

INDUSTRIAL STORMWATER

FACT SHEET SERIES

Sector E: Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities



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What is the NPDES stormwater permitting program for industrial activity?

Activities, such as material handling and storage, equipment maintenance and cleaning, industrial processing or other operations that occur at industrial facilities are often exposed to stormwater. The runoff from these areas may discharge pollutants directly into nearby waterbodies or indirectly via storm sewer systems, thereby degrading water quality.

In 1990, the U.S. Environmental Protection Agency (EPA) developed permitting regulations under the National Pollutant Discharge Elimination System (NPDES) to control stormwater discharges associated with eleven categories of industrial activity. As a result, NPDES permitting authorities, which may be either EPA or a state environmental agency, issue stormwater permits to control runoff from these industrial facilities.

What types of industrial facilities are required to obtain permit coverage?

This fact sheet discusses stormwater discharges from glass, clay, cement, concrete, and gypsum product manufacturing facilities as described by Standard Industrial Classification (SIC) Major Group 32. Facilities and products in this group fall under the following categories, all of which require coverage under an industrial stormwater permit:

- ◆ Flat glass (SIC 3211)
- ◆ Glass containers (SIC 3221)
- ◆ Pressed and blown glass, not elsewhere classified (SIC 3229)
- ◆ Hydraulic cement (SIC 3241)
- ◆ Brick and structural clay tile (SIC 3251)
- ◆ Ceramic wall and floor tile (SIC 3253)
- ◆ Clay refractories (SIC 3255)
- ◆ Structural clay products, not elsewhere classified (SIC 3259)
- ◆ Vitreous china plumbing fixtures and china and earthenware fittings (SIC 3261)
- ◆ Vitreous table and kitchen articles (SIC 3262)
- ◆ Fine earthenware (whiteware) table and kitchen articles (SIC 3263)
- ◆ Porcelain electrical supplies (SIC 3264)
- ◆ Pottery products, not elsewhere classified (SIC 3269)
- ◆ Concrete block and brick (SIC 3271)
- ◆ Concrete products, except block and brick (SIC 3272)
- ◆ Ready-mix concrete (SIC 3273)
- ◆ Gypsum products (SIC 3275)
- ◆ Minerals and earths, ground or otherwise treated (SIC 3295)
- ◆ Non-clay refractories (SIC 3297)

What does an industrial stormwater permit require?

Common requirements for coverage under an industrial stormwater permit include development of a written stormwater pollution prevention plan (SWPPP), implementation of control measures, and submittal of a request for permit coverage, usually referred to as the Notice of Intent or NOI. The SWPPP is a written assessment of potential sources of pollutants in stormwater runoff and control measures that will be implemented at your facility to minimize the discharge of these pollutants in runoff from the site. These control measures include site-specific best management practices (BMPs), maintenance plans, inspections, employee training, and reporting. The procedures detailed in the SWPPP must be implemented by the facility and updated as necessary, with a copy of the SWPPP kept on-site. The industrial stormwater permit also requires collection of visual, analytical, and/or compliance monitoring data to determine the effectiveness of implemented BMPs. For more information on EPA’s industrial stormwater permit and links to State stormwater permits, go to www.epa.gov/npdes/stormwater and click on “Industrial Activity.”

What pollutants are associated with my facility’s activities?

Pollutants conveyed in stormwater discharges from facilities involved with the manufacturing of glass, clay, cement, concrete, and gypsum product will vary. There are a number of factors that influence to what extent industrial activities and significant materials can affect water quality.

- ◆ Geographic location
- ◆ Topography
- ◆ Hydrogeology
- ◆ Extent of impervious surfaces (e.g., concrete or asphalt)
- ◆ Type of ground cover (e.g., vegetation, crushed stone, or dirt)
- ◆ Outdoor activities (e.g., material storage, loading/unloading, vehicle maintenance)
- ◆ Size of the operation
- ◆ Type, duration, and intensity of precipitation events

The activities, pollutant sources, and pollutants detailed in Table 1 are commonly found at glass, clay, cement, concrete, and gypsum product manufacturing facilities.

