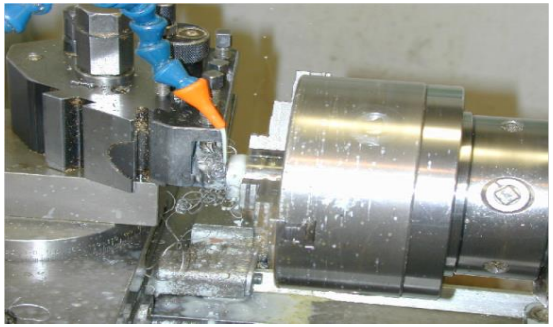
Development of a hybrid technology for treating recalcitrant water contaminants- assessing e-beam potential.

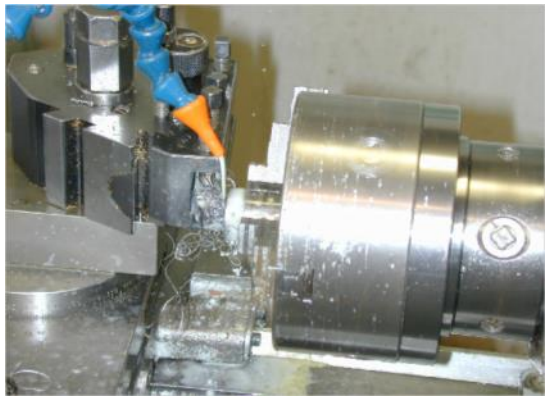
Why we got together?

The challenge is resource (organics, metals and water) recovery from industrial waste waters on site.



Current clean-up approaches such as reverse osmosis and ultrafiltration (shown above) are not ideal- concentrate the problem and very energy intensive.

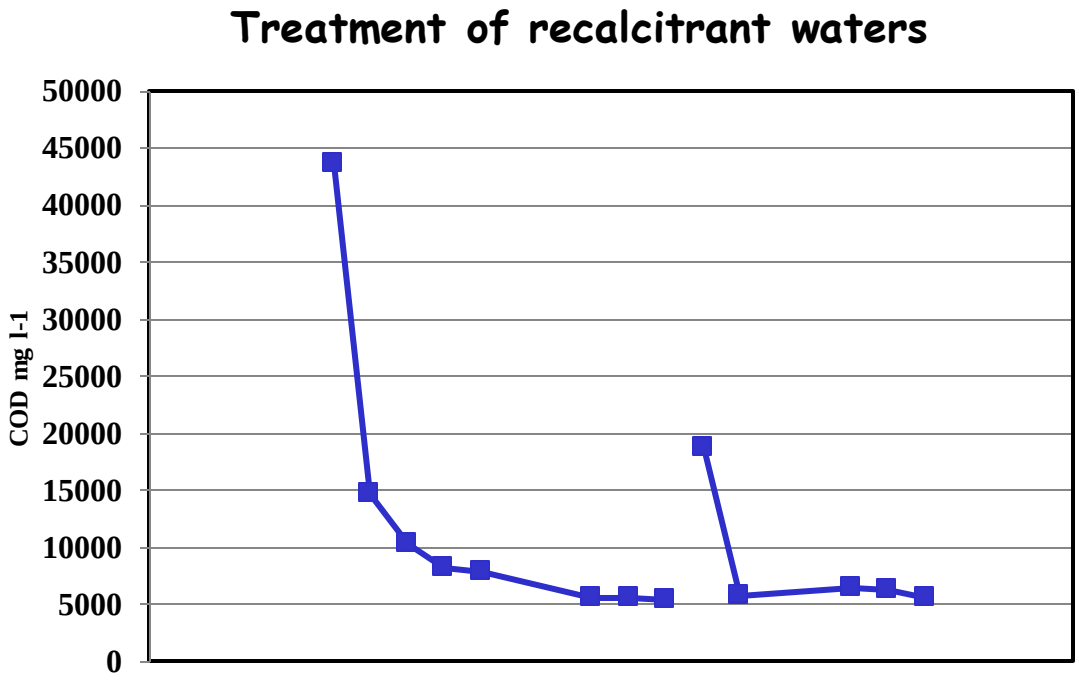
Our experience- microbiological treatment.



