Biosolids Land Application: Background & Basics

Ned Beecher • North East Biosolids & Residuals Association (NEBRA)

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Biosolids Nutrient Management Training • Franklin, NH
What NEBRA Does For You

Tours, workshops, conferences, outreach to advance best practices & understanding to advance the recycling of biosolids & other organic residuals in New England & eastern Canada.
What NEBRA Does For You

Tracking & sharing research, news, legislation, & regulation

NEBRAMail – free email newsletter; sign up at nebiosolids.org
On Twitter: @nebiosolids

We depend on members. Join.

nebiosolids.org
Water ~ 5% (heat dried pellets) to ~ 95% (liquid biosolids)

Organic matter ~ 20% to 70% dry weight biological molecules from foods, human waste, runoff, etc., including lipids, proteins, sugars, starches, etc., dissolved and suspended, which contain…

Nutrients ~ 12% dry weight N, P, K, Ca, Fe, & micro-nutrients (Cu, Zn, etc.)

Binding Sites reducing bioavailability of Pb, As, etc.

Energy ~ 5,000-10,000 Btu/d lb. (when dry, similar to low grade coal)

Also:
- Inert sand, silt, grit, and synthetic particles
- Trace elements (mostly in compounds)
- Pathogenic micro-organisms
- Synthetic and natural organic chemical compounds (e.g. including polymers)
**Charting the Future**

**What’s ideal for sustainability?**

**MAXIMIZE RESOURCE RECOVERY OF CONSTITUENTS**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Benefits</th>
<th>Concerns</th>
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</thead>
<tbody>
<tr>
<td>Water</td>
<td>valuable in agriculture in arid climate</td>
<td>cost of transport</td>
</tr>
<tr>
<td>Organic matter</td>
<td>vital to soils</td>
<td>putrescible, odors</td>
</tr>
<tr>
<td>Nutrients</td>
<td>food for soil, plants &amp; animals</td>
<td>impacts to water</td>
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<tr>
<td>Energy</td>
<td>renewable, displaces oil/gas</td>
<td>air emissions, maybe no use of nutrients &amp; organic matter</td>
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**MINIMIZE POTENTIAL RISKS OF CONSTITUENTS**

Reduce/control/mitigate trace elements (e.g. metals), pathogens, synthetic and natural organic chemical compounds
Enabling the Future
Our Changing View of Solids Management

From WEF: Enabling the Future

Technologies today are producing higher quality products and recovering more energy from biosolids.

Slide courtesy of David Parry, formerly CDM Smith
Farmers Love Biosolids

Net Profit Increase = $250 – $500 per acre

10 ton biosolids/ac

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

Zinc Deficient Soils in U.S.

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
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
USA total wastewater solids:
7,180,000 dry U. S. tons/year (~35.9 million wet tons)

55% is used on soils
Percent Biosolids Beneficially Used by State, 2004
Markets are diverse – and diversifying

- Agriculture – Class B (and some A) in bulk, like manures
- Horticulture, landscaping, turf (sports fields, parks, golf courses, turf production, etc.) – Class A heat-dried & composts
- Topsoil blending – Class B and A, including for exacting sports field and golf green standards
- Reclamation of disturbed sites – using engineered topsoil blends of Class B (and some A)
- Specialized uses to solve environmental challenges, e.g. carbon (C) sequestration
- Energy – the current hot topic... Water Resource Recovery Facilities can be net-zero energy consumers!
Other organics enter the marketplace

- Increased FOG diversion to protect collection systems
- MA, VT, and other states implement landfill disposal bans of food scraps; CA plans for no organics to landfills by 2025.
- Food, other organics + co-digestion → net zero energy
- Urine diversion anyone?
Options for Organic Waste Management

Slide courtesy of D. Perry, formerly of CDM Smith
Organics GENERATED in 10 Northeast Region States

- 31% Organics
- 27% Biosolids
- 42% Food Waste
- Other Organic

% of the 24,514,000 wet tons/year organics GENERATED
Comparing RECYCLING RATES in 10 Northeast Region States

6,817,000 wet tons/year organics RECYCLED
What deserves recycling attention?

- **Food residuals: ~10 million wet tons/year underutilized**
  - Creates methane / GHG emissions in landfill
  - Wet & costly to burn
  - Recycling is a worthy goal!
  - Can create valuable energy & soil amendment products
    → *Challenging to accumulate and make clean products*

- **Wastewater solids (sludge): ~4.3 million wet tons underutilized**
  - Also creates methane / GHG emissions in landfill
  - Also wet & costly to burn
  - Recycling is a worthy goal!
  - Can create valuable energy & soil amendment products
    → *Already accumulated, ready to go, quite consistent*
Organic* matter is organic matter...

- Food waste
- Animal manures
- Wastewater solids
- Grass, green crop waste
- Leaves, stalks

* containing carbon (C)

more putrescible -> lower C:N ratio
less putrescible -> higher C:N ratio

Slide courtesy Sally Brown, PhD, Univ. of WA
More co-management with other organics

- Co-composting
- Co-digestion
- Co-combustion (e.g. FOG at SSIs)

Co-digestion followed by land application, Essex Jctn., VT

Co-composting, Unity, ME