2013: ANNUAL BIOSOLIDS REPORT

Introduction

The City of Salem, Oregon, is located in the Willamette Valley, an area of rich agricultural production. The local climate is characterized by cool, moist winters and warm, dry summers, with an average annual precipitation of 40 to 45 inches. Snowfall and extended periods of freezing weather are infrequent. In 2013, total annual rainfall was well below the average, just 27.32 inches as recorded at Willow Lake Water Pollution Control Facility (WLWPCF).

The soil conditions, agricultural practices and the mild climate allow local biosolids application during fair weather, from early spring through mid-October. Locally, soils are dominated by silty-clay deposits of Willamette River bottom sediments. Eastward of Salem the soils are predominantly clay, while to the northeast loamy soils predominate. During the winter months and periods of local inclement weather, the City of Salem stores dewatered biosolids products locally in a multi-purpose agricultural building or transports dewatered biosolids products to application sites in Eastern Oregon.

Wastewater Processing Systems

The City of Salem owns and operates a municipal sewage collection system and two wastewater treatment facilities; WLWPCF and the River Road Wet Weather Treatment Facility (RRWWTF), under the National Pollutant Discharge Elimination System (NPDES) Permit Number 101145, Department of Environmental Quality (DEQ) File No. 78140.

Salem provides wastewater treatment for a population of approximately 229,000, including Salem, Keizer, Turner, and unincorporated parts of Marion County. Salem's annual wastewater flow totaled 11.79 billion gallons. The proportional breakdown of the total annual flow was:

- 94 percent residential.
- 1.3 percent commercial.
- 4.7 percent light industrial and institutional dischargers.

Septage is accepted at a receiving facility located at the City Shops approximately 8 miles from the WLWPCF. The receiving facility received an annual total of 3,954,482 gallons of septage which was conveyed to WLWPCF for treatment.

Salem also manages an Environmental Protection Agency (EPA) approved pretreatment program which oversees 38 permitted dischargers, including seven categorical industries.
(See Table 1: 2013 City of Salem - Permitted Industries)

Willow Lake Water Pollution Control Facility

The Willow Lake Facility is sited on 40 acres between the City of Keizer's urban growth boundary and the Willamette River. Treatment processes include mechanical screening, primary and secondary treatment, sludge thickening, anaerobic digestion, cogeneration, solids dewatering, chlorine disinfection, and dechlorination.

The facility is designed for an average dry weather flow of 35 million gallons per day (mgd). Plant upgrades completed in 2009 have increased the designed peak wet weather flow to 155 mgd.

The facility can operate in a variety of secondary modes, including; trickling filter, conventional air activated sludge, high purity oxygen activated sludge, trickling filter/air activated sludge, and trickling filter/high purity oxygen activated sludge in parallel. The WLWPCF secondary process flexibility provides excellent treatment for wide variations in Biochemical Oxygen Demand (BOD) resulting from increased loading rates during canning season. Primary solids are thickened in one of three gravity thickeners. Secondary solids are thickened on a Gravity Belt Thickener. Typically, solids are thickened to approximately five percent prior to mesophillic primary/secondary anaerobic digestion. Treated effluent is discharged to the Willamette River (78.4 River Mile) in Marion County, Oregon.

River Road Wet Weather Treatment Facility

The River Road Facility is sited at River Road Park approximately 4 miles upstream from the WLWPCF on the 72-inch interceptor. The RRWWTF is designed to receive flows which exceed the hydraulic capacity of WLWPCF. Utilizing interceptor diversion gates for flow control, the facility provides secondary treatment and disinfection for excessive flows during storm events. The RRWWTF is designed for a nominal daily flow of 50 mgd and a one hour peak of 60 mgd.

The RRWWTF operates as a high-rate, chemical/physical treatment plant. Processes include fine screening, high rate clarification (HRC) utilizing polymer, and micro-sand for coagulation, and ultraviolet disinfection. Influent flow is passed through screening channels prior to coagulation treatment. Solids in excess of 6 mm in diameter are returned to the 72-inch interceptor sewer for transport to the WLWPCF. Treated effluent is discharged to the Willamette River at River Mile 82.6.

