



# Electrochemical Clean Up Of Organic Micropollutants

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- Who we are
- The problems we are addressing
- The technology and how it works
- Some applications
- A selection of results
- The future

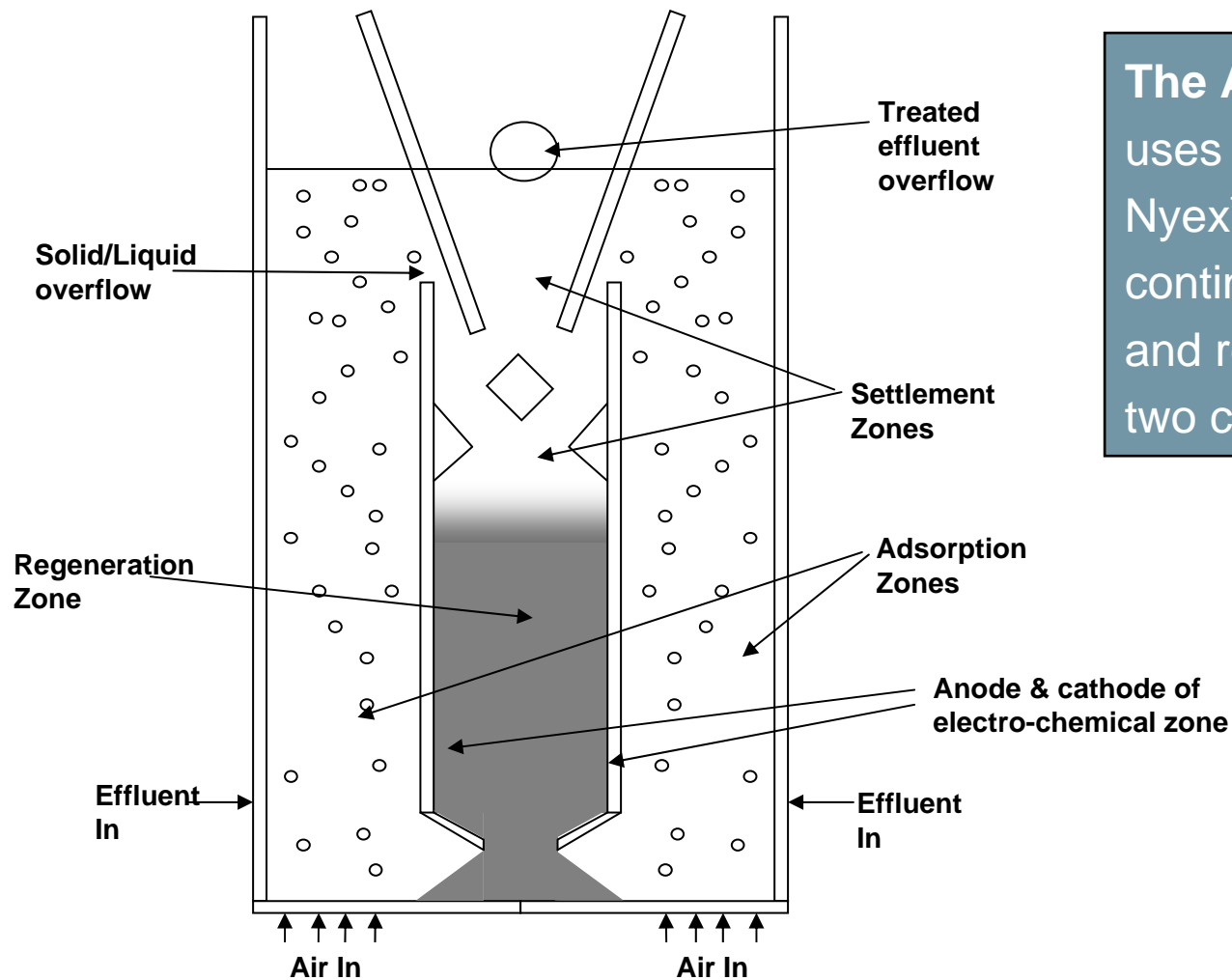
- Spin-out from University of Manchester
  - Cost-effective water treatment process
  - Removal of organic contaminants
  - Replaces activated carbon with lower footprint
  - Uses proprietary adsorbent Nyex™
- Vision for future greywater treatment

- Water becoming as important as oil
  - More stringent environmental legislation
  - Water conservation a global issue
  - Increasing treatment costs
  - Rising population
  - Environmental legacy



- *“Difficult-to-treat” waste*
  - Pesticides, dyes, VOCs, PCBs, EDCs, ....
  - Trace organics - *toxic and non-biodegradable*
  - Conventional methods expensive
  - Arvia continuous process:
    - ✓ Novel adsorbent, Nyex™
    - ✓ Pollutants destroyed by anodic oxidation
    - ✓ Treatment cost linked to the amount of pollution

