



MIAMI DADE WATER AND SEWER EXPERIENCE WITH ELECTRON BEAM FOR SLUDGE DISINFECTION

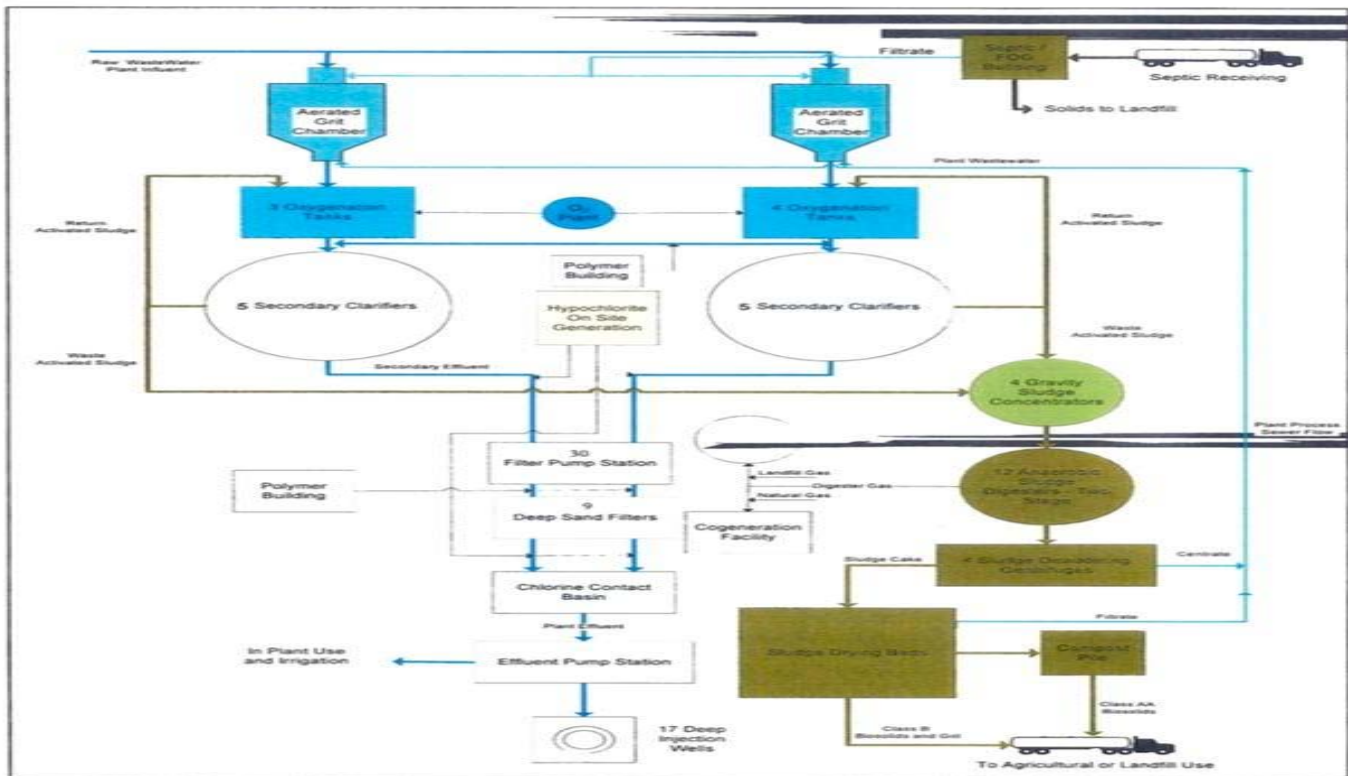
ROBERT FERGEN, P.E. MAY 11, 2017

THREE LARGE WWTP, SOUTH DISTRICT 112.5 MGD



SOUTH DISTRICT

SOUTH DISTRICT WWTP PROCESS DIAGRAM

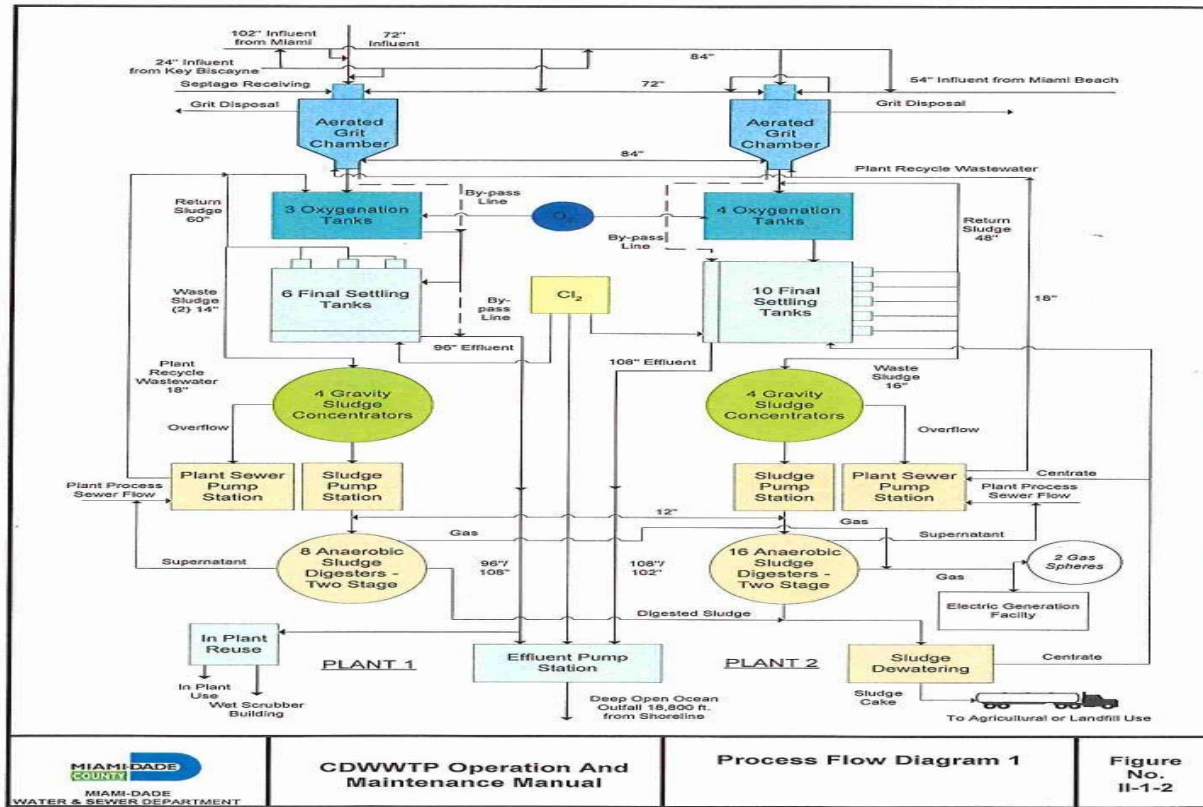


CENTRAL DISTRICT WWTP, 143 MGD



CENTRAL DISTRICT

CENTRAL DISTRICT PROCESS CHART



NORTH DISTRICT WWTP 120 MGD



STATE OF UTILITY 1980

- REGIONALIZATION
- Retire small plants
- Many new pump stations, 1050
- Transmission Lines, 8,000 miles
- Build large treatment plants
- Centralize Treatment
- Population increases rapidly, boatlift
- Large Capital Program

DRIVERS BEHIND PROJECT

- Public Law 92-500 Clean Water Act
- Provided Grant Funding For New Wastewater Facilities
 - 85% Construction established processes
 - 95% Construction innovative processes
- Effluent limits well defined as secondary treatment
- Sludge Utilization Not Well Defined!

CENTRAL DISTRICT WASTEWATER TREATMENT PLANT

- Capacity Average 143 Million Gallons per Day
- Presently has 100 dry tons of Raw Sludge
- Digested Sludge is about 65 dry tons per day
- Sludge Disposal is a Large Expense of the Operations

SLUDGE UTILIZATION GUIDANCE

- Concerns
 - Noxious, offensive
 - Metals
 - Organic Priority Pollutants
 - Pathogens

STABILIZATION OF SLUDGE

- EPA Approved Processes
 - Aerobic Digestion
 - Anaerobic Digestion
 - Composting
 - Starved Oxygenation Process
 - Alkaline Stabilization

INITIAL SLUDGE PLAN FOR CENTRAL DISTRICT

- Anaerobic Digestion, Energy Recovery, Volume Reduction
- Disinfection With Starved Oxygen Processes (Wet Air Oxidation)
 - Zimpro
 - Porteus
- Dewater for Additional Volume Reduction