Table 1. Common Activities, Pollutant Sources, and Associated Pollutants at Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities

Activity	Pollutant Source	Pollutant
<i>Glass Manufacturing</i>		
Storage of materials	Exposed or spilled sand, soda ash, limestone, cullet, and petroleum products	Total suspended solids (TSS), chemical oxygen demand (COD), oil and grease (O&G), pH, lead
<i>Clay Product Manufacturing</i>		
Storage of materials	Exposed ceramic parts, pryophyllite ore, shale, ball clay, fire clay, kaolin, tile, silica, graphite, coke, coal, brick, sawdust, waste oil, and used solvents	TSS, COD, O&G, pH, lead, aluminum, zinc
Material handling, including loading/unloading	Exposed ceramic parts, liquid chemicals, ammonia, waste oil, used solvents, pryophyllite ore, shale, ball clay, fire clay, kaolin, tile, alumina, silica, graphite, coke, coal, olivine, magnesite magnesium carbonate, brick, sawdust, and wooden pallets	TSS, COD, BOD, TKN, O&G, pH, lead, aluminum, zinc
Forming/drying clay products	Clay, shale, slag, cement, and lime	TSS, pH

Table 1. Common Activities, Pollutant Sources, and Associated Pollutants at Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities (continued)

Activity	Pollutant Source	Pollutant
<i>Cement Manufacturing</i>		
Storage of materials	Exposed kiln dust, limestone, shale, coal, clinker, gypsum, clay, slag, and sand	TSS, pH, COD, potassium, sulfate
Material handling	Exposed kiln dust, limestone, shale, coal, clinker, gypsum, clay, slag, anhydrite, and sand	TSS, pH, COD, potassium, sulfate, O&G
Crushing/grinding	Settled dust and ground limestone, cement, oyster shell, chalk, and clinker	TSS, pH
<i>Concrete Product Manufacturing</i>		
Storage of materials	Exposed aggregate (sand and gravel), concrete, shale, clay, limestone, slate, slag, and pumice	TSS, COD, pH
Material handling	Exposed aggregate, concrete, shale, clay, limestone, slate, slag, and pumice as well as spills or leaks of cement, fly ash, admixtures and baghouse settled dust	TSS, COD, pH, lead, iron, zinc
Mixing concrete	Spilled aggregate, cement, and admixture	TSS, pH, COD, lead, iron, zinc
Casting/forming concrete products	Concrete, aggregate, form release agents, reinforcing steel, latex sealants, and bitumastic coatings	TSS, pH, O&G, COD, BOD
Vehicle and equipment washing	Residual aggregate, concrete, admixture, O&G in washwater	TSS, pH, COD, O&G
<i>Gypsum Manufacturing</i>		
Storage of materials	Exposed gypsum rock, synthetic gypsum, recycled gypsum and wallboard, stucco, perlite ore/expanded perlite, and coal	TSS, COD, pH
Material handling	Exposed or spilled gypsum rock, synthetic gypsum, recycled gypsum and wallboard, stucco, perlite ore/expanded perlite, and coal	TSS, pH, COD
Crushing/grinding of gypsum rock	Exposed or spilled gypsum rock and dust	TSS, pH
<i>All Facilities</i>		
Equipment/vehicle maintenance	Leaks or spills of gasoline, diesel, fuel, and fuel oil	O&G, BOD, COD
	Parts cleaning	COD, BOD, O&G, pH
	Waste disposal of solvents, oily rags, oil and gas filters, batteries, coolants, and degreasers	O&G, lead, iron, zinc, aluminum, COD, pH
	Fluid replacement including lubricating fluids, hydraulic fluid, oil transmission fluid, radiator fluids, solvents, and grease	O&G, arsenic, lead, cadmium, chromium, COD, benzene
	Vehicle fueling	Gas/diesel fuel, fuel additives

What BMPs can be used to minimize contact between stormwater and potential pollutants at my facility?

A variety of BMP options may be applicable to eliminate or minimize the presence of pollutants in stormwater discharges from glass, clay, cement, concrete, and gypsum product manufacturing facilities. You will likely need to implement a combination or suite of BMPs to address stormwater runoff at your facility. Your first consideration should be for pollution prevention BMPs, which are designed to prevent or minimize pollutants from entering stormwater runoff and/or reduce the volume of stormwater requiring management. Prevention BMPs can include regular cleanup,

collection and containment of debris in storage areas, and other housekeeping practices, spill control, and employee training. It may also be necessary to implement treatment BMPs, which are engineered structures intended to treat stormwater runoff and/or mitigate the effects of increased stormwater runoff peak rate, volume, and velocity. Treatment BMPs are generally more expensive to install and maintain and include oil-water separators, wet ponds, and proprietary filter devices.

