additional sources of information.

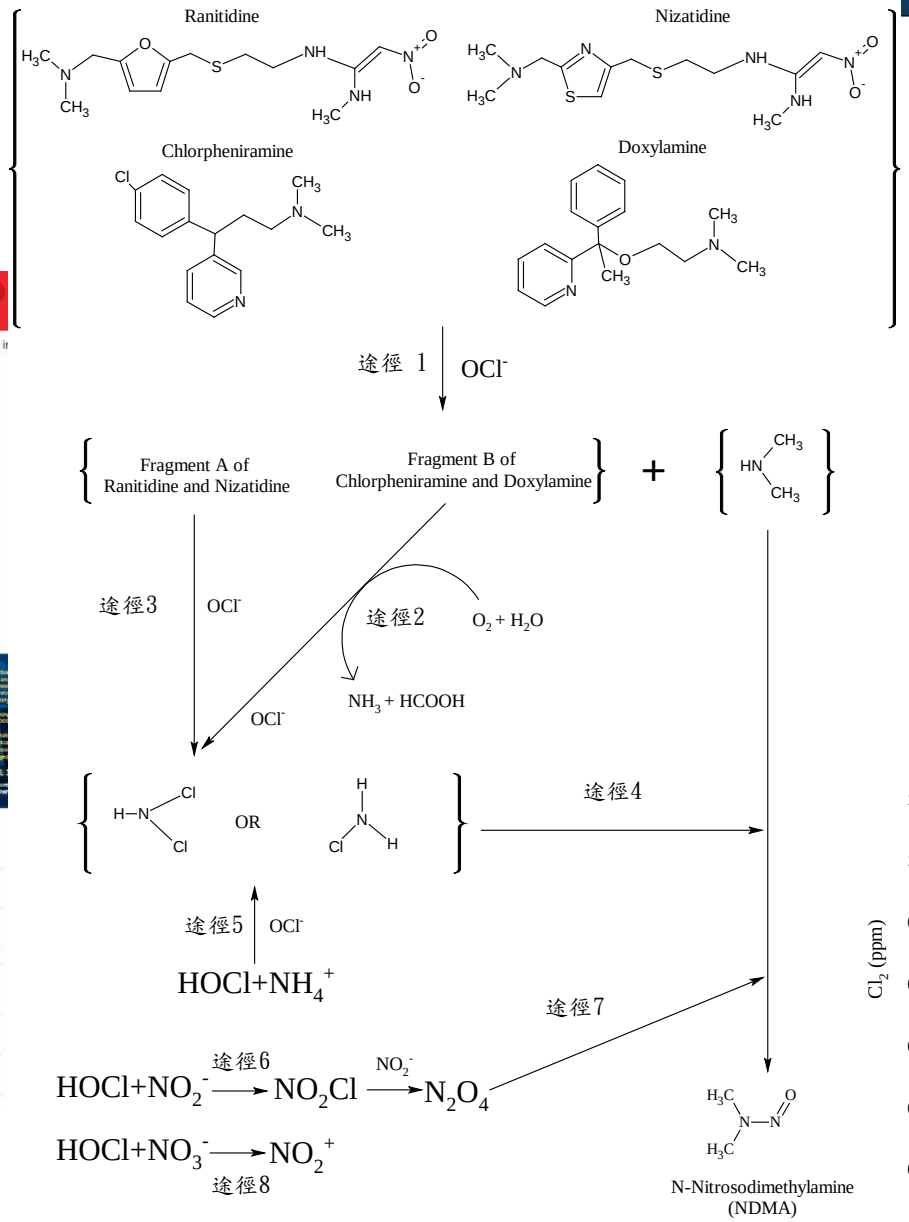
NDMA is an emerging drinking water contaminant that is of interest to the environmental community because of its miscibility with water, as well as its carcinogenicity and toxicity. This fact sheet is intended for use by site managers and other field personnel addressing NDMA contamination at a cleanup site or in a drinking water supply.

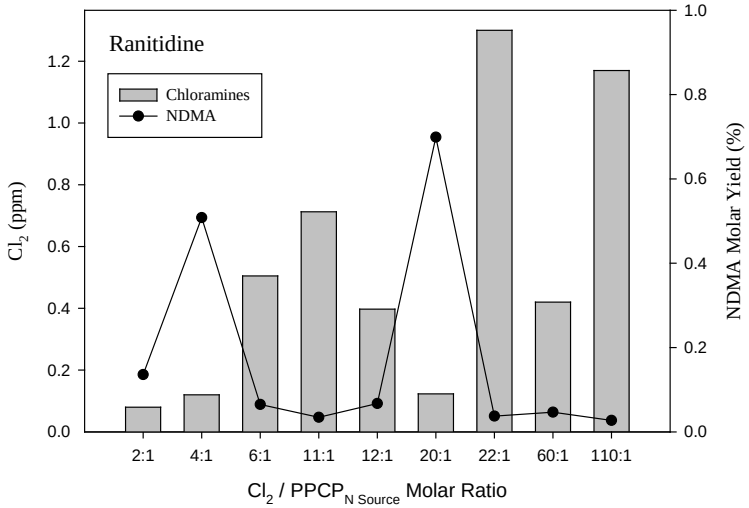
What is NDMA?

