


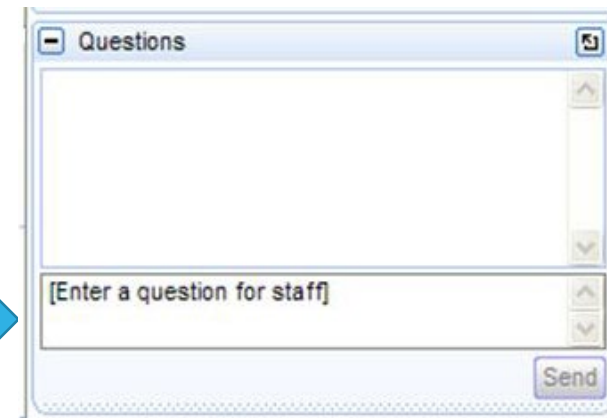


AgSTAR Operator Guidebook

The New Resource for Project Operators

Webinar FAQs

- All participants will be muted at the beginning of the webinar
- When you join, audio will be through your computer
- Questions submitted during the webinar will be reviewed at the end of the webinar
 - Type a question here 
- If you are experiencing technical difficulties, please let us know using the Questions pane on the right side.





Welcome to today's webinar

1 U.S. EPA AgSTAR Program

Who we are and what we do.

2 Overview of New AgSTAR Operator Guidebook

A resource to help digester operators run efficient and safe anaerobic digestion/biogas collection systems.

3 Additional Resources

Visit www.epa.gov/agstar for more information.

The AgSTAR Program



PARTNERSHIP PROGRAM

Collaborative program sponsored by EPA
and USDA.

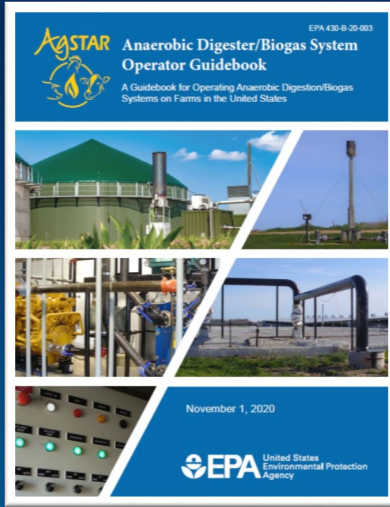
- 1** **Promote Anaerobic Digestion**
Advancing economically and environmentally sound livestock manure management.

- 2** **Strong Ties**
Working with industry, government, NGOs and university stakeholders.

- 3** **Helping Hand**
Assisting those who enable, purchase, or implement farm anaerobic digestion projects.

Today's Webinar – AgSTAR's Operator Guidebook

- 83 Pages covering 10 Chapters of Content:
 - Digester Basics, Operational Fundamentals, Process Control, Laboratory Testing and Data Recording, Fundamentals of Digester Mechanical Systems, Biogas Handling and Conveyance, System Inspection and Maintenance, Odors and Odor Control, Safety
- Today's Additional Insights from Expert Reviewers:
 - Safety – Bernie Sheff, Montrose Environmental Group, Inc.
 - Operations & Maintenance – Brian Langolf, University of Wisconsin – Oshkosh; and David Palmer, Tetra Tech
 - Biogas Conveyance & Upgrading – Chris Noah, Tetra Tech
 - Brief Summary - Craig Frear, Regenisis
 - Questions & Answers



Safety

Bernard Sheff, PE
VP Biogas Engineering / Chair ABC
Montrose Environmental Group

AgSTAR's Operator Guidebook

Topics covered in this section include:

Overview:

- This is simple: we are making something that both wants to explode and has a byproduct that wants to take a life.
- The Safety Pyramid
- Quick review of the basics that the Guide highlights
- Need for detailed formal training

