



Destruction of Oil Using Anodic Regeneration of a Carbon Adsorbent

Innovation in water treatment

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Overview

- **Apology**
- **Introduction**
- **Process Description**
- **Process Benefits**
- **Case Studies**
- **Oil Removal**
- **Use for Contaminated Oils**
- **Conclusions & Questions**

Introduction – Historical Perspective

- Process developed within CEAS at UoM
- Research Funded through EPSRC
- Industrial support from Severn Trent Water Ltd, Nykin Developments, Magneto Anodes & Ashbrooke Simon Hartley
- Spin-out company Arvia Technology Ltd established
- Multi-cell (4) unit constructed
- Prototype “standard” unit currently being constructed

Introduction – Organics in water

- Most cost effective are usually biological processes
- Toxic/non-biodegradable organics in water are more difficult to treat
- Treatment process for low & trace level of organics
- Treatments become increasingly expensive as concentrations decrease
- A proprietary continuous adsorption and regeneration process based on a novel adsorbent (Nyex)

Adsorbent

Characteristic	Nyex 100	Typical AC
Pore volume/cm ³ g ⁻¹	0	0.5
Surface Area/m ³ g ⁻¹	2.75	650 – 1500
Bed electrical conductivity/S cm ⁻¹	0.16	0.025 – GAC 0.016 – PAC
Density/g cm ⁻³	2.225	1.5

