Existing and Future Gypsum Recycling Markets

An Overview

December 14, 2023

Gypsum Association (GA)

- Founded in 1930 in Chicago, IL.
- Relocated to Silver Spring, MD, in 1984.
- Six Regular Members, one Associate Member
- Members produce over 95% of the gypsum panels sold in the U.S. and Canada.

Regular Members

Associate Member

Our Vision

The vision of the Gypsum Association is to ensure a future where gypsum products are recognized and relied upon as being essential to the health, safety, comfort, sustainability and resilience of our buildings and quality of life.

Main Areas Of Focus

- Provide resources, information, and technical assistance for the A/E/C value chain.
- Publish 30 technical documents: Specification, installation, finishing, overall use.
- GA Technical Services Center provides one-on-one technical support.
- Represent the gypsum industry before building code bodies in the U.S. and Canada.
- Participate in standards development organizations: ASTM, NFPA, UL, ASHRAE, etc.
- Lead industry-wide research efforts, testing initiatives, and other programs.
- Develop and maintain industry life cycle resources: PCR, LCA, EPD reports.
- Approved AIA and ICC Continuing Education Program Provider.
- Expanding complement of digital resources for GA members and A/E/C professionals.
- Compile, publish and archive industry production and shipment statistical data.

GA Staff

Stephen H. Meima, MBA, APR, LEED Green Assoc.
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What Do Gypsum Panels Contribute To The Built Environment?

- **Fire protection** for walls, ceilings, floors (as required by the building codes.)
- Smooth, monolithic surface ideal for applied decorative finishes
- Sound control
- Versatile and economical
- Ease of installation and repair
- Long in-place service life (60 or more years)

Why Is Demo Gypsum Rejected As Potential Recycled Feedstock?

- Material product safety concerns:
  - o Exposure during service life (e.g., lead paint)
  - o Unknown sources (e.g., “Chinese drywall”)
  - o Asbestos contamination (older joint compound)
  - o Among others.

- Litigation risk from potential contamination.

GYPSUM ASSOCIATION®

Existing Markets for Recycling and Reuse of Gypsum Panels

- Feedstock for new gypsum panels
- Agricultural soil amendment
- Mushroom cultivation
- Nurseries
- Urban parks and recreation areas
- Residential lawns (sod)
- Golf courses
- Compost (additive)
- Portland cement manufacture
- Grease absorption
- Sludge drying
- Water treatment
- Soil remediation
- Athletic field marking
- Animal bedding (recovered paper)

Current Gypsum Recycling Rates

EPA: C&D Management By Material and Destination in 2018 (600 Million Tons)

Material Type in C&D Debris	Landfill	Next Use					Total Next Use
		Compost and Mulch	Manufactured Products	Aggregate, Other	Fuel	Soil Amendment	
Concrete	71.2	0	32.8	301.2	0	0	334.0
Wood	29.6	2.5	1.2	0	7.5	0	11.2
Gypsum Drywall	13.2	0	.2	0	0	1.9	2.1
Metal	1.1	0	3.6	0	0	0	3.6
Brick and Clay Tile	10.8	0	0	1.5	0	0	1.5
Asphalt Shingles	13.0	0	2.0	.1	.02	0	2.1
Asphalt Concrete	4.9	0	91.8	10.3	0	0	102.1
TOTAL	**143.8**	**2.5**	**131.6**	**313.1**	**7.5**	**1.9**	**456.6**

CALIFORNIA

CA GWB Composition by Supply Region

- Based on 13 plants
  - Weighted average basis

    (may not add to 100% due to rounding)
  - Virgin ore may be either natural or FGD gypsum
- Clean cut-offs input minor but higher for plants operating within CA

Percent Board Composition

All Plants	Virgin Ore	Int Fab Scrap	Clean Cut-offs
Total	96%	4%	1%
North	98%	3%	1%
Central	95%	2%	4%
South	96%	5%	0%
CA Plants	Virgin Ore	Int Fab Scrap	Clean Cut-offs
Total	97%	2%	2%
North	99%	2%	1%
Central	95%	1%	4%
South	98%	3%	0%
Outside CA Plants	Virgin Ore	Int Fab Scrap	Clean Cut-offs
Total	94%	6%	0.02%
North	95%	5%	0.17%
Central	95%	5%	0.04%
South	94%	6%	0.00%

