Natural Stone Council

The United Voice of the Natural Stone Industry

Best Practices of the Natural Stone Industry

Solid Waste Management at the Quarry and Fabrication Facility

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The Natural Stone Council (NSC) is a collaboration of businesses and trade associations that have come together to promote the use of Genuine Stone in commercial and residential applications. By pooling resources, their goal is to increase the understanding of, preference for, and consumption of these natural products. Trade associations affiliated with the NSC include Allied Stone Industries, Building Stone Institute, Elberton Granite Association, Indiana Limestone Institute, Marble Institute of America, National Building Granite Quarries Association, the National Slate Association, New York State Bluestone Association, Pennsylvania Bluestone Association, and the Natural Stone Alliance.

The Natural Stone Council is committed to supporting sustainable initiatives and innovations at all levels of the production of Genuine Stone® products. As such, the NSC has established a Sustainability Committee made up of key industry members to elevate the issue of sustainability within the industry and provide a body responsible for planning and implementing relevant initiatives. In 2007, the NSC Sustainability Committee engaged in a partnership with the Center for Clean Products (CCP) at the University of Tennessee to assess current industry operations relating to dimensional stone production. In 2011, the NSC Sub-committee further reviewed and updated this document. The best practice identified and presented in this document is a direct result of the NSC and CCP's efforts to identify and improve the environmental profile of the natural stone industry.

This document is intended to establish guiding principles for the stakeholders as "Best Practices" in our industry and IS NOT intended to serve as a reference standard.

Importance of Waste Management

Solid waste management is a fundamental component to any manufacturing or production enterprise. The natural stone industry is unique in that the majority of its solid waste stream is its raw material. It is estimated that 175 million tons of quarrying waste are produced each year,[1] and although a portion of this waste may be utilized on-site, such as for excavation pit refill or berm construction, it is often difficult to find a use for all scrap stone and fines produced. Coupling this with the industry's other waste streams, such as heavy equipment, wastewater sludge, and general site trash, it is necessary that every operation in the natural stone industry develop and abide by a waste management plan.

Through implementation of a proactive waste management strategy, unnecessary fines, occupational exposures, and environmental degradation can be avoided. Additionally, an opportunity exists for companies to distinguish themselves as a socially responsible and environmentally considerate operation. This document provides approaches to achieve such practices at a quarry or fabrication facility.

Benefits of Proper Waste Management

Establishment of a thorough waste management plan generates a multitude of advantages for a quarry or fabrication plant. These include the following:

- *Improved health and safety:* Decreasing the amount of scrap piles, airborne particulates, and general trash creates a healthier and safer environment for employees. A healthy workforce provides lower health care costs for employers.

- *Reduced storage, transport, and disposal costs:* With less waste to store and transport, the costs of handling waste are diminished. Landfill fees are avoided, and diesel expenses are reduced.

- *Potential generation of revenue*: Scrap stone, sludge, and other waste products and waste by-products can be sold on an array of markets, from agriculture to construction, creating a secondary company revenue stream.

- *Increased efficiency*: Decreasing the amount of material lost during the quarrying, crushing, and cutting processes increases company efficiency and the quantity of profitable product. In effect, the company sees a heftier return for every ton of product sold.

- *Enhancement of company reputation*: Comprehensive, proactive waste management practices can result in not only a socially responsible reputation but in greater community acceptance of the quarrying operation.

Sources of Waste from Quarries and Fabrication Plants

Waste generated at quarries and fabrication plants is quite similar. Most commonly, scrap stone must be mitigated and managed, but attention must be paid to equipment, petroleum products, wastewater sludge, and general trash. It is recommended that each quarry and fabrication plant establish a waste management plan that includes continuous minimization and proper management, particularly reuse, recycling, and lawful disposal, of all site waste streams.