Pavement Washwaters

A primary source of pollutants in the stormwater discharges from glass, clay, cement, concrete, and gypsum product manufacturing facilities are spilled materials or settled dust from material handling processes. As these materials have the potential for being conveyed in pavement washwater, a primary focus of the pollution prevention plan requirements for these facilities are good housekeeping measures, in particular, sweeping the paved portions of the site surrounding the material handling areas.

When mixed with stormwater, pavement washwaters are authorized under an industrial stormwater permit. However, the accumulated fly ash, cement, aggregate, kiln dust, clay, concrete, or other dry significant materials handled at the facility must be removed in a dry form from the pavement by measures such as sweeping or vacuuming. Washing the paved areas without first removing the accumulated solids may result in the discharge of these pollutants in the washwater unless it is contained on-site or otherwise collected without discharge. Washwaters may be collected into a BMP designed to remove solids prior to discharge, such as sediments basins, retention basins, and other equivalent measures. Where possible, pavement washwater shall be directed to process wastewater treatment or recycling systems.

A number of facilities in the concrete products industry maintain washwater recycle/retention ponds which receive the process wastewater from equipment cleaning and other operations. These ponds may also receive a portion or all of the runoff from the industrial site. These facilities are required to provide an estimate of the depth of the 24-hour duration storm event that would cause the recycle/retention pond to overflow and discharge to receiving waters. Methods to make this estimate can include, but are not limited to, the original design calculations for the recycle/retention pond or historical observation.

BMPs must be selected and implemented to address the following:

Good Housekeeping Practices

Good housekeeping is a practical, cost-effective way to maintain a clean and orderly facility to prevent potential pollution sources from coming into contact with stormwater. It includes establishing protocols to reduce the possibility of mishandling materials or equipment and training employees in good housekeeping techniques. Common areas where good housekeeping practices should be followed include trash containers and adjacent areas, material storage areas, vehicle and equipment maintenance areas, and loading docks. Good housekeeping practices must include a schedule for regular pickup and disposal of garbage and waste materials and routine inspections of drums, tanks, and containers for leaks and structural conditions. Practices also include containing and covering garbage, waste materials, and debris. Involving employees in routine monitoring of housekeeping practices has proven to be an effective means of ensuring the continued implementation of these measures.

Specific good housekeeping practices for glass, clay, cement, concrete, and gypsum product manufacturing facilities include:

- ◆ Preventing or minimizing the discharge of spilled cement; aggregate (including sand or gravel); kiln dust; fly ash; settled dust; or other significant material in stormwater from paved portions of the site that are exposed to precipitation.
- ◆ Using regular sweeping or other equivalent measures to minimize the presence of these materials.

- ◆ Preventing the exposure of fine granular solids (cement, fly ash, kiln dust, etc.) to stormwater where practicable, by storing these materials in enclosed silos/hoppers, buildings, or under other covering.

Minimizing Exposure

Where feasible, minimizing exposure of potential pollutant sources to precipitation is an important control option. Minimizing exposure prevents pollutants, including debris, from coming into contact with precipitation and can reduce the need for BMPs to treat contaminated stormwater runoff. It can also prevent debris from being picked up by stormwater and carried into drains and surface waters. Examples of BMPs for exposure minimization include covering materials or activities with temporary structures (e.g., tarps) when wet weather is expected or moving materials or activities to existing or new permanent structures (e.g., buildings, silos, sheds). Even the simple practice of keeping a dumpster lid closed can be a very effective pollution prevention measure.

Erosion and Sediment Control

BMPs must be selected and implemented to limit erosion on areas of your site that, due to topography, activities, soils, cover, materials, or other factors are likely to experience erosion. Erosion control BMPs such as seeding, mulching, and sodding prevent soil from becoming dislodged and should be considered first. Sediment control BMPs such as silt fences, sediment ponds, and stabilized entrances trap sediment after it has eroded. Sediment control BMPs should be used to back-up erosion control BMPs.

