Implementation of a Demonstration Scale Integrated Managed Passive (IMPI) process

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Rationale

- Identified "Integrated Managed Passive Treatment Process" (**IMPI**) as potential process
  - microbial reduction of sulphate,
  - subsequent chemical reactions.
  - Utilises naturally available energy sources *e.g.* topographical gradient, metabolic energy, photosynthesis & chemical energy
  - Utilises cheap carbon source - hay, wood chips, molasses
  - Requires regular but infrequent maintenance
  - Modular design – 4 stage process *i.e.* to treat 1000 m^3/day to remove 1000 mg/L sulphate = 1t/day sulphate requires 5 x 200m^3/day full-scale modules
  - 20 – 25 year design life
  - Low cost technology
- Evaluation of IMPI process for broader application within the company

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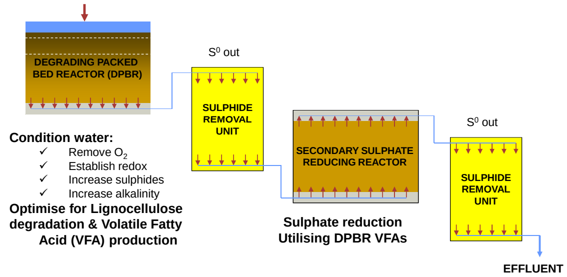
The Four Stage Process



Condition water:
- ✓ Remove O_2
- ✓ Establish redox
- ✓ Increase sulphides
- ✓ Increase alkalinity

Optimise for Lignocellulose degradation & Volatile Fatty Acid (VFA) production

Sulphate reduction Utilising DPBR VFAs

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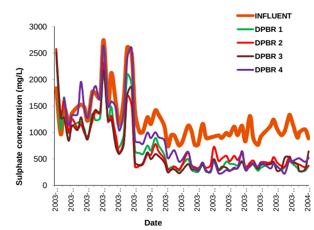
Laboratory Scale Feasibility Testwork



Sulphate reduction data shows sulphate removal in the first stage from about 1000 mg/L to 250mg/L

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Scale-up

Demonstration module required to confirm:

- Design of reactors is appropriate and ensure no hydraulic short-circuiting
- Sulphate reductions achieved on column scale can be achieved on scaled-up process
- Sulphide oxidation is achievable on scaled-up process
- Initial costing – operating and capital costs *e.g.* how do process variables affect costs?
- Optimise performance of process

Degrading Packed Bed Reactor scaled to 200m^3/d, remaining three units of process scaled to 20m^3/d

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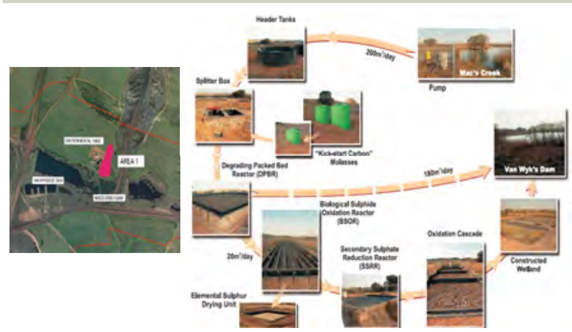
The Integrated Process



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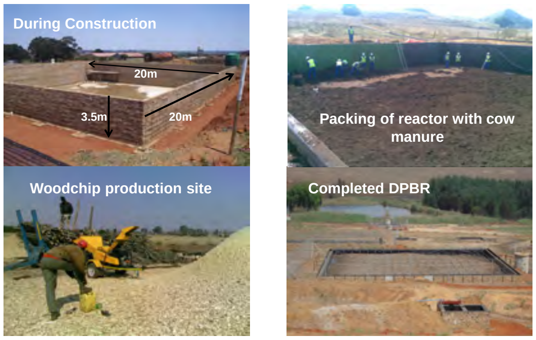
Degrading Packed Bed Reactor (DPBR)



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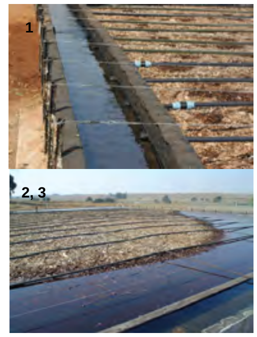
Issues During Commissioning of DPBR



Flooding occurred:
1. Ineffective water distribution system
2. Excessively high flow rate
3. Non-ideal packing

Rising of packed bed:
1. Bacterial activity and gas formation
2. Lack of water movement through bed due to presence of impermeable layers

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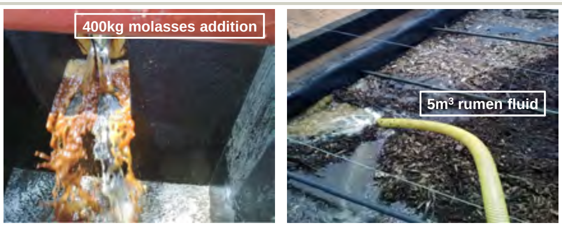
Commissioning the DPBR



	22-Dec-09			21-Apr-10		
SAMPLE	pH	Sulphate	Sulphide	pH	Sulphate	Sulphide
DPBR IN	6.34	385.40	2.40	7.09	1988.00	5.60
DPBR OUT	6.49	95.90	53.63	6.34	1337.00	73.65

Feed water quality seasonally variable due to rainy season

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Biological Sulphide Oxidation Reactor (BSOR) – Stage 2

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Sulphur Biofilm Formation

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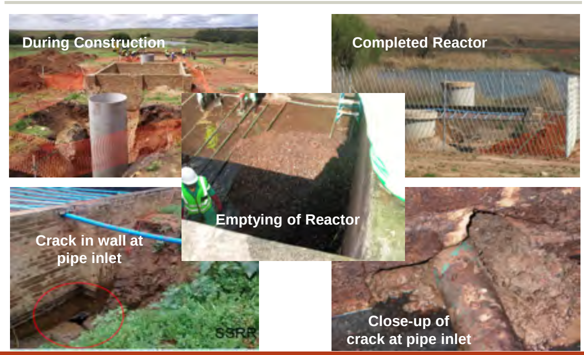
Issues During Commissioning of the SSRR – Stage 3



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Highlights & Lessons Learnt

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Highlights

- *Wet Commissioning of initial construction finished end Oct 2009*
- *Process principles demonstrated:*
  - ✓ Sulphate Reduction achieved in DPBR
  - ✓ Sulphide Oxidation and elemental sulphur formation occurs
- *Snag list and issues dealt with*

Lessons learnt

- *Higher level of engineering in design phase*
- *Success of the project reliant on mine participation due to non-production nature of project*

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THANK YOU FOR YOUR ATTENTION

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