Overview of Lime Stabilization
503 Regulations

Class B
• pH of Biosolids must be elevated to more than 12 for 2 hours and maintained at 11.5 for 22 hours.
• Higher pathogen concentration than A.
• Land applied with restrictions.

Class A
• Requires the addition of heat. For Lime Pasteurization
  • 158-F
  • 30 minutes retention time.
• Extremely low pathogen concentration.
• Land applied with little or no restrictions.

Lime Stabilization Awards

Water Environment Federation - 1996 Innovative Technology Award

First Place in Warren, Ohio - USEPA Award for Public Acceptance

First Place Lenoir, North Carolina - USEPA Beneficial Reuse Award
Process Equipment for Lime Stabilization

Class B
- Lime added to a pug mill.
  Generally not proprietary.

Class A
- N-Viro Advanced Alkaline Stabilization
- Schwing Bioset Process
- RDP EnVessel Pasteurization
The Chemistry of Lime Stabilization

CaO + H₂O = Ca(OH)₂ + HEAT

calcium oxide  water  calcium hydroxide

The heat kills pathogens and the pH provides vector attraction reduction.
The N-Viro Process

Heat generated through addition of Lime and Cement Kiln Dust

Advantages:
- Dry end product that is easy to handle and stacks well.
- Simple process equipment.

Disadvantages:
- More regulated biosolids to handle.
- High lime dosage limits land app rates.
- Require high number of acres.
Schwing-Bioset Process

Heat generated through addition of Lime and Sulfamic Acid

Advantages:
• Dry end product that is easy to handle and stacks well.
• Simple process equipment.

Disadvantages:
• More regulated biosolids to handle.
• High lime dosage limits land app rates.
• Require high number of acres.
EnVessel Pasteurization

The use of supplement heat reduces the operating cost and lime dosage; making it the most cost effective Class A product on the market.
EnVessel Pasteurization Continued

Advantages
• Electricity less expensive heat source then lime.
• Lowest lime dosage, by design.

Disadvantages
• Low cake solids lead to sloppy end product
• Lime addition is used as a bulking agent for wetter cake.
Why Lime Stabilization…?

“The alkaline stabilized product is suitable for application in many situations, such as landscaping, agriculture, and mine reclamation. The product serves as a lime substitute, source of organic matter, and a specialty fertilizer. The addition of alkaline stabilized biosolids results in more favorable conditions for vegetative growth by improving soil properties such as pH, texture, and water holding capacity.”
Why Lime Stabilization…?

“…alkaline stabilization is often the most cost-effective process for wastewater solids stabilization.”

Alternatives such as thermal drying and anaerobic and aerobic digestion. …

dosage of alkaline material or the addition of supplemental heating (pasteurization).”
Pros and Cons Inherit with Lime Stabilization in General

Pros

• Simple process.
• Simple equipment.
• Low Capital cost.
• Easy to upgrade from Class B to A.
• Handle wide range of sludge.
• Valuable end product for many soils.

Cons

• End product not suitable for all soils.
• Cannot leave unattended.
• No volume reduction.
• Lime dust.
Lime Stabilization has historically been one of the most popular treatment processes in the USA. In many parts of the country, it is the preferred treatment process because it is a) simple b) inexpensive c) provides a valuable product for the local community.
BEING “GREEN” ISN’T ABOUT BEING TRENDY...

It’s about conserving natural resources, using less energy, and making fundamentally sound choices to promote a sustainable local environment.

Magenta represents soils with pH - 6.0
Nutrient Uptake vs. pH

The single most important you can do is get your soil pH right because more nutrients are taken up into the plant. This increases yield, makes more efficient use of fertilizer. Also minimizes run off into the waterways of the USA.
The farmers tell us that they see excellent results from the Class A Biosolids, a real savings to them with the increase in commercial fertilizer prices.

As one farmer told us “…it is just too valuable to waste…”
Danny Hall
Biosolids Manager
Greenwood, SC

“...It is real simple, we are returning valuable nutrients back to our local farmers... If you take care of the farmers they will take care of you...”
Greenwood, SC

Danny Hall
Biosolids Manager,

“...It is real simple, we are producing a good quality product that is safe and tested daily. ...If you take the time to explain that to people then their fears are alleviated.
Greenwood used to haul and spread Class B...