Safety Pyramid



The Safety Pyramid

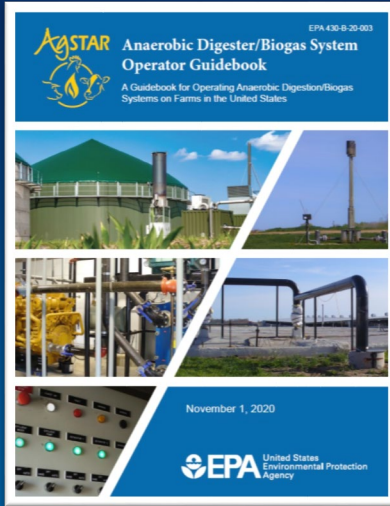
The safety pyramid is a theory that several lower level incidents lead to higher incidents. If we make a concerted effort to reduce at risk behaviors, then minor injuries will be prevented and it will be substantially less likely to have severe injuries or fatalities.

Quick Overview

- A) Hazards in the Biogas
 - 1. Personnel Detection
 - 2. Fixed Monitoring
- B) PPE
- C) Confined Space – General and Specific conditions
- D) Lock Out – Tag Out
 - Electricity Focused
 - Hydraulic Focused
- E) Vectors

Safety is a way of Life

- There is a constant demand for evaluation and assessment of operations; is this the safest option?
- Training, Training, Training
- ABC Operators training and the Safety Course



Operations & Maintenance

David Palmer

Senior Bioenergy Project Manager

Tetra Tech, Inc.

Brian Langolf

Director of Biogas Systems

University of Wisconsin Oshkosh

Topics covered in this section include:

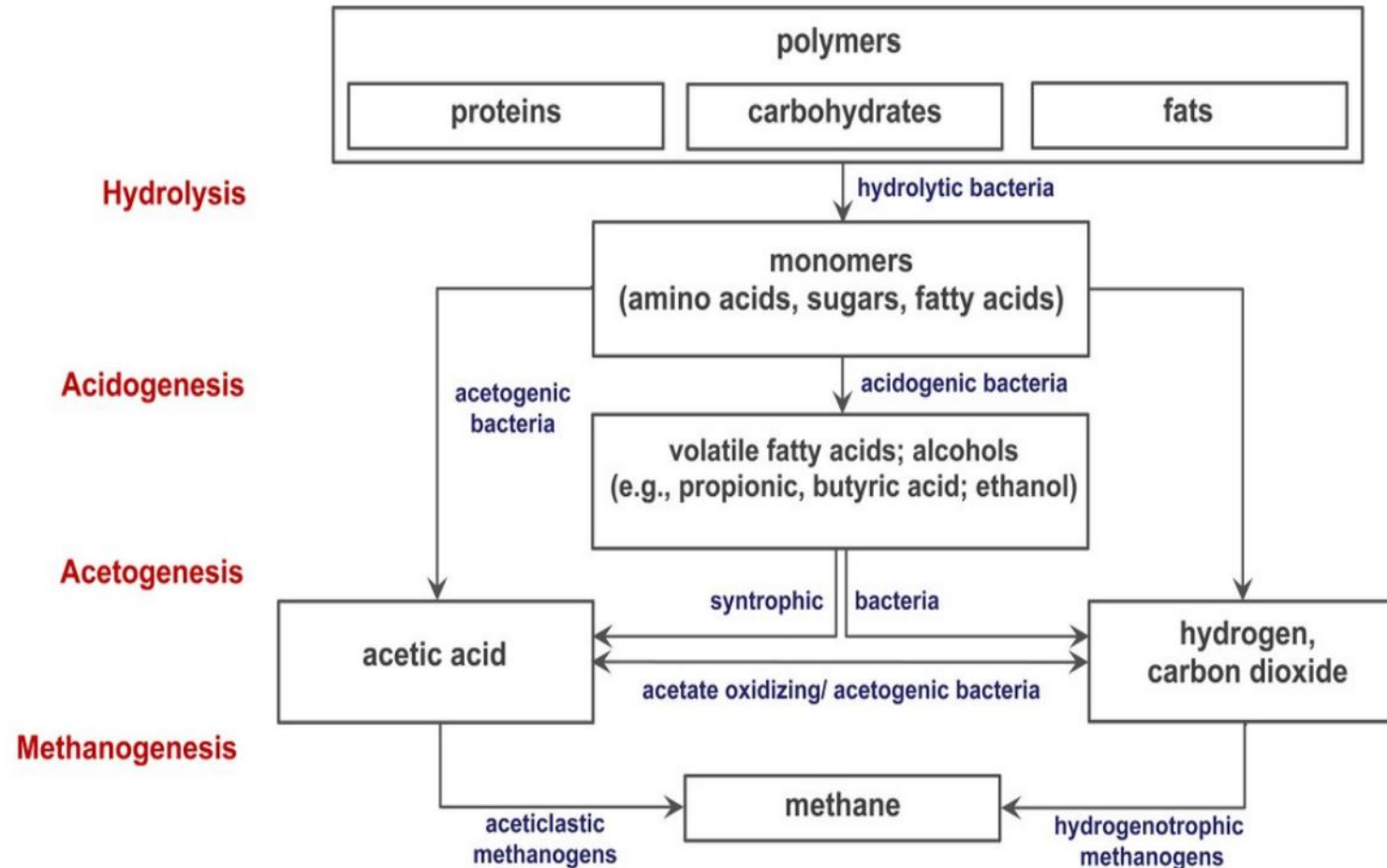
- The Biological Process
- The Mechanical Process
- Performance monitoring
- Testing
 - On-Site
 - Labs
- Mechanical Systems
 - Pumps
 - Piping
 - Mixing
 - Effluents