- Synonyms include dimethylnitrosamine (DMNA), nitrosodimethylamine, N-methyl-N-nitrosomethanamine, and N,N-dimethylnitrosamine (EPA IRIS 2006).
- NDMA is not currently produced in pure form or commercially used, except for research purposes. It was formerly used in production of

新興污染物生成與流佈

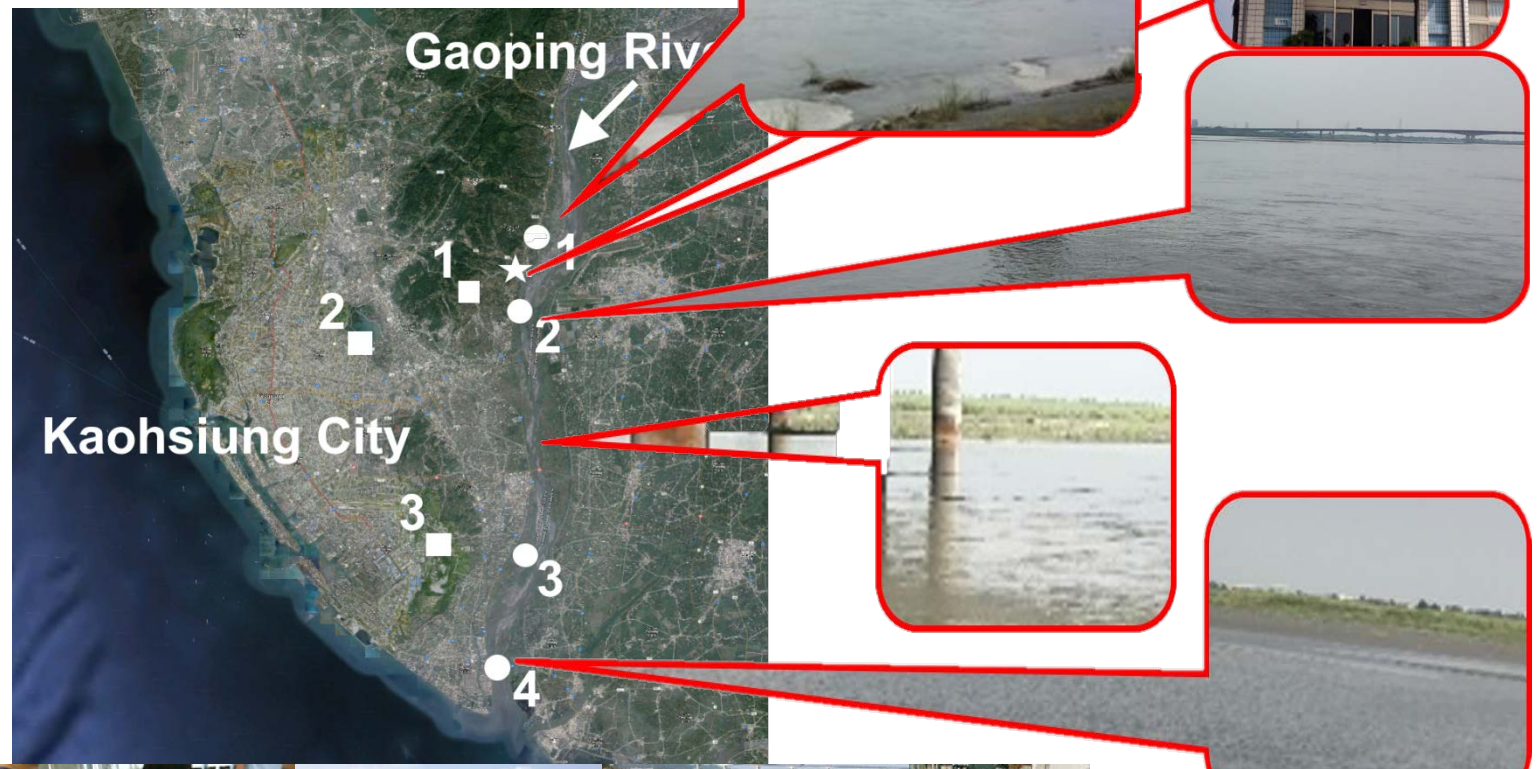
研究原生性污染物與衍生性致癌副產物間的反應機制與動力資訊

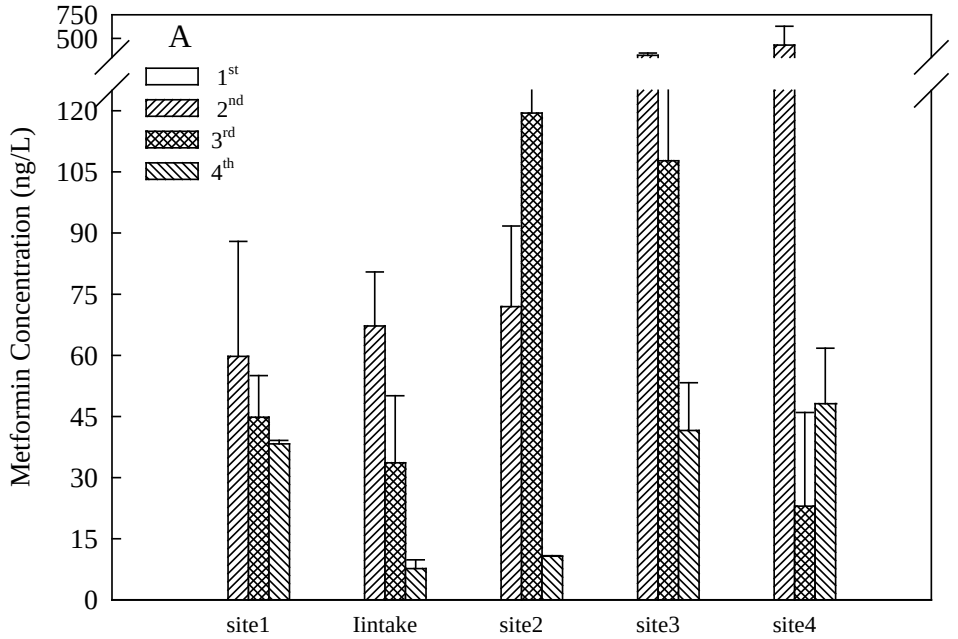


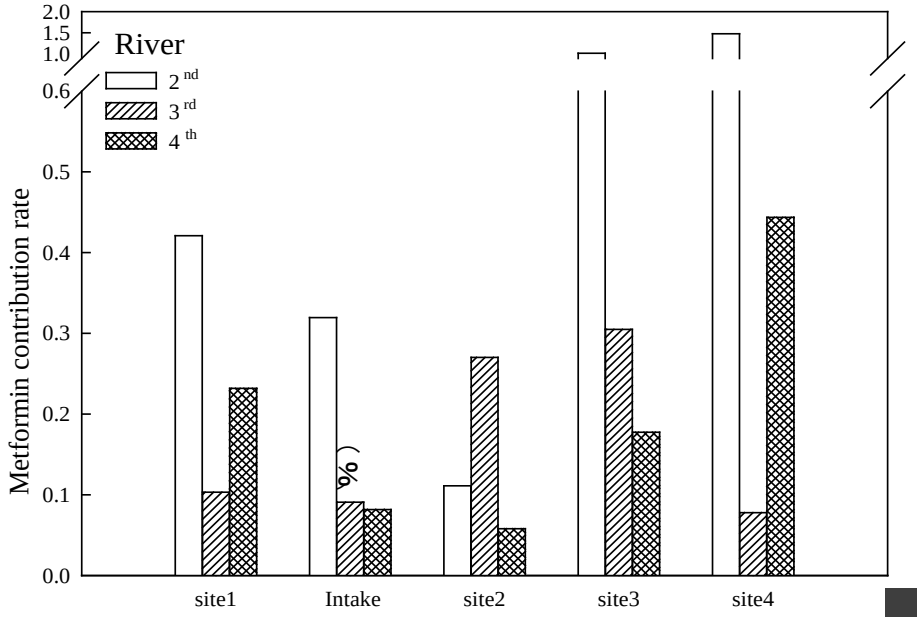


新興污染物生成與流佈

收集特定原生性污染物（如藥品）