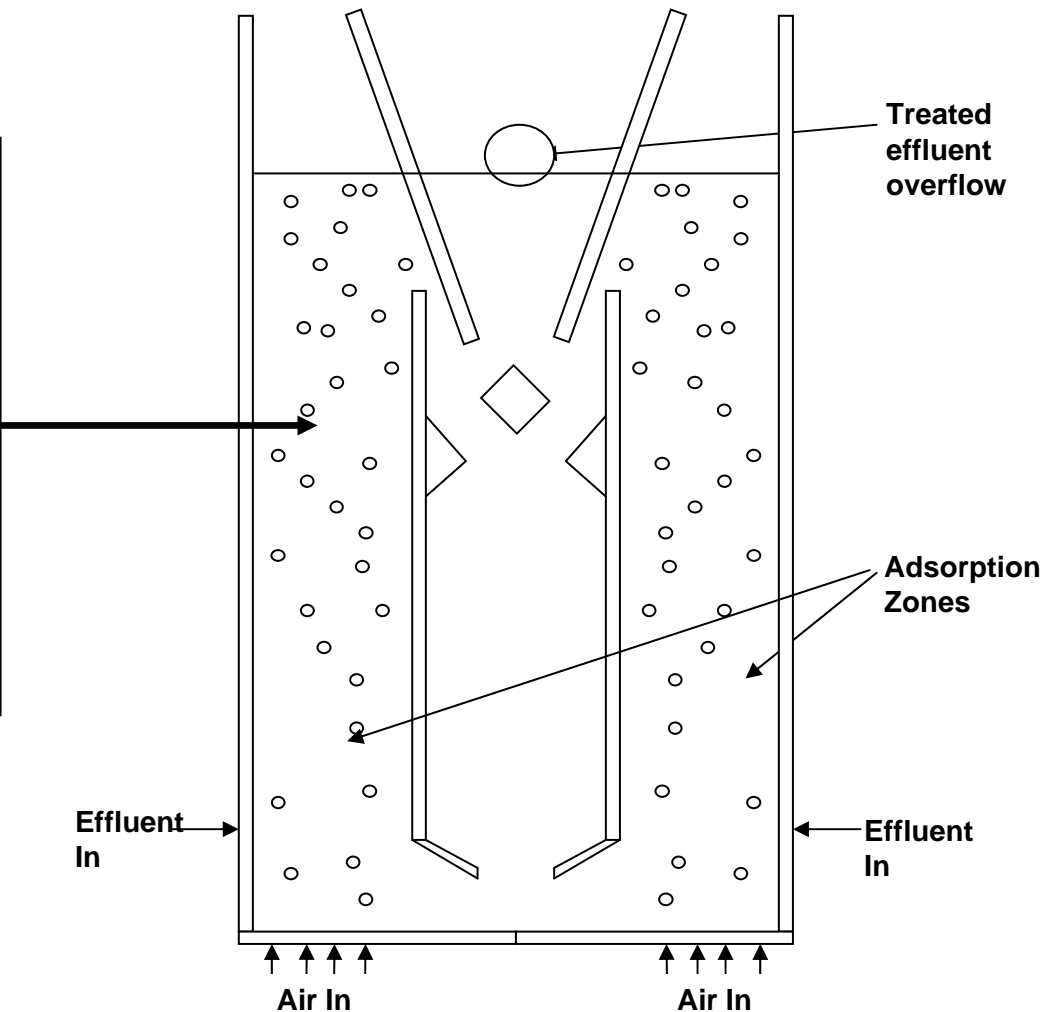
# How it works



The Arvia™ process uses a novel adsorbent Nyex™ to achieve continuous adsorption and regeneration within two concentric cells

# How it works

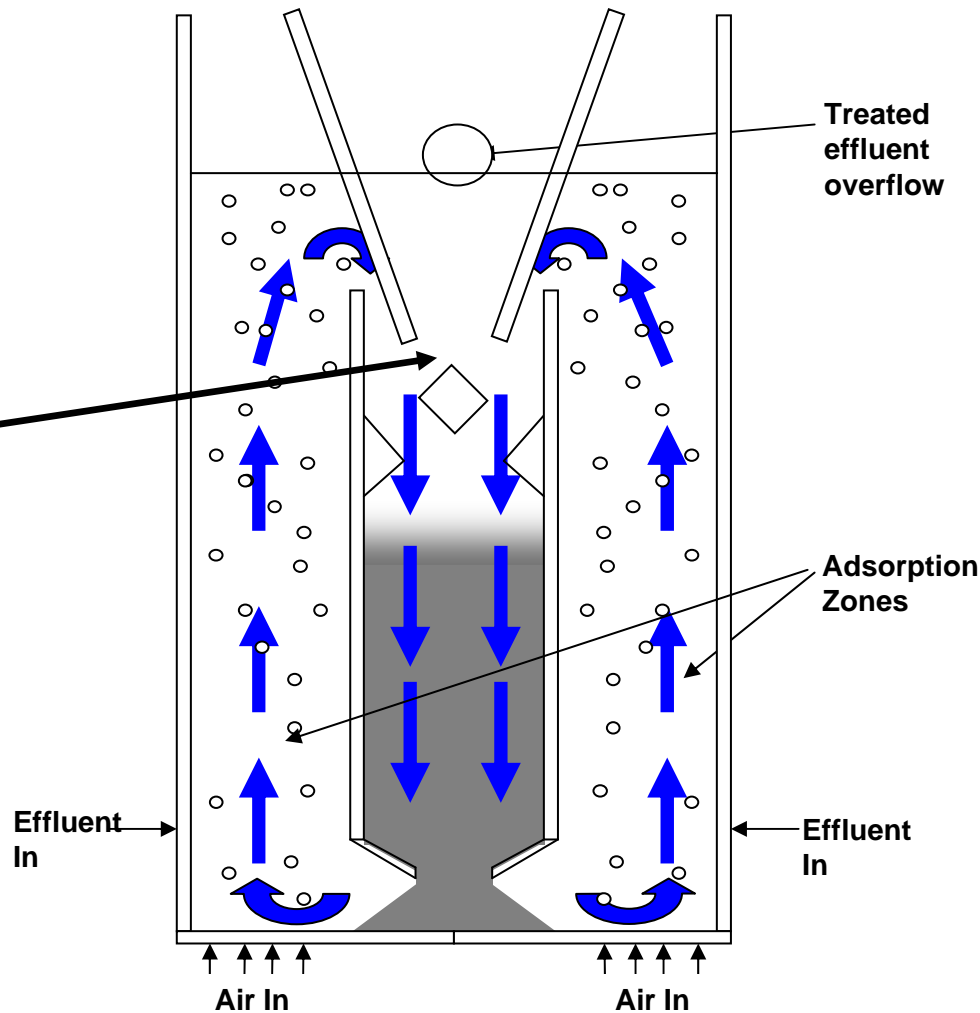
**Adsorption zone** (outer upward flow cell) where effluent is introduced with air used for fluidization and mixing. Within this zone organics are adsorbed from the effluent and