WLWPCF & RRWWTF Wastewater Treatment Strategy

The combination of WLWPCF system upgrades and the implementation of the RRWWTF are designed to eliminate Sanitary Sewer Overflows (SSO's) under certain conditions. In December 2010 Salem submitted an evaluation of the effectiveness of overflow reduction and elimination efforts to DEQ as part of the Mutual Agreement and Order (filed in January 1998).

The combined designed peak wet weather flow for both facilities is 205 mgd. Salem staff work collectively to prevent SSO's, by utilizing flow routing options for optimum conveyance capacity, and effective treatment strategy for maximum combined treatment capacity.

Biogro Management Description

The City of Salem's biosolids program (Biogro) oversees the coordination of biosolids reuse, including cooperative biosolids transport using wastewater plant operations staff, oversight of augment service contracts, regulatory reporting, documentation procedures, budget issues, and active participation with regards to the program's future needs. The WLWPCF dewatering processes and distribution methods have continually evolved since the formal beginning of the Biogro program in 1975.

The Biogro Program is designed to make use of its attributes which include a historically stable base of customers and excellent farmer-relations. Indeed, these attributes are the foundation of the Biogro Program. Today the Biogro Program can be easily divided into two distinct seasons:

- Spring & Summer Season - Local transport and application from May through October.
- Wet Season - Local storage and/or eastern Oregon transport from November through April.

During the wet season, Salem utilizes a multi-purpose agricultural building located in Marion County to store dewatered biosolids products during winter months. Stored biosolids are applied on nearby application sites the following July and August. Salem also retains 720 leased acres on Madison Ranch located near Hermiston, in eastern Oregon, through the year 2020 for biosolids reuse.

Class B Biosolids Digester Components & Statistics

The south digester facility is composed of two gas-mixed, fixed cover, primary digesters which overflow to two secondary digesters. The north digester facility is composed of two mechanically mixed, fixed cover, primary digesters which overflow to a floating dome, secondary digester. The digester facilities gas systems are common and provide fuel for the cogeneration system. Each primary digester is externally heated with coiled heat exchangers using a modified hot water loop from the cogeneration system as a heat source. Additionally, both facilities are equipped with boilers as a redundant heat source.

Annual Digester Feed Gallons

Willow Lake produced an annual total of 39,429,147 gallons of thickened primary and secondary sludge which were fed to the primary digesters. The primary and secondary sludge flow streams were divided between the north and south digester facilities using magnetic flow meters and automated feed valves. Approximately 60.1 percent of the treatment plant's solids production was stabilized in the larger south primary digesters while the north facility received 39.9 percent.

Contracted Receipt Sludge & Biosolids Products

- From01-01-13 through 03-31-13, Willow Lake received 910,350 gallons of mesophillic, anaerobic digested biosolids, and primary and waste activated sludge from the Silverton Wastewater Treatment Plant.
- From 01-01-13 through 12-31-13, Willow Lake 4,418,400 gallons of aerobic digested biosolids and waste activated sludge from Wilsonville's Wastewater Treatment Plant.
- From 04-01-13 through 10-31-13, Willow Lake received 90,800 from Aurora's stored anaerobic lagoon sludge.

These solids were received, sampled, and sent directly to the digesters. Pumping was scheduled to facilitate our standard 60/40 flow split between the two (North and South) digester complexes using the automated feed valves; however, the magnetic flow meters were not utilized due to lack of available solids piping. Volatile solids concentrations were very similar to Salem's and within the typical range of domestic biosolids at about 80 percent of total solids.

In addition to the receipt of Silverton, Wilsonville, and Aurora sludge, Salem also contracted to receive SeQuential Bio Diesel waste product. From January through December, 425,636 gallons were delivered via tankers once or twice per week. The product's total volatile solid loading was 332,847 lbs. The product was mixed at a one to one ratio with Willow Lakes previously digested biosolids and pumped through the magnetic flow meters to the north and south primary digesters.

