

3rd Annual
Midwest Soil Improvement Symposium:
2013
Research and Practical Insights into Using Gypsum

FGD Gypsum:
How it's made, how we know it's safe, and how to apply it

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GYPSOIL/BENEFICIAL REUSE MANAGEMENT



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How it's made, how we know it's safe, and how to apply it

Midwest Soil Improvement Symposium

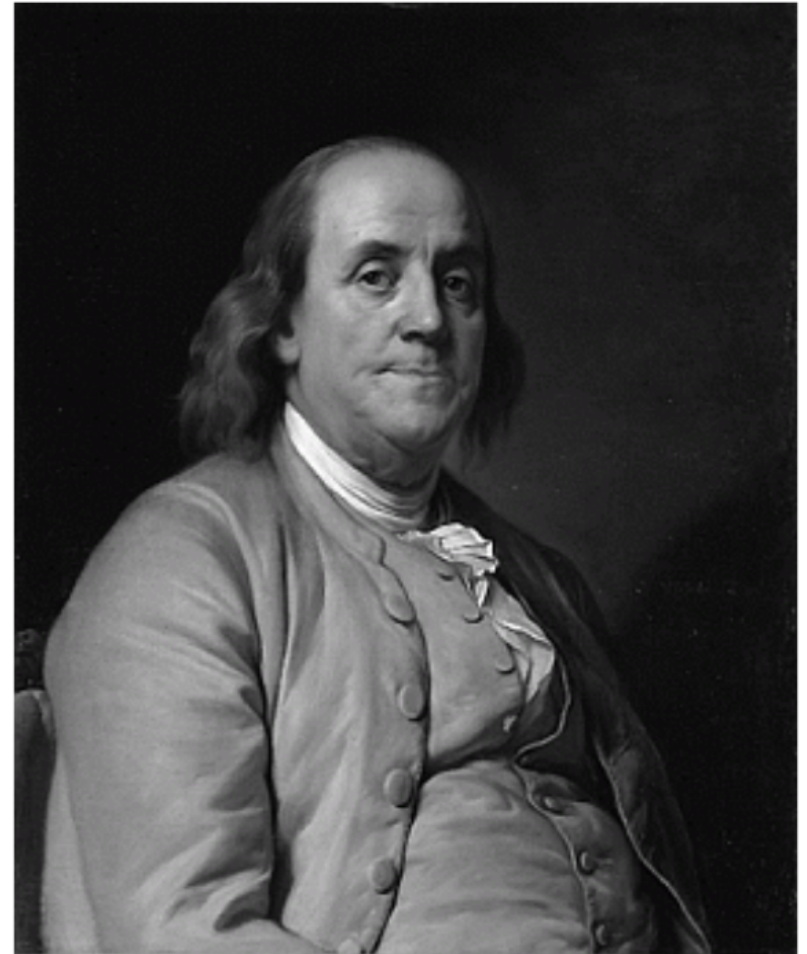
March 7, 2013

Topics

- Background
- What is gypsum?
- Application/Rates/Storage
- Questions
- Experienced applicator panel

Early Use

- Ben Franklin saw beneficial effects of gypsum more than 200 years ago
- "This hill has been land plastered!"
- Franklin's clover grew thicker and greener



Use on Specialty Crops

- Expensive to mine and transport so gypsum use was limited to certain specialty crops



Clean Air Technology

- Clean Air Act
Amendments of 1990
- Wet scrubbers at
coal-fired utilities
produce synthetic
“FGD gypsum”



We Energies

What is gypsum?



Composition

$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Calcium Sulfate Dihydrate

Analysis

Calcium 20%

Sulfate Sulfur 16%

1 Ton

Calcium 400#

Sulfate Sulfur 320#

Gypsum Sources

Mined Gypsum



- Limited availability
- Costly
- Highly variable

Gypsum Sources

- Recycled wallboard
- Manufacturing co-product (citric acid, lactic acid)
- ★ • FGD Gypsum



FGD Gypsum

- Supplies to expand dramatically with more scrubbing
- Regulated on a state-by-state basis
- GYPSOIL is the primary liaison to help growers access FGD gypsum



FGD Gypsum

PROCESS

- Starts with high quality, high-calcium limestone
- Process is preceded by the removal of particulate and NOx