Stone Waste

The greatest waste concern in the stone industry is stone itself, specifically in the forms of overburden, screening residual, wastewater sludge, baghouse fines, and stone fragments.[2] There is wide variation in waste generation across the industry due in part to the varying types of products being manufactured. A 2006 survey of the natural stone industry conducted by the University of Tennessee Center for Clean Products (UT) indicated that anywhere from 3-93% of the total material quarried is wasted[3], while other studies report values from 15% to 78%.[4,5] Additional waste is generated from fractured blocks, the sawing and polishing processes, and the rejection of broken or damaged slabs. One study approximates that for every 1000 tons of marble quarried, only about 70 tons will be used in a completed building.[6] The 2006 UT survey mentioned above found that 6-69% of the stone that enters a fabrication plant leaves as waste.[7]

Cladding material needs to be carefully selected and cut for visual appeal and structural stability, whereas stone being crushed can carry less favorable aesthetics and be ridden with fractures. Monument construction also creates a large amount of waste due to the stringent requirements for visual appeal; it is estimated that 75% of the stone used to build such decorative pieces is discarded as waste through the cutting and shaping process.[8]

No matter the extent of precaution taken in curtailing stone waste, some amount will inherently be produced. Natural fissures and weaknesses in a deposit may inevitably result in stone that chips or does not meet structural standards. Moreover, sawing processes unavoidably generate kerf waste, the amount of which is dependent on numerous factors, including saw quality, wire tension and grit, as well as blade diameter and width. Choosing an appropriate saw type for the specific stone being cut can minimize kerf waste but will not eliminate it. As such, developing and implementing a comprehensive waste management strategy should be a priority for every quarry and processing facility.

Other Types of Waste

Additional waste created by quarrying and fabricating operations includes equipment, spent petroleum products, wastewater sludge, and trash. Machinery and tools eventually warrant refurbishment or replacement, creating a potential stream of scrap metal and mechanical parts. Proper disposal of petroleum products is mandated by law. If a wastewater treatment system is in place, as is recommended by the NSC (see the best practice entitle Water Consumption, Treatment & Reuse) and as may be required by law, sludge must be utilized or disposed of properly. Further, miscellaneous trash produced by employees must also be consciously managed. Minimization of each one of these waste stream is feasible by implementing the best practices recommended in this document and continuously exploring new avenues of mitigation. These practices have become especially paramount as landfill fees continue to rise with diminishing landfill space and increased regulation of landfills in the United States.

Impact of Quarry Waste

Waste from quarry and fabrication operations can be unsafe and environmentally detrimental. Scrap stone can create an undesirable visual impact as well as dangerous working conditions if it is not well organized or if piles are allowed to be stacked carelessly. Runoff from the scrap mounds can cause erosion problems, and fines introduced into natural waterways can suffocate local ecosystems. Airborne dust from uncovered stockpiles or poorly functioning filtration equipment can cause respiratory, ocular, or dermal irritation for employees and be a visual or even respiratory burden on local communities. If a stone contains silica, employees could potentially be afflicted with silicosis, a lung disease causing breathing difficulties and sometimes mortality. Further, if waste must be disposed of off-site, landfill fees can create additional costs for quarry and fabrication operators. Other types of manufacturing wastes, like antifreeze and lubricants, have the potential to create environmental problems if they are leaked onto the ground or into a waterway. A multitude of regulations exists to minimize these impacts, and noncompliance can

lead to regulatory fines. The intent of this document is to provide guidance in going above and beyond legal mandates.

Best Practices

The NSC recommends that each facility develops a waste management plan built on three hierarchal principles:

1. *Produce less waste:* Improve production methods to mitigate all types of waste.

2. *Exploit the value of waste:* Implement strategies to reuse, recycle, compost, sell, create new products, or otherwise prevent waste from being landfilled or incinerated.

3. *Manage waste properly:* Follow regulations for lawful disposal of wastes that cannot be given a second life.

In addition to the recommendations presented in this document, the Environmental Protection Agency (EPA) Office of Solid Waste's website provides information that can assist in developing a proactive and sustainable waste management strategy. Visit http://www.epa.gov/osw/conserve/rrr/index.htm to learn about both industrial and municipal solid waste streams.

