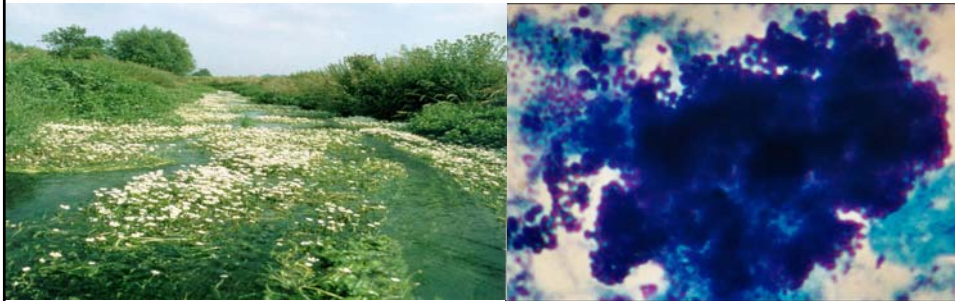


## **P Removal in Severn Trent Water The role for Bio-P**



**CIWEM NW&NW Wastewater Conference 2007  
Pete Vale, Technology & Development, Severn Trent Water**

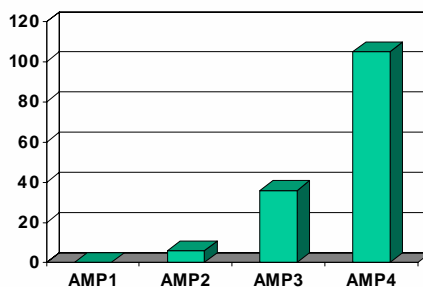
## **Contents**

- Why we need an alternative to chemical removal
- Pro's & con's of EBPR
- Severn Trent Strategy

## The Issue; much more P removal

- In AMP4 ~ 70 new P removal schemes
- AMP5; EA list includes most of the remaining large works Minworth (B'ham), Nottingham, Stoke etc.

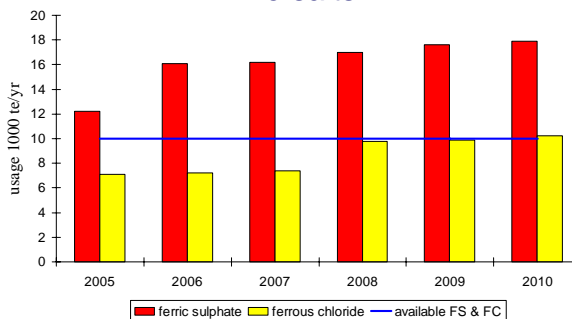
No. of works requiring P removal



## & not enough Iron!

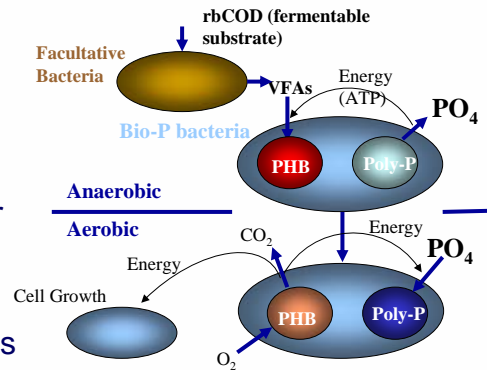
- Dosing iron is the conventional way to remove P
  - Until recently Derby was ST's only EBPR plant
- Iron salts a by-product of TiO<sub>2</sub> & steel industry
  - Demand beginning to outstrip supply
- Effluent iron consents are getting tighter

Projected usage & availability of Fe salts



## The alternative

- Enhanced Biological P Removal (EBPR):
  - A 'standard' ASP will remove ~ 20% of P (uptake of P essential for normal cell growth)
  - Reconfiguring the ASP as a BNR plant can give upwards of 90% P removal



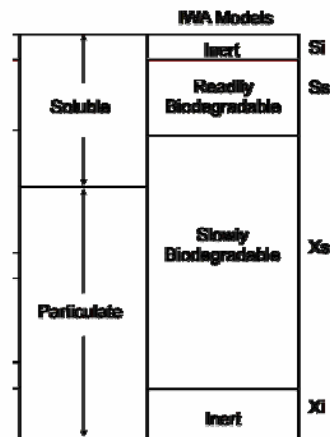
## Advantages of EBPR

- lower OPEX (CPR; substantial chemical costs & increased sludge production).
- No metal consent (if 'full' EBPR). The CPR route may require tertiary sand filters to comply with Fe consent).
- May be possible to retrofit into existing process volume
- More sustainable (liked by the EA)