Electro-chemical reactions

- Cathodic Reaction

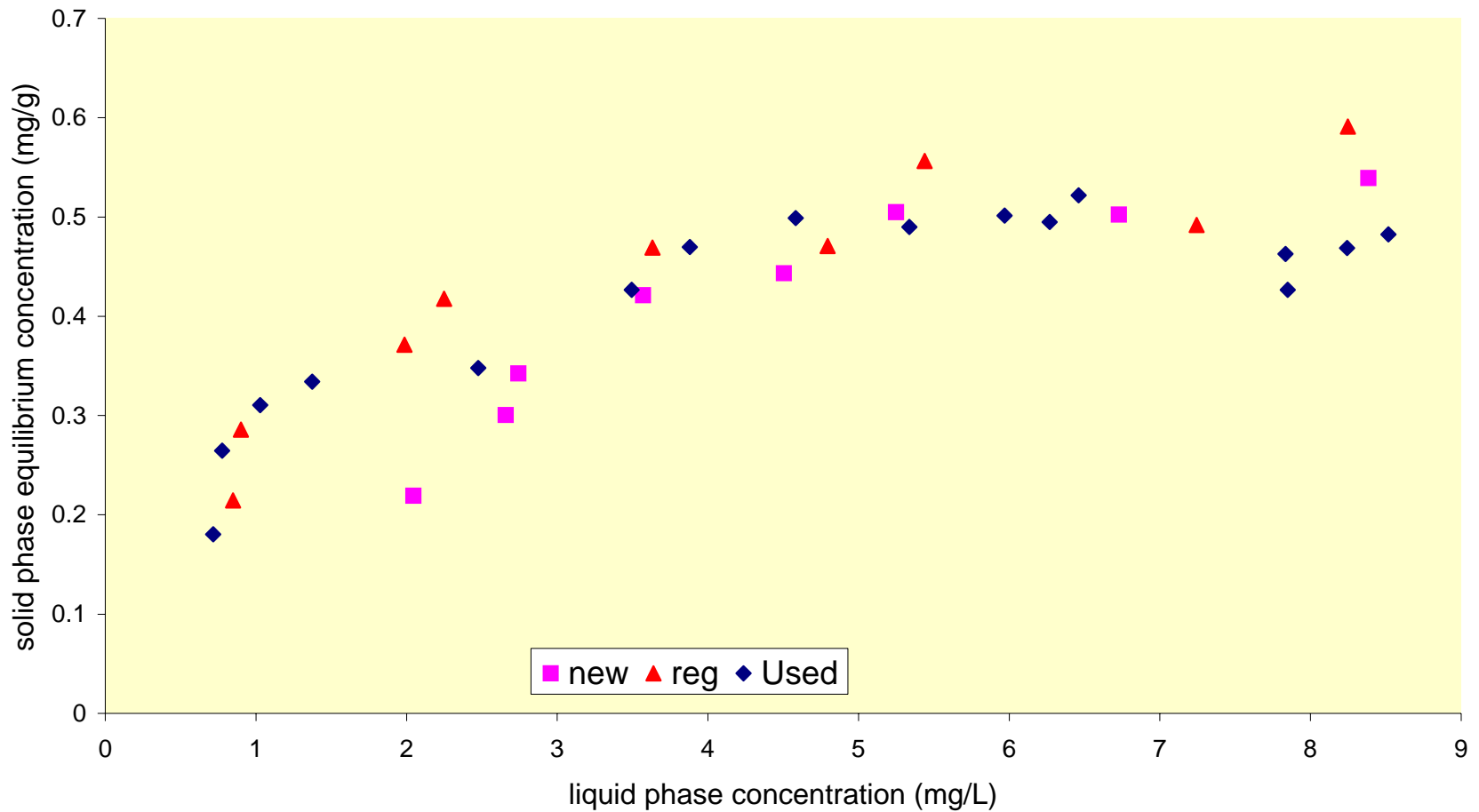