Minimization of Waste Production

A number of practices can be implemented to reduce the waste generated during quarrying and fabrication operations. By implementing these strategies, additional product is created, operational efficiency is enhanced, and occupational hazards are mitigated or eliminated. Each of these results is a form of cost savings.

Quarry Reconnaissance

- Conduct accurate resource evaluations so that excavation is carried out in such a way as to maximize production.

- Ensure that the quarry design maximizes the amount of usable product. Quarry yields can be affected by the direction of cuts.

- Use wire and belt saws where possible as a replacement method for blasting. This can improve accuracy and efficiency during extraction. If blasting is necessary, learn about proper techniques to minimize deposit damage, as well as airblast and vibrations.

Fines & Screenings

- Research and select machinery that produce fewer fines during crushing.

- Ensure that proper screen sizes are used to sift aggregate.

- Check equipment periodically to certify that dull saws or worn-out drills are not creating excessive dust.

- Sweep floors regularly to minimize dust build-up and prevent excessive airborne particulates. Power sweepers are handy machines for this task. When considering the use of sweeping compounds, evaluate the human health and environmental impacts of the product prior to use. Always provide proper personal protective equipment as needed.

Scrap Stone

- Consult with an equipment expert who can provide advice tailored to the type of stone being cut. Discuss such topics as appropriate cutting equipment, machine settings, and technology limitations.

- Use thinner saw blades where possible to reduce kerf.

- Carefully design and measure cuts to minimize scrap. The use of CNC (computer numerically controlled technology) equipment can aid with radial work and profiling.

Other Waste Streams

- Purchase only recyclable and/or compostable packaging material.

- Invest in reusable packaging material, and *reuse it*. Minimizing the amount of garbage landfilled reduces hauling and dumping fees.

- Encourage employees to utilize reusable lunch sacks and containers. Again, disposal fees are a function of the mass of trash discarded.

Waste Exploitation

A large portion of the waste created at a quarry or fabrication plant has inherent value. Scrap stone has a monetary value whether it is in the form of fragments, fines, or wastewater sludge. Compostable materials degrade into nutrients, providing free topsoil for site landscaping. Equipment can be sold for scrap metal or for second-hand use. Identifying a second life can prove profitable instead of discarding these materials or storing them on-site. Although some of the waste streams may not generate significant revenue, a company's commitment to creatively utilizing their waste helps establish a reputation of social responsibility. In today's eco-minded society, such a reputation can be particularly influential to customers.

Waste Stone

In some areas of the country, the market for scrap stone is bursting as production overwhelms demand. This requires that the quarry or plant operator be inventive in the search for a market niche. Surveying employees or even the community may generate constructive ideas. At the very least, a multitude of options should be explored; some suggestions ensue. Keep in mind that stone may need testing, such as for mineral composition, prior to marketing it for certain applications.

Sell
Many areas around the country have salvage yards and scrap dealers that may accept or purchase stone scrap. Websites like http://recycle.net/ create a place to sell and buy scrap materials. The lists below provide potential market avenues for natural stone.

- Fine materials can be sold for use in a variety of applications, including the following:[9]
  - Asphalt and concrete production[10,11]
  - Brick manufacturing[12]
  - Construction fill[13]
  - Media for biofiltration systems or soil remediation[14]
  - Mineral content for soil[15]
  - Alternative aggregate production[16]

- Aggregate is a profitable material as it has numerous functions, such as the following:

- Construction fill
- Concrete mixture ingredient
- Landscaping & decorative uses
- Media for biofiltration systems[17]
- Residential driveway development
- Roadbed construction material

- Larger stone pieces and cobbles can be marketed in the following capacities:
  - Fill for gabion retaining walls
  - Jetty rock
  - Landscaping & decorative uses
  - Rip rap

- Damaged blocks or slabs may be promoted for use as the following:
  - Aggregate
  - Cut stone tiles
  - Stone pavers
  - Veneer

- Consider investing in a stone crusher, striker, breaker, or other such equipment to minimize waste and create revenue in the form of crushed products.

- Sell scrap to be used as fiber in paper production. Visit http://naturalsourceprinting.com/fiberstone.html for details.