## But....

- The degree & robustness of EBPR very dependant on wastewater quality/strength:
  - The rbCOD fraction very important
  - Nitrate inhibits & must be excluded from anaerobic
- Performance can be affected by wet weather
- To upgrade an ASP to achieve EBPR/BNR can incur large CAPEX

### COD Fractions



## ST Strategy

- To put in EBPR as the preferred option; where it is technically viable and the costs stack up
- Change in mindset - partial EBPR may still be well worth having i.e. EBPR + supplementary Fe dosing
- Develop low cost EBPR plant upgrades for smaller ASP's
- To investigate ways of enhancing EBPR for weaker (typical?), wastewaters

## Our Approach

1. Screening Tests to check for EBPR propensity
2. Large Works – Pilot Trials
3. Medium sized ASP's – economic retrofits
4. Small ASP's – Alternating double ditches
5. BNR Enhancement R&D

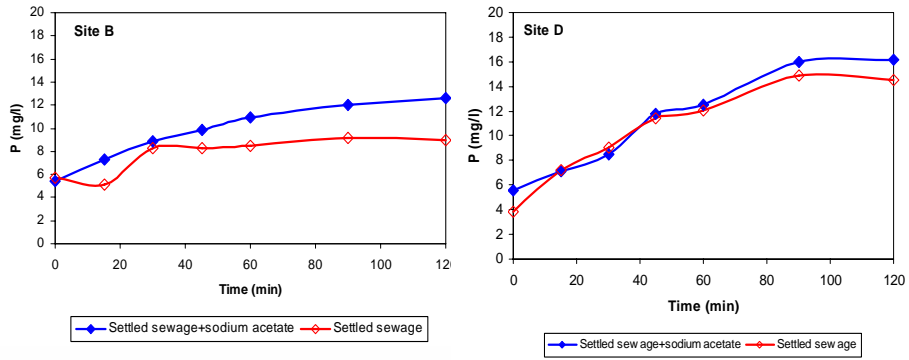


## Screening Tests:



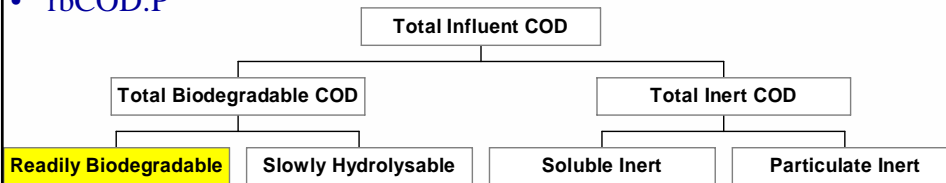
- How can we test a wastewater to evaluate whether EBPR is a viable process?
  - No 'standard' accepted test in literature
  - COD:P / BOD:P commonly used, but considered unreliable
- Two approaches selected:
  - P Release tests
  - COD Fractionation - rbCOD:P ratio

# 1) P-Release Tests



# 2) COD Fractionation

- rbCOD:P



- Works Survey - rbCOD:P & total COD:P

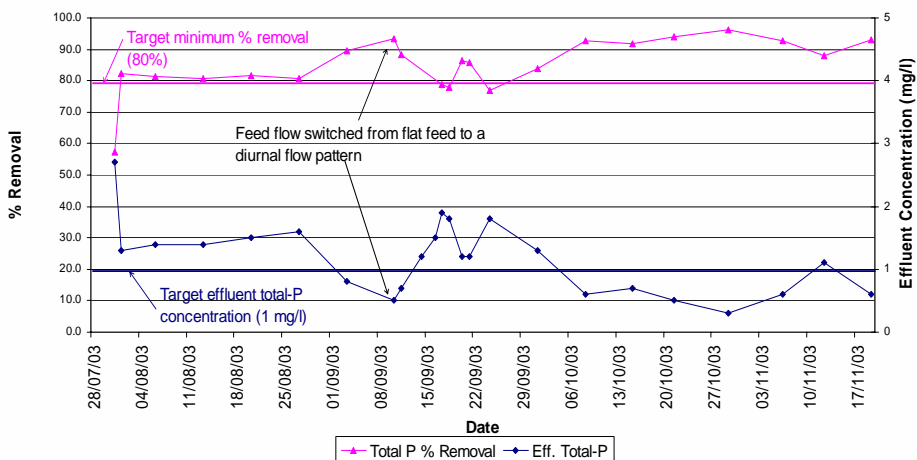
Ratios	Tewksbury	Lutterworth	Shepshed	Atherstone	Whetstone
COD:P	71.0	39.7	43.1	54.9	42.2
rbCOD:P	16.6	6.5	10.7	19.1	9.2