Enables: 1) Water recycling on site. 2) Organic converted microbiologically to biogas and bio-plastics. 3) Some metal recovery- but does not always work since biological systems have their limits.

This has been commercialised by the PI- Microbial Solutions Ltd.

Limitation - we do not always get complete degradation.



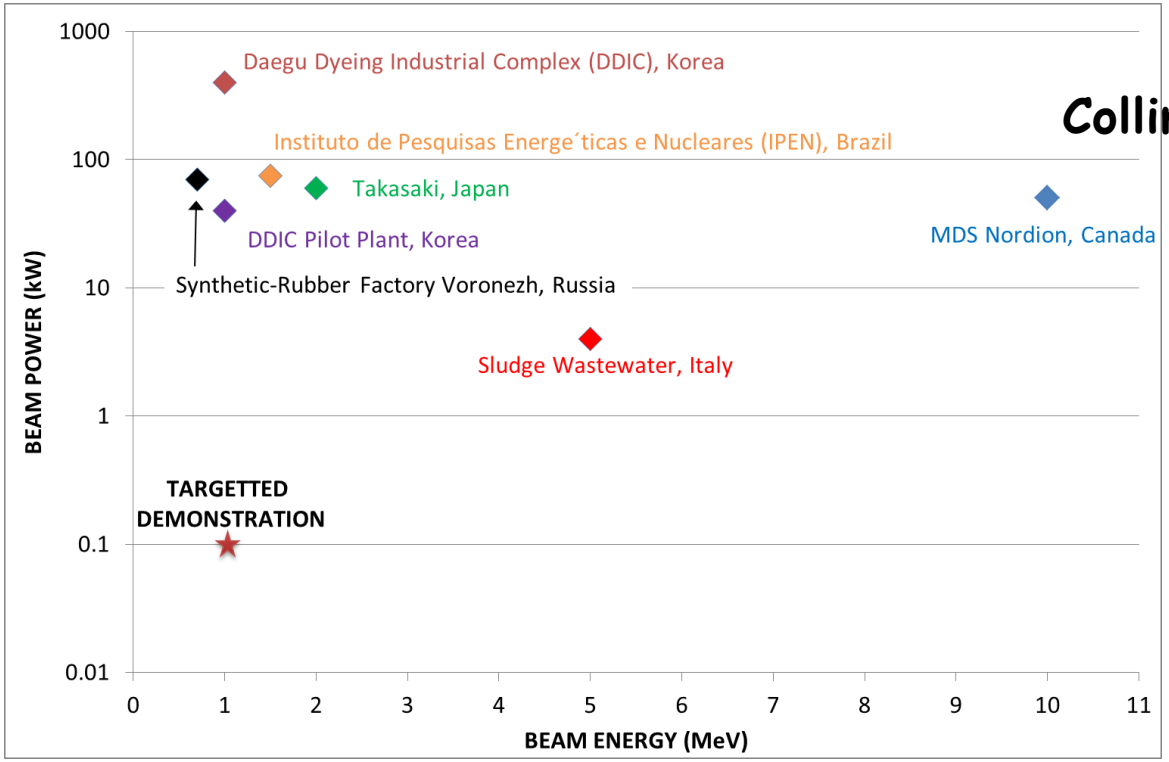
Waste streams we will test.

