2009: 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, warm; dry summers, with an average annual precipitation of 40 to 45 inches. Snowfall and extended periods of freezing weather are infrequent.

The soil conditions, agricultural practices and the mild climate allow local biosolids application during fair weather from early spring through 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.

2009 Wastewater Processing

The City of Salem owns and operates a municipal sewage collection and two wastewater treatment facilities; Willow Lake Water Pollution Control Facility (WLWPCF) and the River Road Wet Weather Treatment Facility (RRWWTF) under the National Pollutant Discharge Elimination System (NPDES) Permit Number 101145. Septage is also accepted at a receiving facility located at the City Shops approximately 8 miles from the WLWPCF. In 2009 the facility received 1,191,659 gallons of septage which was conveyed to the plant for treatment. Additionally, the City manages an Environmental Protection Agency (EPA) approved pretreatment program which oversees 33 permitted dischargers, including seven categorical industries.
(See Table 1: 2009 City of Salem - Permitted Industries)

The WLWPCF and RRWWTF facilities provide wastewater treatment for a population center of approximately 225,000 which includes Salem, Keizer, Turner, and unincorporated parts of Marion County. In 2009 the two facilities; received a total flow of 12.918 billion gallons of sewage. The proportional breakdown of the total annual flow was:

- 64 percent residential
- 29 percent commercial
- 7 percent light industrial and institutional dischargers

WLWPCF is designed for an average dry weather flow of 35 million gallons per day (mgd) and a designed peak wet weather flow of 155 mgd. The combined designed peak wet weather flow for both facilities is 205 mgd.

WLWPCF 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.

WLWPCF 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. 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 (3) gravity thickeners. Secondary solids are thickened on a Gravity Belt Thickener. Typically, solids are thickened to approximately five percent prior to mesophilic primary/secondary anaerobic digestion. Treated effluent from WLWPCF is discharged to the Willamette River (78.4 River Mile) in Marion County, Oregon.

RRWWTF is sited at River Road Park approximately 4 miles upstream from WLWPCF on the 72-inch interceptor. 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. RRWWTF is designed for a nominal daily flow of 50 mgd and a one hour peak of 60 mgd.

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 from RRWWTF is discharged to the Willamette River at River Mile 82.6.

The City of Salem has essentially completed expansion and upgrade projects designed to meet the requirements of a Mutual Agreement and Order (MAO) to eliminate sanitary sewer overflows (SSOs) under certain conditions by the year 2010.

2009 BIOGRO Management Description

The City of Salem's biosolids distribution program (BIOGRO), is charged with the task of biosolids management. Important elements of the program include digester operation, liquid and dewatered biosolids production, transport, and application. Salem utilizes a multi-purpose agricultural building located in Marion County to store dewatered biosolids products during winter months. Biosolids stored locally over the winter months are applied on nearby application sites following the completion of grass seed harvest in July and August. The City of Salem also retains a lease of 720 acres on Madison Ranch located near Hermiston, in eastern Oregon, through the year 2020 for the beneficial reuse of biosolids. In 2009 a total of 168 acres were newly approved for local beneficial reuse by the Department of Environmental Quality

(DEQ). Additionally, older application sites continue to be re-authorized as owners and acreages are adjusted.

2009 Class B Biosolids Processing

In 2009 a total of 35,287,295 gallons of primary and thickened secondary sludge was 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. In 2009 approximately 60 percent of the treatment plant's solids production was stabilized in the larger south primary digesters while the north facility received 40 percent.

The south digester facility is composed of two (2) gas mixed, fixed cover, primary digesters which overflow to two (2) secondary digesters. The north digester facility is composed of two (2) 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.

Design organic loading on the primary digesters is approximately 0.23 pounds of volatile solids/day/cubic feet of digester volume. In 2009 the average organic loading on the primary digesters was 0.058 volatile pounds/day/cubic feet of digester volume compared to approximately 0.064 pounds in 2008.
(See Table 2: Digester Volatile Feed Pounds Loading Rates)

2009 Class B Biosolids Treatment Description

In 2009 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)

In 2009 the MCRT averaged (four primary digesters) between 43.2 and 49.0 days at an average temperature of 99.0 and 99.1 degrees Fahrenheit (37.2 degrees Celsius).
(See Table 3: Annual Bioedge Digester Performance Report: Monthly & Annual Averages)

2009 Biosolids Analysis Reporting

In 2009 WLWPCF analyzed biosolids 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 were measured daily. Primary digester feed rates and temperatures were also measured daily. Primary digester alkalinity and pH were measured three (3) times per week. Monthly averages were used to calculate total volatile solids reduction.