- Communicate with architects and designers. Some firms are very conscious of the need to utilize waste material and may purchase material that others would deem unsuitable.

Donate

Natural stone can be donated to a diverse array of projects—from construction to landscaping to decorative. By giving away material that does not sell, not only is the scrap stone removed from the quarry or processing site, the donation may generate a tax credit for the company.

- Donate scrap to neighborhood projects. Demonstrating community involvement garners local support and may generate new or repeat customers.

- Donate scrap to Habitat for Humanity. Their Habitat ReStores collect and sell discounted, used construction materials for extremely low prices. Proceeds help fund the construction of Habitat houses. See their website for locations and details: http://www.habitat.org/env/restores.aspx

Advertise

Exchange your services and products for advertising, only requiring that a small advertising sign be placed near the work. What better way to attract customers than to demonstrate your company's capabilities in a bustling public area? Moreover, local media may be interested in covering your company's good will, resulting in additional printed or verbal advertising. Specific initiatives may entail the following:

- Offer landscaping services to a community park, government building, or schools.

- Offer to construct stone signage for local businesses or neighborhood developments.

- Landscape the property (of the quarry and fabrication facility), particularly around the sales office. A well-manicured site will send a message of company pride and professionalism.

Innovate

There's always room for creativity. Turn scrap stone use into an innovation point for the company.

- Design new marketable products that can consistently be made from common scrap shapes.[18]
- Form scrap piles into artistic pieces around the facility.
- Hold a contest for company employees or community members to determine ways in which scrap stone can be put to good use.

Other Waste Streams

- Give used oil[*] a second (or third!) life. Re-refining oil requires only about one-third of the energy needed to refine crude oil into lubricant.[19]
    - Transport spent oil and oil filters to an oil recycling facility. To find a facility or for details, call the Filter Manufacturers' Council hotline at 800-99-FILTER or the EPA RCRA hotline at 800-424-9346.
    - If recycling is not available in the area, burn used oil for heating purposes with an approved oil burner.[†20] Federal regulations regarding used oil management are located under Title 40 of the Code of Federal Regulations (CFR) Part 279. Contact your state environmental department for local regulations.
    - On a related note, consider purchasing reclaimed oil instead of virgin. Look for the American Petroleum Institute's (API) starburst symbol that certifies the product meets the same high-quality standards as virgin oil. See the logo and read more on the API website: http://www.api.org/certifications/engineoil/about/index.cfm.
    - For more information, visit the EPA's Used Oil Management Program website: http://www.epa.gov/epawaste/conserve/materials/usedoil/index.htm.
- Sell equipment for parts and scrap metal or to be refurbished. Numerous websites exist to facilitate the sale and purchase of these products, and some equipment manufacturers' websites even have a page for secondhand items. Moreover, purchase secondhand equipment when possible. Not only may this be less expensive that procuring new tools but it will avoid the human health and environmental impacts associated with manufacturing new products.
- Find a new use for old tires. The most common recycling options in use are production of tire-derived fuels, civil engineering applications, and ground rubber/rubberized asphalt. Several organizations that facilitate tire recycling exist, and the EPA dedicates a portion of their website to this effort: http://www.epa.gov/epawaste/conserve/materials/tires/index.htm.

[*]Used oil is not the same as waste oil. Waste oil is virgin oil, such as storage tank bottoms and spill cleanup residue. Used oil is defined in Title 40 of the Code of Federal Regulations (CFR) Part 279 as "any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities". It does not include gasoline or diesel fuels.

[†]Found by a life-cycle assessment performed by the Institute for Energy and Environmental Research (IFEU of Germany), the environmental impact of burning oil is generally greater than re-refining, and depends on the type of primary fuel being replaced by the used oil. Re-refining is a more eco-friendly option (in categories of fossil fuel resources, global warming, acidification, nitrification, carcinogenic risk potential, and emissions of fine particulates) when used oil would replace gasoline or fuel oil in combustion. However, if spent oil is to replace coal or petroleum coke, burning the oil has a more favorable global warming impact than re-refining; combustion still generates a more detrimental footprint in all other categories.

