Engineering/Analytical Analysis Services and Capabilities
UI Environmental Engineering Lab

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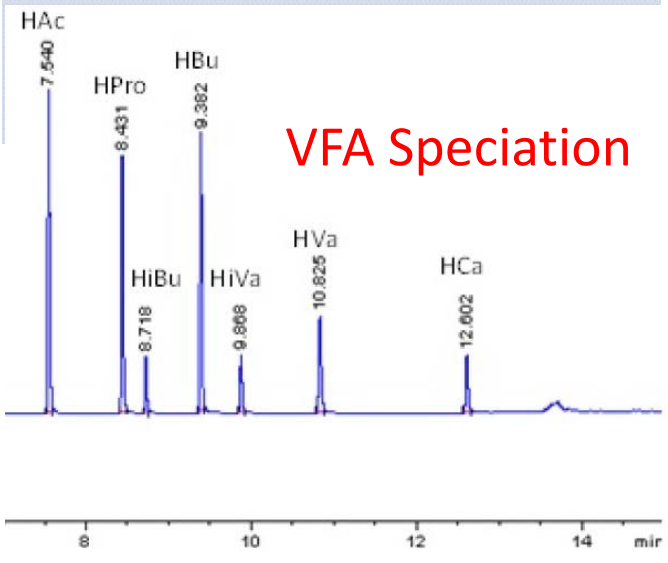
Analytical Chemistry to Assess the Performance of Water Reclamation Facilities

- Comprehensive Analysis of Biological Nitrogen and Phosphorus Removal:
  - Volatile Fatty Acid (VFA) speciation
  - EBPR Intracellular Carbon Reserves – PHA and Glycogen
  - Phosphorus (all forms)
  - Ammonia
  - Nitrate
- Anaerobic Digestion:
  - Methane quantification
  - VFA speciation
  - Volatile solids analysis



VFA Speciation

Wastewater Treatability Studies

Example bioreactors set-up. All reactor operations, including pumping, mixing, aeration, etc., are controlled by a fully programmable PLC.

- Municipal and Industrial Wastewater
- Nitrogen and Phosphorus Removal
- Conventional and Membrane Configurations

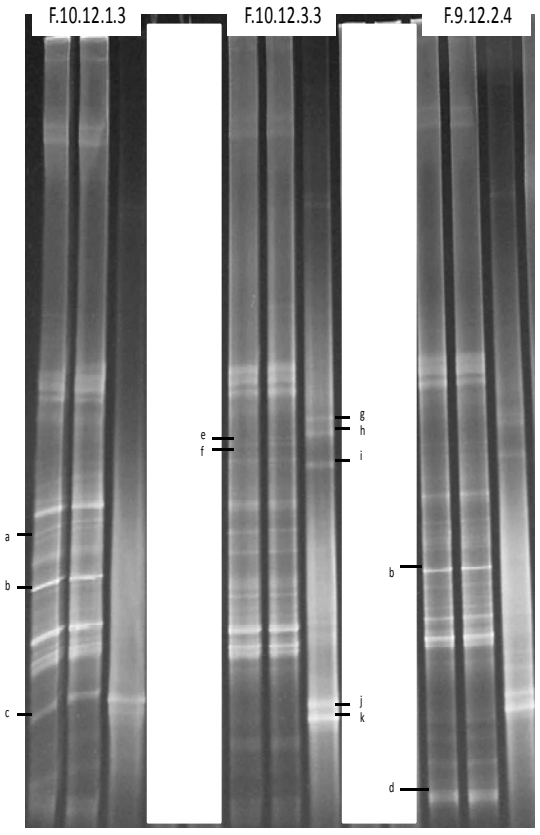
40L completely mixed **Anaerobic Digesters** – employed for both research projects and treatability studies

Consulting Services

- Process Analysis and Troubleshooting
  - For example, we regularly assist the city of Moscow with process evaluation for their EBPR facility
- Process Design – biological, physical, and chemical water reclamation processes….suspended growth and fixed film processes….liquid and solid stream processes
- Life Cycle Analysis studies
- Operator Training, including courses with CEUs

Molecular Analysis of Wastewater Treatment Systems

We apply advanced molecular capabilities to characterize and quantitatively assess bacterial communities in wastewater treatment environments. Not only can we compare and contrast population diversity (DGGE – see figure below), we can quantify the relative fraction of important bacterial populations (qPCR – see table below). In addition to PAOs and GAOs (see table below), we can quantify methanogenic species in anaerobic digesters, and filamentous microbes and species that induce foaming in activated sludge systems..



We can learn a lot about bacterial communities in wastewater treatment environments through the use of a molecular technique known as Denaturing Gradient Gel Electrophoresis (DGGE). DGGE is used to generate a community profile to assess dominant members of a bacterial community. A typical bacterial community "fingerprint" for enhanced biological phosphorus removal (EBPR) reactors is shown in the photo to the left. When you compare the three reactors in the photo, you will see different "bands" appearing in different locations on the gel. What this means is different species are more or less abundant in a particular reactor for a particular operating condition compared to another. By closely examining the differences of these "bands" we can learn a lot about different EBPR consortia for certain operating conditions. Utilizing this type of molecular analysis could be helpful if a treatment process is upset, and you would like to have a better idea of the bacteria that are predominating the consortia.

We can quantify the relative fraction of bacteria of interest within a wastewater treatment environment using a molecular technique known as quantitative PCR (qPCR). The value of qPCR data lies in trouble shooting process upsets or in assessing alternative process configurations and the potential correlation with process performance. For example the data shown in the table below represent relative fractions (%) of phosphorus accumulating organisms (PAOs) and glycogen accumulating organisms (GAOs) within an enhanced biological phosphorus removal reactor. Assessing PAO and GAO fractions relative to operating conditions can be useful in optimizing process performance and also in understanding process upsets.

Sample ID	PAOs		GAOs			
			GAO Primer Set		GB Lineage	
	Reactor O	Reactor C	Reactor O	Reactor C	Reactor O	Reactor C
DNA1	24.5±1.4	24.1±1.8	2.8±0.7	3.5±0.2	3.6±0.2	5.4±0.8
DNA2	1.0±0.06	1.5±0.11	5.3±1.3	6.0±0.5	10.4±0.8	11.4±1.7
DNA3	0.9±0.09	1.5±0.12	2.4±0.3	11.5±1.0	12.9±1.0	46.6±3.6
DNA4	4.1±0.11	12.4±0.11	0.3±0.04	3.5±0.3	3.4±0.6	8.9±0.4
DNA5	8.7±±0.51	12.5±0.54	2.6±0.6	3.6±0.5	14.9±1.8	15.2±2.4
DNA6	4.7±0.24	17.0±1.53	0.2±0.1	3.4±0.2	3.5±0.9	10.7±0.7

University of Idaho