Management of Runoff

Your SWPPP must contain a narrative evaluation of the appropriateness of stormwater management practices that divert, infiltrate, reuse, or otherwise manage stormwater runoff so as to reduce the discharge of pollutants. Appropriate measures are highly site-specific, but may include, among others, vegetative swales, collection and reuse of stormwater, inlet controls, snow management, infiltration devices, and wet retention measures.

A combination of preventive and treatment BMPs will yield the most effective stormwater management for minimizing the offsite discharge of pollutants via stormwater runoff. Though not specifically outlined in this fact sheet, BMPs must also address preventive maintenance records or logbooks, regular facility inspections, spill prevention and response, and employee training.

All BMPs require regular maintenance to function as intended. Some management measures have simple maintenance requirements, others are quite involved. You must regularly inspect all BMPs to ensure they are operating properly, including during runoff events. As soon as a problem is found, action to resolve it should be initiated immediately.

Implement BMPs, such as those listed below in Table 2 for the control of pollutants at glass, clay, cement, concrete, and gypsum product manufacturing facilities, to minimize and prevent the discharge of pollutants in stormwater. Identifying weaknesses in current facility practices will aid the permittee in determining appropriate BMPs that will achieve a reduction in pollutant loadings. BMPs listed in Table 2 are broadly applicable to glass, clay, cement, concrete, and gypsum product manufacturing facilities; however, this is not a complete list and you are recommended to consult with regulatory agencies or a stormwater engineer/consultant to identify appropriate BMPs for your facility.

Table 2. BMPs for Potential Pollutant Sources at Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities

Pollutant Sources	BMPs
Storing dry bulk materials including sand, gravel, clay, cement, fly ash, kiln dust, and gypsum	<ul style="list-style-type: none"> <input type="checkbox"/> Store materials in an enclosed silo or building. <input type="checkbox"/> Cover material storage pile with a tarp or awning. <input type="checkbox"/> Confine storage to designated and labeled areas outside of drainage pathways and away from surface waters. <input type="checkbox"/> Practice good stockpiling practices such as: storing materials on concrete or asphalt pads; surrounding stockpiles with diversion dikes or curbs to limit run-on and to slow runoff. <input type="checkbox"/> Install sediment basins, silt fence, vegetated filter strips, or other sediment removal measures downstream/downslope. <input type="checkbox"/> Only store washed sand and gravel outdoors.
Handling bulk materials including sand, gravel, clay, cement, fly ash, kiln dust, and gypsum	<ul style="list-style-type: none"> <input type="checkbox"/> Use dust collection systems (e.g., bag houses) to collect airborne particles generated as a result of handling operations. <input type="checkbox"/> Promptly dispose of waste materials from dust collection systems and other operations. <input type="checkbox"/> Remove spilled material and settled dust from paved portions of the facility by shoveling and sweeping on a regular basis. <input type="checkbox"/> Periodically clean material handling equipment and vehicles to remove accumulated dust and residue. <input type="checkbox"/> Install sediment basins, silt fence, vegetated filter strips, or other sediment removal measures downstream/downslope. <input type="checkbox"/> Train employees in good housekeeping, spill prevention and control, and materials management.
Mixing operations	<ul style="list-style-type: none"> <input type="checkbox"/> Use dust collection systems (e.g., bag houses) to collect airborne particles generated as a result of mixing operations. <input type="checkbox"/> Remove spilled material and settled dust from the mixing area by shoveling and sweeping on a regular basis. <input type="checkbox"/> Clean exposed mixing equipment after mixing operations are complete. <input type="checkbox"/> Install sediment basins, silt fence, vegetated filter strips, or other sediment removal measures downstream/downslope. <input type="checkbox"/> Train employees in good housekeeping, spill prevention and control, and materials management procedures.
Dust collection	<ul style="list-style-type: none"> <input type="checkbox"/> Schedule maintenance of dust collection system and baghouse. <input type="checkbox"/> Regularly remove and recycle or dispose of collected dust to minimize exposure to precipitation.
Pouring and curing pre-cast concrete products	<ul style="list-style-type: none"> <input type="checkbox"/> Pour and cure precast products in a covered area. <input type="checkbox"/> Clean forms in a designated area designed to prevent the discharge of waste materials. <input type="checkbox"/> Clean forms before storing outdoors.
Vehicle fueling	<ul style="list-style-type: none"> <input type="checkbox"/> Conduct fueling operations (including the transfer of fuel from tank trucks) on an impervious or contained pad or under a roof or canopy where possible. Covering should extend beyond spill containment pad to prevent rain from entering. <input type="checkbox"/> When fueling in an uncovered area, conduct fueling operations on a concrete pad (asphalt is not chemically resistant to the fuels being handled). <input type="checkbox"/> Use drip pans where leaks or spills of fuel can occur and where making and breaking hose connections. <input type="checkbox"/> Use fueling hoses with check valves to prevent hose drainage after filling.

