

Wisconsin Best Management Practices for Processing and Applying Waste Gypsum Wallboard as a Soil Amendment on Construction Sites

Building-related construction and demolition debris makes up 28.7% of the waste in Wisconsin's municipal solid waste landfills, the largest single waste stream in Wisconsin's landfills.¹ Gypsum wallboard is the second largest contributor to the residential construction waste stream and the largest contributor to the commercial waste stream, representing 20% of each of these sectors' waste, by weight.²

As interest in sustainable building grows, interest in recovering gypsum wallboard from the waste stream and beneficially utilizing it is increasing. This document provides best management practices for determining generation, processing and application of ground construction scrap gypsum wallboard as a soil amendment on all construction sites, and in particular, home construction sites.

What do I need to do to process wallboard as a soil amendment?

Before undertaking any gypsum wallboard processing, you must obtain an exemption from your local Wisconsin Department of Natural Resources office. You can do this by submitting a letter requesting a low hazard exemption for using ground wallboard as a soil amendment. An example letter developed by WasteCap Wisconsin is attached at the end of this document.

1. Estimate how much you will generate

Using estimates of waste breakdown from home construction provided by the National Association of Home Builders, a rule of thumb when determining scrap gypsum wallboard generation is that approximately one pound of waste is created for every square foot of construction area.³ Interviewing drywall contractors and conducting field tests should also help give you an accurate estimate of generation.

For a more accurate estimate, US Gypsum uses a 3.8 times multiplier of the square foot floor area for single family homes to estimate scrap gypsum wallboard generation and an estimated 20% waste factor. Therefore, the calculation for a 2,000 square foot home would be:

$2,000 \text{ ft}^2 \text{ (floor area)} * 3.8 = 7,600 \text{ ft}^2 \text{ of wallboard. } 7,600 * 20\% \text{ waste } (.20) = 1,520 \text{ ft}^2 \text{ of wallboard waste. Current weight of } \frac{1}{2}'' \text{ regular is } 1.6 \text{ lb/ft}^2. 1,520 \text{ ft}^2 \text{ waste} * 1.6 \text{ lb/ft}^2 = 2,432 \text{ lb of wallboard waste.}$

2. Separate clean scrap gypsum wallboard from construction

Gypsum wallboard to be processed and land spread must be new and clean construction scrap free of tape, joint compounds, paint, nails, screws, or other contaminants. Only regular $\frac{1}{2}$ " drywall, Type X drywall, and Plaster Base (standard blue board) may be used for a soil amendment. There is less than 1% fiberglass content and no paraffin or other additives in the sheetrock or the paper.

¹ Wisconsin Statewide Waste Characterization Study. Cascadia Consulting Group. May 2003. Figure 1-1.

² Quantity and Composition Study of Construction and Demolition Debris in Wisconsin. Prepared by Camp, Dresser and McKee for the Recycling Market Development Board, Department of Commerce, State of Wisconsin. February 1998. Tables 3-2 and 3-4.

³ Waste News. National Association of Home Builders. March 31, 2003.

The following paper-faced gypsum panel can not be used as a soil amendment: WR (Green Board), Sheathing (Brown/Black Board), Mold Resistant Panels or Specialty Type X. These contain additives which may not be suitable as a soil amendment.

If you are not sure what the gypsum wallboard contains, obtain the materials safety data sheets (MSDS sheets) from the manufacturer. Note that as gypsum wallboard formulations change, this document may need to change, so you may want to check with your local DNR office on the types of wallboard you intend to recycle.

3. Conduct soil test and determine the application rate

Composition of gypsum wallboard

Gypsum is used in agriculture as a fertilizer and as a soil amendment. Both calcium and sulfur are essential plant nutrients. Normal agronomic application rates for calcium would be in the range of 100 to 200 pound of calcium per acre. Sulfur would be applied at 20 to 50 pounds of sulfur per acre. It is likely that the rate of crushed wallboard would be higher because of the spreading characteristics of the crushed material. The need for these nutrients depends on the crop, the soil type, the existing soil supply, and the contribution from other sources. Gypsum is not a liming material and will not increase the soil pH. In fact, large applications of gypsum may lower the soil pH slightly because the calcium ions displace hydrogen ions from clay surfaces, increasing the concentration of hydrogen ions in the soil solution. The effect is relatively short-lived and does not affect crop growth.⁴

Figure 1. A comparison of the nutrient content of ground scrap wallboard and agricultural gypsum.