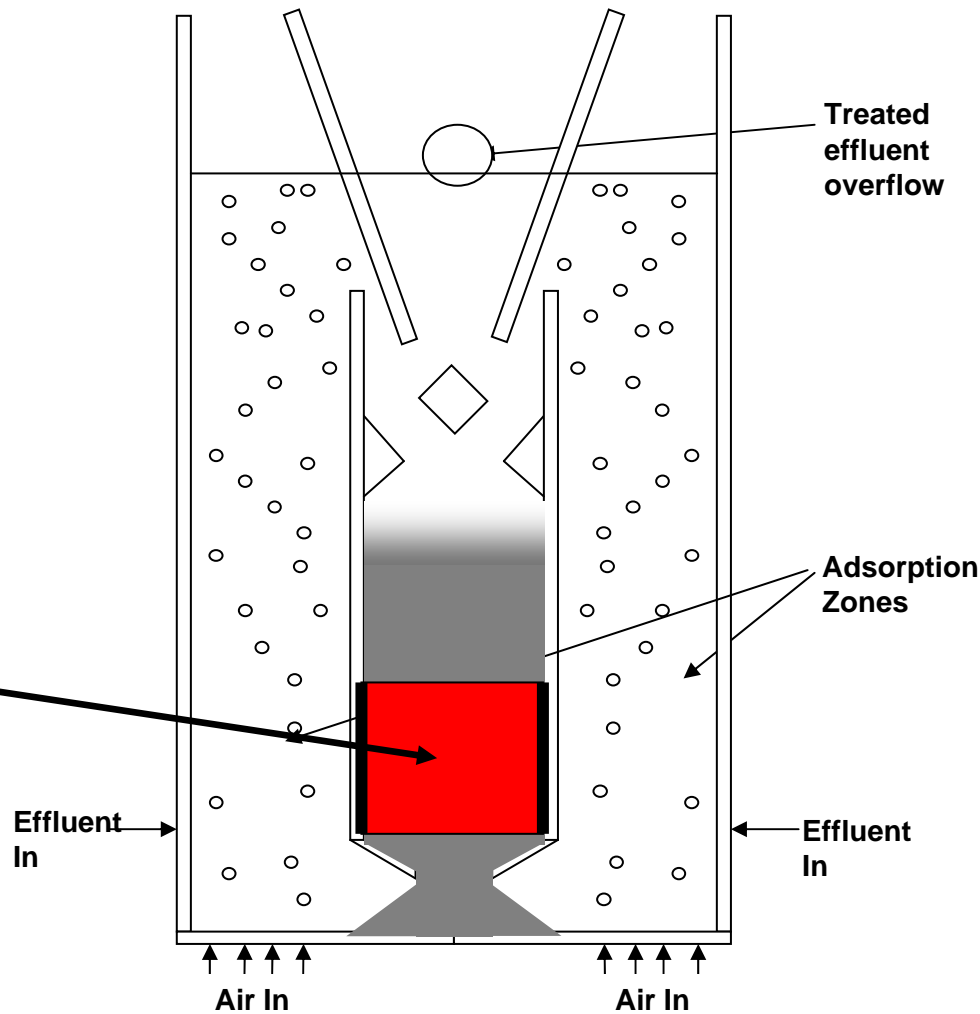
# How it works

***Sedimentation zone***  
(inner cell), where conditions are quiescent. Contaminated Nyex™ enters this zone and forms a bed of particles which continuously move downwards.