Table 2. BMPs for Potential Pollutant Sources at Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities (continued)

Pollutant Sources	BMPs
Vehicle fueling (continued)	<ul style="list-style-type: none"> <input type="checkbox"/> Use spill and overflow protection devices. <input type="checkbox"/> Keep spill cleanup materials readily available. Clean up spills and leaks immediately. <input type="checkbox"/> Minimize/eliminate run-on into fueling areas with diversion dikes, berms, curbing, surface grading or other equivalent measures. <input type="checkbox"/> Collect stormwater runoff and provide treatment or recycling. <input type="checkbox"/> Use dry cleanup methods for fuel area rather than hosing down the fuel area. Follow procedures for sweeping up absorbents as soon as spilled substances have been absorbed. <input type="checkbox"/> Provide curbing or posts around fuel pumps to prevent collisions from vehicles. <input type="checkbox"/> Discourage “topping off” of fuel tanks. <input type="checkbox"/> Regularly inspect and perform preventive maintenance on fuel storage tanks to detect potential leaks before they occur. <input type="checkbox"/> Inspect the fueling area for leaks and spills. <input type="checkbox"/> Train personnel on vehicle fueling BMPs.
Vehicle and equipment washing	<p data-bbox="428 909 1438 947">Good Housekeeping</p> <ul style="list-style-type: none"> <input type="checkbox"/> Confine vehicle and equipment washing to designated areas outside of drainage pathways, away from surface waters and that drain to recycle ponds or process wastewater treatment systems. <input type="checkbox"/> Clean washwater residue from portions of the site that drain offsite. <input type="checkbox"/> Train employees on proper procedure for washing vehicles and equipment including a discussion of the appropriate location for vehicle washing.
Vehicle and equipment maintenance	<p data-bbox="428 1167 1438 1205">Good Housekeeping</p> <ul style="list-style-type: none"> <input type="checkbox"/> Eliminate floor drains that are connected to the storm or sanitary sewer; if necessary, install a sump that is pumped regularly. Collected wastes should be properly treated or disposed of by a licensed waste hauler. <input type="checkbox"/> Do all cleaning at a centralized station so the solvents stay in one area. <input type="checkbox"/> If parts are dipped in liquid, remove them slowly to avoid spills. <input type="checkbox"/> Use drip pans, drain boards, and drying racks to direct drips back into a fluid holding tank for reuse. <input type="checkbox"/> Drain all parts of fluids prior to disposal. Oil filters can be crushed and recycled. <input type="checkbox"/> Promptly transfer used fluids to the proper container; do not leave full drip pans or other open containers around the shop. Empty and clean drip pans and containers. <input type="checkbox"/> Clean up leaks, drips, and other spills without using large amounts of water. Use absorbents for dry cleanup whenever possible. <input type="checkbox"/> Prohibit the practice of hosing down an area where the practice would result in the discharge of pollutants to a stormwater system. <input type="checkbox"/> Do not pour liquid waste into floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections. <input type="checkbox"/> Maintain an organized inventory of materials. <input type="checkbox"/> Eliminate or reduce the number and amount of hazardous materials and waste by substituting nonhazardous or less hazardous materials. <input type="checkbox"/> Label and track the recycling of waste material (e.g., used oil, spent solvents, batteries).