- Anodic oxidation (phenol)

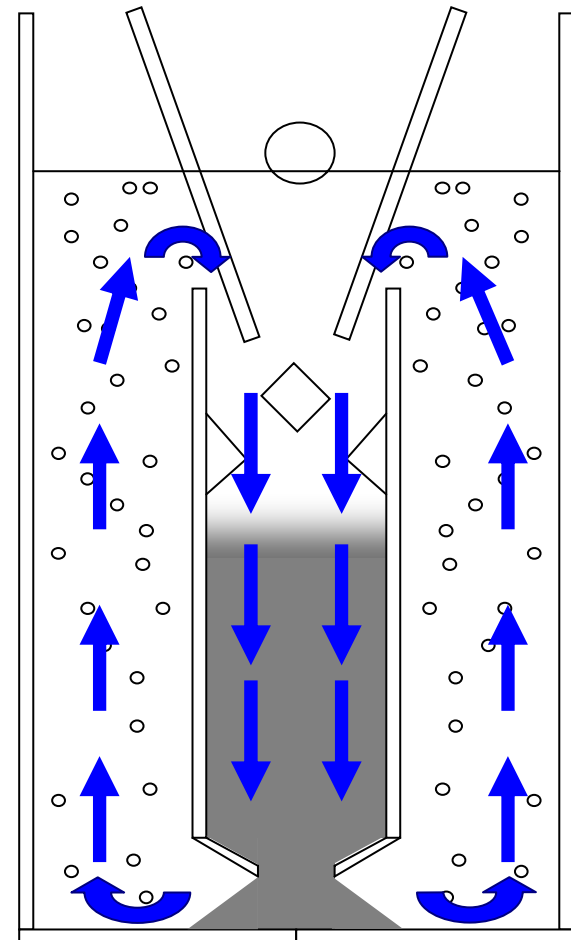
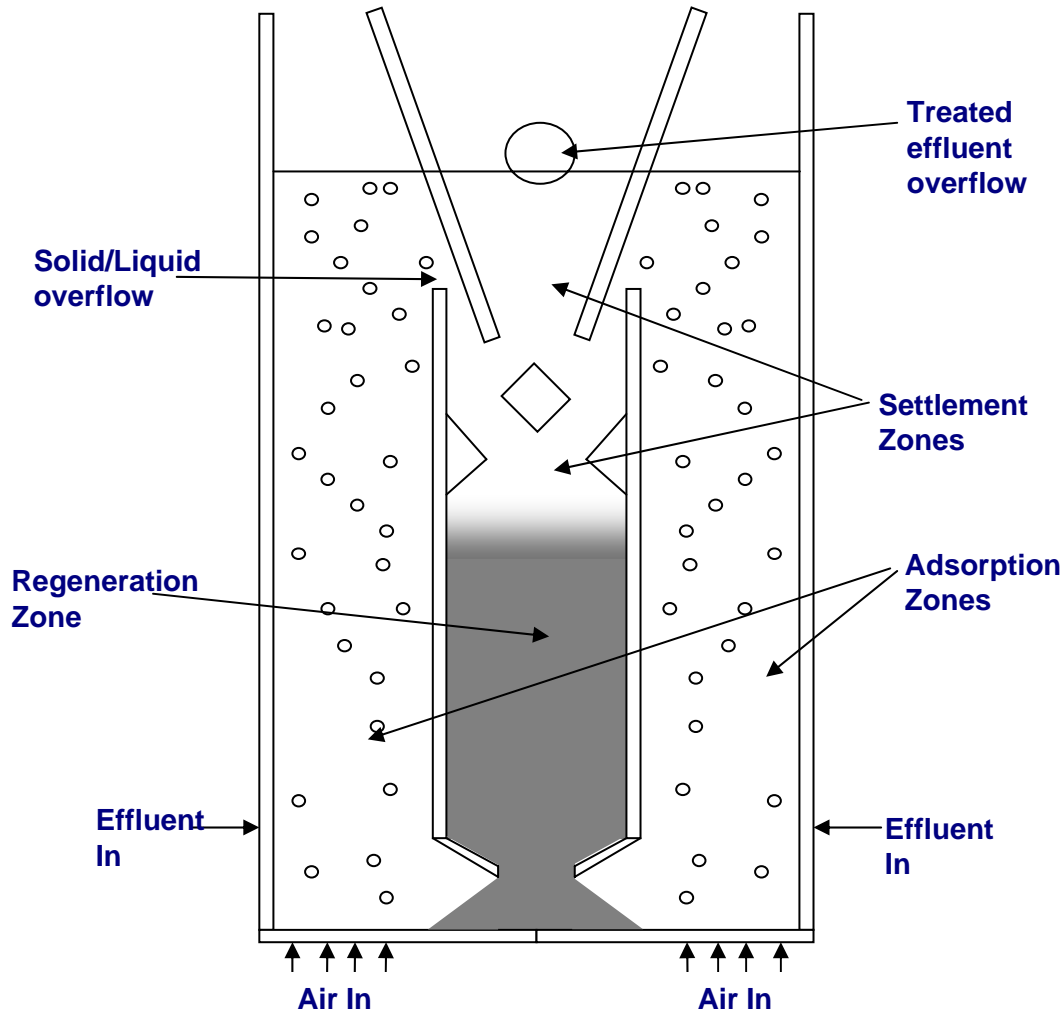