# How it works

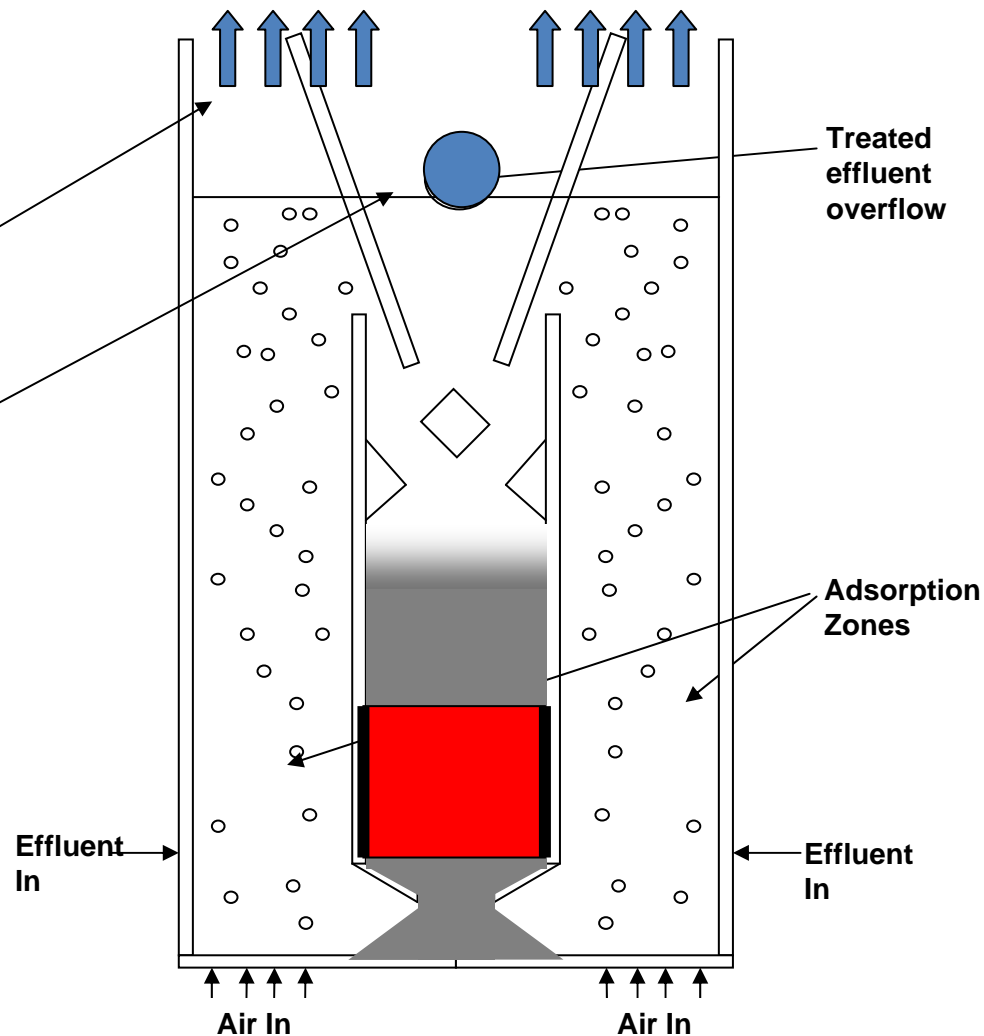
***Electrochemical destruction zone*** (base of inner cell) where adsorbed organics are destroyed electrochemically with regenerated Nyex™ entrained into the outer cell while the treated effluent overflows from



# How it works

## Breakdown Products:

- Gaseous products pass safely to the environment with the entrained air
- Harmless ionic species pass out with the effluent via the overflow



Characteristic	Nyex™
<i>Density</i> (g cm <sup>-3</sup> )	2.225
<i>Bed electrical conductivity</i> (S cm <sup>-1</sup> )	0.16
<i>Pore volume</i> (cm <sup>3</sup> g <sup>-1</sup> )	0
<i>Surface Area</i> (m <sup>2</sup> g <sup>-1</sup> )	2.75

Lower  
is co

Lack of pores  
facilitates more  
complete and rapid  
regeneration

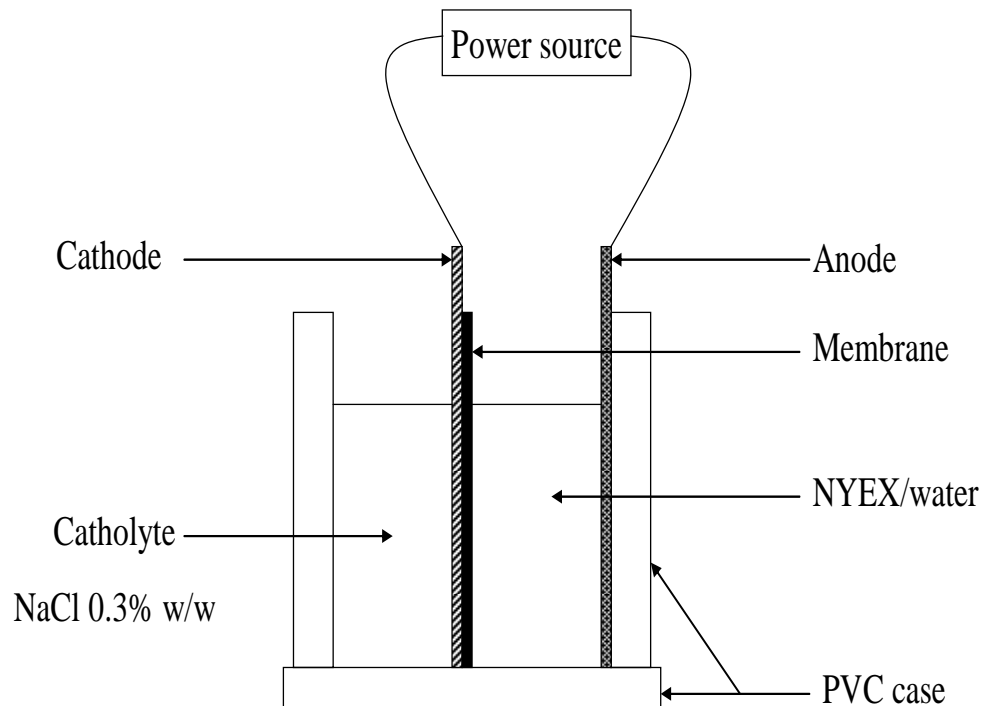
Ten fold increase in  
electrical  
conductivity aids  
electro-chemical  
regeneration

