Sewage Sludge Regulatory Background

aka Protect your right to Land Apply – Know the 503s

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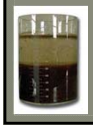
Background and Intro to the World of Biosolids

What are Biosolids

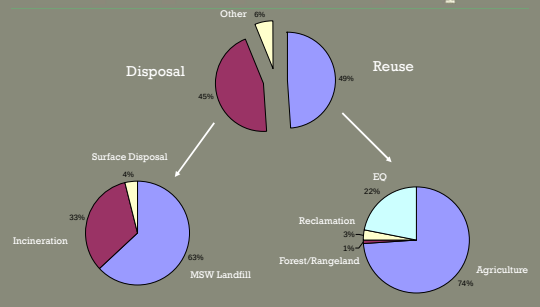
- Simple answer – Treated Sewage Sludge
  - e.g. additional digestion of primary and waste activated sludge
- *Sewage sludge is solid, semi-solid,* or liquid residue generated during the treatment of domestic sewage in a treatment works



How much are produced

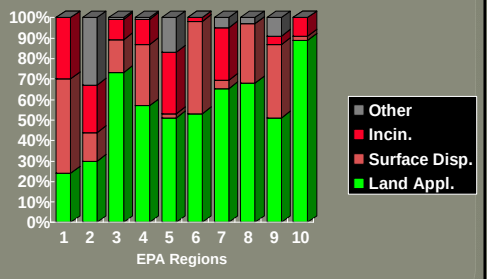
- Nationally - ~7 million dry tons per year
- Regionally 100,000 dt – 1E6 dt/y
- State
  - Rural states ~6-12,000dt/y
  - Urbanized states ~ 775,000dt/y (CA) most 350,000dt
- Estimating Treated Sludge(Biosolids) Production ~0.35-0.5dt/MG
  - e.g. a facility treating 5 MGD should produce ~ 900 dt/y

National Biosolids Use/Disposal



After 2007 NEBRA Report

Biosolids Use/Disposal Practices by EPA Region

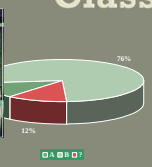


Current Quality--2006 Biosolids Data

	CO 2006 mg/Kg[1]	R8 2006 mg/Kg[1]	National 2006 mg/Kg[2]	Typical Soils Conc. mg/Kg	503 Table 3 mg/Kg[5]
As	4	8	7	5.5[3]	41
Cd	2.5	3	3	0.27[4]	39
Cr	25	30	83	40[4]	N.R.
Cu	550	525	569	16.3[4]	1500
Pb	34	45	80	11.8[4]	300
Hg	0.8	2.3	1.3	0.05[3]	17
Mo	11	12	17	1-2	(75)[6]
Ni	18	24	53	15[4]	420
Se	8	10	7	0.29[3]	100
Zn	599	645	1029	54.3[4]	2800

Notes: [1]2006 Annual Reports summarized in US EPA Region 8 BDMS,[2] US EPA 2009, [3] As, Hg, Se are median values from Shacklette and Boerngen 1984; [4] Cd, Pb, Zn, Cu and Ni are background Great Plains means from Holmgren et al 1993; [5] US EPA 1993; [6]Table 1 Requirement; N.R. Not Required

Class A vs. Class B



Regulatory History

Focus of Federal Program
Addressing Management of Sewage Sludge

- Late 1960's through late 1980's
  - Extensive R&D Program
  - Construction Grants Program
  - Technical Assistance & Guidance
  - Research Results led to development of Federal policy encouraging recycling
  - Part 257 rule (under RCRA & CWA)
  - CAA, MPRSA, NEPA
  - Building of State Programs

Focus of Federal Program
Addressing Management of Sewage Sludge

- Late 1980's through early 1990's
  - CWA '87 Amendments & Active Court Cases drove rulemaking effort
  - Intra-Agency Task Force
  - National Sewage Sludge Survey
  - Development of Part 503 rule
  - Active Federal oversight and reinforcement of Federal policy encouraging recycling
  - Coordination w/State Programs, external groups