Biological Process

- **Anaerobic digestion is the natural decomposition of organic matter in an anaerobic environment (oxygen free).**
 - **This degradation is accomplished by anaerobic micro-organisms under controlled conditions, including temperature, and leads to the production of biogas**
- **The process requires at least two steps:**
 - **Acidogenesis**
 - **Organics converted to acetate and H₂**
 - **Methanogenesis**
 - **Acetate and H₂ converted to methane**
- **These steps rely on a diverse and interdependent group of bacteria to complete the process**
- **Organic Loading Rate (OLR) – Remember this!**

Biological Process

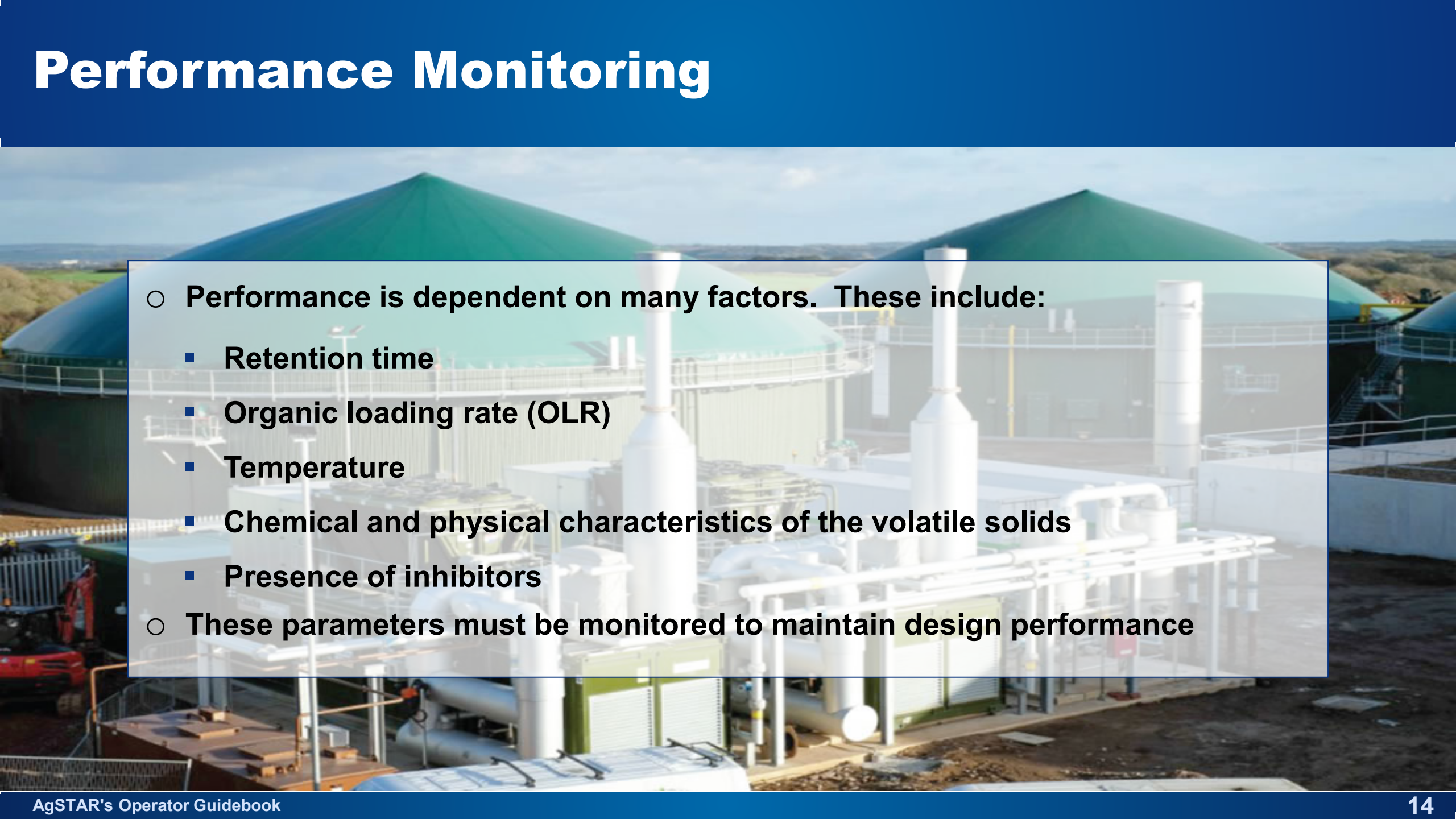
The Anaerobic Digestion Process



Mechanical Process

- **Feed material consistently.**
- **Create homogenous feedstock.**
- **Maintain the proper OLR.**
- **Effluent matches influent. A gallon in, a gallon out.**
- **The mechanical process involves the facility's conveyors, pumps, blowers, piping, tanks, and other equipment used to feed the digester and manage the residuals. It also include the equipment required for biogas utilization.**

Performance Monitoring

- 
- **Performance is dependent on many factors. These include:**
 - **Retention time**
 - **Organic loading rate (OLR)**
 - **Temperature**
 - **Chemical and physical characteristics of the volatile solids**
 - **Presence of inhibitors**
 - **These parameters must be monitored to maintain design performance**