But they’ve switched to Class A. Here’s why...

Class A allows more people to use the product
Saves time and money by allowing access to more convenient fields
The closer fields require less travel time and less fuel consumption
“Using our own equipment allows us to set our priorities, we waste when we need to waste, we spread when the weather is good and if we get behind we use our storage pad to get caught up. Things can be very simple around here if you just build some flexibility into your planning...”

Danny Hall, Biosolids Manager
Sand Hills State Forest
South Carolina
Table 5—D.b.h., basal area, total height, and volume per tree growth increments by treatment and measurement period from a 1963 planted longleaf stand (Alpin soil series) on the Sand Hill State Forest in Chesterfield County, SC

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>d.b.h.</th>
<th>Basal area</th>
<th>Total height</th>
<th>Tree volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>in</td>
<td>ft² acre⁻¹</td>
<td>ft</td>
<td>ft³</td>
</tr>
<tr>
<td>1995-1999</td>
<td>Control</td>
<td>0.5</td>
<td>8.1b</td>
<td>1.6</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td>NPK</td>
<td>0.9</td>
<td>13.4a</td>
<td>3.0</td>
<td>2.39</td>
</tr>
<tr>
<td></td>
<td>Biosolids</td>
<td>0.8</td>
<td>10.6ab</td>
<td>1.5</td>
<td>1.80</td>
</tr>
<tr>
<td>1999-2005</td>
<td>Control</td>
<td>0.7b</td>
<td>13.3b</td>
<td>3.6</td>
<td>2.34b</td>
</tr>
<tr>
<td></td>
<td>NPK</td>
<td>1.1a</td>
<td>19.1a</td>
<td>4.9</td>
<td>3.84a</td>
</tr>
<tr>
<td></td>
<td>Biosolids</td>
<td>1.1a</td>
<td>18.1a</td>
<td>4.5</td>
<td>3.41a</td>
</tr>
<tr>
<td>1995-2005</td>
<td>Control</td>
<td>1.2b</td>
<td>21.4b</td>
<td>5.2</td>
<td>3.63b</td>
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<td>28.9a</td>
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<td>5.21ab</td>
</tr>
</tbody>
</table>

Treatment means within a measurement period followed by a different letter are significantly different using Duncan’s Multiple Range Test at the 5 percent alpha level.
LIME—AN ESSENTIAL INGREDIENT FOR SUCCESSFUL FOOD PLOTS

BY GRANT R. WOODS, PH.D.

Most sportsmen realize that fertilizer is an important component in establishing or maintaining successful food plots. However, rarely do I hear of sportsmen applying lime or discussing the soil's pH in reference to food plots. Actually, lime is often a more important ingredient than fertilizer in the recipe for successful food plots. In this article I'll define soil pH, describe the negative effects of acidic soil on forage crops, and describe when and how to apply lime.

What is soil “pH”? It is a measurement of the soil's acidity or basicity based on a 0 to 14 scale, where 7 is neutral, below 7 is acidic, and above 7 is basic. Lime raises the pH of acidic soils, while sulfur is used to lower acidic soils. Lime is often added to regions with acidic soils. Therefore, I'll speak primarily about acidic soils since few will encounter basic soils.

Acidic soil is cause for concern because of several negative effects it has on food plot crop growth and nutritional value. One of the negative effects of acidic soil is reduced microbial and insect activity. For example, the survival and proliferation of Rhizobium bacteria, which assist legumes in fixing nitrogen, is limited in acidic soil.

Also, several critical nutrients for plant growth, such as phosphorus, potassium, and calcium, may be present in reduced quantities in acidic soil. Lime can be added to raise the pH and make more nutrient elements available to plants.
Soil Moisture—THE MOST IMPORTANT INGREDIENT FOR SUCCESSFUL FOOD PLOTS

by Dr. Grant R. Woods and Bryan Kinkel

Being responsible for establishing food plots throughout the whitetail’s range, we have been frustrated by the weather during the summer and fall of 2000. Rainfall and temperatures have varied greatly across the eastern U.S. Drought conditions continued in the Southeast for the third consecutive year, and the extreme lack of rainfall this past summer and fall caused widespread food plot failures. On the other hand, many of the northeastern states were significantly wetter and cooler than normal. For example, New York experienced the tenth coldest summer on record. The bright spot were the central states. After a cooler than normal spring, Pennsylvania experienced ideal growing conditions. The early-season deer harvest data collected from this area already reflect the good growing conditions.