## Pilot Trials – Large Works

- STW own 4, 2000l flexible & mobile ASP pilot plants
- 6 trials completed over last 3 years:
  - Leicester, Wolverhampton, Burton, Stourbridge, Loughborough & Nuneaton
    - 3 suitable, 3 not
  - Pilot plants now at Birmingham (Minworth) & Stoke – for AMP5 feasibility work
- Trials are generally ran at Works >100,000 PE, that require P removal



## Wanlip STW (Leicester): Pilot Plant Tot-P Removal Performance

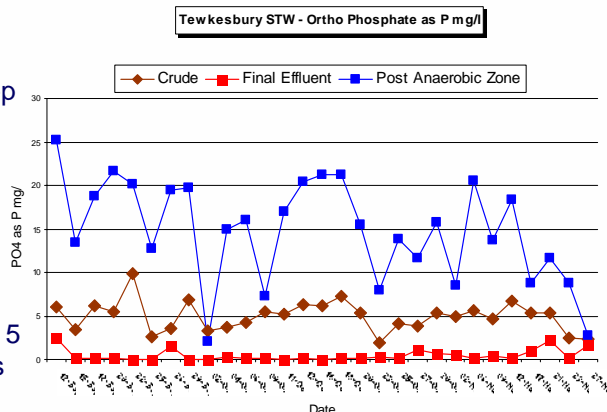


## Medium sized ASP's – economic retrofits

- Pocket ASP's common in STW
- First pocket converted to anaerobic
- Anoxic zone converted to RAS pre-denitrification zone
- 90% of settled sewage redirected to first pocket – by opening existing valves
- Retrofit total cost at Tewksbury £60K (for mixer, & new pump).

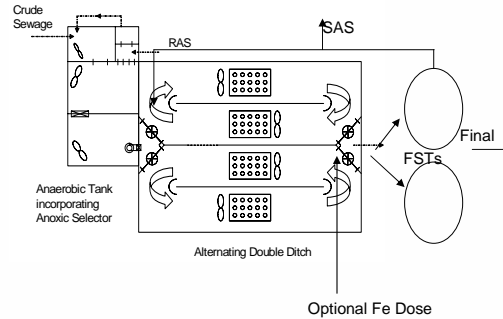
## Tewksbury STW – Performance

- Commissioned Sep 06
- Average Effluent Ortho-P to Dec 06: 0.48mg/l
- No iron dosed yet
- By Summer 07 will have commissioned 5 EBPR Pocket ASP's



## Small ASP's – Ledbury STW

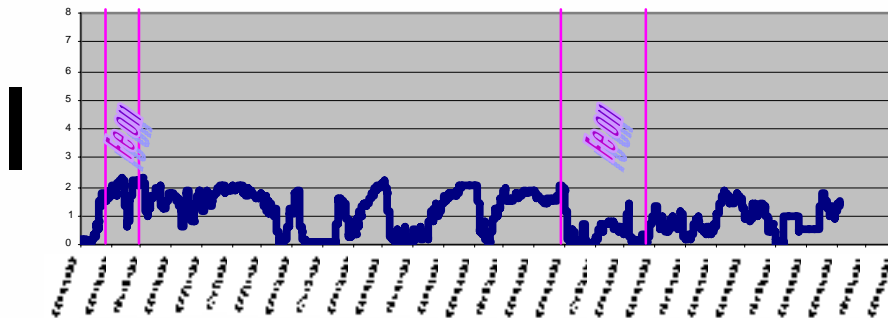
### EBPR in an Alternating Double Oxidation Ditch



## Ledbury effluent quality

Final Effluent Ortho P Trend  
September 05 to June 06

Ferric dosed at 2 to 5 mg/l during highlighted periods



- Very low dose of Fe (~2 mg/l) required periodically
- Another two BNR double ditches (Craven Arms & Grendon) are currently being built

## Enhancing EBPR

- Making EBPR viable for weaker wastewaters
  - Fermenting RAS – Loughborough STW
    - Trialled successfully at pilot scale & recommended as solution
  - Cell disintegration to generate C; Cranfield University PhD project (sponsored by ST & Thames)

## Summary - Making the most of Bio-P

- Key Messages:
  - Application of bio-P can be far wider, if it is accepted that some supplementary iron dosing needed
  - Bio-P as a solution can be equally valid for medium & small ASP's as large ASP's
  - BNR retrofits can be cheap & offer considerable savings in Fe, even with domestic wastewaters
  - Future total N standards – Bio-P helps, CPR doesn't