The Remarkable Benefits of Recycling Biosolids to Soils

Ned Beecher • NEBRA

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Northeast Residuals and Biosolids Conference • Burlington, VT
Science, after having long groped about, now knows that the most fecundating and the most efficacious of fertilizers is human manure. The Chinese, let us confess it to our shame, knew it before us. Not a Chinese peasant--it is Eckberg who says this,--goes to town without bringing back with him, at the two extremities of his bamboo pole, two full buckets of what we designate as filth.... There is no guano comparable in fertility with the detritus of a capital. A great city is the most mighty of dung-makers.... Fleets of vessels are despatched, at great expense, to collect the dung of petrels and penguins at the South Pole, and the incalculable element of opulence which we have on hand, we send to the sea. All the human and animal manure which the world wastes, restored to the land instead of being cast into the water, would suffice to nourish the world.

Victor Hugo, Les Miserables, 1862
Consider...

http://www.waterburyobserver.org/node/2254

Wallace Coles Jr. · John F. Kennedy High School, Waterbury, CT
That stupid plant should have never been built I always said and this is exactly why
Consider:

Magic Hat Brewery, So. Burlington, VT

Essex Junction, VT new CHP engine

We are making electricity AND returning human “guano” to soils.
Consider:

GROWING A REVOLUTION
BRINGING OUR SOIL BACK TO LIFE

David R. Montgomery

nebiosolids.org
Consider...

- California has a new “Healthy Soils Initiative”

- They have ambitious goals to reduce disposal of organic materials in landfills: cutting methane emission dramatically in the next 10 years.

- Biosolids are positioned to play a key role in these major initiatives, working with a variety of state agencies.

- Marin Carbon Project: SFPUC is talking with John Wick; biosolids are part of the pictures.
Options for Organic Waste Management

Slide courtesy of D. Perry, formerly of CDM Smith
Biosolids use: Agriculture

- Bulk material markets: animal feed crops (corn, hay), grains (wheat, hops), soy, other commodity crops

- Prices:
  - Class B - $0 - $30 / wet ton
  - Class A – up to $60 / ton

- Trend: increasing demand; waiting lists in some areas

Moorhead, MN: Feed corn grown with liquid injected, Class B, anaerobically-digested biosolids, July 2012
Farmers Love Biosolids

Net Profit Increase = $250 – $500 per acre

Slide courtesy Lakhwinder Hundal, MWRDG Chicago
Why Apply Biosolids To Farmland?

To ensure sustainable farming

Being able to produce nutritious food to feed the growing population indefinitely without impacting the resource base of agriculture.

Slide courtesy Lakhwinder Hundal, MWRDG Chicago
Our Farmland Is Nutrient Deficient!

- Emphasis on application of NPK only
- Micronutrients are rarely applied to farmland
- Limited or no change in cropping pattern

Our soils are showing micronutrient deficiency

Slide courtesy Lakhwinder Hundal, MWRDG Chicago
Essential Elements for Proper Plant Growth

Carbon (C), Hydrogen (H), oxygen (O)

- **Major Nutrients**
  - Nitrogen (N)
  - Phosphorous (P)
  - Potassium (K)

- **Minor Nutrients**
  - Calcium (Ca)
  - Magnesium (Mg)
  - Sulfur (S)

- **Micro Nutrients**
  - Iron (Fe)
  - Manganese (Mn)
  - Boron (B)
  - Chlorine (Cl)
  - Molybdenum (Mo)
  - Zinc (Zn)
  - Copper (Cu)

Slide courtesy Lakhwinder Hundal, MWRDG Chicago
# Nutrients in Common Manures and Biosolids

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Beef Manure</th>
<th>Poultry Manure</th>
<th>Swine Manure</th>
<th>Biosolids&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>46-76</td>
<td>36-72</td>
<td>44-62</td>
<td>25</td>
</tr>
<tr>
<td>Phosphorus (P&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt;)</td>
<td>28-102</td>
<td>72-180</td>
<td>44-98</td>
<td>22</td>
</tr>
<tr>
<td>Potassium (K&lt;sub&gt;2&lt;/sub&gt;O)</td>
<td>30-42</td>
<td>34</td>
<td>14-34</td>
<td>0.6</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0-6</td>
<td>10-12</td>
<td>10-16</td>
<td>10</td>
</tr>
</tbody>
</table>

### lbs/wet ton

### g/wet ton

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<tbody>
<tr>
<td>Zinc</td>
<td>20-200</td>
<td>200-550</td>
<td>50</td>
<td>237</td>
</tr>
<tr>
<td>Copper</td>
<td>100-300</td>
<td>200-500</td>
<td>450-900</td>
<td>108</td>
</tr>
</tbody>
</table>

<sup>1</sup>MWRD’s centrifuge cake biosolids.

Slide courtesy Lakhwinder Hundal, MWRDG Chicago

nebiosoils.org
Why We Must Land Apply Biosolids?

To ensure agricultural sustainability

Being able to produce nutritious food to feed the growing population indefinitely without impacting the resource base of agriculture.