- Mechanisms
 - direct electron transfer
 - by the generation of hydroxyl radicals
 - indirect oxidation mediated by other oxidised species (chloride)

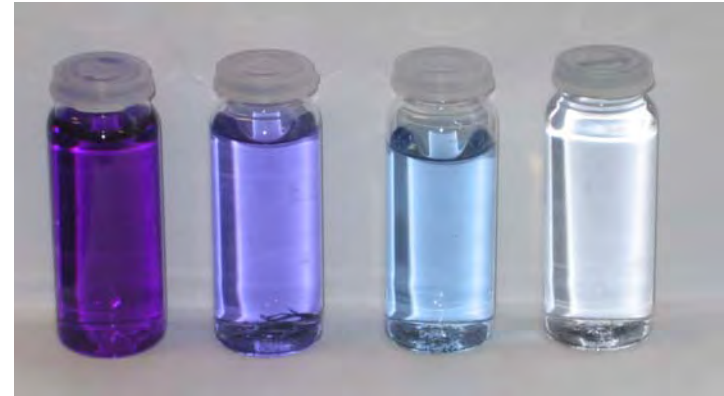
Regenerated Absorptive Capacity



The Arvia™ Process



The Arvia™ Process



Early pilot-plant



Operational Parameters – Standard Unit

- Typical voltage 4.5 – 5V at 5A (dc)
- Maximum current 15 A per cell (dc)
- 42 cells per standard unit
- Maximum power per standard unit – 5kW
- Maximum voltage across unit 48V