與衍生性致癌物(如亞硝胺)
在環境中的流佈資訊







新興污染物生成與流佈

收集特定原生性污染物（如藥品）
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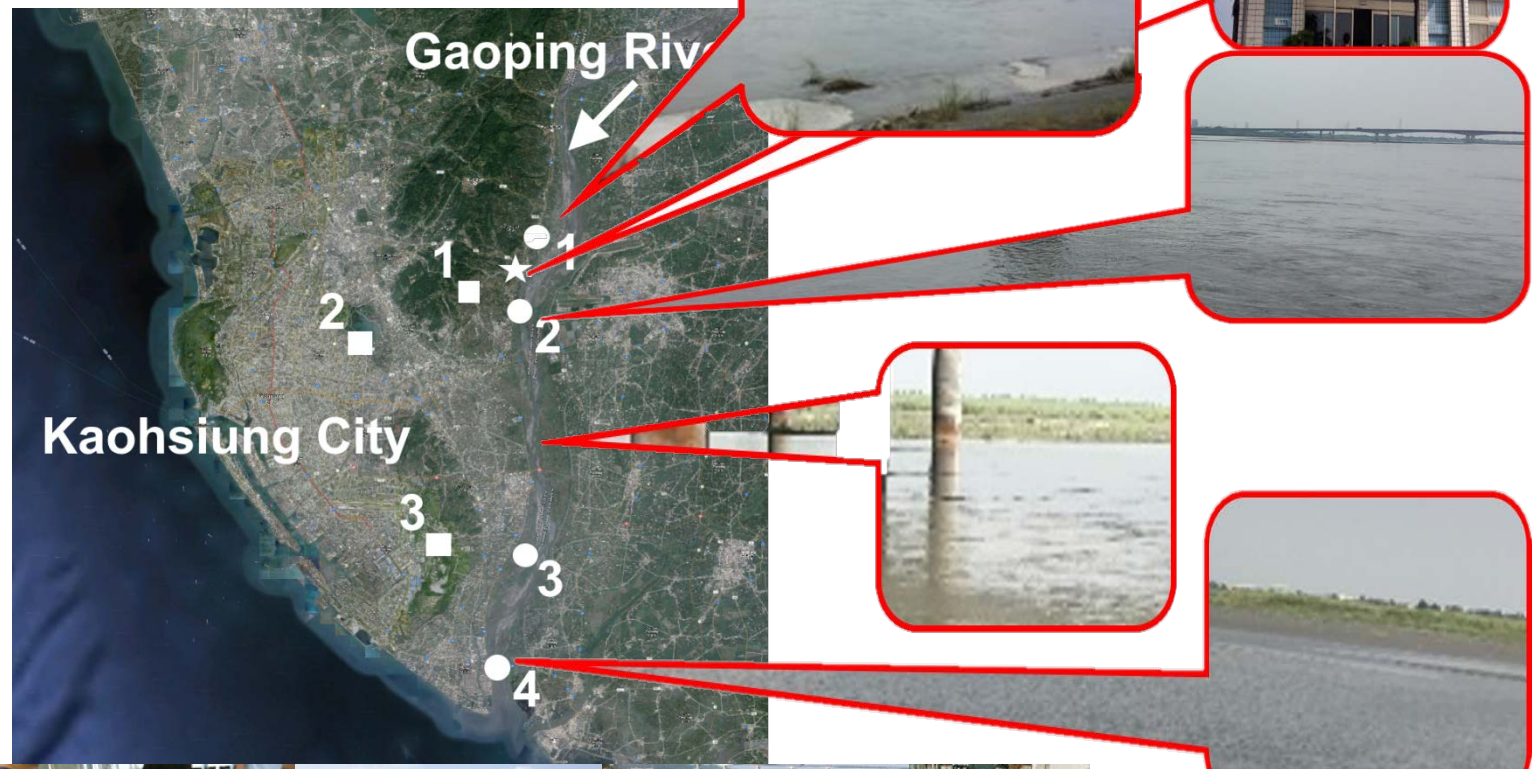
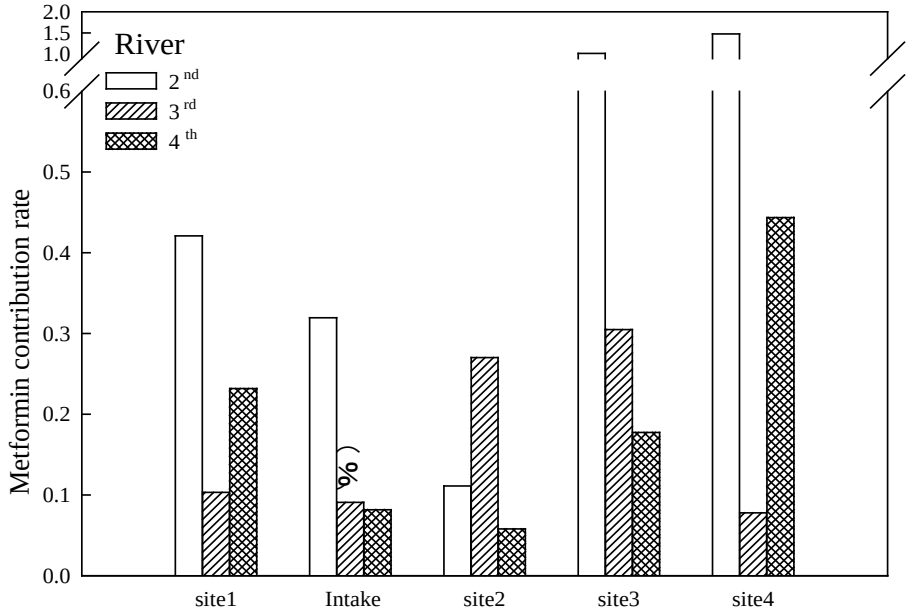
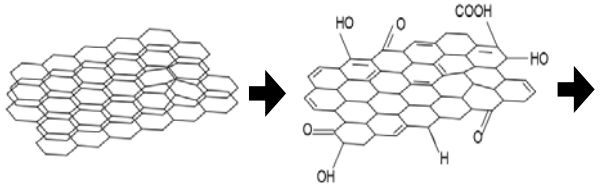


