

Are Land Application Programs in Georgia Complying with the Part 503 Regs?

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Overview

- Objectives
- Background
- Methodology
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- Conclusions

Objectives

1. Controversy concerning microbial pathogens in sludge.
2. Study undertaken to determine compliance with pathogen reduction criteria.
3. Study undertaken to determine compliance with vector attraction reduction criteria.

Land Application Regs: Part 503 Subparts B & D

- Sewage sludge must meet pollutant limits for specific metals that include:
 - ◆ maximum or ceiling concentration
 - ◆ monthly average concentration
 - ◆ annual pollutant loading
 - ◆ cumulative pollutant loading
- Pathogen reduction criteria
- Vector attraction reduction criteria

Class A Sludge Pathogen Requirements

- Fecal coliform bacteria \leq 1000 MPN per gram of total solids (dry wt. basis).
- Density of *Salmonella sp.* Bacteria $<$ 3 MPN per 4 grams of TS (total solids).
- Must utilize one of 6 technologies.

Class B Sludge Pathogen Requirements

Alternative 1:

geometric mean of fecal coliform bacteria density in 7 samples < 2 million MPN or CFU per gram of TS or

Alternative 2: sludge must be treated by PSRP.

Technologies for Meeting Class A Pathogen Requirements

1. Time and temperature.
2. pH and time.
3. Analysis for enteric viruses (EV) prior to treatment.
4. Analysis for viable helminth ova (VHO)
5. Analysis for EV or VHO at disposal.
6. Sludge should be treated in a PFRP.

Vector Attraction Reduction Criteria

1. Volatile solids (VS) reduced by 38%.
2. VS reduced $< 17\%$, bench-scale anaerobic digester operated for 40 days.
3. VS reduced $< 15\%$, bench-scale aerobic digester for 30 days.
4. SOUR of aerobically digested sludge ≤ 1.5 mg/hr-g of total solids @ 20 ° C.

Vector Attraction Reduction Criteria

5. Aerobically digested sludge treated 14 more days @ avg. temp. of 45 ° C.
6. pH raised to > 12 ; remains @ 12 or > for 2 hrs & @ pH of 11.5 or > for 22 hrs.
7. Sewage sludge containing no unstabilized primary sludge must have a solids content => 75 %.
8. Sewage sludge that contains unstabilized primary sludge must have a solids content => 90 % .

VAR Options: Agricultural land, forests, public contact

1. Sewage sludge must be **injected beneath the surface** and **no significant amount** of sludge shall be present **after 1 hour** of injection.
2. Sewage sludge shall be **incorporated into the soil within six hours** after land application.

Methodology

- Study focused on publicly owned treatment facilities
- Annual sludge reports submitted to
 - ◆ GA EPD: Permitting, Compliance & Enforcement Program
 - ◆ Reviewed for 2001 calendar year
- 31 reports were reviewed in detail
- A cursory review of 20 additional reports

Aerobic Digestion

Facility ID	Dry Solids (tons)	Vector Attraction Reduction Method				Class B Pathogen Reduction Method			
		Sour Test	n	Volatile Solids Reduction (%)	n	Mean Fecal Coliform Density (#organisms/gram)	n	Other	Result
1	29.5	1.26	3					Aerobic Digestion	NR
2	150.49	0.69	3			68	14		
3	289.5	0.16	3			19036	15		
4	103.32	0.975	4			206159.9	3		
5	95.33	1.04	21			18361	7		
6	49.24	0.47	5			1074633	6		
7	68.2	1.03	12			196000	7		
8	49.7	0.39	12			308000	7		
9	357.8	1.38	2			144187	2		
10	747	0.2-1.19	NR			29127	28		
11	1276	1.05	83			292	63		
12	107.89	0.49	3			33246	21		
13	90.84	0.56	2			34414	14		
14	2333.5	0.93	29			43479	4		
15	83.13	0.29	24			30120	7		
16	1691.17	0.5	6			32714	42		
17	150	0.42	1			120	1		
18	61.9	0.44	1			Below Detection	1	Aerobic Digestion	Annual MCRT of 209 days at 24.2°C
19	4711.7	NA	NA	6.67 (aerobic bench-scale)	6	3359	42		

NR = Not Reported. NA = Not applicable.