Process Benefits

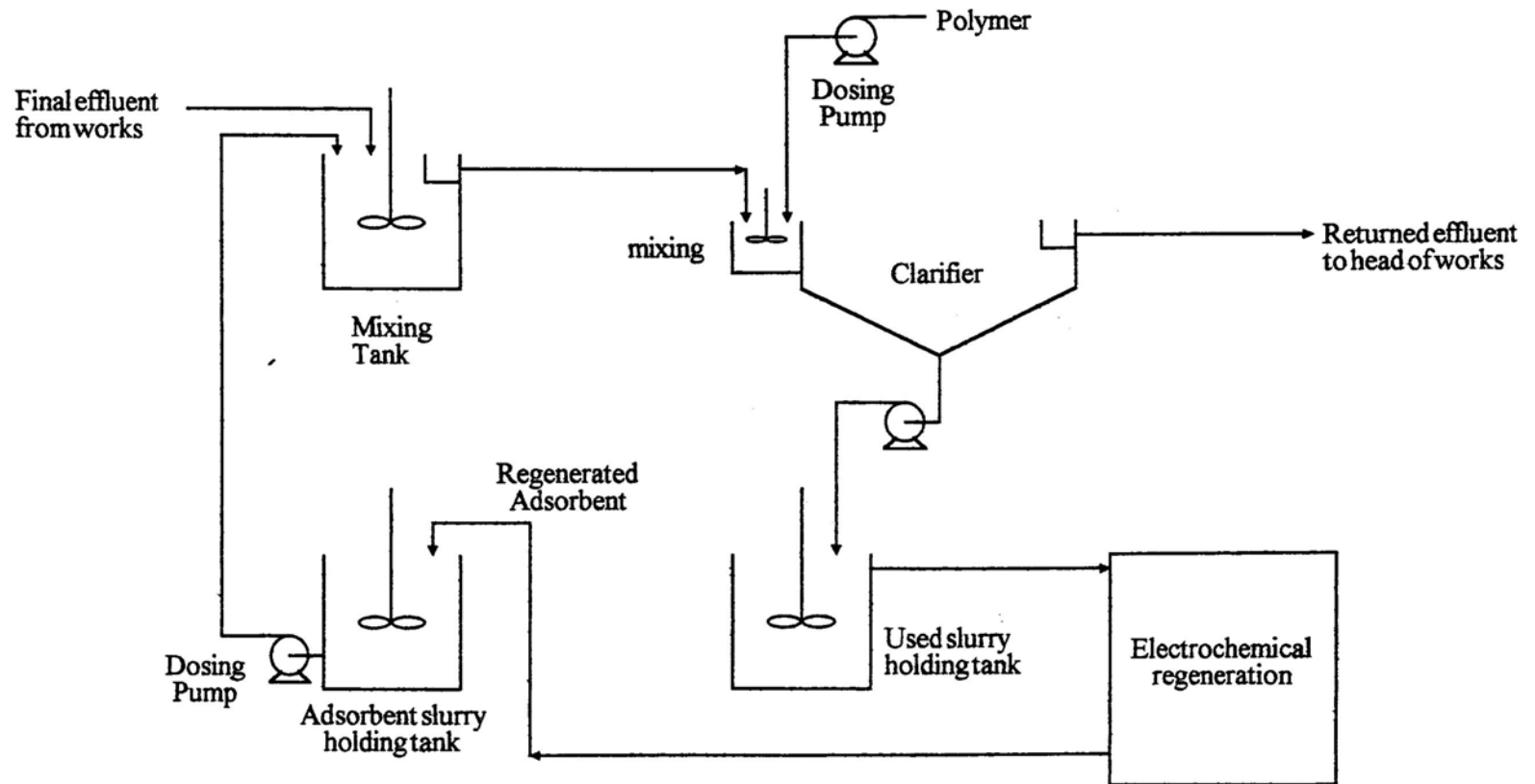
- Pollutants adsorbed and destroyed
- Simple design with no moving parts
- Simple Scale up
- No sludge produced
- On-site regeneration eliminates transportation of loaded adsorbent
- Quick regeneration at room temperature and pressure
- Chemicals addition minimised/avoided
- High quality effluent – reuse/recycle
- Immediate start up/shut down

Applications

Competition to activated carbon

- Lower quantities of adsorbent
- No transportation offsite
- No secondary waste
- Lower regeneration costs
- Lower treatment costs

