BHR Group

EXPERTS IN FLUID ENGINEERING

Water & Wastewater Mixing

(WWM)

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Helix ECL

Environmental Consultancy Limited

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BHR Group offer

- Research
- Consultancy
- Product development

  in the field of

  Water, Environment

  and Power (WEP)
- With a multi-disciplinary team covering all aspects of fluid engineering
- With dedicated facilities enabling the simulation of water engineering systems

BHR Group: Introduction

- **Modelling of Flows in Sludge Mixing Equipment – The Use of Physical Models and Computational Fluid Dynamics (CFD) as design and evaluation tools**

  (2004) Dawson. M.K [1]., Leefe. S.E. [1], Harrison. D. [2], Cumiskey. A. [2]. Sludge 12. University of Surrey & IChemE

- **Improving Prediction of Sludge Pumping Losses & Mixing Energy**

  (2005) Dawson. M.K [1], Harrison. D. [2]. 10th European Biosolids Conference. Aqua Enviro

[1] BHR Group

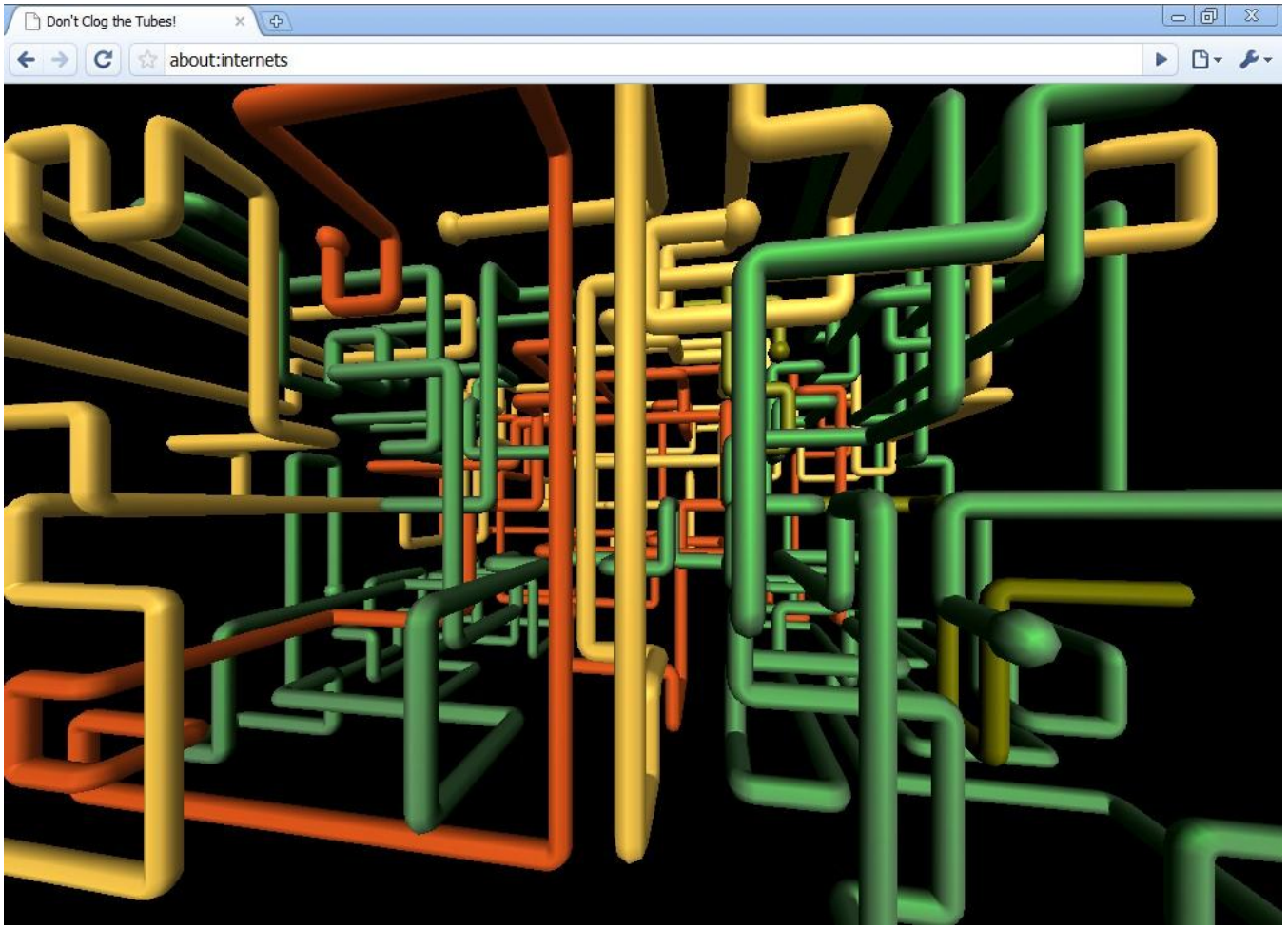
[2] Monsal Ltd

BHR Group: Sludge Pumping

BHR Group: Sludge Pumping

BHR Group: Mixing

BHR Group: Pipe Hydraulics



Challenges facing the Water Industry

- More efficient use of water
- Increased energy efficiency
- Increasing production of renewable energy
- Minimising carbon footprint
- Optimising chemical consumption
- Increased nutrient removal
  - Phosphate crisis