When either dewatering process was in operation, daily dewatered biosolids samples were collected every four (4) 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 72.6 percent. The average volatile solids reduction rate in the digesters ranged between 44.5 and 72.3 percent.
(See Table 5: Volatile Solids Reduction: Monthly & Annual Averages)

2009 Class B Biosolids Products

In 2009 approximately 36,970,594 gallons of digested biosolids were utilized for the production of liquid, belt filter press and centrifuge biosolids products. The proportional breakdown of the total annual biosolids production (in gallons) was:

- 50.2 percent centrifuge product (18,572,430 gallons)
- 38.2 percent belt filter press product (14,108,664 gallons)
- 11.6 percent liquid product (4,289,500 gallons)

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

Biosolids feed concentrations sent to the dewatering processes averaged between 1.95 percent and 2.41 percent by weight. Total polymer costs for dewatered biosolids production were

approximately $189,840.

The three meter belt filter press provided an annual average cake dryness of 16.1 percent utilizing an average polymer dosage of 38.5 lbs/ton of dry feed solids and yielding an average capture rate of 90.8 percent. Belt filter press polymer consumption was 5,566 gallons at a cost of $50,651.

The 21 inch diameter bowl centrifuge provided an annual average cake dryness of 23.0 percent utilizing an average polymer dosage of 81.2 lbs/ton of dry feed solids and yielding an average capture rate of 84.8 percent. Centrifuge polymer consumption was 14,729 gallons at a cost of $139,189.
(See Table 7: Centrifuge/Belt Filter Press Production)

2009 Biosolids Production and Transport Quantity

In 2009 Salem produced and transported 2,977.62 dry US tons of biosolids products. Monthly dry ton values are based on transport records and utilize monthly composite sample analysis for calculation dry tons transported.
(See Table 8: Total Annual Wet Tons & Gallons Produced & Transported)

2009 Biosolids Application, Storage & Staging Quantities, & Application Rates

Biosolids sites receiving applications extending into a second month utilized monthly composite sample data from the month with the largest tonnage production. In addition, biosolids applications utilizing a combination of centrifuge and belt filter press products required a weighted average calculation to determine dry tons applied. Each of these conditions can produce a slight variance between annual production/transport tonnage and annual application tonnage.

Control of application rates was the responsibility of the City of Salem and 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 PAN application rates from 100 pounds to 150 pounds per acre.

Liquid biosolids were applied using 6,000 and 5,500 gallon pressurized tanker trucks at application rates pre-approved by the DEQ. Typically, an application rate of about 1.14 dry tons per acre provided approximately 115 pounds of PAN.

Dewatered biosolids were applied using a tractor and manure spreader. Typically, an application rate of about 2.87 dry tons per acre provided approximately 120 pounds of PAN.
In 2009 the City of Salem applied, stored, and staged 3067.07 dry US tons as follows:

- 2,548.83 dry US tons land applied (including 101.88 dry US tons from 2008)
- 508.02 dry US tons stored locally in the Willamette Valley for 2010 summer application
- 10.21 dry US tons remain staged for application in January 2010

In 2009 the City of Salem managed 32 applications of Class B biosolids (liquid and dewatered) on various sections of 21 DEQ authorized sites consisting of sod, hay, grass seed, and pasture lands totaling 1,082 acres. The proportional breakdown (by location) of the total annual biosolids production was:

- 29 percent (dry US tons) were applied in eastern Oregon
- 71 percent (dry US tons) were applied locally (May to October) in the Willamette Valley

In 2009 the applied biosolids contained:

- 129,933 pounds of PAN
- 107,380 pounds of P
- 17,987 pounds of K

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

2009 Site Management

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.

Well and soil samples were collected at all local application sites. Wells adjoining beneficial reuse sites were analyzed for NO3. Application site soils were analyzed for background levels of pH, Cation Exchange Capacity (CEC), total NO3, P, K and 40 CFR 503.13, Table 1 pollutants. 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.

2009 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.