Currently, Hach-WIMS data entry forms are used to record receipt of solids products introduced directly into the anaerobic primary digesters. However, Hach-WIMS has not yet been programmed to utilize lab and flow data to totalize, calculate, and report both "received and produced" values on a daily basis. Currently, the Biogro Supervisor reviews the data, and makes calculations utilizing excel spreadsheets. All reporting will continue to meet or exceed all regulatory requirements, including daily volatile solids loading rates and digester detention times.

Design organic loading on the primary digesters is approximately 0.23 pounds volatile solids/day/cubic feet of digester volume. The annual averaged organic loading on the primary digesters was 0.076 volatile pounds/day/cubic feet of digester volume. This figure reflects the calculated sum of received and produced solids entering the primary digesters.
(See Table 2: Digester Volatile Feed Pounds Loading Rates)

Class B Biosolids Treatment Description
All biosolids produced met the Class B pathogen and Vector Attraction Reduction (VAR) requirements as specified in:

- 40 CFR 503.32(b) (3), Appendix B; Processes to Significantly Reduce Pathogens (PSRP), Item 3, which states: Anaerobic digestion - Sewage sludge is treated in the absence of air for a specific Mean Cell Residence Time (MCRT) at a specific temperature. Values for the MCRT and temperature shall be between 15 days at 35 to 55 degrees Celsius and 60 days at 15 degrees Celsius
- 40 CFR 503.33(b) (1) which states: The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent (see calculation procedures in "Environmental Regulations and Technology-Control of Pathogens and Vector Attraction in Sewage Sludge," EPA-625/R-92/013, 1992, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268)

The annual average MCRT (four primary digesters) was 36.2 days and ranged between 31.0 and 43.3 days at an average temperature of 98.9 degrees Fahrenheit (37.2 degrees Celsius).
(See Table 3: Annual Bioedge Digester Performance Report: Monthly & Annual Averages)

Biosolids Analysis Reporting
Biosolids were analyzed for metals and nutrient characteristics more frequently than the minimum requirements listed in 40 CFR 503.16, Table 1. All biosolids analysis was performed in-house.
(See Table 4 a, b, & c: Monthly Biosolids Analysis)

Total and volatile solids of raw digester feed (and received solids) were measured daily. Primary digester feed rates and temperatures were also measured daily. Primary digester alkalinity and pH were measured three times per week. Monthly averages were used to calculate total volatile solids reduction.

When producing dewatered products, biosolids samples (centrate, pressate, feed solids, and dewatered product) were collected every four hours. During local liquid application, biosolids samples were taken when filling each tanker load.

Samples from the centrifuge, belt filter press and liquid biosolids products were composited separately and analyzed monthly for all pollutants listed in 40 CFR 503.13, Table 1, as well as Total Solids, Total Volatile Solids, pH, Total Kjeldahl Nitrogen (TKN), Nitrate Nitrogen (NO3) and Ammonia Nitrogen (NH3), Phosphorus (P), and Potassium (K).

The average volatile content of biosolids utilized for production of dewatered and liquid biosolids products was 65.7 percent. The average volatile solids reduction rate in the digesters ranged between 51.7 and 71.5 percent.
(See Table 5: Volatile Solids Reduction: Monthly & Annual Averages)

Class B Biosolids Products: Centrifuge, BFP, and Liquid:
An annual total of 40,521,326 gallons of digested biosolids were utilized for the production of centrifuge, belt filter press, and liquid biosolids products. In 2013, local application began the last week of June and continued through the first two weeks of October.

The Biogro Program attempts to maintain a self-set goal of limiting liquid transport/application to 10.0 percent of total production. In 2013 liquid transport was 11.9 percent of total production. The proportional breakdown of the total annual biosolids production (in gallons) was:

- 69.3 percent centrifuge product (28,903,220 gallons).
- 18.8 percent belt filter press product (7,623,806 gallons).
- 11.9 percent liquid product (4,804,300 gallons).