Water Industry Drivers

- **OFWAT**
  - Competition in upstream sewage and sludge markets (PROC/01/0166)
- **Defra / DECC**
  - Anaerobic Strategy and Action Plan. A commitment to increasing energy from waste using anaerobic digestion
- Sewage Sludge Directive
- Landfill Directive
- Waste Framework Directive

Competition in Upstream Sewage & Sludge Markets

- Treatment & disposal of sewage and sludge
  - 'Traditional' sewage treatment
  - Sewage treatment for individual households and small communities
  - Sludge treatment & disposal
  - Sludge transport
  - Pre-treatment of trade effluent and commercial wastewater recycling
  - Recycling of wastewater from domestic sources

Potential Competition

- Separation of sludge & sewage treatment
  - Sludge processing is difficult to separate from sewage treatment processing
- Co-digestion with alternative feedstocks
  - Commercial & industrial wastes
    - Catering waste, food waste, vegetable packing, abattoir etc
  - Agricultural residues and wastes
    - Farm manure & slurries
    - Energy crops
  - Municipal solid waste
    - Municipal household
    - Municipal non-household

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- The ***BHR Group*** is an internationally renowned team of experts covering all aspects of fluid engineering
- Fluid engineering contributes significantly to the challenges facing
  - The Water Industry
  - The Waste Industry
  - The Biogas Industry
- The BHR Group have now partnered with Aqua Enviro to combine their respective fluid engineering and process engineering skills

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aqua enviro
limited

- To maximise their collaborative contribution to the water, waste, and biogas markets

BHR Group: WWM Overview

- **WWM:** the **Water and Wastewater Mixing Research Programme** at BHR Group is supported by Water PLCs, consultants, chemical, and equipment suppliers
- The **WWM** programme is conducted as a series of 2-year phases with members signing –up to each phase and receiving a defined 2-year work programme and deliverables in return

WWM Overview

- **WWM 1** (1996 to 1998): Blending in pipes & channels without dedicated mixers
- **WWM 2** (1998 to 2000): Pipe static mixers, channel static mixers, weirs & stirred tank flash mixers
- **WWM 3** (2000 to 2002): In-line dosing of additives into sludge and the effect of additive viscosity on blending rates
- **WWM 4** (2002 to 2004): Sludge conditioning, dosing for P removal, sludge blending and mixing in-line, ragging and anoxic zone mixing
- **WWM 5** (2005 to 2006): Produced the BHR **Sludge Rheology Database (SRDB)** and extended work on dosing for P removal, sludge tank blending and anoxic zone mixing

WWM Overview (Continued)

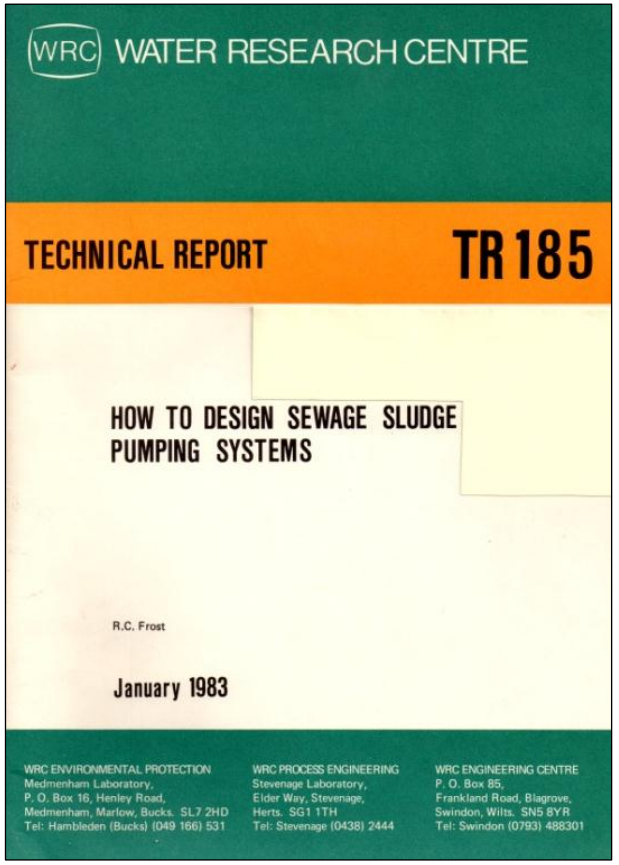
- **WWM 6** (2007 to 2009): Produced the BHR **Sludge System Losses Tool (SLOT)**, the Sludge Tank & Digester Mixing Design Guide, significantly upgraded the **SRDB**, conducted successful site trials on coagulant mixers for P-removal as well as energy benchmarking mixing and flocculation processes
- **WWM 7** (2009 to 2011): Produced an upgraded version of **SLOT,** an upgraded **SRDB**, a sludge tank and digester mixing software tool as well as a pilot scale floc strength demonstration project
- **WWM 8** (2011 to 2013) The research areas covered are closely aligned to both the UKWIR roadmap and the themes identified to OFWAT by the water companies as part of the AMP 5 submission
  - Enhanced process efficiency
  - Reduction in carbon footprint