Flue Gas Scrubbing Process

Ash, metals, & NO_x are removed from the flue gas

Limestone + Flue Gas  Calcium Sulfite (CaSO₃)

Calcium Sulfite + Oxygen  Gypsum (CaSO₄)

IPL Metals Concentrations

| Indianapolis Power & Light | | | |
|---|------------------------------------|------------|----------------------|
| Metals Concentrations vs Regulatory Standards | | | |
| | Metal Concentration | | vs Regulatory Limits |
| | Regulatory Limits | | |
| | 40 CFR part 503 Table 3 Sec 503.13 | IPL Levels | IPL Levels |
| Pollutant | mg/kg | mg/kg | |
| Arsenic | 41 | 1.01 | 2.5% |
| Cadmium | 39 | n.d. | |
| Copper | 1500 | 15.8 | 1.1% |
| Lead | 300 | n.d. | |
| Mercury | 17 | 0.14 | 0.8% |
| Molybdenum | 75 | n.d. | |
| Nickel | 420 | n.d. | |
| Selenium | 100 | 1.83 | 1.8% |
| Zinc | 2800 | 42.8 | 1.5% |

Lab analysis done by: Midwest Laboratories
 1364 B Street
 Omaha, NE 68114

Gypsum Characteristics

- FGD gypsum
 - Fine, tan powder
 - Damp to the touch
 - 8-10% moisture
- Gypsum from manufacturing
 - White to grey powder
- Mined gypsum
 - More variable



Gypsum Characteristics

- Gypsum does not affect the soil pH
 - It is not a liming agent!
- Fine particle gypsum is highly water soluble that allows for easy movement into the soil profile
 - Makes it ideal for no-till and conventional-till farming



FGD Gypsum: Safe and Effective

- USDA-EPA risk analysis
- GYPSOIL does rigorous testing for purity, moisture, and Ca & S content

GYPSOIL also makes significant investments in the USDA and university research trials



FGD Gypsum

USDA/EPA Risk Assessment

Evaluated exhaustive list of possible pathways for contaminant exposure from applying “new” FGD gypsum (crop produced on amended fields, soil ingestion by children, livestock, wildlife, livestock exposure to crops, and leaching/runoff from amended fields)

Study found no evidence of toxicity

“FGD gypsum is good stuff.” - Rufus Chaney, USDA lead researcher

EPA



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GYPSOIL Sources



We Energies

GYPSOIL has a growing network of supply partners including coal-fired utilities and food grade manufacturing plants

GYPSOIL Sources

Midwest, Southeast, Mid-south



Application & Storage



Applying GYPSOIL

- Unlike any other bulk-applied material
- Requires learning process
- Once you figure it out, it's not difficult

[Video Link](#)

Storage

Storage Gypsum: It is common to store Gypsum in large piles. The piles should be covered with a tarp to prevent moisture from entering the pile.



Application Period



Rates



Equipment



Application & Storage



Applying GYPSOIL

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- Requires learning process
- Once you figure it out, it's not difficult

[Video Link](#)

Equipment

Ideal:

- Stainless steel box
- Steep sides
- Belt/chain at least 20" wide
- Twin spinners



Spreader Box

- Requires steep, slick sides
- Clean and coat rusted areas
- If not stainless, use plastic liner
- Treat with SLIP-Plate graphite film coating



GYPSOIL™
BRAND GYPSUM

New Leader 30-Series



BBI Lime/Fertilizer Spreader



Litter and Lime Spreaders

BBI



Chandler



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Litter and Lime Spreaders

BBI



Chandler



Application Period

Timing

Apply Gypsoil any time that it is appropriate to be in the field without damaging the soil or the crop.



Ideal Application Periods

- After harvest
- Before planting
- After any alfalfa cutting once crop is off the field



Incorporation? Gypsum is Flexible

- Gypsum is water soluble; there is no need to incorporate



- But there's no harm in applying prior to tillage either



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Rates

BRAND GYPSOILTM

Depends on objectives, circumstances

- Amending soil: 1/2 ton - 2 tons per acre (every 1 to 2 years)
- As a nutrient source: 300 - 1,000lbs/acre depending on the crop*