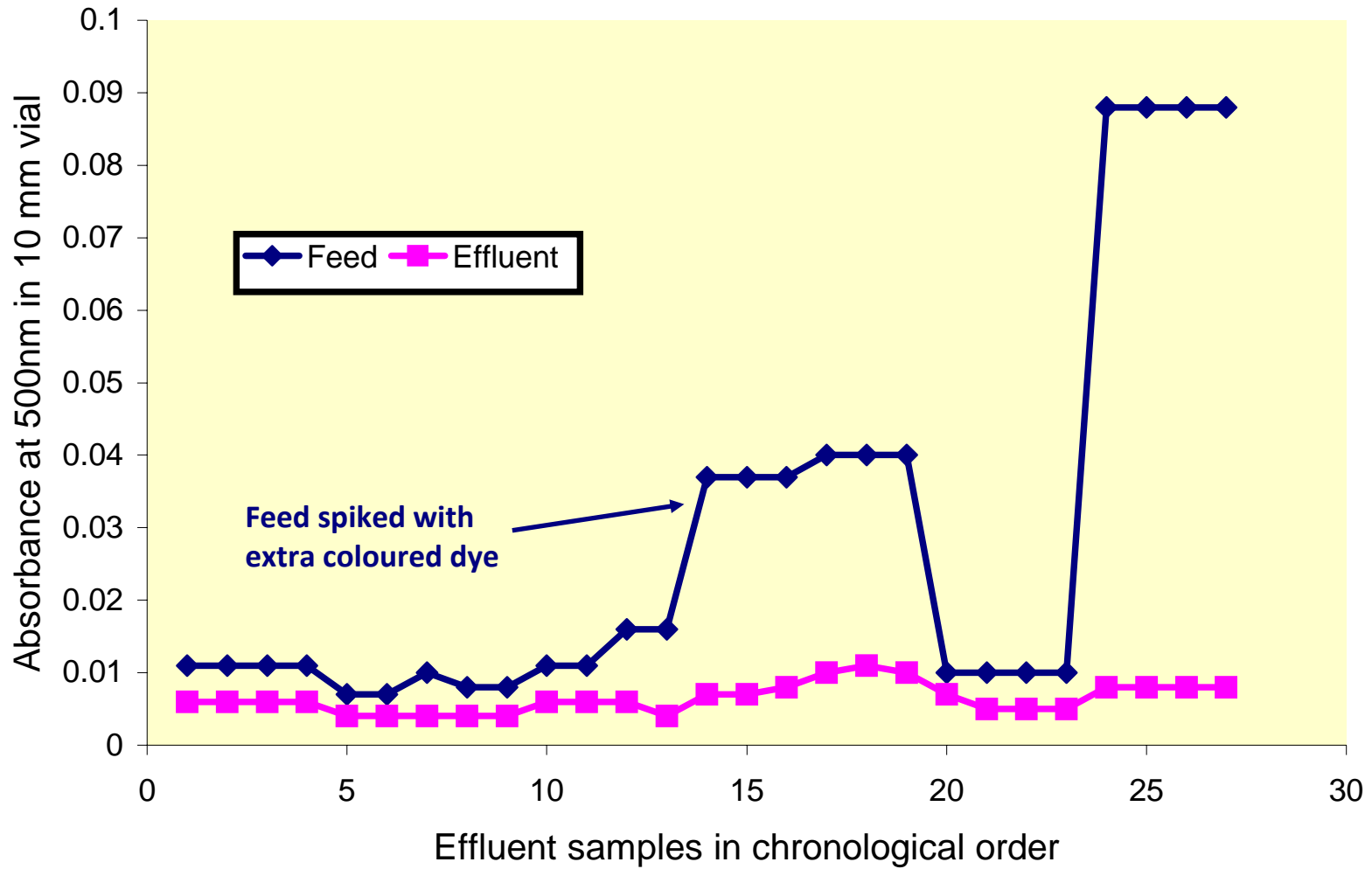
Case Study – Final Effluent - 1



Case Study – Final Effluent 2



Case-study – Final Effluent 3



Case-study – Final Effluent 4

Final Effluent

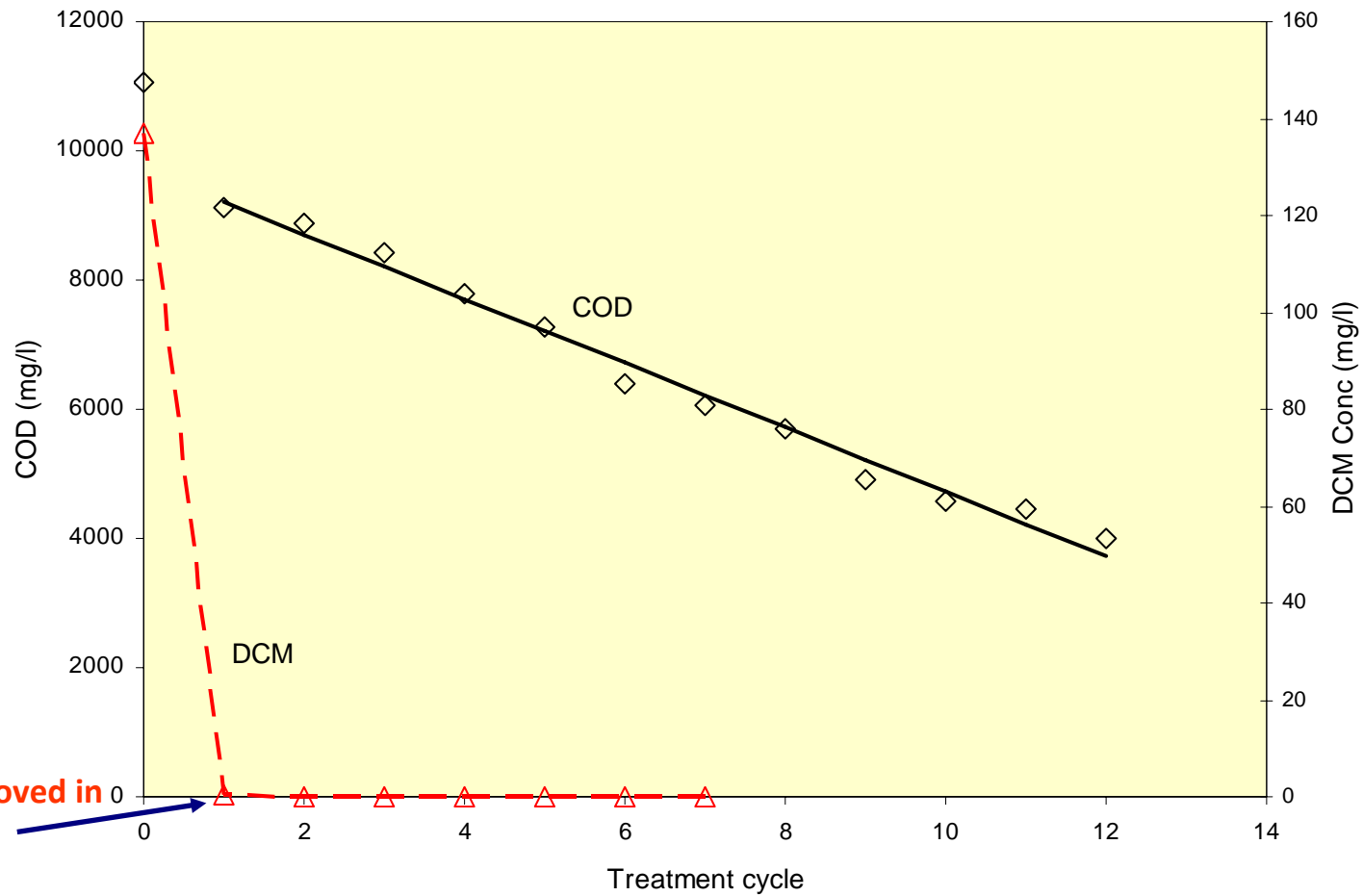
- Removal of colour for sewage works
- Adsorption & Regeneration quick
- Regeneration cost ~ £3/tonne (Arvia™)
- Regeneration with activated carbon ~ £400/tonne
- Treatment cost ~ 0.3p/m³ (Arvia™)
- Alternative technologies ~2-6p/m³
- Technology cumbersome