Checking the average rainfall for the last month and numerous others receiving 1/4-inch or less. Although these recent dry conditions have been record setting, the fall months are typically the driest months of the year in much of the Southeast.

This fact is of great importance since cool season foods plots are traditionally planted in September and October in this region. This tradition often results in seeds being sown during extended dry periods. When seeds are planted during extremely dry periods with no rain predicted, it is termed “dusting in.” Using this planting technique is risky—it is a gamble whether seeds will receive adequate soil moisture to germinate and grow before they desiccate (dry out) and die. This year, dusting in was a poor gamble across the South as many food plots established by this technique resulted in total failures. That is to say that there was almost no germination more than 30 days after planting.
Class B Lime Stabilization is popular because it is simple and inexpensive.
The heart of any sludge lime stabilization system is the mixer.
Sludge/Lime mixers are twin shafted pug mills but for lime they need to be longer than normal
Importance of Adequate Lime Mixing

- pH=12: Good enough for regulations but not the whole story for high-quality products
- Inadequate mixing can lead to odors while still passing pH tests
- Septic solids from secondary clarifiers (anaerobic microbes) produce reduced sulfur compounds
  - Poor mixing does not inactivate microorganisms
  - Proper mixing will inactivate these microbes and prevent odors
Better mixing yields lower odors over time

H2S vs. Storage Time for 5 days
The Future of Lime Stabilization
“A big part of any City's work is dealing with the regulatory burden. It is getting to the point that Class A is less expensive than Class B but you don't develop a Class A market over night.

You need to key one eye on the future and one eye on the bottom line...” Daniel Williams – Morehead City, NC
New processes are addressing “cons”

Pros
• Low Capital cost.
• Cheapest way to Class A
• Flexibility from Class B to A.
• Simple Technology.
• Handle wide range of sludge.
• Vector attraction.
• Valuable end product for acidic soils.

Cons
• End product not suitable for all soils.
• No volume reduction
• Lime handling & dust related issues
Enhanced Pasteurization Flow Sheet

Minimum lime dosage for pH

3 fold volume reduction

Totally sealed system
Enhanced Pasteurization

EVAPORATION

CYCLE 2
PULSE FEED

20 Minute Hold At 162° F.
For Class A Pathogen Reduction
Regulatory Requirements

PULSE DISCHARGE
Key Feature

Load cells.

The legs sit on load cells which enables the system to precisely and continuously monitor the weight in the Pasteurization Reactor.

As water is evaporated, we can watch the weight decrease and calculate the exact solids concentration, at any point in time.

When the predetermined solids concentration is achieved, then the heat is terminated and the Reactor is unloaded.
Conclusions & Recommendations

1. Lime Stabilization remains one of the most cost effective Class B and/or Class A processes, while returning valuable nutrients back to the soil. Biosolids are too valuable to waste.

2. Class B Lime Stabilization operations will be greatly improved if the Systems are viewed as an engineered system, with a single vendor being responsible for meeting an overall performance based specifications. When Systems are broken up in different specification sections, each going to the lowest bidder, you’ll likely have more of the same problems that have lead to Lime Stabilization being very much out of vogue.

3. An improved testing techniques will eliminate false pH readings.
   - Core the samples
   - Allow sample to “gas off” before taking pH readings

4. A 5 mgd plant will buy about over $40,000/year of lime which totals over $800,000. A well designed system would reduce cost by at least 10%.
   1. Reduces operating cost
   2. Reduces land requirements by being able to spread more per acre
   3. The mixers cost less then $80,000 to buy and you need a good mixer to avoid the “DCWASA problems”.

Sometimes a little bit of lime can be a good thing...