- In situ regeneration of Nyex™
- Preferential removal of chlorinated compounds
- Simple operation - no moving parts
- Small footprint
- Low electrical power – 20 watts per cell

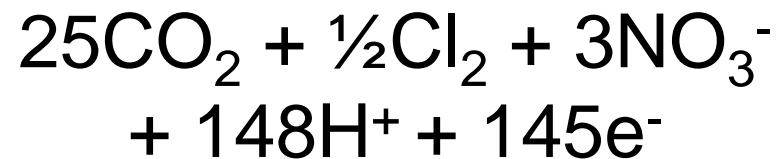
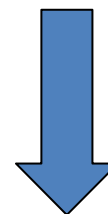
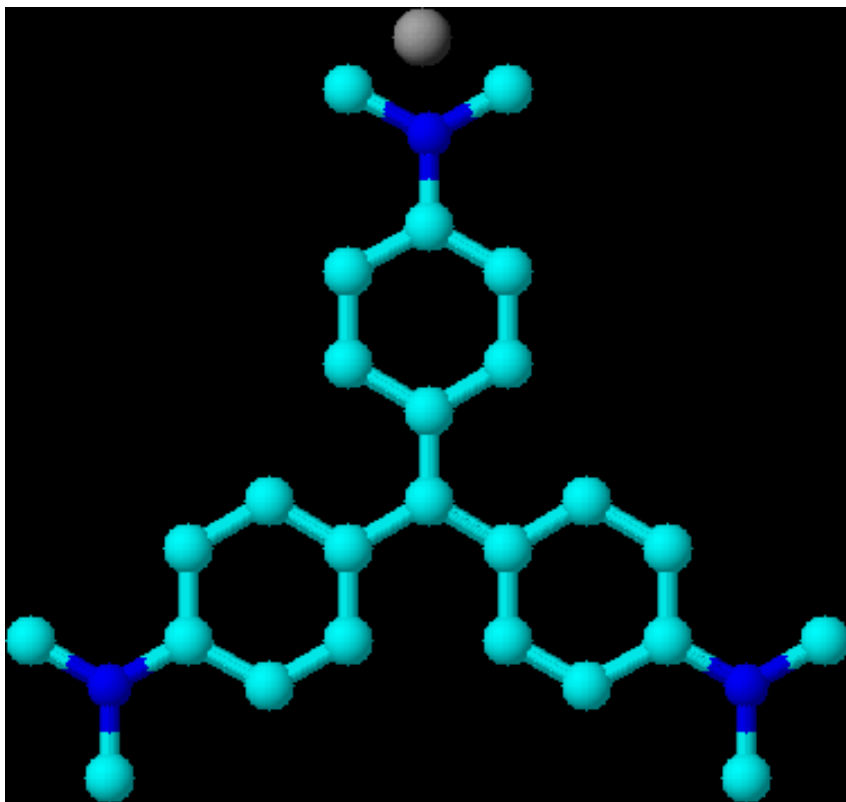
# Continuous Trials