EPA FUNDING ISSUE

- Due to Multiple Process Failures EPA Grant Funding Was Withdrawn from Starved Oxygen Processes.
- A Solids Handling Program Is Required For Grant Eligibility For Entire System, Over \$5 Billion Dollars today
- Sludge Rules Were Under Development but Finalization Uncertain

ALTERNATIVE SOLIDS PLANT DEVELOPMENT

- Chief Engineer Was An Electrical Engineer
- Electron Beams Were Proposed For Disinfection MIT
- EPA had an electron beam dosage established CFR 257
- EPA Grant Program Provide 95% Funding
- A Trial Unit Capable of Treating 25% of Solids Was Installed for Process and Materials Handling Verification

ALTERNATE SOLIDS PLAN CONTINUED

- Prototype 75 kW Unit Testing Plan Implemented, 25% of Sludge
- If Results Positive Four Additional Electron Beams Installed
- Grant Funding Established to Implement
- Innovative Process Funding Has Minimum Risk to Utility

ELECTRON BEAM PROTOTYPE TEST PROGRAM

- Procure E Beam
- Test For Pathogen Reduction
- Test For Organic Priority Pollutant Reduction
- Establish Dewatering Characteristics
- Decide to Expand or Cancel and Demolish

PROCUREMENT

- Contract Awarded
- Contractor Purchased the Equipment
- Apparatus Arrived Disassembled
- Change Orders and Delayed
- Inservice and Performed Reliably

PATHOGEN TESTING

- Pathogens
- Viruses (smallest and most limiting)
- Certain Bacteria
- Helminth Ova

VIRUS SUMMARY

- Retained Florida Department of Health Virology Lab
- Anaerobic Digestion Process Generates Ammonia to 10,000 mg/L which inactivated viruses
- Because there were no viruses in the feed sludge, effectiveness on viruses not demonstrated.
- Spiking sludge with viruses was not acceptable to FDH
- Overall treatment process effective on virus elimination

BACTERIA RESULTS

- Tested Fecal Coliform and Fecal Streptococcus
- Both groups were reduced to detection levels, about a 5-7 log reduction.
- Bacteria Results Confirmed Effectiveness

HELMINTH OVA



HELMINTH OVA

- Acaris Ova Present in Feces
- Analytical Methods Relied on Presence not viability
- Presence Was Consistent Thru Process
- Later Viability Test was Developed (Robert Reimers of Tulane)
- Could Not Demonstrate Effectiveness of e beam on Ascaris

ORGANIC PRIORITY POLLUTANTS

- Detected Few Organic Priority Pollutants
- bis (2 ethyl-hexyl) phthalate a common plasticizer
- Levels near detection limit, about one thousandth of levels of concern
- Because near detection limit could not document removal



METALS

METALS CONCENTRATIONS WERE NOT CHANGED

PROTOTYPE STUDY CONCLUSIONS

- Electron Beam was demonstrated effective on Fecal Coliforms and Fecal Streptococcus
- Viruses Were Inactivated By Anaerobic Digestion
- Helminth ova persisted, viability uncertain
- Organic Priority Pollutants not a concern
- Metals not changed

EPA RULE CHANGES IMPACT SLUDGE PLAN

- EPA Electron Beam Dosage Increased 4 fold!
- Number of Units Increased From 4 Additional to Atleast 16 Additional, Likely 20 Additional
- EPA funding for the Units over 4 was uncertain
- Cost to the County was significant

FDEP RULES CHANGES

- Guidance on Sludge Utilization Was Developed
- Land Application Does Not Require Full Pathogen Reduction
- Large Acreage Available
- Materials Handling Considerations Important

CHANGES TO SLUDGE PROGRAM

- Electron Beam not Economically Viable
- Retain Electron Beam for Research, FIU and UM
- Divert EPA Grant to Material Handling, Air Drying
- Adapt to the Agricultural Needs and Equipment
- Avoid Application Site Special Equipment

SLUDGE AIR DRY AND COMPOST



MDWASD PROGRAMS 2018

- Capital Programs
- Consent Decree, \$1.8 Billion
- Ocean Outfall Legislation, \$5.5 Billion
- R and R, \$25 Million per Year

ELECTRON BEAM POTENTIAL AREAS

- Consent Decree
- Replace Possible Thermal Hydrolysis of Sludge
- OOL
- Reuse of Effluent, 600 Organic Parameters

EPILOGUE

- Yogurt and Whey