Testing

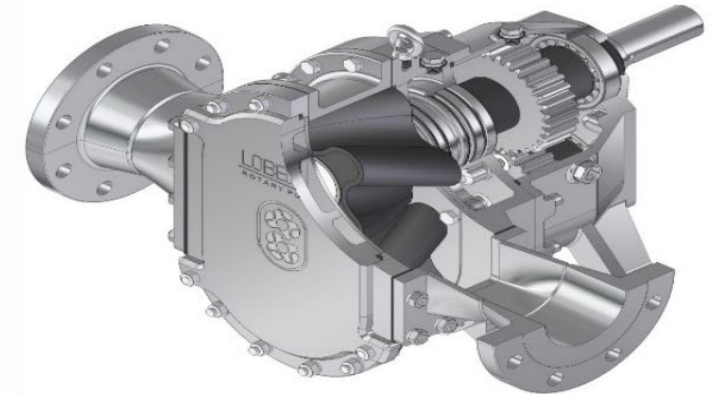
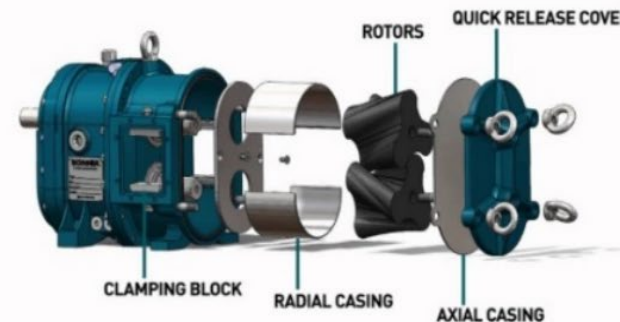
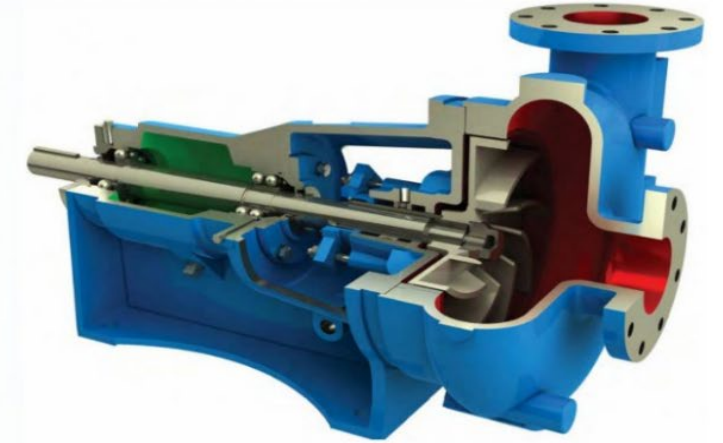
- **On-Site**
 - Total solids
 - Volatile solids
 - Alkalinity
 - % Methane
 - Temperature
- **Laboratory**
 - BMP – Biochemical Methane Potential
 - COD – Chemical Oxygen Demand
 - ATA – Anaerobic Toxicity Analysis
 - NH₃ – Ammonia
 - TKN – Total Kjeldahl Nitrogen
 - Others



Mechanical Systems

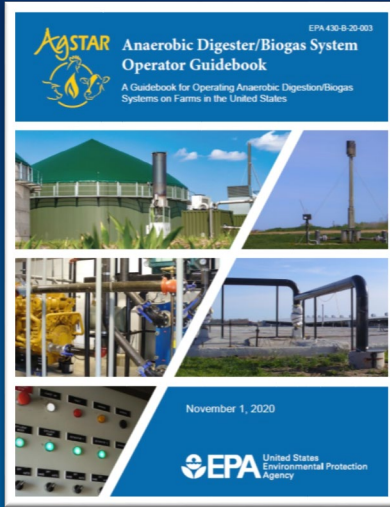
The mechanical systems are designed to maintain the proper conditions in the digester to allow the bacteria to thrive and produce biogas.

- Keep the bacteria warm and fed.
- Do not overfeed the digester
- Make sure influent = effluent
- Properly handle digester effluents
- Transport and treat the biogas
- Recover the energy from the biogas



Pump Type Examples

The 50840 series Low Pressure Cyclone Centrifugal Pump (top left), a Horizontal Hydro-Solids pump (top right), the BLUEline rotary pump (bottom left), and a LobePro Rotary Pump (bottom right).



Biogas Conveyance & Upgrading

Chris Noah

Mechanical Engineer

Tetra Tech, Inc.