## Cell holds 15g Nyex™ as a wet cake

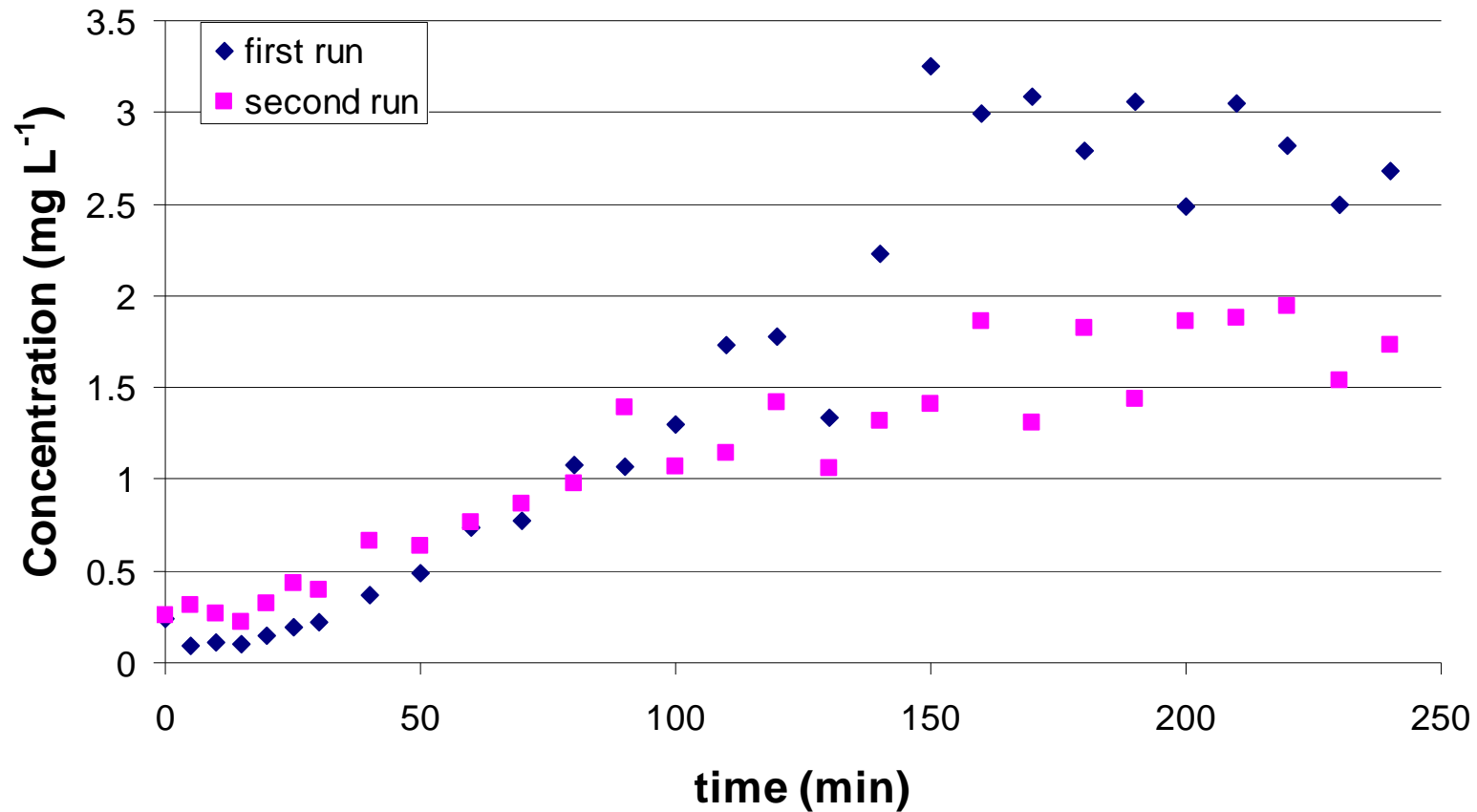


# Crystal Violet





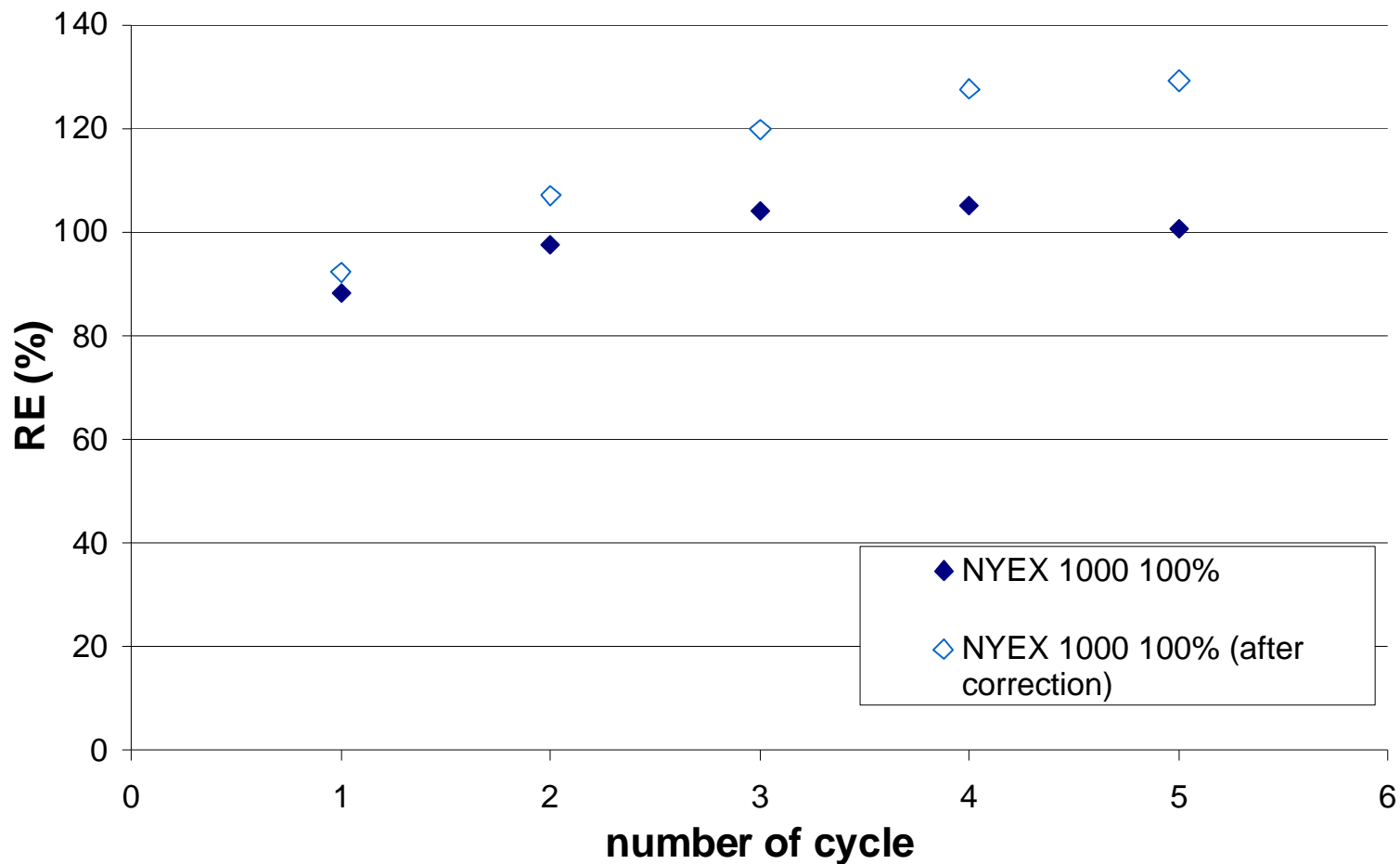
## Outflow



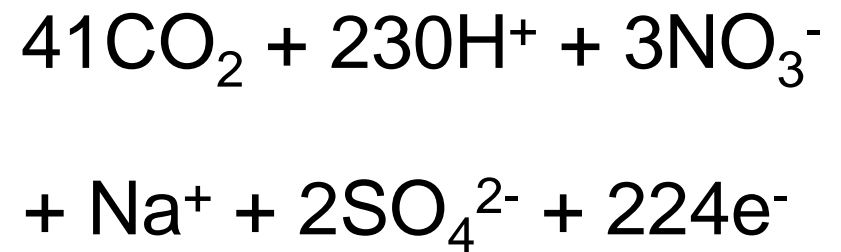