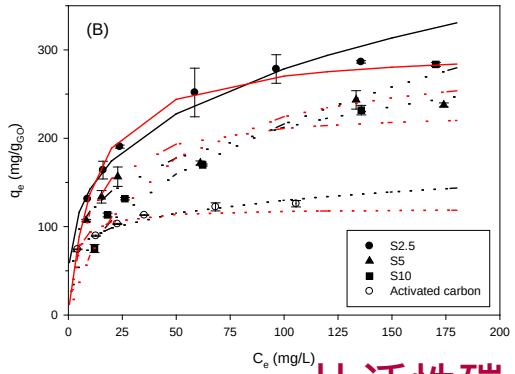


物理化學或生物水處理技術

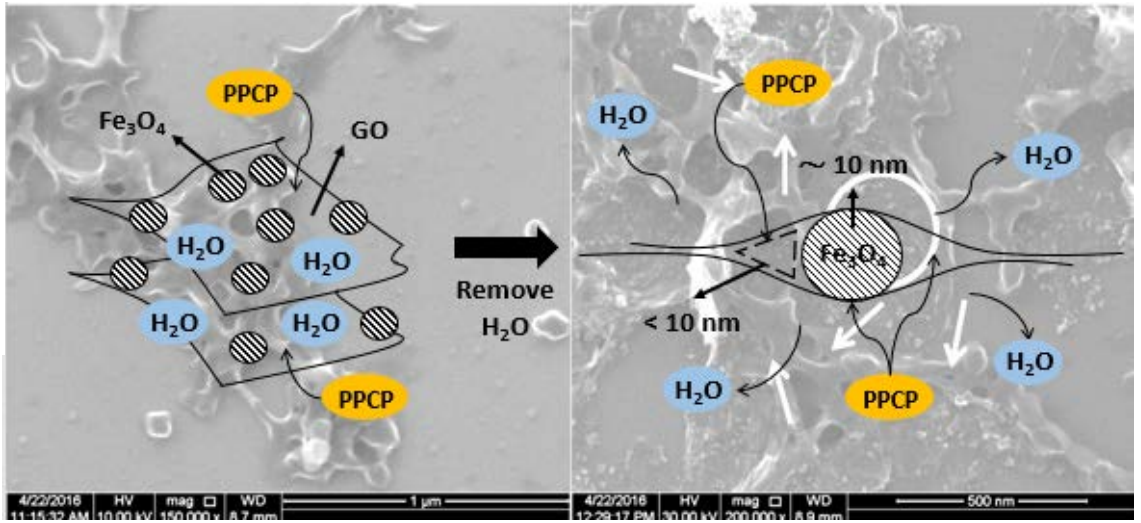
物化處理技術 – 新穎氧化石墨烯複合材料應用於**吸附**水中藥品污染物

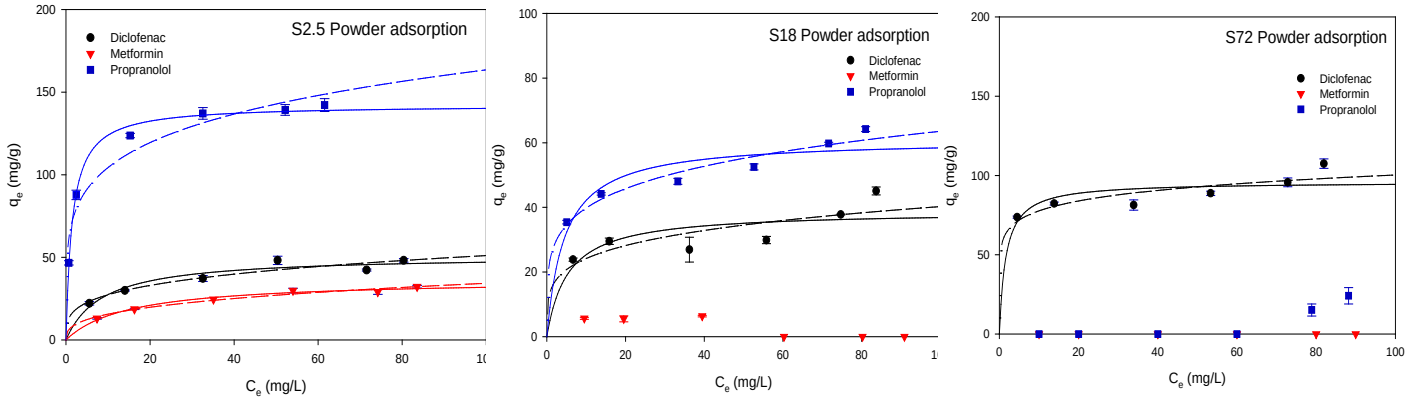


Graphite Graphene Oxide GO/Fe_3O_4



比活性碳更佳的吸附效能

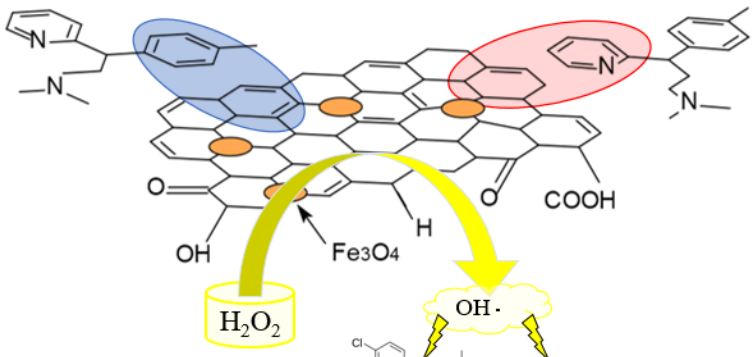




選擇性的吸附特定藥物（左邊：藍色，右邊：黑色）

物理化學或生物水處理技術

物化處理技術 – 新穎氧化石墨烯複合材料應用於**降解**水中藥品污染物

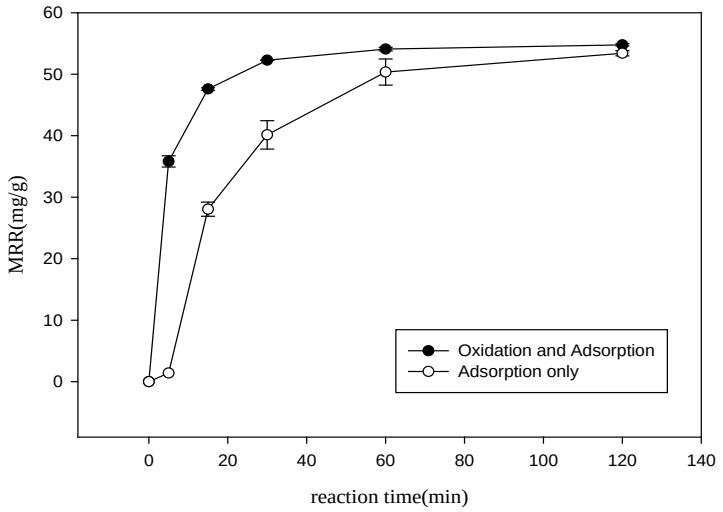


