# Treatment and Disposal of Gypsum Board Waste

## *Industry Position Paper*

*Editor's note: This is Part One of a two-part article on gypsum board waste. Originals developed as an "Industry Position Paper" by the Gypsum Association, the article is reprinted with permission of the Gypsum Association, Washington, D.C.*

**Background**

Gypsum, or calcium sulfate dihydrate, ($CaSO_4 \bullet 2H_2O$) is the major component of drywall, or gypsum board, core. It is a naturally occurring mineral, deposited largely as a result of the evaporation of water in ancient inland seas, which contained large amounts of dissolved gypsum. For example, the evaporation of a typical 20,000 gallon residential swimming pool filled with seawater will generate about 250 pounds of gypsum.

In the White Sands National Park in New Mexico, over the years the action of the wind has caused a physical change to surface deposits of natural gypsum rock, converting them into gypsum sand which covers an area of 270 square miles. Yellowstone National Park, on the other hand, provides several good examples of chemical changes of naturally occurring gypsum within the sulfur hot springs, whereby bacterial action changes the gypsum into other sulfur-containing materials, including elemental sulfur.

The well-known large deposits of sulfur in the salt domes of Texas and Louisiana are believed to be derived from the action of sulfate reducing bacteria (SRB) on large deposits of gypsum previously formed by the evaporation of ancient seas.

However, such natural chemical changes of gypsum into other sulfur-containing compounds require very specific conditions, including the presence of other chemical species. gypsum alone is a very stable material which will not decompose in air, as illustrated by the excellent condition of gypsum plaster decorations lining the walls of 5,000-year-old Egyptian tombs. The normal impurities in natural gypsum rocks are limestone ($CaCO_3$), dolomite [$CaMg(CO_3)_2$] and anhydride ($CaSO_4$), with minor amounts of clay and silica. These minerals are also very stable and do not detract from the inert nature of gypsum rock.

**Gypsum manufacturing companies are learning how to recycle gypsum board wastes.**

**What is Gypsum Board?**

Gypsum board is the generic name for a family of panel products consisting of a non-combustible core, primarily of gypsum, with a paper surfacing on the face, back and long edges. Often called drywall, wallboard, or plasterboard, it differs from products such as plywood, hardboard and fiber board because of its noncombustible core.

Gypsum rock is mined or quarried, then processed into various products --most notably the gypsum wallboard and plaster which make up the wall and ceiling surfaces of most homes and offices in the United States and Canada today. To make the board, the gypsum rock is crushed and heated to about 350 degrees F, driving off three fourths of the chemically combined water in a process called calcining. One hundred pounds of gypsum rock contains approximately 21 pounds (or 10 quarts) of chemically combined water. The calcined gypsum (or hemihydrate) ($CaSO_4 \bullet 1/2H_2O$) powder is then used in producing the base for gypsum plaster, wallboard and other gypsum products.

To produce gypsum board, the calcined gypsum is mixed with water, foam and additives to form a slurry which is fed between continuous sheets of paper on a continuous belt line. As the board moves down this belt line, the calcined gypsum recrystallizes or

rehydrates, reverting to its original gypsum state, and the paper sheets becomes firmly bonded to the rehydrated core. The board is then cut to length and conveyed through dryers to remove free moisture.

Gypsum is a mineral which will not bum: therefore, gypsum products are recognized as fire resistant by building, fire, and insurance authorities throughout the world.

**Other Uses of Gypsum**

Gypsum is non-toxic to humans and can be helpful to animals and plant life. In fact, it is beneficial to humankind and the environment when used:

--As a soil additive to improve the workability and water penetration of soils through calcium-sodium exchange. Sometimes called "landplaster," it is particularly effective with alfalfa, corn, cotton, wheat and other crops which require substantial amounts of sulfate sulphur.

--To supply plants with readily available calcium--e.g., potatoes, cranberries and peanuts.

--To counteract the corrosive effect of alkali on plant roots by adding sulfates to the soil.

--To settle dirt and clay particles in turbid water, particularly ponds, without injury to aquatic life.

--To neutralize and buffer acidic waters.

--As a basic ingredient in blackboard chalk.

--In sheep and cattle feed to overcome sulfur deficiencies in the animals.

--In animal wastes, to combine with ammonia (NH,) and reduce odor.

--In plaster molds used to form dental work, and other items such as china plates, cups and saucers.

--For surgical and orthopedic casts, as Plaster of Paris.

--To neutralize the salt placed on roads during the winter and enable grass to grow more easily along the roadway.

--As a soil additive for lawn care purposes.

Gypsum (calcium sulfate) is recognized as acceptable for human consumption and a wide variety of uses by the U.S. Food and Drug Administration (FDA).

--As a nutrient and/or dietary supplement as a source of calcium.

--As a conditioning agent for water used in the brewing of beer and as an agent to control the tartness and clarity of wine.

--As an element in food containers since it is considered safe as a migrating substance from such containers.

--As a color additive base for drugs and cosmetics, and as a pigment to color food contact surfaces.

Perhaps not so well known are the many ways gypsum hascontributed to culture through the ages. Much of the world's masterful statuary has been carved from alabaster, a form of gypsum. Michelangelo's ceiling mural in the Sistine Chapel was painted on a gypsum base to assure its preservation, as were most murals of the period. The Egyptians as far back as 3700 B.C. also used gypsum as a base to preserve the wall murals in their pyramids. Gypsum, in the age of man, has been an important contributor to culture as well as construction.

**Sources of Waste Gypsum Building Material**

Waste gypsum building materials are generated in any of three different ways; during the gypsum board manufacturing process, from new construction, and from remodeling/demolition.