Focus of Federal Program
Addressing Management of Sewage Sludge

- Early 1990's until today
  - Outreach efforts re: Part 503 requirements
  - Coordination w/State Programs
  - Less active EPA oversight, but continued support of Federal policy encouraging recycling
  - BDMS and PCS Modernization
  - EMS development (odor management, etc.)
  - Improvements in test methods & technology
  - Addressing areas of growing interest (e.g., Odors, Dioxins, Radiation, Bioaerosols, Bioassay, Emerging Contaminants)

Current Federal Rules
Addressing Sewage Sludge Use/Disposal

- 40 CFR Part 503 *Sewage Sludge Use/Disposal* requirements
- 40 CFR Part 258 *Municipal Solid Waste Landfill* requirements

Regulatory Basics

40 CFR Part 503

- Minimum National requirements applicable to the use/disposal of sewage sludge (including septage)
- Specific requirements for land application, surface disposal (monofills, dedicated sites), and incineration
- Based upon extensive amount of research information/field experience, peer-reviewed risk assessment, National Sewage Sludge Survey, etc.

40 CFR Part 503

- Self-implementing rule
  - Federally enforceable without a permit
  - Although CWA implementation through 402 permits
- Most states have adopted Part 503 or something more restrictive
  - Typically include additional requirements to address local factors
  - Eight states are formally delegated at least parts of 503 (**UT**, **OK**, **SD**, **WI**, **TX**, **AZ**, **OH** & **MI**)
- Choice of use/disposal practice remains a local decision

The Basics
Part 503 Standards

- General Requirements
- Pollutant Limits
- Management Practices
- Operational Standards
- Frequency of Monitoring
- Record Keeping
- Reporting

Surface Disposal- **property boundary and Pollutant concentration**

	As	Cr	Ni
Distance (meters)	**---(mg/kg)---**		
0 to < 25	**30**	**200**	***210***
25 to < 50	**34**	**220**	**240**
50 to < 75	**39**	**260**	**270**
75 to <100	**46**	**300**	**320**
100 to < 125	**53**	**360**	**390**
125 to < 150	**62**	**450**	**420**
> 150	**73**	**600**	**420**

40 CFR Part 503
Key Land Application Requirements

- Heavy metal limits
  - Maximum concentration limits
  - Cumulative loading limits
  - High quality concentration limits
- Pathogen reduction requirements
  - Class A (below detectable levels)
  - Class B (significant reduction treatment req's.)
    - w/Harvesting and site restrictions
- Vector Attraction reduction requirements
- Management and Site

METALS BASED CLASSIFICATION
Maximum Concentration mg/kg dry

	Table III	Table I
Arsenic	41	75
Cadmium	39	85
Copper	1500	4300
Lead	300	840
Mercury	17	57
Molybdenum		75
Nickel	420	420
Selenium	100	100
Zinc	2800	7500

Pathogen Destruction Criteria

Class A Biosolids*

Class B Biosolids*

***with respect to pathogens**

Class "A" With Respect to Pathogens

- Fecal < 1000 MPN/g or Salmonella s.p. < 3 MPN/4g (based on seven samples per event) AND
- Use one of 5 approved methods to Further Reduce Pathogens:
  - Time/temp depending on solids content
  - pH/time then dry to at least 50% solids
  - Testing for enteric viruses/viable helminth ova
  - Testing
  - PFRP: composting, heat drying, heat treatment, TAD, beta ray irradiation, gamma ray irradiation, pasteurization, other as approved by EPA Region 8

Class "B" With Respect to Pathogens

- 7 samples - Geometric Mean <2,000,000 MPN/g or CFU* (based on seven samples per event) OR
- Use 1 of 5 Approved PSRP methods:
  - Aerobic Digestion: 40 days @ 20 °C no less than 60 days @15 °C
  - Air Drying: 3 months with two months above 0 °C
  - Anaerobic Digestion: 15 days @ 35-55 °C no less than 60 days at 20 °C
  - Composting: Minimum 40 °C for 5 days with min 4 hours at 55 °C
  - Lime Stabilization: Add lime to raise pH to 12 after two hours of contact
  - Other as approved by EPA or the permitting authority