WWM Overview (Continued)

- The main **WWM** deliverables to date are Software Tools, Design Guides and Research Reports
- Design Guides
  - Pipe & Channel Mixing and Dosing (CR8238)
  - Liquid Blending in Pipes and Channels (CR8240)
  - Sludge Tank & Digester Mixing (CR8237)
- **Sludge Rheology Database (SRDB)** provides the most comprehensive collection of sludge flow data in the world. The database has enabled correlations for the prediction of sludge flow behaviour for sludge types (such as potable and hydrolysed sludges), where no accurate prediction was previously possible
- **Sludge System Losses Tool (SLOT)** provides users with calculation of sludge pipeline head losses incorporating the latest rheology from the **SRDB**, enabling selection of the most energy efficient pumps

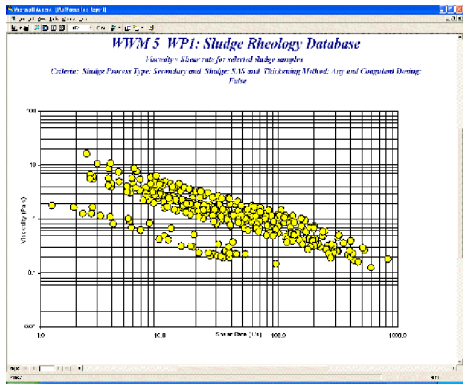
Sludge System Losses Tool (SLOT)

- TR185 has been used for designing sewage sludge pumping systems since 1983
- The ***BHR Group*** have produced an up-to-date **Sludge System Losses Tool (SLOT)** that supersedes TR185
- **SLOT** estimates total pressure losses on the suction and discharge side of pumps for alternative
  - pipes & fittings
  - sludge types, concentrations and rheological properties
  - flow rates ranging from laminar to turbulent flow



Sludge Rheology Database (SRDB)

- The **Sludge Rheology Database (SRBD**) is an extensive database of potable and wastewater sludge rheology
- It is the world's largest body of sludge data, with over 500 rheograms
- Including predictive correlations for 15 sludge types
- Previously unreported sludge types
  - Polymer thickened sludges
  - Potable sludges
  - Iron-dosed sludges
  - Hydrolysed sludges
- The **SRBD** is linked to **SLOT** enabling correct selection of pumps



WWM 8: Programme of Work

- Pipe Fouling
- Floc Strength
- Optimised Polymer Dosing
- Coagulant Dose Optimisation Toolkit
- Sludge & Sludge Pumping
  - Update SRDB
  - Update SLOT
- Sludge Dewatering
- Anaerobic Digestion Technology
- Sludge Tank & Anaerobic Digester Design
- Primary Sedimentation Tank Optimisation

Anaerobic Digestion Technology

- Potential for existing plants to accept and process sludge from external sources
- Effect of co-digestion on the rheological properties of the digestate
- Carry out a survey of new waste streams, ***BHR Group*** to investigate rheology and density and use **WWM** partner **Aqua Enviro** to analyse nutrient content
- With **Aqua Enviro**, perform laboratory scale co-digestion experiments on suitable waste streams as identified from the survey and ascertain effectiveness of co-digestion
- Evaluate the effect of co-digestion on the sludge rheological properties and dewaterability of digestate
- Evaluate the potential for existing process plant to adapt to take advantage of the co-digestion potential

Enzymatically Hydrolysed Sludge

Thermally Hydrolysed Sludge

Biowaste

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Summary

- Over the last 15 years the ***BHR Group*** has undertaken 7 high-quality research programmes
- Improving the Water Industry's understanding of fluid engineering
- **WWM 8** promises to continue this work providing
  - Process optimisation
  - Energy savings
  - Reduced chemical consumption

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Thank you

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