Obviously, for economic and competitive reasons, it is in a manufacturer's best interest to produce the highest quality board while generating as little waste as possible. Some gypsum board that does not meet product standards is cut into pieces and used for risers between stacks of finished product to facilitate mechanical handling and warehousing of the board.

New construction also generates waste gypsum board. It is estimated that 10% of ail construction site board ends up as waste. This is because it is more cost effective to cut out necessary openings in the board than it is to pre-measure around the opening and cut the board accordingly. Much of the material that is cut out for ducts, small windows, electrical outlets, etc, becomes waste.

Another source of gypsum waste is remodeling/demolition. Every time an old building is torn down or renovated, waste gypsum is generated. Also, every time office space is renovated--for instance, to accommodate new tenants--and every time homeowners remodel their homes, waste gypsum may be generated.

Some gypsum board waste cannot be recycled. Demolition and remodeling waste cannot be recycled into gypsum board due to the presence of contaminants from other products which cannot be separated and may affect the gypsum board manufacturing process or subsequent board quality. Therefore, this particular waste board must be handled in an alternative manner.

**Landfill Sites**

North America is suddenly awakening to the fact that its existing, easily accessible landfill sites are rapidly being filled by ever increasing amounts of garbage and waste. Coincident with this is a growing grass roots movement to increase the recycling of waste products, and a greater awareness of the potential environmental damage which poorly designed and/or ill-managed landfill sites can wreak.

Inarguably, conservation and recycling of waste materials are foremost among the requirements of municipal, state, provincial and federal authorities in North America today.

Due to the significant environmental impact studies required, and the frequent opposition of local concerned residents, it is becoming much more difficult and very costly to obtain approvals for thedevelopment of new landfill sites. Further, potential liabilities for violation of the U.S. Resource Conservation and Recovery Act (RCRA), which regulates solid and hazardous waste disposal, can be as high as $50,000/day or imprisonment for up to five years, or both.

In light of these issues, it is no surprise that the disposal of new

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construction waste, demolition waste and gypsum board manufacturing waste is becoming more costly.

**Gypsum Waste is Landfills**

In the past, gypsum production and construction waste has been acceptable waste material at landfill sites, but some landfill operators and municipalities (essentially due to shortage of landfill space) are no longer accepting gypsum wastes of any kind. Other landfill sites are increasing the cost of landfilling to the extent that alternative means of disposal, such as effective reuse or recycling, is becoming economically feasible. Any negative publicity on the disposal of gypsum wastes, valid or otherwise, serves to generate more incentive to recycle, for both the independent recycler and the gypsum board manufacturer.

***The gypsum industry supports the goal of reducing the U.S. landfill burden.***

As always, problems create opportunities.

Most gypsum manufacturing companies, many of whom in the past have been involved in some forms of limited recycling, are now learning how to increase the amount of recycling they are doing and are looking for new uses for waste materials Where the economics are favorable, independent recycling firms are also developing gypsum waste recycling systems.

Coincident with the growing public concern over waste disposal and the environment, and the rapid rise in the cost of disposal of gypsum wastes, there has been a growing base of very misleading reports that gypsum board, on its own, creates toxic hydrogen sulfide gas when disposed of in landfill sites. Typical of one of the more recent of such reports is an early 1988 article entitled "Building Boom Byproduct" which presents a very negative view of the potential of gypsum board waste to decompose to hydrogen sulfide gas in landfill sites. The source documents referenced in this news article originated from Vancouver, Canada, where a very localized problem had existed in the 1970s and early 1980s but is no longer a problem.

Gypsum and other sulfate minerals may decompose to hydrogen sulfide gas in landfill sites, but only in the presence of other materials and under limited specific conditions. Control of drywall landfilling so that it is separated from organic waste materials appears to eliminate or reduce hydrogen sulfide gas generation to below the nuisance level.

**Solutions: Gypsum Board Waste Management**

Gypsum board manufacturers arc increasingly recycling board waste back into new board products. Based on

current technology, however, there is a limit to the amount of recycled material that can be used in new manufactured board before the board quality and performance characteristics are compromised.

Several states have approved gypsum board for use as a soil conditioner. The finely ground up gypsum waste functions much like gypsum landplaster as a soil softener and calcium nutrient additive.

Gypsum board waste does not normally create problems in landfills. However, under extremelywet conditions (high water table), waste board can contribute to the growth of anaerobic bacteria, as previously addressed. Gypsum is simply a good "food source" for anaerobic bacteria. When wet landfill conditions occur it is suggested that board waste be separated from other wastes, especially organic wastes, and placed in a specific area of the landfill. At least one scientificstudy has shown that adding lime (calcium oxide) at a rate of 3-5 pounds per ton of gypsum will help protect against the growth of anaerobic bacteria. The lime will raise the pH of the gypsum to a level that inhibits the growth of anaerobic bacteria. * Wells can be placed (if desired) around the gypsum filled areas to test and monitor for the presence of any leachate.

These recommended solutions are made on the basis of laboratory research which has indicated that they may be effective and environmentally sound methods of disposing of waste gypsum board. The gypsum industry is continuing to explore research options which will verify that similar results would be observed under real-world conditions.

**Conclusion**

The gypsum industry supports the goal of reducing the landfill burden in both the United States and in Canada. The industry is committed to reaching the maximum recyclability of gypsum board that is both economically feasible and technologically practicable without sacrificing either the quality of the integrity of subsequent board products.

* As reported in "Investigation of Means to Control Sulphide Production in Drywall Landfill Disposal Operations," Hardy Associates, British Columbia, 1984.

Additional technical information, complete with references, is available from the Gypsum Association.