(See Table 6: Digester Balance – In versus Out)

Biosolids feed concentrations sent to the dewatering processes vary insignificantly from year to year. The annual biosolids feed concentration averaged between 2.07 percent and 2.72 percent by weight.
(See Table 7: Centrifuge and Belt Filter Press Production)

Dewatered Production & Polymer Costs
The combined (BFP & Centrifuge) polymer costs for dewatered production was $387,461. Polymer costs increased 17.1 percent from the previous year, due largely to higher polymer prices which were in place for the entire year.

Centrifuge

- In 2013 centrifuge polymer consumption totaled 28,854 gallons at a cost of $345,094.
- The 21 inch diameter bowl centrifuge provided an annual average cake dryness of 26.13 percent.

In 2013 the average polymer dosage increased 4.7 lbs to 105.1 lbs/ton of dry feed solids and yielded an average capture rate of 90.54 percent. The average capture rate was increased 0.27 percent.

Belt Filter Press

- In 2013 belt filter press polymer consumption totaled 3,542 gallons at a cost of $42,367.
- The three meter belt filter press provided an annual average cake dryness of 17.74 percent.

In 2013 the average polymer dosage was reduced 3.4 lbs to 38.4 lbs/ton of dry feed solids and yielded an average capture rate of 90.14 percent. The average capture rate decreased 0.24 percent. (See Table 7: Centrifuge/Belt Filter Press Production)

NOTE: For polymer cost estimates, Table 7 utilizes the averaged daily total solids concentrations for the various flow streams (feed, cake, and pressate/centrate) rather than monthly composite samples.

Biosolids Production Quantity
In 2013 Salem produced and transported an annual total of 3,475.61 dry US tons of biosolids products. Monthly dry ton values are calculated using the monthly composite sample analysis. (See Table 8: Total Annual Wet Tons & Liquid Gallons Produced)

Biosolids Application & Storage Quantities
Including dewatered cake product stored during the winter of 2012-13, Salem applied an annual total of 3743.50 dry US tons of biosolids product. Additionally, Salem stored 834.72 dry US tons (from October 23 – December 31, 2013) for application in the summer of 2014. A summary follows below:

Winter Storage 2012-2013: Applied locally in summer 2013.

- 2164.40 dry US tons winter stored centrifuge product applied on 669 acres

Summer Production 2013: Applied locally in summer 2013:

- 710.23 dry US tons summer production of dewatered BFP product on 249 acres.
- 493.72 dry US tons liquid Biogro application on 277 acres.

Winter Storage 2013: October 23 – December 31, 2013.

- 834.72 dry US tons centrifuge product.

(See Table 9 a, & b: Application Site Totals – Acreage, Tonnage & Nutrient Values)

Biosolids Application Sites & Acreage
Salem managed 30 applications of Class B biosolids (liquid and dewatered) on various sections of 19 DEQ authorized sites consisting of livestock pasture, hay, grass seed, flower seed, and mint, on lands totaling 1,195 acres.
(See Table 9 a, b, & c: Application Site Totals – Acreage, Tonnage & Nutrient Values)

Biosolids Annual Nutrient Pounds Applied and Average Application Rates
Control of application rates was the responsibility of the City of Salem. All applications were consistent with site restrictions outlined in 40 CFR 503.32 (b)(5) and application rates specified in DEQ site authorization letters. DEQ site approval letters approved Plant Available Nitrogen (PAN) application rates from 100 pounds per acre for tall fescue to 200 pounds per acre for mint. These values are also dependent on soil, and cropping practices.