Table 2. BMPs for Potential Pollutant Sources at Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities (continued)

Pollutant Sources	BMPs
Vehicle and equipment maintenance (continued)	<p>Good Housekeeping (continued)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Store batteries and other significant materials indoors. <input type="checkbox"/> Dispose of greasy rags, oil filters, air filters, batteries, spent coolant, and degreasers in compliance with RCRA regulations. <p>Minimizing Exposure</p> <ul style="list-style-type: none"> <input type="checkbox"/> Perform all cleaning operations indoors or under covering when possible. Conduct the cleaning operations in an area with a concrete floor with no floor drainage other than to sanitary sewers or treatment facilities. <input type="checkbox"/> If operations are uncovered, perform them on concrete pad that is impervious and contained. <input type="checkbox"/> Park vehicles and equipment indoors or under a roof whenever possible and maintain proper control of oil leaks/spills. <input type="checkbox"/> Check vehicles closely for leaks and use pans to collect fluid when leaks occur. <p>Management of Runoff</p> <ul style="list-style-type: none"> <input type="checkbox"/> Use berms, curbs, grassed swales or other diversion measures to ensure that stormwater runoff from other parts of the facility does not flow over the maintenance area. <input type="checkbox"/> Collect the stormwater runoff from the cleaning area and provide treatment or recycling. Discharge vehicle wash or rinse water to the sanitary sewer (if allowed by sewer authority), wastewater treatment, a land application site, or recycle on-site. DO NOT discharge washwater to a storm drain or surface water. <p>Inspections and Training</p> <ul style="list-style-type: none"> <input type="checkbox"/> Inspect the maintenance area regularly to ensure BMPs are implemented <input type="checkbox"/> Train employees on proper waste control and disposal procedures.

What if activities and materials at my facility are not exposed to precipitation?

The industrial stormwater program requires permit coverage for a number of specified types of industrial activities. However, when a facility is able to prevent the exposure of ALL relevant activities and materials to precipitation, it may be eligible to claim no exposure and qualify for a waiver from permit coverage.

If you are regulated under the industrial permitting program, you must either obtain permit coverage or submit a no exposure certification form, if available. Check with your permitting authority for additional information as not every permitting authority program provides no exposure exemptions.

Where do I get more information?

For additional information on the industrial stormwater program see www.epa.gov/npdes/stormwater/msgp.

A list of names and telephone numbers for each EPA Region or state NPDES permitting authority can be found at www.epa.gov/npdes/stormwatercontacts.

References

Information contained in this Fact Sheet was compiled from EPA's past and current Multi-Sector General Permits and from the following sources:

- ◆ City of Phoenix, Street Transportation Department, Storm Water Management Section. 2004. Prevent Stormwater Contamination Best Management Practices for: Section E - Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturers. SIC Codes: 3210-3299."
<http://phoenix.gov/STREETS/glasclay.pdf>
- ◆ Orange County, California, Watershed & Coastal Resources Division. "Concrete and Asphalt Production, Application, and Cutting."
www.ocwatersheds.com/StormWater/documents_bmp_existing_development.asp#ind
- ◆ USEPA. Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. 1992. EPA 832-R-92-006.
www.epa.gov/npdes/stormwater
- ◆ USEPA, Office of Compliance and Office of Enforcement and Compliance Assurance. 1995. EPA Office of Compliance Sector Notebook Project: Profile of the Stone, Clay, Glass, and Concrete Industry. EPA-310-R-95-017.
www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/stone.html
- ◆ USEPA, Office of Science and Technology. 1999. Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA-821-R-99-012.
www.epa.gov/OST/stormwater/
- ◆ USEPA, Office of Wastewater Management. *NPDES Stormwater Multi-Sector General Permit for Industrial Activities (MSGP)*.
www.epa.gov/npdes/stormwater/msgp
- ◆ World Bank Group. "Pollution Prevention and Abatement Handbook: Cement Manufacturing."
[www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_CementandLimeMfg/\\$FILE/Final+-+Cement+and+Lime+Manufacturing.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_CementandLimeMfg/$FILE/Final+-+Cement+and+Lime+Manufacturing.pdf)
- ◆ World Bank Group. "Pollution Prevention and Abatement Handbook: Glass Manufacturing."
[www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GlassMfg/\\$FILE/Final+-+Glass+Manufacturing.pdf](http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GlassMfg/$FILE/Final+-+Glass+Manufacturing.pdf)