Case-study – Pre-treatment 1

Pre-treatment to remove DCM

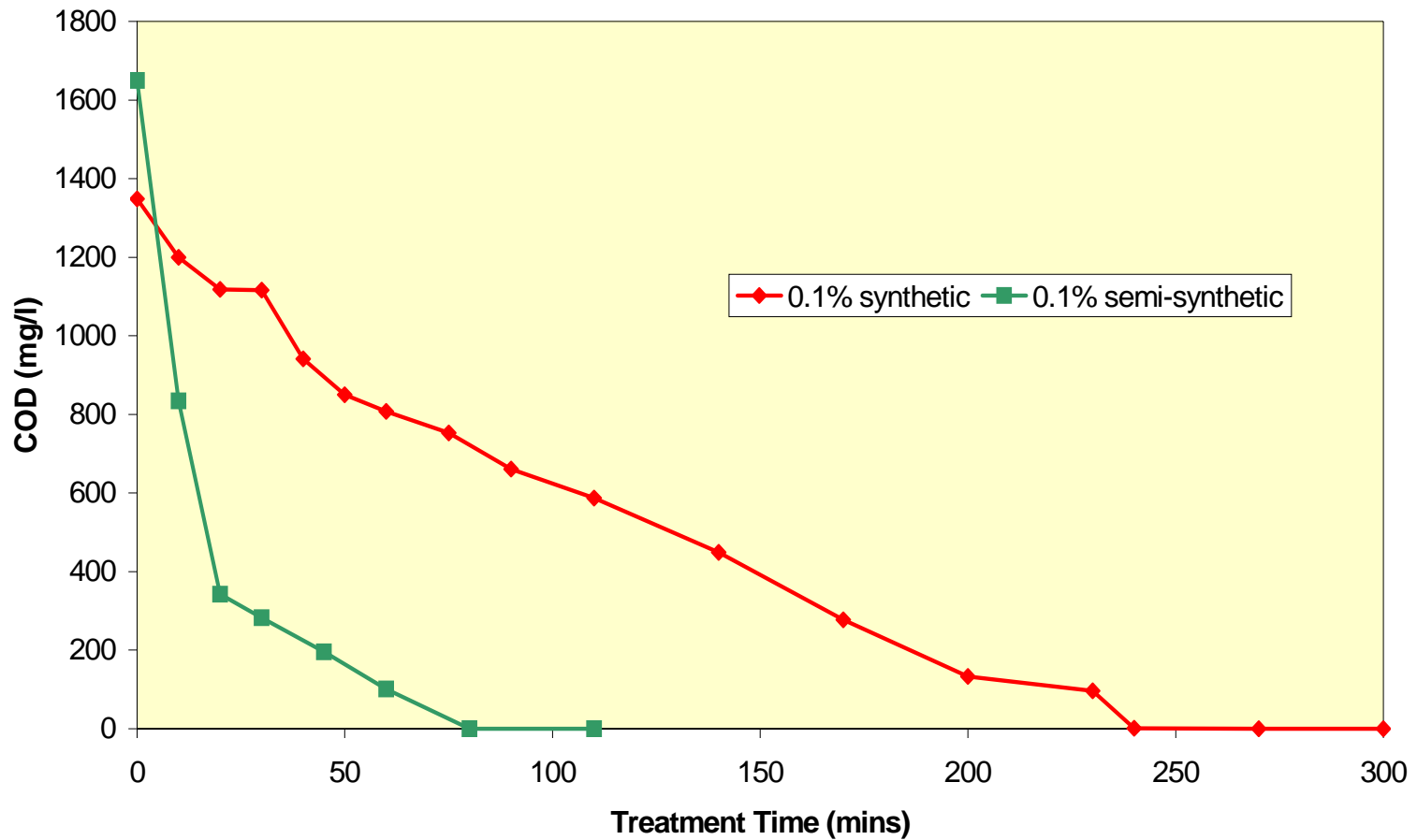
- Initial COD of 11,000 (~125ppm dichloromethane)
- DCM content too high for biological treatment
- Existing treatment costing ~ £100/m³
- 99% of DCM removed in 1st cycle by (£0.7/m³)
- Biological treatment of remaining waste (£7/m³)
- Treatment on-site - saving over £90/m³