Topics covered in this section include:

- Safety Reminder
- Fundamentals of Gas Handling
- Common Operational Issues
- Biogas Upgrading Overview

Safety Reminder

- Biogas is FLAMMABLE
- Biogas contains TOXIC and ASPHYXIANT gases
 - Hydrogen Sulfide (H_2S) – toxic and flammable
 - Methane (CH_4) – asphyxiant and flammable
 - Carbon Dioxide (CO_2) - asphyxiant
- Biogas Condensate is CORROSIVE
- Pressurized gases store energy that can be dangerous when released



Fundamentals of Gas Handling

- **Gases are compressible – not the same as liquids. They can store energy (like a spring).**
- **Gas Safety Equipment – mitigates pressure and flammability risks**
- **Blowers / Compressors – increase pressure and provide flow**
- **Heat Exchangers – add or remove heat**
- **Separators / Filters – separate gases from liquids and solids**
- **Piping / Valves – contain and direct flow**
- **Gas Separation – separates constituents like H₂S, CO₂, or N₂**

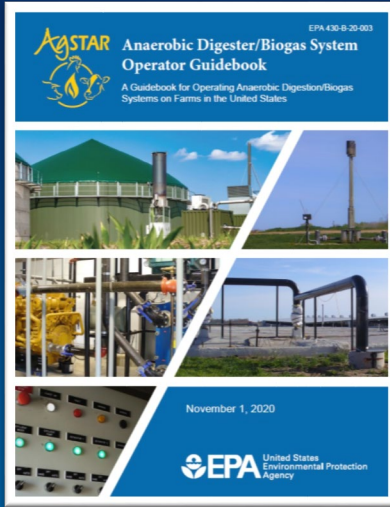
Common Operational Issues

- Testing of Safety Devices
- Leaks – typically around connections and equipment due to corrosion, vibration, thermal expansion.
- Corrosion – due to system design and materials selection.
- Condensate and Liquids
 - Draining – must be accounted for in all piping and equipment
 - Freeze Protection – required in climates where temperature drops below freezing
- Maintaining Gas Separation Equipment and Medias
 - Typically complex preventative and routine maintenance requirements



Biogas Upgrading

- Overview – separation of the CH₄ from biogas.
- Technology depends on inlet and outlet gas specs.
- Common Technologies:
 - Non-Regenerative Media Adsorption – Activated carbon, Iron sponge
 - Regenerative Media Adsorption – PSA, TSA
 - Membrane Separation
 - Physical and Chemical Solvents
 - Biological Processes
- Common Operational Issues – deferred maintenance, failure of instrumentation, failure of precision components



In Summary

Topics covered in this section include:

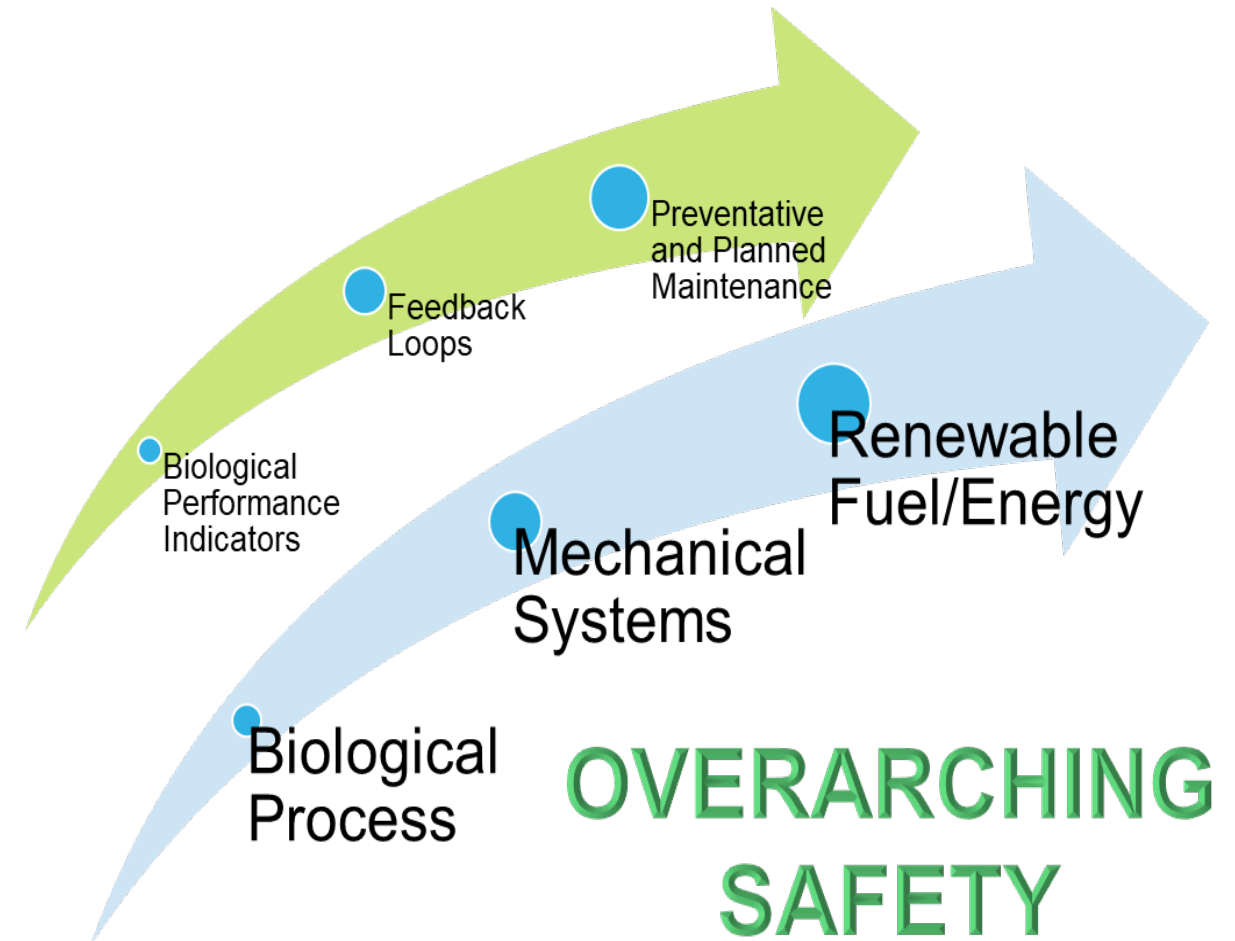
- Summarizing goals of the Guidebook
- An emphasis on the importance of workforce training & development

Craig Frear
Director of Research and Technology
Regenis

In Summary: Putting it Together

The AgSTAR Operator's Guidebook is a living document designed to:

- Educate and inform operators within the digester industry, specifically so:
 - Operators and facilities become better informed on safety and make safety considerations foremost in their minds and practice;
 - Appropriate, long-term maintenance is practiced for optimal renewable energy/fuel production and lengthened facility lifespan;
 - Increased adoption of AD in the US.



In Summary: Workforce Training

The AgSTAR Operator's Guidebook serves as reference material to support an operator's need for on-going educational opportunities which emphasize improving and expanding an AD operator's knowledge.



AgSTAR provides the Operator Guidebook as an educational resource free to all parties interested in utilizing its content to develop workforce training skills in AD technologies.

- One example of workforce training is the American Biogas Council (ABC), which has chosen to utilize the AgSTAR Operator Guidebook's content to design training course modules and an operator certification program.
 - An upcoming training will be held by ABC on Tuesdays and Thursdays | February 2-25, 2021 (except February 16)| 1-4 PM ET daily



**AMERICAN
BIOGAS
COUNCIL**

Questions & Answers

Panelists:

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- Operations & Maintenance – Brian Langolf, University of Wisconsin – Oshkosh; and David Palmer, Tetra Tech
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Thank you for attending

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