- Market wastewater sludge in a number of applications. Some may require testing but may lead to a fiscally-worthwhile method of disposal.

    - Agricultural applications
    - Cement production[21]
    - Ceramics manufacturing, particularly floor and roof tiles[22,23,24]
    - Porcelain manufacturing, particularly floor tiles[25]

- Provide recycling bins for employees. The collection should include, at minimum, cardboard, glass, metal, paper, and plastic products. In states where a deposit is returned for cans and bottles, invest the money in the employees. Even minor acts of appreciation can boost morale and company loyalty.

- Establish a compost area, and encourage maximum composting at the facility. Provide signage to educate employees on compostable (and non-compostable) materials. In larger operations, this may create a new product to market; smaller businesses may only find the compost useful for site landscaping. Alternatively, allow employees to take the material for home use. For details on composting, visit the EPA's website: http://www.epa.gov/osw/conserve/rrr/composting/.

Proper Waste Disposal

When no option for recycle or reuse can be identified, waste should be disposed of in a safe and legal manner.

- Properly recycle antifreeze, petroleum products, and other potentially hazardous materials. Information about antifreeze and lubricant recycling can be found on the EPA website: http://www.epa.gov/epawaste/conserve/materials/index.htm.

Final Remarks

Operators and managers in the stone industry work to ensure that their products are quarried or manufactured in the most timely and cost-effective manner possible. Although some best practices may not appear to generate a profitable return, innovative practices can improve an operation in surprising ways. At minimum, a comprehensive waste management strategy should be enacted by ever quarry and processing operation in the natural stone industry. Employing even a few of the recommended best practices can provide important economic and environmental benefits to the company, the community, and the environment.

For questions regarding the content of this document or to learn more about the Natural Stone Council's sustainability efforts, please visit the GenuineStone® website at www.genuinestone.com or by email at info@genuinestone.com.

Industry Example

With scrap stone piles perpetually in sight, it is easy to overlook other waste streams leaving a quarry or processing facility, but Blume's, a Pennsylvania fabrication and installation business, strives to keep those emissions on their radar. Since its inception in 1988, the concept of recycling has been paramount to the company. Aluminum (soda) cans, ink cartridges, and paper products comprised the initial list of recycled materials, and as resources became available, that list expanded.

When the company began fabricating stone products in 2005, a closed-loop system was constructed to reclaim and reuse 100% of the production water. Shortly thereafter, it became apparent that something needed to be done with all of the scrap being generated. The solution was to use and sell the product as aggregate, but shipping and handling costs proved to be prohibitive. As such, Blume's purchased a stone crusher in 2008 and started churning out gravel, only crushing scrap that cannot otherwise be employed. The fabrication facility generates one quarter to one half ton each day and operates four days per week. Although Blume's current use of the gravel includes only enhancement of their own site, the company plans to one day sell the product as concrete aggregate or fill material.

As Marketing Manager Ashley Blume asserts, "By using our stone crusher and cardboard bailing system, we have seen great improvements in the frequency and cost it takes to remove our waste. By creating our own fill for our parking lots, we eliminate the need to constantly purchase from outside sources. Our water purification system nearly eliminates the amount of fresh water that is needed in our production process."

Crushing machine used at Blume's processing facility. Crushed material is currently used as fill for Blume's parking lots.

Donations are also an integral part of Blume's recycling program. Scrap material is given to schools who find it quite useful in shop classes, cell phones are collected and provided to a nearby battered women's society, and unwanted computers are sent to Habitat for Humanity. Although no profit is turned, the sense of social responsibility and good will is payment enough for the folks at Blume's.

Implementing such environmentally-conscious practices has not been simple for Blume's, though. "The largest challenge has been coordinating the recycling into our production process. We had to integrate it into the system while trying to minimize disruption to production. It takes a great deal of determination to keep with and enforce a broad recycling program," explains Ms. Blume. Based on her experience, Ashley advises, "Find a program that will work best for you and your company. Be persistent and get your employees to believe in the system." Lead by example, indeed.

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