Data adapted from Korcak, 1996. Table from “On Site Beneficial Use of Scrap Wallboard in Georgia Residential Construction” 2002.

Constituent (lbs/ton)	Ground Wallboard	Agricultural Gypsum
Calcium	444 – 456	534-570
Sulfur	320 – 328	402-424
Phosphorus	0.4 – 0.6	0.4
Potassium	1	0.1 – 0.2
Magnesium	11	3.0 - 3.8
Iron	4.24 – 4.82	.94 – 1.61
Manganese	0.2 – 0.3	.07 - .10
Boron	.03 - .04	.17 - .19
Sodium	1.8	1.8 – 2.0

Gypsum wallboard is a source of calcium and sulfur, similar to agricultural gypsum [see figure 1]. Most turf grasses and ornamental plants need these nutrients, and gypsum wallboard helps break up heavy clay soils, common especially in Southern Wisconsin.

Soil Test and Application Rate

Before ground gypsum is applied, a routine soil test must be taken on soil where gypsum wallboard will be applied to determine soil type. A routine analysis will tell you the soil pH, and the amounts of phosphorus, calcium, magnesium, and zinc available for plants to use. The application rate for the gypsum wallboard is based on the amount of silt and clay that is typically

⁴ Using Recycled Wallboard for Crop Production. Richard P. Wolkowski. Jan, 2005. www.wastecapwi.org

present in the soil surface. A list of Wisconsin DATCP certified laboratories is included at the end of this document.

Based on research by Richard Wolkowski, University of Wisconsin soil scientist, it is recommended that crushed wallboard application be limited to two tons per acre on sandy soils and five tons per acre on medium-textured or clay soils.⁵

Figure 2. Recommended rates of ground scrap wallboard for sandy soils

Sandy Soils (2 tons/4,000 lbs per acre)			
House Size (ft ²)	Scrap Wallboard (lbs)*	Area Need for Application	
		ft ²	acre
1,500	1,500	15,750	.36
1,750	1,750	18,375	.42
2,000	2,000	21,000	.48
2,500	2,500	26,250	.60
3,000	3,000	31,500	.72

*Assumes one lb of scrap gypsum wallboard per ft² of house

Figure 2. Recommended rates of ground scrap wallboard for medium-textured or clay soils

Medium-Textured or Clay Soils (5 tons/10,000 lbs per acre)			
House Size (ft ²)	Scrap Wallboard (lbs)*	Area Need for Application	
		ft ²	acre
1,500	1,500	6,300	.14
1,750	1,750	7,350	.17
2,000	2,000	8,400	.19
2,500	2,500	10,500	.24
3,000	3,000	12,600	.29

*Assumes one lb of scrap gypsum wallboard per ft² of house

Calculate the amount of land needed

The figures above provide estimates of amount of land needed for land application. To determine the actual application rates for your site:

1. Multiply the number of square feet in the house by one to determine scrap gypsum wallboard generation (or use estimates from your drywall contractors or your own analysis). (Example: a 2,000 ft² house will generate an estimated 2,000 lbs of scrap gypsum wallboard.)
2. Based on the soil tests, determine application rate (4,000 or 10,000 lbs per acre)
3. Determine square footage needed by multiplying pounds available by 43,560 ft² (1 acre) and dividing by application rate. (Example: 2,000 of scrap wallboard x 43,560 ft² divided by 10,000 lbs per acre = 8,712 ft² of land will be needed to apply the scrap wallboard to clay soils from a 2,000 ft² home)

Determine area you have available for application. For example, a 2,000 ft² house is being built on half acre lot (21,780 ft²). Approximately 4,000 ft² of the lot will be occupied by the house and impervious areas. This means 17,780 ft² of land is available for gypsum wallboard application. Using the above example, 8,712 ft² of land is needed for the gypsum wallboard scrap from one 2,000 ft² home. So, you could utilize the scrap gypsum wallboard generated from two 2,000 ft² houses (8,712 x 2 = 17,424 ft²) on this lot.