TESTING-Fecal Coliform Reduction

- Representative Samples
- are sufficiently **accurate** and **precise** to provide reliable estimates
  - Sample **Accuracy** is usually achieved by some form of Random Sampling
  - Sample **Precision** is commonly achieved by taking an appropriate # of samples from the population.
    - Note the 7 Sample listed in the Regulations is a minimum and does not guarantee a representative sample
- A Sampling and Analysis Plan will contain more than 7 samples per event

Vector Attraction Reduction (VAR)

- (3) 38% VSR
- (4) Anaerobic - bench scale test (40 days)
- (5) Aerobic - bench scale test (30 days)
- (6) Aerobic - SOUR =< 1.5mg O2/hr @ 20 °C
- (7) Aerobic - 14+ days @ >40 °C (avg >45 °C)
- (8) pH ^ 12+ for 2 hr then 11.5+ for 22hr
- (9) Dry to 75% when stabilized solids used (digested)
- (10) Dry to 90% when unstabilized solids used (undigested)
- (11) Sub. injection (no significant after 1hr)
- (12) Surface application w/incorporation (w/in 6hrs)

Requirements at the Site – Beneficial Use

- **Management Practices**
  - **No harm to Endangered Species**
  - **No harm to Historic Sites**
  - **Groundwater protection**
  - **Frozen/snow covered sites**
  - **Wet weather**
  - **Storage requirements**

Nutrient Management

- **Agricultural – apply N at agronomic rate**
- **Reclamation – may apply up to 5X agronomic rate or permission (*R8*)**
- **No application where available P > (*R8*)**
  - **100 ppm sodium bicarb**
  - **50 ppm AB-DTPA**
  - **170 ppm Bray P1* use Bray when pH ≤ 6.5**
  - **State may allow application based on NRCS Code 590**

Class B Crop Harvesting Restrictions

- **Food crops with parts that touch biosolids or gr… face – 14 months**
- **Food crops w… s below surface and biosolid… e for 4 months prior to inco… ths**
- **Food crops wi… ts below surface and biosolids … face for less than 4 months prior to … ration – 38 months**
- **Food, feed and non-food crops – 30 days**

Class B Site Restrictions

- **No domestic livestock grazing for 30 days after application**
- **Turf may not be harvested for 1 yr**
- **High public exposure sites - limit access for 1 yr**
- **Low public exposure sites – limit access for 30 days**

Land Application

basic requirements

- **Must meet Table I Metals**
- **Must meet either Class A or Class B and**
- **One of VAR 3 thru 13**
- **Table I subject to Cumulative Pollutant Loading Limits**
- **No land application if metals exceed Table I limits**
- **Meet appropriate management/site Req.**

Monitoring & Analysis Biosolids

Biosolids Frequency of Sampling & Analysis	
Annual Production DST/YR	Frequency
Less than 319 (<290 DMT/Yr)	Once per year collected during 4th QTR
319 to 1,649	Once per quarter
1,650 to 16,499	Once per two months
16,500 +	Monthly
Lagoons	Prior to removal

Record Keeping

- **Preparers & Appliers must develop and maintain the following information for 5 years:**
  - **Documentation demonstrating compliance with Pathogen Destruction, VAR and Metals Criteria**
  - **Certification Statements**
  - **Results of Biosolids and Soils Analysis**

The Quiz

- How many metal are regulated for LA? SD?
- How does Class A differ from Class B?
- What is the most frequently used math formula for VSR?
- What is agronomic rate?
- Do land app site require soil samples?
  - State methods? – EPA methods?

The Quiz (continued)

- Does a contractor relieve the preparer of responsibility?
- Who have to maintain records?
  - How Long? Is that the same as the discharge data?
- Do you need a permit from EPA?
  - The State? -- Both?
- When were the annual reports due?
- Is P regulated by 503 / Region 8 / CO

Initial findings and concerns beginning of the inspection process

Some of the issues faced in R8

- Falsification of results (1)
- TCLP incomplete (5)
- Metals > table 1 (2)
- Using MF rather than MPN (5)
- Too small of an aliquot for analysis (5)
- Miscalculation of VSR (10)
- Less than the appropriate number required samples (5)
- Van Kleek Eq misuse

Who is Responsible?