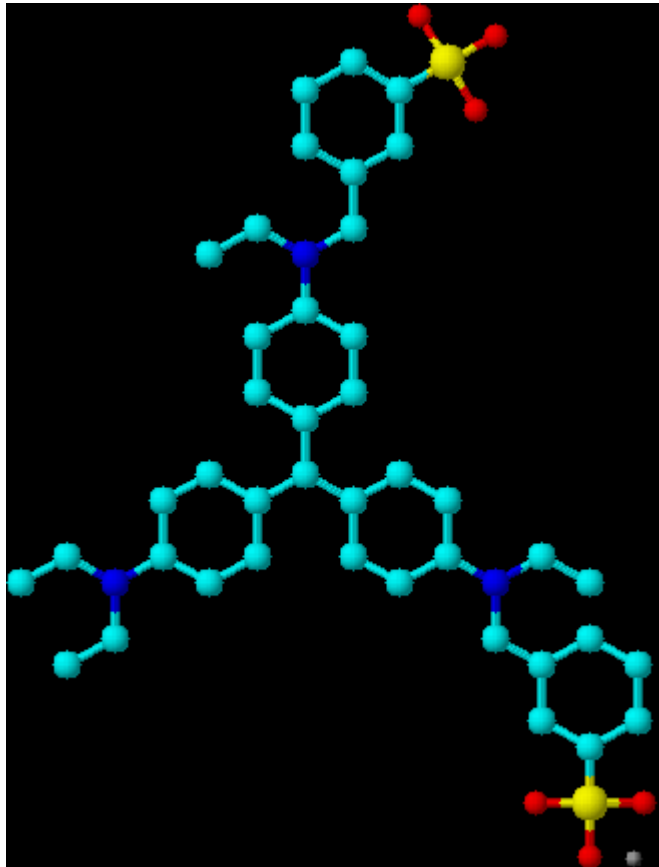
Batch

$$\text{Batch} = \frac{\text{Removal of Pollutant in this Cycle}}{\text{Removal of Pollutant in initial Cycle}}$$