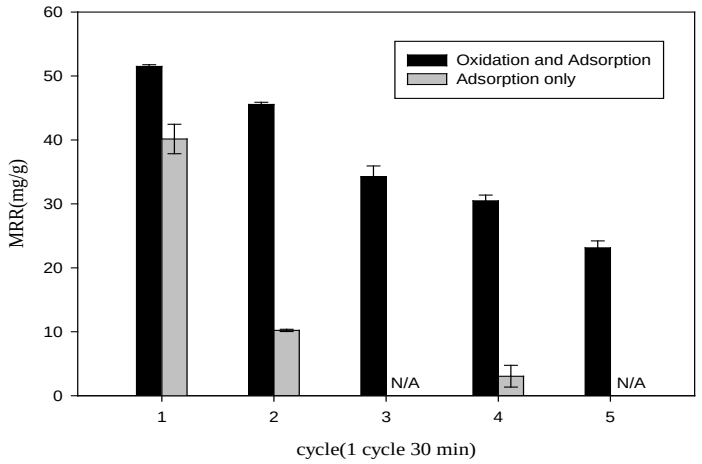
Adsorption

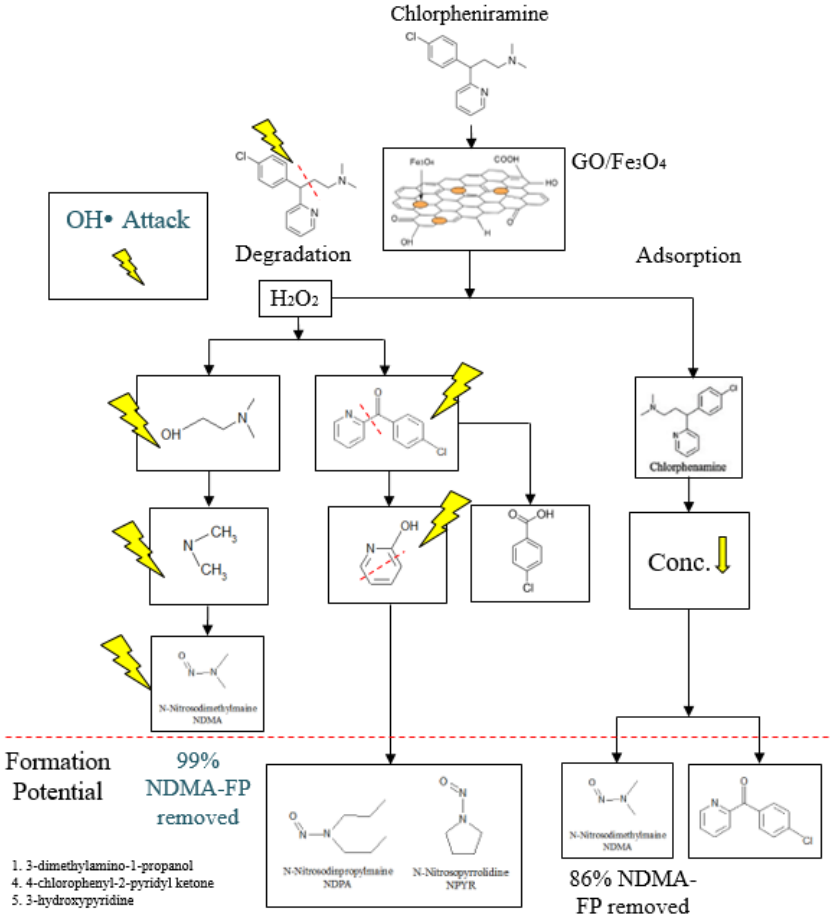
- ✓ π-π bonding
- ✓ Cation-π bonding

Degradation

- ✓ Fenton-like



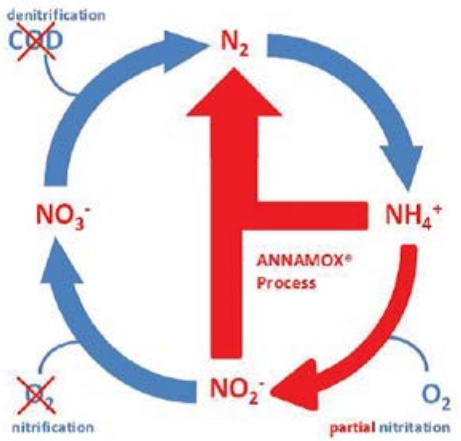


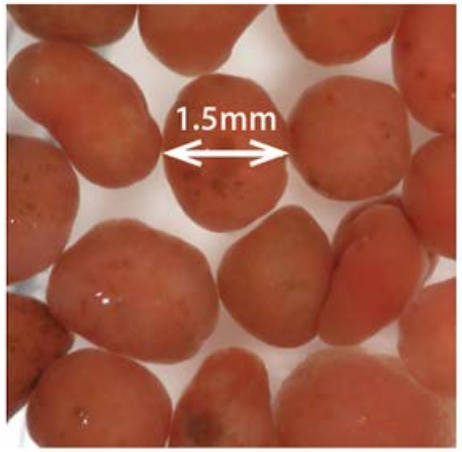


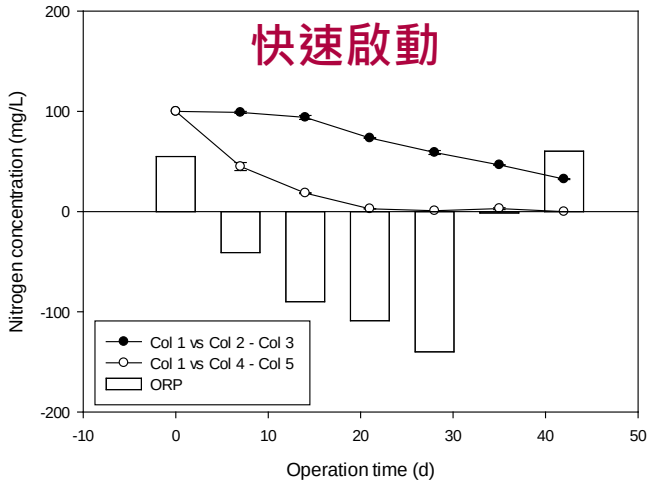
開發一種具實際應用於現場處理水中藥品與致癌性副產物生成潛勢之潛力材料

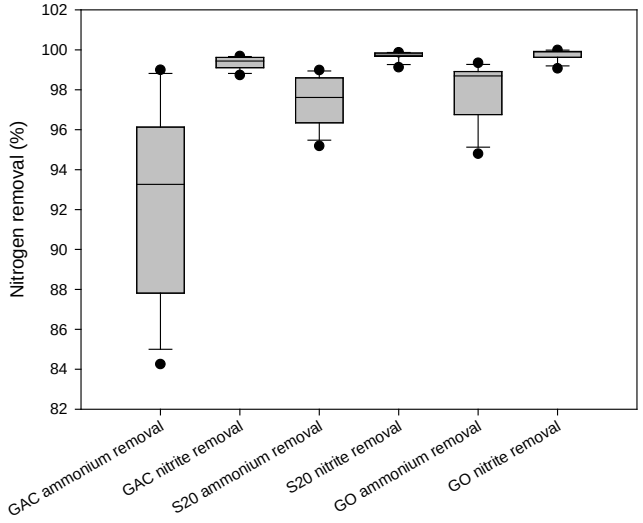