- A contractor land apply biosolids
  - therefore ????? Responsible
- The preparer land apply your biosolids
  - therefore ?????? Responsible

The preparer is responsible

- "Sec. 503.7 Requirement for a person who prepares sewage sludge.

Any person who prepares sewage sludge shall ensure that the applicable requirements in this part are met when the sewage sludge is applied to the land, placed on a surface disposal site, or fired in a sewage sludge incinerator."

Metals (lab issues)

- Too small of a sample in digest (too many < or NDs)
- Not checking the data you receive from the lab
- Wet Weight rather than Dry weight
- Improper calibration curves
- Improper Methods
- Improper units

Land Application Sites

- Restricting Access to the biosolids on the site (1)
  - Including biosolids leaving the site
- Cumulative Loads
- Agronomic Rates
- Endangered Species
- Certification Statements

Facility Inspections

Biosolids Treatment

- Size of treatment plants (in general) uses digestion
  - Larger WWTP (>5MGD) – Anaerobic
  - Smaller WWTP (<5MGD) - Aerobic
- Major issues
  - VAR Calc.
  - Pathogen Determination
- Estimating Treated Sludge(Biosolids) Production ~0.35-0.5dt/MG
  - e.g. a facility treating 5 MGD should produce ~ 900 dt/y

Demonstration of Compliance: Fecal Coliform Reduction

- Geometric Mean of 7 Samples
  - Use either
    - the antilog of $\{\log X_1+\log X_2+\log X_3 \ldots \log X_n\}/n$
    - $\{X_1 * X_2 * X_3 \ldots . X_n\}^{1/n}$

Volatile Solids Reduction

- Available Methods to Calc VSR
  - Van Kleek Method (most Common)
  - Approximate Mass Balance
  - Full Mass Balance
  - Constant Ash

$$FVSR = 1 - \frac{VS_b * (1-VS_f)}{VS_f * (1-VS_b)}$$

b= bottoms; f=feed Note inputs are in fractional format not whole %

Points to concider

- For Compost operations
  - Temperature gauges/probes calibrated correctly
  - Temperature measured at many locations and depths
  - Must be Aerobic
- For WWTPs
  - Digester operational standard – calc MCRT
  - Proper use of VSR calculation
  - Pathogen- must collect 7 representative samples per event and calculate Geomean (class b) and max 1000MPN/g (class a)

Point to consider - Laboratory

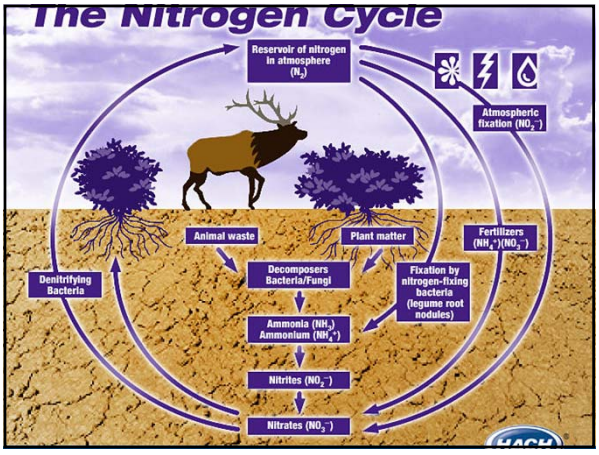
- SOUR test limitations
  - Temp between 10oCand 30oC
  - TS <2%
  - Test must be started shortly after sampling
- Metal analysis
  - Preservation ice
  - Very liquid samples may have a lot of N.D.
    - Cause by lack of solids
    - Solution digest more liquid (use equiv to 1gm dry Solid)
- Some methods in SW 846 Some in 40CFR 136 and some in SM et al