Liquid biosolids were applied using 5,500 and 6,000 gallon pressurized tanker trucks at application rates pre-approved by the DEQ. The average annual application rate of 1.22 dry tons per acre provided an average of 112 pounds of (PAN) per acre.
(See Table 9 b: Liquid Application Site Totals & Averages – Average Dry Tons/Acre and Average PAN lbs/acre)

Dewatered biosolids were transported to sites using tarp-covered semi-end dump trailers. Dewatered product was applied using a tractor and manure spreader. The average annual application rate of 3.02 dry tons per acre provided approximately 123 pounds of PAN.
(See Table 9 a, b, & c: Application Site Totals – Acreage, Tonnage & Nutrient Values)

NOTE: The following conditions can produce a slight variance between annual application tonnage and the monthly production/transport tonnage:

- When biosolids applications at specific sites extended into a second month, the composite sample data from the month with the largest production tonnage was used for application estimates.

Biosolids applications utilizing a combination of centrifuge and belt filter press products on a specific site required a calculated weighted average to determine dry tons applied. In 2013 however, no sites were applied using combined dewatered products.

The total pounds of nutrients applied for PAN, phosphorus (P), and potassium (K) were:

- 156,388 pounds of PAN.
- 112,138 pounds of P.
- 20,284 pounds of K.

(See Table 9 a, b, & c: Application Site Totals – Acreage, Tonnage & Nutrient Values)

Application Site Management
This year no new reuse sites were authorized for Salem's Biogro Program. Older application sites continue to be re-authorized as owners and acreages are adjusted.

Biogro staff used a Global Positioning System (GPS) to measure acreage and lay out buffer zones around wells, structures, sensitive areas, and the perimeter of the property. A minimum buffer zone of 50 feet was required around property perimeters and near surface water. A buffer zone of at least 200 feet was required around all residences and wells. Application site worksheets and daily application maps were completed for each site. Salem staff and associated biosolids augment contract service staff carried route maps and a copy of the site authorization letter when in transport to application sites and during field application.

Soil samples were collected at application sites. Domestic wells on site and adjoining beneficial reuse sites were analyzed for NO3 whenever possible. Application site soils were analyzed for background levels of pH, Cation Exchange Capacity (CEC), total NO3, P, K. The Bray 1 method was used to determine available soil phosphorus. Additionally, the organic content of application site soils was analyzed to evaluate increases in the soil's organic content as a result of biosolids applications. Cumulative loading for nutrients and pollutants were recorded for each site.

A Farmer's Report was also generated to evaluate the economic value of biosolids applications. The City's Biogro Program saved farmers $192,872 dollars. This amount is based on quoted costs from Wilco Co-Op for fuel and fertilizer in September of 2013, and an assumed hourly wage of $14 for tractor work.
(See Application Site Reports for individual Farmers Reports).

Biosolids Spill Incidents
The City of Salem's Biogro Program had no biosolids spill incidents in 2013.

Anticipated Biosolids Production & Acreage Requirements For 2014
Salem anticipates very little change concerning biosolids production and acreage requirements in 2014. Biogro staff anticipates future annual biosolids production to be between 3,100 and 3,400 dry tons and acreage requirements to be between 1,462 and 1,604 based on an annual average application rate of 2.12 dry tons per acre.
(See Table 9 a: Application Site Averages & Totals)

Application Record Management
All record keeping and reporting practices including the NPDES Discharge Monitoring Report, Site Monitoring Reports, and the EPA 503 Annual Compliance Report comply with 40 CFR 503.17 and 503.18.

All analytical results were incorporated into the Biogro program database and shared with the farmer. In addition, the cumulative loading of nutrients and pollutants were recorded. To date, the City's monitoring of site soils and domestic wells adjacent to application sites have not revealed any problems related to the City of Salem's beneficial reuse of biosolids for land application.

Oregon Administrative Rules (OAR) 340 – 050 – 0006
Policy
The Environmental Quality Commission (EQC) encourages the land application of treated domestic wastewater biosolids, biosolids derived products, and domestic septage which are managed in a manner which protects the public health and maintains or improves environmental quality. These beneficial recyclable materials improve soil tilth, fertility, and stability and their use enhances the growth of agricultural, silvicultural, and horticultural crops.