物理化學或生物水處理技術

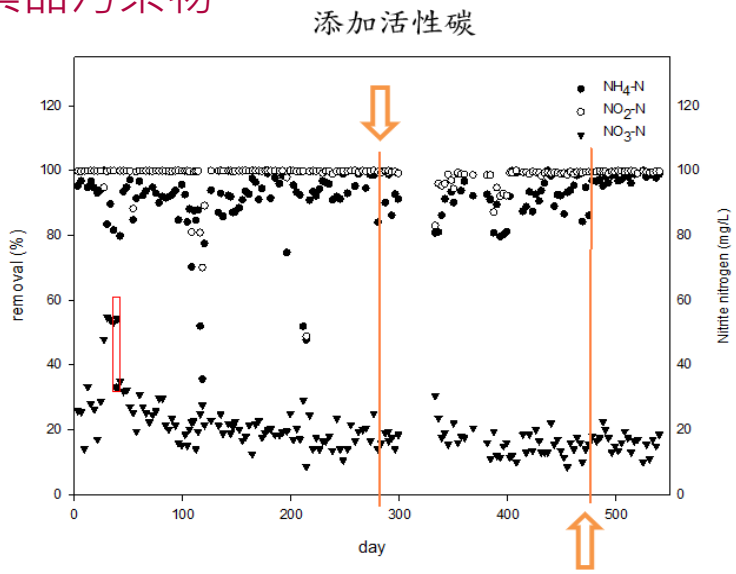
生物處理技術 – 厭氧氨氧化菌 + 新穎氧化石墨烯複合材料 = 應用於**降解**水中藥品污染物

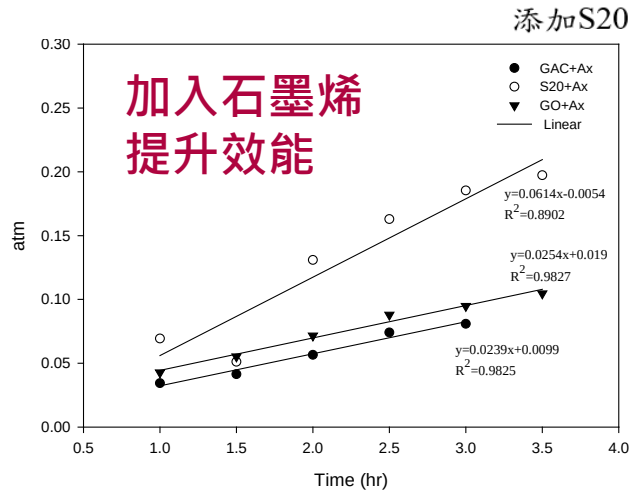












健康風險評估

水環境或大氣環境衍生之健康風險評估

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Impact of pre-oxidation on nitrosamine formation from a source to drinking water: A perspective on cancer risk assessment