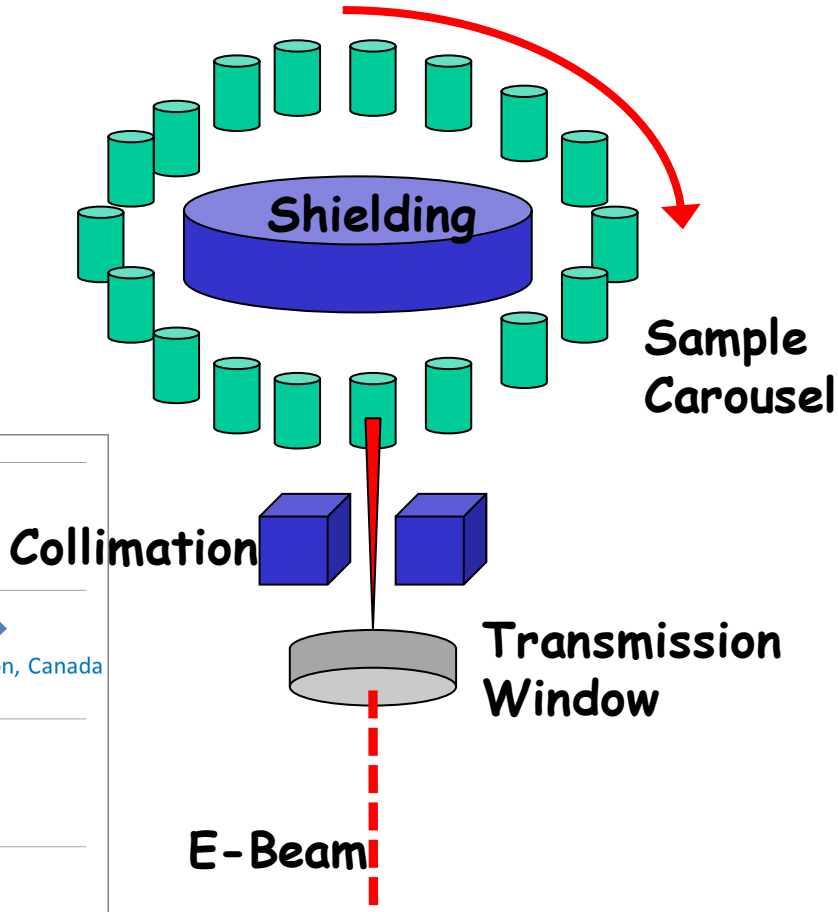
- Chemically mixed industrial end-of-pipe oily effluent (Biffa).
- Refinery wastes provided by BP and Exxon (including heavy oils).
- Ground water contaminants such as TCE.
- Pharmaceutical waste (GSK).
- Diageo brewery effluent (mixed humic and copper).

How can we routinely and sustainably reduce the pollution load (expressed as COD-Carbon Oxygen Demand) to consent levels of <2000 mg L?

E-Beam Treatment

- Anticipate treating ~20 samples.
- Optimum e-beam parameters to be determined based upon:
  - Duration,
  - Regime of exposure,
  - Energy,
  - Beam intensity.





Engineered solution to be developed

Drivers and Objectives

Drivers

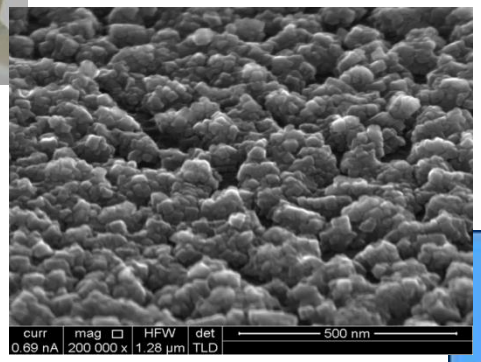
- STFC Futures Programme- "Identifying and meeting unmet needs in the Environment."
- The programme will develop new inter-disciplinary communities.
- Water security and smarter systems to reduce pollution and waste.

Our objectives

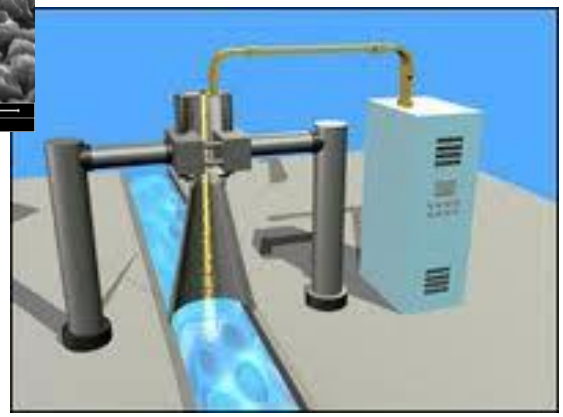
1. The primary objective of this study is determine the most effective e-beam exposure that enables degradation of recalcitrant water-borne organic contaminants, resistant to other treatment procedures, and in parallel assess the potential of the e-beam to precipitate metals, so enabling their recovery, end-of-pipe.
2. To determine the most effective e-beam regime which leads to microbial cell inactivation.
3. From these studies determine the key issues that will define the commercial potential of e-beam application for treating problematic contaminated waters.