Concentration on Land Application Inspections

Methods of Sewage Sludge Application

8

General Considerations



Agronomic Application Rate

- All biosolids applied according to agronomic application rate
- GOAL: To apply enough nutrients, i.e. nitrogen, in order to supply the required amount of nutrients to grow the expected yield of the expected crop
- RESULT: No excess nitrogen; No leaching

Forms of Nit

- Major Forms of N found in biosolids, soil or environment
  - Organic N
  - NH4+
  - NO3-
  - NO2-

MISSOURI COOPERATIVE EXTENSION SERVICE

UNIVERSITY OF MISSOURI & LINCOLN UNIVERSITY

Soil Test Report

FIELD INFORMATION

SOIL TEST INFORMATION

RATING

SUGGESTED ANNUAL TREATMENTS

LIMESTONE SUGGESTIONS

Agronomic Rate

- The Calculation
- Plant Available N from biosolids = Inorganic N*(Loss Factor) + Organic N*(Mineralization Factor) less the amount available currently in the soil.

Inches Apart

Not Inches Thick

Or in a ditch

The Math

Some 'Parts' Math

100% = 1,000,000 mg/Kg (ppm)

10% = 100,000 mg/Kg (ppm)

1% = 10,000 mg/Kg (ppm)

1,000 mg/Kg or 1g/Kg = 1000ppm

1 mg/Kg =1 ppm

1 µg/Kg =0.001 ppm = 1 ppb

1 ng/Kg = 0.000001 ppm = 1 ppt

Concentrations of chemicals in soil are typically measured in units of the mass of chemical (milligrams, mg or micrograms, ug) per mass of soil (kilogram, kg). This is written as mg/kg or ug/kg. Sometimes concentrations in soil are reported as parts per million (ppm) or parts per billion (ppb). For soil, 1 ppm = 1 mg/kg of contaminant in soil, and 1 ppb = 1 ug/kg. A measurement of 6 mg/kg is the same as 6 ppm or 6,000 ppb, which is equal to 6,000 ug/kg.

VSR

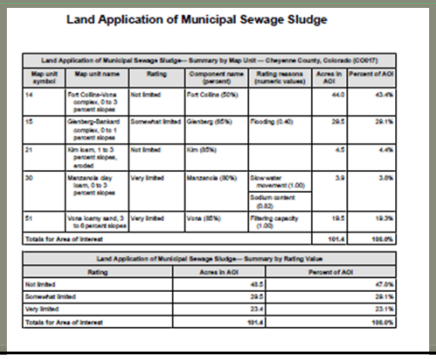
Pathogen - GeoMean

Agronomic Rate

Inspection forms

Web Soil Survey

Land Ap of Biosolids



Land Application of Municipal Sewage Sludge

Land Application of Municipal Sewage Sludge— Summary by Map Unit — Cheyenne County, Colorado (CO017)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
14	Fort Collins-Vona complex, 0 to 3 percent slopes	Not limited	Fort Collins (50%)		44.0	43.4%
15	Glenberg-Sankard complex, 0 to 1 percent slopes	Somewhat limited	Glenberg (65%)	Flooding (0.40)	29.5	29.1%
21	Kim loam, 1 to 3 percent slopes, eroded	Not limited	Kim (85%)		4.5	4.4%
30	Manzanola clay loam, 0 to 3 percent slopes	Very limited	Manzanola (90%)	Slow water movement (1.00)	3.9	3.8%
				Sodium content (0.82)		
51	Vona loamy sand, 3 to 9 percent slopes	Very limited	Vona (85%)	Filtering capacity (1.00)	19.5	19.3%
Totals for Area of Interest					101.4	100.0%

Land Application of Municipal Sewage Sludge— Summary by Rating Value

Rating	Acres in AOI	Percent of AOI
Not limited	48.5	47.8%
Somewhat limited	29.5	29.1%
Very limited	23.4	23.1%
Totals for Area of Interest	101.4	100.0%

QUESTIONS?

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Worksheets discussed available at
www.epa.gov/region8/water/biosolids