Egg-Shaped Anaerobic Digestion:
Shaping the Future of Digestion

JOHN CURRIE, PE
WHERE WERE THE FIRST EGG-SHAPED DIGESTERS BUILT?
WHAT PLANT BUILT THE FIRST ESDs IN NORTH AMERICA?
LARGEST ESD VESSEL BUILT?
SMALLEST ESD VESSEL BUILT IN NORTH AMERICA?
PREDOMINANT MATERIAL FOR ESDs IN NORTH AMERICA?
PREDOMINANT METHOD FOR MIXING?
CAN ESD’S PROVIDE A CLASS A BIOSOLIDS?
WHEN & WHERE CAN ESDS BE UTILIZED?
Overview

1. Raw Digested
2. Methanogenic
3. Hydrolyzation
4. Acetic Acid
5. Organic Acid

CH₄
Ideal Treatability
Municipal Sludge @ 35ºC

Overview
EARLY BEGINNINGS OF GERMAN DIGESTERS

- Process engineers
  Dr. Karl Imhoff
  Dr. Max Pruess
- 1927 U.S. Patent
- Patent No. 1,722,945
HANNOVER, GERMANY - LATE 1930’S

- Separated Primary Clarifier & Digester
- Pumped Recirculation
- Provided Digester Heat
- Insulated Vessels
- Utilized Digester Gas
BOTTROP
1991 – (4) 4,000,000 Gallons, Each
MIXING SYSTEM

- Mech’l Draft Tube Mixer
- Allows Flexibility
- Low Energy Requirements
- Separate Heating System
- Separate Foam Suppression
- Rotating Equip’t Inside
- Additional Load on Top
MECHANICAL MIXER
EARLY BEGINNINGS

Kansas 1950’s

TWO-STAGE “MAU DIGESTER”
TERMINAL ISLAND
1978 – (4) 1,427,000 Gallons, Each
ST. CHARLES, IL
1991- (2) 450,00 Gallon ESDs

- 10 MGD Wastewater Facility
- New Digester Facility
- (2) 450,000 Gallon ESDs
- External Liquid Recirculation
- AFIP Insulation System
- Installed 1991
EXTERNAL PUMPED RECIRCULATION

- Liquid Recirculation
- Includes Heating System
- No Internal Moving Parts
- Flexibility
- Complex System
- Costly Piping System
APPLETON, WI
1992- (2) 2,200,00 Gallon ESDs

- Expansion to Existing Facility
- Liquid-Gas Mixing System
- (2) 2,200,000 Gallon ESDs
- Insulation w/ Membrane Cover
- Installed 1992
APPLETON, WI
Gas Mixing System

- Multiple Small Diameter Injectors
- Designed to Mix Quadrants
- High Horsepower Requirements
- Separate Heating & Foam Suppression
- Class I, Div’n 1 Gallery Rating
KUTZTOWN, PA
1997- (1) 120,00 Gallon ESD

- 1.0 MGD Wastewater Facility
- Replace Existing Facility
- Life Cycle Bid Evaluation
- Design-Build Construction Bid
- (1) 120,000 Gallon ESD
- (1) 150,000 Gallon Storage
JET PUMP MIXING SYSTEM

- Lower Capital Cost
- Low Energy Requirements
- No Rotating Equipment
- Upward & Downward Mixing
- Redundant Pumps
- Integral Mixing & Heating
- Foam Suppression
JET PUMP MECHANICS

- High velocity jet inlet
- Induced flow
- Flow multiplier effect
- Reversible mixing
- Integral foam control
- Multiple modes / rates
HONOLULU, HAWAII
2004- (1) 2,340,00 Gallon ESD

- Dual Zone Mixing System
- Design-Build Construction
- (1) 2,340,000 Gallon ESD
- (1) 535,000 Gallon Storage
- (1) 10,000 FT³ Gasholder
- Pelletizer Facility
DUAL ZONE MIXING SYSTEM

- (2) Independent Mix Zones
- (2) Draft Tubes w/ Jet Nozzles
- (2) External Circulation Systems
- Heat Exchangers on Lower Zone
- Flexible Mixing Schedule
- Variable Operating Level
- Automated Control System
AUTOMATED CONTROL SYSTEM
EXTERNAL DISCHARGE CHAMBER

- Stand Pipe w/ T-Valve
- Foam & Scum Removal
- Open Top Chamber
- Odor Emissions
- Corrosion
- Confined Space
INTERNAL DISCHARGE

- Sets Liquid Level
- Removes Heavy Solids
- Removes Foam & Scum
- Eliminates External Chamber
- Reduces Odor Emissions
- Prevents Corrosion
- No Confined Space
- 34 ESD Facilities in US & Canada
- 10 Wastewater Facilities ≥ 30 MGD
- 15 Wastewater Facilities ≤ 10 MGD
- Over 90 ESD Digester Vessels
- > 170,000,000 Gallons in Operation
- New & Existing Digester Facilities
North American Facts

- 11 Mechanical Mix Systems
- 13 Jet Pump Mix Systems
- 7 Liquid Recirculation Systems
- 3 Gas & Liquid Recirculation
APPLICATIONS
Midland, Ontario, Canada
1996 - (1) 264,000 Gallons
GRANDVILLE, MI
2012 - (1) 1,000,000 Gallons

- 10 MGD Wastewater Facility
- Exist’g Facility Upgrade
- (1) 1,000,000 Gallon ESD
- Jet Pump Mixing System
- AFIP Insulation System
- Cogen Facility
- Class A Future Upgrade
FREMONT, NE
2001 - (1) 1,200,000 Gallons

- 10 MGD Wastewater Facility
- Exist’g Facility Upgrade
- Municipal & Industrial Waste
- (1) 1,200,000 Gallon ESD
- Jet Pump Mixing System
- AFIP Insulation System
ESD EQUIPMENT ROOM
HYPERION WWTP
1998 - (20) 2,500,000 Gallons, Each
LAKELAND, FL
2007- (1) 264,00 Gallon Acid Reactor

- 10 MGD Wastewater Facility
- Existing Facility Upgrade
- Class A, 2-Stage Digestion
- First Stage Acid Reactor
- Dual Zone Mixing System
- AFIP Insulation System
LONDON, OH
2008- Class A Biosolids

- 2 MGD Wastewater Facility
- Replaced Existing Facility
- 2-Stage Digestion System
- (1) 450,000 Gallon ESD
- Jet Pump Mixing System
- AFIP Insulation System
What’s Next?