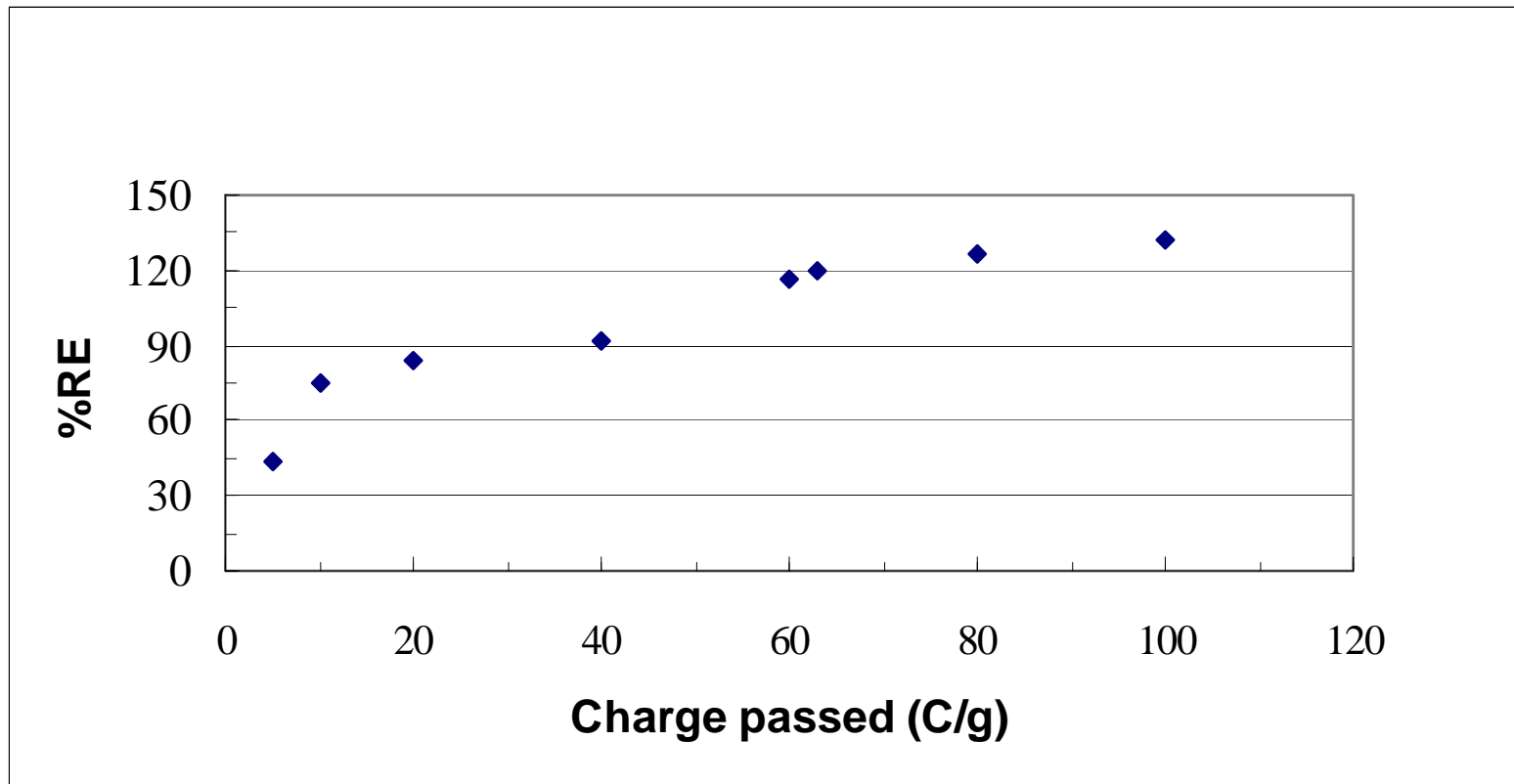
## Number of Batch Cycles



# Acid Violet 17

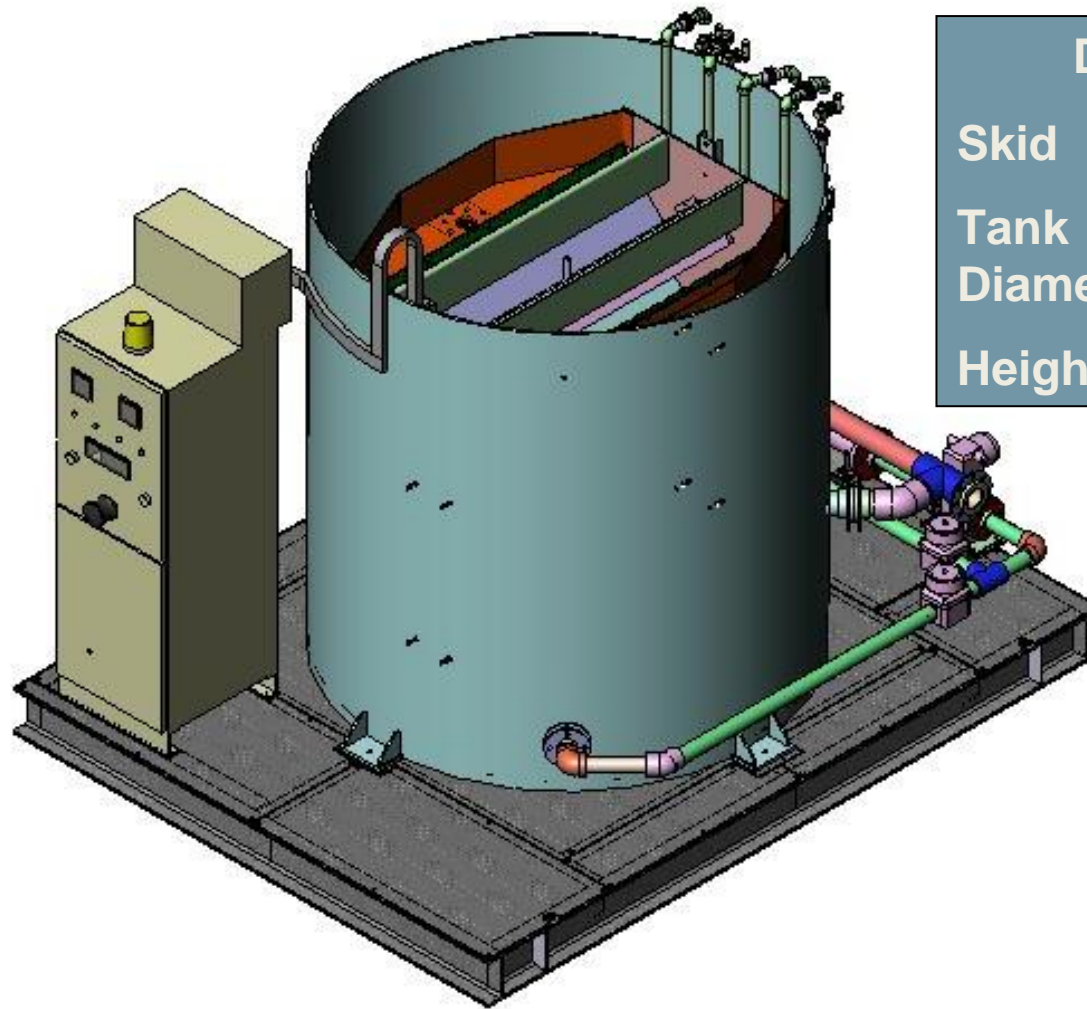


Theoretical Charge = 63 C/g



- Gemini 200 unit (Max flow 5-10m<sup>3</sup>/day)
  - For site testing
  
- Arvia™ 4200 unit (Max flow 200m<sup>3</sup>/day)
  - For industrial applications & pilot trials with utilities

# Arvia™ 4200



## Dimensions

Skid	2.4m x 3m
Tank Diameter	1.9m
Height	2m

# Arvia™ 4200





- Innovative continuous process
  - destruction of problem contaminants
  - addresses current problems
  - substantial economic benefits
  
- Future vision for greywater treatment

- Students:
  - Marie Chauve
  - Fadhil M Mohammed

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