Our proposal- Sequential hybrid treatment.

Microbiological



Advanced Oxidation Processes with nanoscale-Fe oxide

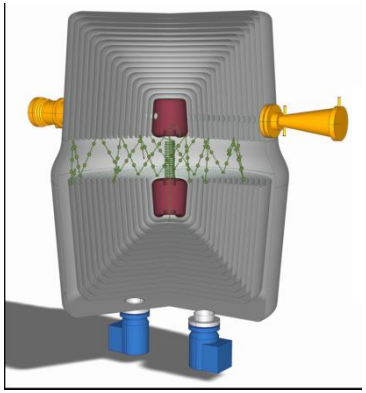


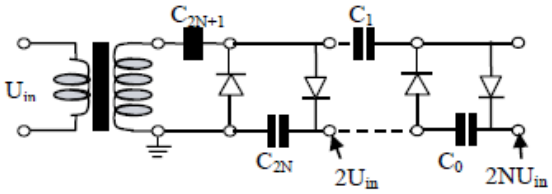
Electron-beam

The order and condition of waste treatment is the key focus of the study.

Siemens Technology Development

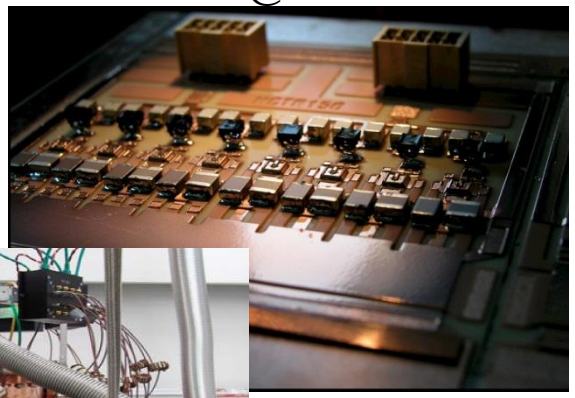
- Oniac:
  - Spherical Tandem Accelerator

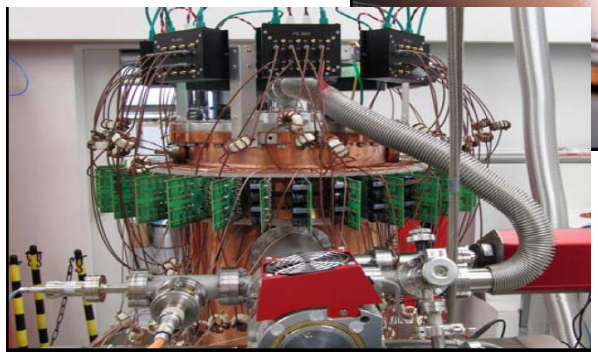




- RELIA:
  - SiC transistor drive amplifier.
  - Targeting 100W/ € installed cost.

50 kW @ 352 MHz





- STFC testing on FETS at RAL.

- STFC providing consultancy for R&D programme.

Other opportunities

Oil and water sector

- Exxon- Heavy oils.
- BP-Castrol and Microbial Solutions Ltd- recalcitrant waste waters.
- Hydraulic "fracking" water- Cuadrilla.

Liquid waste

- Diageo and Coca Cola- end of pipe organics and metals.
- GSK- Pharmaceutical waste.

Green waste

- Breakdown of lignin and conversion to bioenergy.

Even more opportunities

- End of pipe metal recovery.
- Metal recovery for mining systems.
- Recovery of radioactive elements from waste.