Case-study – Pre-treatment 2

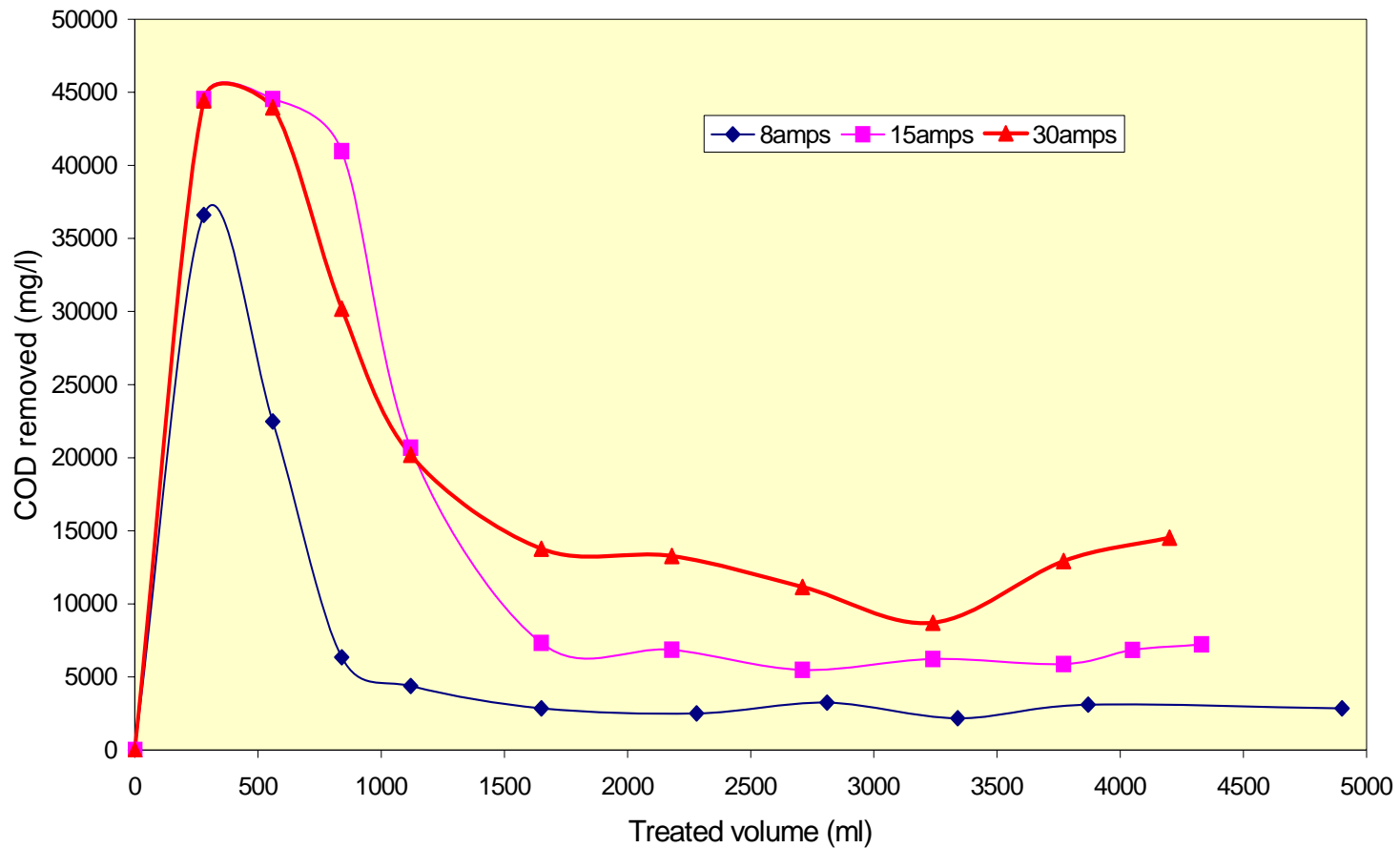


99% DCM removed in 1st cycle

Case-study – Cutting oil treatment 1



Case-study – Cutting oil treatment 2



Applications

Contaminated Oil

- Elimination of Oil without adsorption of metals
- Removal of radioactive elements through existing aqueous treatment technologies
- No transportation offsite
- No secondary waste?

Summary

Arvia™ Technology

- Continuous treatment of difficult organic pollutants
- Removes and destroys toxic organics
- Unique, patentable process & material
- In-house control of wastes
- Enables water recycle
- No Secondary waste



**THANK YOU
FOR YOUR ATTENTION
QUESTIONS?**