To ensure environmental sustainability

- Reduce stormwater runoff and protect water quality.
- Reduce ecological footprint.
- Mitigate global warming — Conversion of atmospheric N\textsubscript{2} into ammonia (Haber-Bosch Process) to produce N fertilizers uses enormous amount of fossil fuel.
Early growth of corn on control (left) and compost amended (right) plots on Woodstown silt loam soil (Epstein and Chaney, 1974).
Revegetated coal mine spoil at Frostburg, MD, treated with composted biosolids (Armiger et al., 1975).
Palmerton, PA, 1980; Dead Ecosystem on Blue Mountain.

Slide courtesy of Rufus Chaney, PhD, USDA ARS
Appalachian Trail ("protected" area)

Palmerton, PA: Blue Mountain – 1999
Foreground = Biosolids+Limestone+FlyAsh; Background = untreated Control

Slide courtesy of Rufus Chaney, PhD, USDA ARS
Reclamation is still in demand
Biosolids use: Forestry

Photos courtesy of King County, WA
http://dnr.metrokc.gov/WTD/biosolids/

- Only in some areas
- Speeds up harvest cycle in actively managed stands
- Price:
  - Class B $0 - minimal

nebiosolids.org
Biosolids use:
Horticulture / Landscaping / Turf

- Class A bulk material markets: potting mixes (e.g. Tagro), golf courses (e.g. Milorganite), parks, lawns, growing turfgrass (e.g. in RI), sports fields (hi-spec turf)

- Prices:
  - Class A bulk – up to $60 / ton
  - Class A bagged/retail – up to $450 / ton

- Trend: increasing demand for quality, consistent products

Biosolids compost use on my home garden – raspberries, May 2014
Biosolids Use: Topsoil Blending

- Bulk biosolids given or sold to topsoil blenders
- Prices: vary, often $0
- A way to use less processed material
- Topsoils used for reclamation, landfill cover, highway embankments, construction sites
- Trend: steady use

Topsoil blending with paper mill residuals and biosolids, central MA, 2006
Reclamation of Disturbed Sites

Bulk material market

Used to restore healthy soil ecosystem and either native vegetation or cropland

Prices: vary, often $0
- Uses a lot of biosolids

Trend: increasing use, because of huge benefits – biosolids use is best practice for this kind of reclamation

Spectacle Island in Boston Harbor was reclaimed with biosolids compost and other recycled organics, 2004.
Reclamation of Disturbed Sites

Pennsylvania mine before

Same Pennsylvania mine after

Photos courtesy Bill Toffey, MABA
Biosolids Use:
Landfill Leachate Treatment

Slide courtesy of Sylvis,
Vancouver, BC
Biosolids Use: Energy
Anaerobic digestion (followed by use or disposal)

- A biosolids treatment process that results in biosolids to be used or discarded.
- Trend: Huge interest & activity now, across the continent.
**The potential of AD & biogas use**

<table>
<thead>
<tr>
<th>3%</th>
<th>Approximate total of U.S. electricity consumption used by water and wastewater operations (~100 billion kWh annually)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35%</td>
<td>Amount of municipal energy consumption used by water / wastewater systems</td>
</tr>
<tr>
<td>~17,000</td>
<td>POTWs in the U.S. (&lt; 4000 produce 90%+ of U.S. solids)</td>
</tr>
<tr>
<td>40,000,000,000</td>
<td>Gallons of wastewater treated in the U.S. every day</td>
</tr>
<tr>
<td>8,000,000</td>
<td>Approximate amount of dry tons of biosolids generated per year by U.S. POTWs</td>
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<tr>
<td>730,000</td>
<td>Amount of cars equivalent to offset emissions if digestion facilities installed energy recovery*</td>
</tr>
<tr>
<td>600</td>
<td>MW of CHP Potential from POTWs over 1 MGD*</td>
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*EPA CHPP, 2007 and January 2011 (Draft)
There is a long history of generating electricity by using biogas as a reliable, renewable fuel in engines, turbines, fuel cells, as well as for combined heat and power (CHP). CHP, electricity generation with the capture of the historically wasted heat energy, is an efficient, clean, and reliable approach to generating power and thermal energy. Biogas CHP can greatly increase many facilities’ operational efficiency and decrease energy costs. At the same time, CHP reduces the emission of greenhouse gases.
Biosolids are products.
BLOOM GOOD SOIL, BETTER EARTH.

An exceptional soil amendment

bloomsoil.com
General biosolids resources

http://www.endless-films.com/site/?portfolio=biosolids

http://www.loopforyoursoil.com

http://www.nebiosolids.org/about-biosolids/
Biosolids improve soils.
Numerous studies demonstrate the benefits derived from adding organic matter, such as biosolids, to soils: higher carbon content (carbon sequestration), increased microbial activity, increased water-holding capacity, and lower bulk density (which means easier tillage & handling).

– Dr. Sally Brown, Univ. of WA, 2011 research
Findings:
Lower GHG emissions from use on soils

"Methane avoidance"

- Energy recovery
- Cold wet climate
- 800°C
- 25% solids
- No recovery
- 900°C
- 30% solids
- Energy recovery
- Using virgin lime
  **if recycled lime → total to -211**
- 65% heat
- 30% elect.
- 1% fugitive
- Anaerobic dig.

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Are you using biosolids?

April 2012

May 2, 2013
Sign up for free NEBRAMail: left side of nebiosolids.org

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