*In states where gypsum is registered as a nutrient source

Soil Amendment Guide

SOIL ANALYSIS REPORT by MINNETONKA LABORATORIES

| SAMPLE | | LOCATION | | DATE | | ANALYST | | LABORATORY | | METHODS | | RESULTS | | UNITS | | COMMENTS | |
|--------|-------------|----------|-------|---------|-------|----------|-----|------------|---------|---------|-------|---------|---------|-------|----------|----------|------|
| NO. | DESCRIPTION | DATE | TIME | DATE | TIME | NAME | NO. | NAME | ADDRESS | CITY | STATE | ZIP | DATE | TIME | NAME | NO. | NAME |
| 1 | Topsoil | 10/1/10 | 10:00 | 10/1/10 | 10:00 | J. Smith | 101 | 101 | 101 | 101 | 101 | 101 | 10/1/10 | 10:00 | J. Smith | 101 | 101 |
| 2 | Subsoil | 10/1/10 | 10:00 | 10/1/10 | 10:00 | J. Smith | 102 | 102 | 102 | 102 | 102 | 102 | 10/1/10 | 10:00 | J. Smith | 102 | 102 |

CEC Rate
 <10 0.5 T/A
 10-15 1.0 T/A
 >15 2.0 T/A

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Soil Amendment Guide

SOIL ANALYSIS REPORT by MIDWEST LABORATORIES

| ORGANIC MATTER | | PHOSPHORUS | | | | | | NEUTRAL AMMONIUM ACETATE (EXCHANGEABLE) | | | | | | | | pH | | CATION EXCHANGE CAPACITY | PERCENT BASE SATURATION (COMPUTED) | | | | | |
|----------------|--|----------------|------|----------------|------|------------------------|-----------------|---|-----------|------|---------|------|--------|------|------|------|------|--------------------------|------------------------------------|----------|--------|------|------|------|
| | | P ₁ | | P ₂ | | BICARBONATE P OLSEN | POTASSIUM | | MAGNESIUM | | CALCIUM | | SODIUM | | | | | | | | | | | |
| | | WALKLEY BLACK | RATE | WEAK BRAY 1:7 | RATE | | STRONG BRAY 1:7 | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | SOIL | BUFFER | C.E.C. | % K | % Mg | % Ca |
| | | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | pH 1:1 | INDEX | meq/100g | | | | |
| 1.8 | | 8 | | 14 | | | | 61 | | 214 | | 1118 | | | | | | 6.4 | 6.9 | 8.2 | 1.9 | 21.7 | 68.0 | 8.4 |
| 2.1 | | 8 | | 11 | | | | 66 | | 239 | | 1439 | | | | | | 6.3 | 6.8 | 10.5 | 1.8 | 19.0 | 68.5 | 10.9 |

| CEC | Rate |
|-------|---------|
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Soil Amendment Guide

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|----------------|--|--------------------------|------|-------------------------|------|---------------------------|------|-----------|------|-----------|------|---------|------|--------|------|-----------|--------|--|------------------------------------|------|------|------|
| | | P ₁ | | P ₂ | | BICARBONATE P OLSEN | | K | | Mg | | Ca | | Na | | SOIL | BUFFER | | % K | % Mg | % Ca | % H |
| | | WALKLEY BLACK PERCENT | RATE | WEAK BRAY 1:7 ppm | RATE | STRONG BRAY 1:7 ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | ppm | RATE | pH 1:1 | INDEX | | | | | |
| 1.8 | | 8 | | 14 | | | | 61 | | 214 | | 1116 | | | | 6.4 | 6.9 | 8.2 | 1.9 | 21.7 | 68.0 | 8.4 |
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CEC

Rate

<10

0.5 T/A

10-15

1.0 T/A

>15

2.0 T/A

Storage

Storing Gypsum

- Ideal: under cover
- As with all farming materials, keep away from livestock, pets, and children

- If stored in open field or farm lot
 - > 200 ft. from nearest stream or drainage
 - Scrape ground bare (remove stalks, grass, & debris)
 - Pile so water drains away from bottom of pile
 - Pile to a peak (Rain seals the surface and water will run off)



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Various application questions

Q: What will happen if you put too much gypsum on your soil?

Q: Would you use a general rate of gypsum on both no-till and min-till soils?

Q: What is a one time, maximum application rate of gypsum on a loamy sand to improve root structure and tie up aluminum?

Q: Do you recommend applying every year, or every other year?

Questions?

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Gypsum Spreader Panel

Steve Songer

Veedersburg, IN

Gary Pennell

New Bavaria, OH

Travis Ulmer

New Haven, IN