Aerobic Digestion Summary

- 19 of 31 facilities used aerobic digestion
- 12,446 dry tons of aerobically digested sludge land applied
- 10 of 11 achieved SOUR required for VAR criteria, other used bench-scale test.
- 17 of 19 chose fecal coliform density to meet pathogen reduction criteria
- 5 did not report a minimum of 7 samples

Lime Stabilization

Facility ID	Sludge Treatment	Dry Solids (tons)	Vector Attraction Reduction Method		Pathogen Reduction Method			
				Other	Mean Fecal Coliform Density (#organisms/gram)	n	Other	Result
20	Lime Stabilization	23.19		Lime Stabilization	26165	2	Lime Stabilization	
21	Lime Stabilization	7.88		Lime Stabilization	33000	1	Lime Stabilization	

Lime Stabilization

- 2 of 31 facilities used lime stabilization
- Although not required, these facilities presented a limited number of fecal coliform data showing an average value of 29,583 organisms per gram of TS.
- 31 dry tons of lime stabilized sludge land applied.

Anaerobic Digestion

Facility ID	Sludge Treatment	Dry Solids (tons)	Vector Attraction Reduction Method			Pathogen Reduction Method			
			Volatile Solids Reduction (%)	n	Other	Mean Fecal Coliform Density (#organisms/gram)	n	Other	Result
22	Anaerobic Digestion	5939.2	46.2	204		44637	130		
23	Anaerobic Digestion	2531.32	7.5 (anaerobic bench-scale)	7		476	42	Anaerobic Digestion	Annual MCRT = 54 days at 33° C
24		380.63	42	1		322.2	1		
25		8203	2.76 (anaerobic bench-scale)	6		384591	6		
26		514.8	41	1		38357.9	19		
27		60.54	7.8 (anaerobic bench-scale)	4		31891	35		
28		429	41	12				Anaerobic Digestion	Annual MCRT =125 days at 31°C
29		70.8	62.3	3		10746	21		
30		32.95	83	2		11833	14		
31		3155.53			Liquid Injection	26331	81		
32		1651.98	42.3	24		1512	43		

Anaerobic Digestion

- 11 of 31 facilities used anaerobic digestion
- 23, 000 dry tons of anaerobically digested sludge land applied
- 7 met VAR with 38% VS reduction
- 3 used bench-scale anaerobic tests for VAR
- 11 used fecal coliform density to meet PR criteria, 2 < 7 samples
- 2 chose anaerobic digestion as PSRP

Conclusions

1. Fecal coliform densities of < 2 million organisms/g of TS achieved using:
aerobic digestion, anaerobic digestion, and lime stabilization.
2. VAR criteria met with SOUR of 1.5 mg/h-g for all 18 aerobic digesters.
3. VAR criteria met by 38% reduction in VS for 7 anaerobic digesters.
4. Pathogen monitoring frequency determined by total quantity of sludge land applied.

Conclusions continued

5. Facilities using a PSRP must provide monitoring data over entire operating period (time-temp).
6. Monitoring program should adequately represent year round performance of the facility.
7. Approximately 35,500 dry tons of sludge were land applied in Georgia from 31 municipal wastewater treatment facilities.

Maximum Pollutant Concentration

<u>Pollutant</u>	<u>Concentration, mg/Kg</u>
Arsenic	75
Cadmium	85
Copper	4300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
Selenium	100
Zinc	7500

Monthly AVG Pollutant Concentration

<u>Pollutant</u>	<u>Concentration, mg/Kg</u>
Arsenic	41
Cadmium	39
Copper	1500
Lead	300
Mercury	17
Nickel	420
Selenium	100
Zinc	2800

Annual Pollutant Loading

<u>Pollutant</u>	<u>Loading, lb/ac-yr</u>
Arsenic	1.8
Cadmium	1.7
Copper	67
Lead	13
Mercury	0.76
Nickel	19
Selenium	4.5
Zinc	125

Cumulative Pollutant Loading

<u>Pollutant</u>	<u>Loading, lb/ac-yr</u>
Arsenic	37
Cadmium	35
Copper	1338
Lead	268
Mercury	15
Nickel	375
Selenium	89
Zinc	2498