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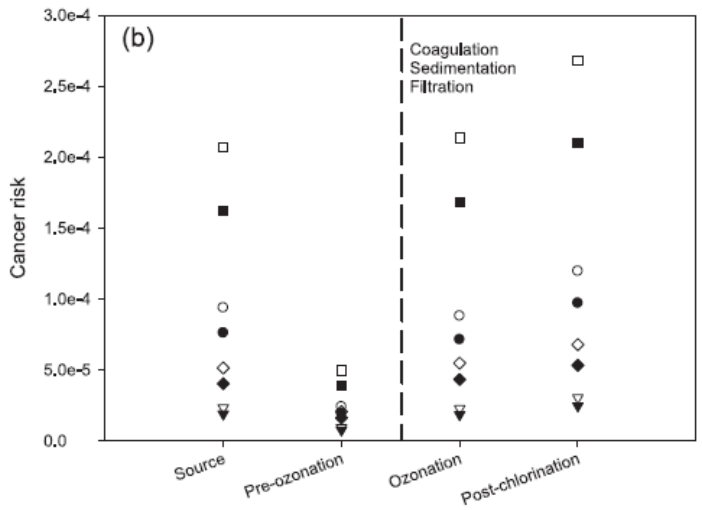
ABSTRACT

Given the carcinogenicity of nitrosamines as nitrogenous disinfection byproducts, this study investigated the impacts of different pre-oxidation technologies on nitrosamine formation

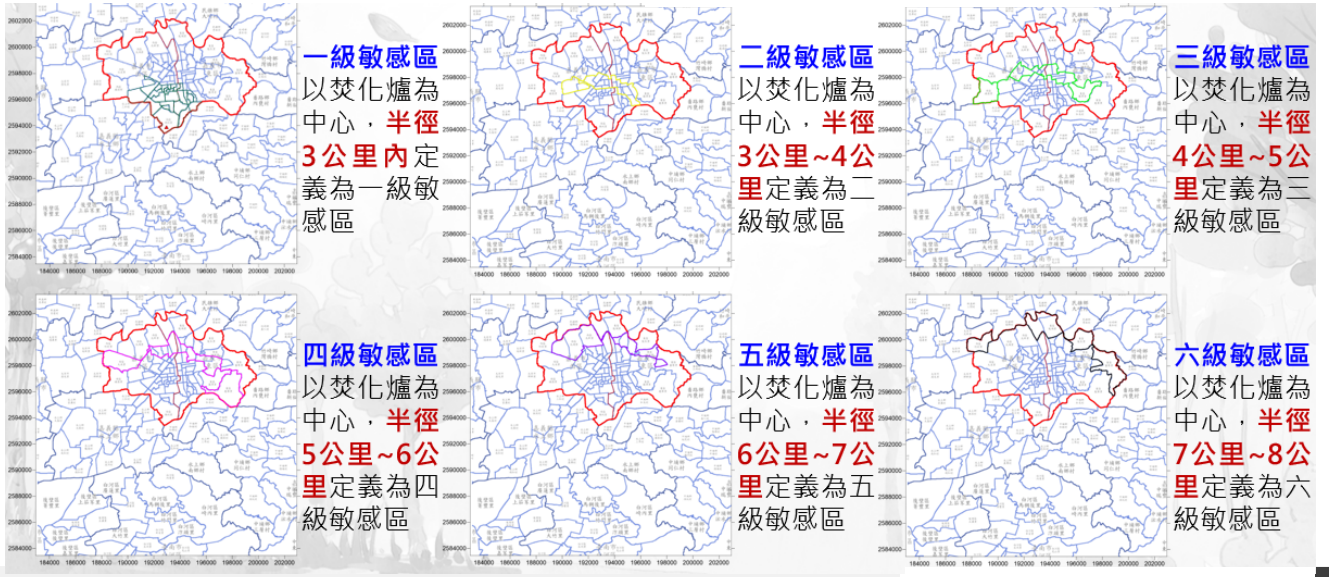


南臺灣河川與淨水場供水風險評估

高雄地區緊鄰工業區健康風險評估

- 有害物種需削減之風險值與風險百分比，依據沿岸六里最大風險的平均值，訂定各物種等比例削減法。
- 假設各物種需於近期（3 ~ 5年）內需降至1×10^{-5}，則以山明里的各物種需削減的百分比最高，高達92.7%；沿岸六里平均值則為87.6%；高松里、港口里、港正里、港后里、港明里、港南里及港墘里等七個里則無須削減。

嘉義地區焚化爐周邊健康風險評估



一級敏感區以焚化爐為中心，**半徑3公里內**定義為一級敏感區

二級敏感區以焚化爐為中心，**半徑3公里~4公里**定義為二級敏感區

三級敏感區以焚化爐為中心，**半徑4公里~5公里**定義為三級敏感區

四級敏感區以焚化爐為中心，**半徑5公里~6公里**定義為四級敏感區

五級敏感區以焚化爐為中心，**半徑6公里~7公里**定義為五級敏感區

六級敏感區以焚化爐為中心，**半徑7公里~8公里**定義為六級敏感區

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