Potential Future Markets

Phase II Research: Partial Cement Replacement in Concrete with Gypsum Powder from Waste Drywalls

— Sponsored by Divert Nova Scotia and the Gypsum Association

— Conducted by Pedram Sadeghian, Associate Professor and Canadian Research Chair in Sustainable Infrastructure, Dalhousie University and Kasra Takbiri, MASc Student (Graduated Apr. 2023)

Phase I Research: Promising

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Recycled gypsum powder from waste drywalls combined with fly ash for partial cement replacement in concrete

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ABSTRACT

Recent developments towards sustainable infrastructure have motivated more environmentally conscious construction practices. The concrete industry is known to have a large carbon footprint, which can be decreased by reducing the amount of cement required, thereby reducing the demand for virgin material production and its associated carbon emissions. Excessive waste accumulation is another notable environmental issue, and gypsum drywall is a major source of construction and demolition waste, typically disposed of unsustainably in landfills. To assess the recycling potential of gypsum waste in concrete, this research utilized gypsum in quantities above those typically considered to partially replace cement. This experimental study was conducted to investigate the mechanical performance of concrete with recycled gypsum powder (hereafter called gypsum) combined with fly ash as supplementary cementing materials. A total of 15 different concrete mixes were prepared containing 0, 5, 10, 15, and 20% gypsum and 0, 25 and 50% fly ash as partial replacement for cement. Superplasticizer was used to regulate the mixture consistency, as adding gypsum was found to dehydrate the mix. Nine identical specimens per mix were cast into 200 mm × 100 mm cylindrical molds, and three of each were tested for compressive strength after curing in a moist room for 7, 28 and 90 days. The study revealed that using only gypsum as a partial cement replacement was disadvantageous to strength, however combining fly ash and gypsum was beneficial at later ages. After 90 days, all mixes containing 50% fly ash revealed that additional gypsum did not have negative effects on the compressive strength. The presented research suggests that the novel application of recycled gypsum in concrete is achievable from a structural perspective, and including fly ash is essential. In order to be considered a practical alternative to traditional concrete, further investigation is recommended.

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Article

Durability of concrete containing gypsum powder recycled from waste drywalls combined with high content of fly ash as supplementary cementing materials

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Abstract

To address the negative contribution of cement production on global carbon emissions, this study aims to reduce the cement content typically required in concrete by using partial replacement by gypsum powder recycled from waste drywalls (15%) and fly ash (50%), by weight. The durability of concrete cylinders made of the mixture was evaluated by testing the cylinders in compression after exposure to various environmental conditions for 1000, 3000, and 5000 h. A total of 45 specimens under 5 exposure conditions were considered. The conditions included dry, submerged in fresh water, submerged in seawater, and two groups rotated weekly between dry and submerged in either fresh water or seawater. Overall, specimens in both freshwater and seawater conditions after 5000 h showed strength higher than control specimens. Results indicate that the strength of the concrete specimens containing recycled gypsum powder and fly ash was not adversely affected by exposure to the conditions.

Key words: concrete, durability, recycled gypsum, waste drywall, fly ash, compression

Why Look at Replacement of cement?

- Roughly 1,370 pounds of CO2 is produced for every metric ton of cement manufactured: Any reduction of cement in concrete is good for the environment.
- Avoid landfilling gypsum waste: Takes up valuable space and can generate hydrogen sulfate gas.
- Conserves virgin resources.

Phase II: Evaluate impact of Gypsum / Fly Ash as supplementary cementitious material

Mixes

Recipe 1	Recipe 2
30 % Cement	40% Cement
20% Waste Gypsum	10% Waste Gypsum
50% Fly Ash	50% Fly Ash

Durability Testing

- Specimens exposed to durability exposures: dry, submerged in fresh or sea water, and wet/dry cycles.
- 1000–6000-hour exposure in the above scenarios.
- Followed by compression testing.

Phase II Results: A Few Take Aways

- Comparable performance with conventional cement under certain conditions.
- Recycled gypsum with visible paper remnants showed as much promise as finely sieved gypsum.
- Over the long term, environmental conditions had no negative impact on the mechanical properties of gypsum concrete.
- Results will be published in the American Society of Civil Engineering's *Journal of Materials in Civil Engineering*.

Thank you!

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Questions?