⁵ Richard P. Wolkowski. Land application of crushed gypsum wallboard waste for alfalfa.

Worksheet to calculate amount of land needed and area available for application

Calculate amount of land needed

1. Size of house (ft²) _____ x 1 lbs/ft² = _____ lbs of scrap gypsum wallboard
2. _____ lbs (from step 1) ÷ _____ lbs/acre application rate (4,000 or 10,000 lbs/acre) = _____ acres of land needed to apply scrap gypsum wallboard
3. _____ acres (from step 2) x 43,560 ft² = _____ ft² of land needed to apply scrap gypsum wallboard

Calculate area available for application

4. Size of lot (ft²) _____ - size of impervious areas (ft²) = _____ ft² available for application.

Compare. If the area available for application is equal to or larger than the amount of land needed, you have enough land to apply all the ground gypsum wallboard from your building site.⁶

4. Process and Store the Gypsum Wallboard

Grind clean gypsum wallboard with equipment that has a 2 1/8 inch screen or less to make sure the paper is shredded and there are no large chunks of wallboard. Controlling dust during grinding and storage is important. Cover the conveyor belt and the chute at the end of the grinder (see photo) to minimize dust. If ground gypsum wallboard will be stored before application, store it in a location where wind will not be an issue such as a concrete bunker, cover it with a tarp, or spray the material with water to form a light crust on the scrap gypsum wallboard and minimize blowing.



Store ground wallboard in a well-drained location away from organic matter (trash, grass clippings, etc.) as the combination of ground wallboard and organic matter in an anaerobic condition could lead to a bio-chemical problem.

5. Apply the ground gypsum wallboard

Apply ground gypsum wallboard according to the soil test results and calculated application rates. The ground gypsum wallboard should be evenly mixed into the top four to twelve inches of soil at or less than the recommended rate.

Note that dry, ground gypsum wallboard weighs about 400 pounds per yd³, and a skid loader bucket holds about 1 yd³, facts which may assist you in application.

⁶ Soil Test and Application Rate section adapted from "On-Site Beneficial Use of Scrap Wallboard in Georgia Residential Construction" University of Georgia, College of Agricultural and Environmental Sciences, Cooperative Extension Service and the Engineering Outreach Service along with the Pollution Prevention Assistance Division. December 2002.

For more information

For more information on recycling ground gypsum wallboard, see: www.drywallrecycling.org or www.wastecapwi.org/drywall.htm.

The following soil testing laboratories are Wisconsin DATCP certified. You will receive soil type information as well as University of Wisconsin nutrient application recommendations based on the soil test results.

UW Soil & Plant Analysis Laboratory
5711 Mineral Point Rd
Madison, WI 53705
(608)262-4364
soil-lab@uwmadmail.services.wisc.edu

Dairyland Laboratories
217 E. Main Street
Arcadia, WI 54612
(608)323-2123
info@dairylandlabs.com

Rock River Laboratory
PO Box 169
Watertown, WI 53904
(920)261-0446
rllab@execpc.com

A&L Great Lakes Laboratories
3505 Conestoga Dr.
Fort Wayne, IN 46808
(219)483-4759
lparker@algreatlakes.com

Agsource Soil & Forage Lab
106 N. Cecil Street
Bonduel, WI 54107
(715)758-2178
aglab@agsource.com

Mowers Soil Testing Plus, Inc.
117 E Main St
Toulon, IL 61483
(309)286-2761
swiedman@mowersplus.com

UW Soil & Forage Lab
8396 Yellowstone Dr.
Marshfield, WI 54449
(715)387-2523
jbpeter1@facstaff.wisc.edu

This document was created by WasteCap Wisconsin, Inc. with technical review and assistance provided by Prairie Tree Landscape, UW-Madison Soil Science Department, US Gypsum, Wisconsin Department of Natural Resources, Wisconsin Department of Agriculture, Trade and Consumer Protection, Construction Materials Recycling Association, Packer Industries, and 3-D Building Solutions, LLC. www.wastecapwi.org. February, 2005.