# PERLITE MANAGEMENT

AIGA 032/12

GLOBALLY HARMONISED DOCUMENT

**Based on CGA P-8.3**
**Third Edition 2012**

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# 1 Introduction

This publication is one of a series compiled by the Compressed Gas Association, Inc. (CGA), in response to inquiries for information relating to perlite. Perlite is used as an insulation medium in cryogenic coldboxes, cryogenic liquid tanks, field-erected flat bottom tanks, and pipe ducts, where perlite is filled into the annular spaces between the inner and the outer shells.

As part of the programme of harmonization of industry standards, the Asia Industrial Gases Association (AIGA) has adopted the original CGA standard P-8.3 as AIGA 032/12. This standard is intended as an international harmonized standard for the use and application by members of CGA, EIGA, JIMGA and AIGA. This edition has the same content as the CGA edition except for editorial changes in formatting, units, spelling and references to AIGA documents.

# 2 Scope

Perlite is nontoxic and nonflammable; however, the nature of the material and the large quantities involved require the use of special operations, handling, and safety procedures. This publication provides guidance for reducing the risks of unplanned perlite releases and incidents that could have potential for personal injury, property damage, downtime, and environmental impact.

It covers the use of perlite in cryogenic coldboxes and cryogenic bulk storage vessels and focuses on safety, perlite handling procedures, and emergency perlite management. This publication is directed to industrial gas plant manufacturers, owners, and operators of facilities that utilize and maintain perlite as an insulation medium for cryogenic equipment. Insulating materials, such as rock wool or vermiculite and other synthetic silicates, are not covered in this publication. This publication does not cover hazards related to toxic and flammable gases.

Information regarding design considerations, operation, and maintenance of cryogenic enclosures is contained in AIGA 079/12 *Safe Design and Operation of Cryogenic Enclosures* [1][1].

NOTE—This publication does not attempt to recommend or establish specific design or usage criteria, but to provide best practices. The end user shall determine the specific requirements.

# 3 Definitions

For the purpose of this publication, the following definitions apply.

## 3.1 Verbal Forms

- Shall indicates that the procedure is mandatory. It is used wherever criterion for conformance to specific recommendation allows no deviation.
- Should indicates that a procedure is recommended.
- May and need not indicate permission and that the procedure is optional.
- Will is used only to indicate the future, not a degree of requirement.
- Can indicates a possibility or ability.

## 3.2 Coldbox

Cylindrical or rectangular enclosure, typically metal, surrounding the distillation columns and other cryogenic equipment.

NOTE—The space between the columns and the inner coldbox shell is filled with insulation material, typically perlite.

## 3.3 Cryogenic

Temperatures below –130 °F (–90 °C).

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

### 3.4 Perlite

Inert volcanic glass that forms a lightweight powder aggregate when expanded by heat.

NOTE—Perlite is an odorless, nonflammable, nontoxic white to off white silicate powder. Perlite is a highly effective insulating material used to reduce refrigeration losses or heat leak into the coldbox, which would otherwise reduce production, increase power consumption, or both.

### 3.5 Perlite releases

Uncontrolled spillage of perlite to the environment.

### 3.6 Purge gas

Moisture free, oil-free inert gas.

NOTE—For purge gas purity requirements, see AIGA 079/12.

## 4 Personnel safety

### 4.1 Working with perlite

Operations and maintenance personnel involved in working with equipment that contains bulk perlite shall be trained in the safe and correct methods of handling perlite and its characteristics. This training shall be recorded. Installation and removal work crews shall be experienced in perlite handling and should be supervised.

### 4.2 Personal protective equipment

Expanded perlite is a nontoxic material, but the recommended protective equipment should be used as required for the particular task. Overalls, gloves, and hard hats should be used to prevent skin irritation.

Perlite is lightweight and becomes airborne very easily. If perlite enters the eyes or respiratory tract, it can cause serious irritation. Eye protection shall be used to provide protection due to the dusting of handled perlite.

***CAUTION:*** *If insulation enters the eyes, do not rub them. Flush the eyes immediately with water.*

If personnel must work in or enter an area with a high concentration of airborne perlite, they shall use a dust mask or full-face air-purifying respirator equipped with dust filters (NIOSH-approved or equivalent).

***CAUTION:*** *A perlite product can contain crystalline silica, which is considered to be a nuisance dust. Inhalation of high amounts of any nuisance dust over long periods can overload the lung clearance mechanism and make the lungs more vulnerable to respiratory disease.*

Other safety considerations deal with the cryogenic fluids that can be entrained in the perlite during handling.

### 4.3 Coldbox entry

Entry into coldboxes involves many potential hazards, which include but are not limited to the following:

- falling into the perlite and becoming submerged;
- oxygen deficiency due to release of residual nitrogen purge gas or condensation of oxygen against cold surfaces;
- oxygen enrichment due to leakages of oxygen-enriched liquid or liquid oxygen or from condensation of air against cold surfaces;
- falling ice or blocks of frozen perlite caused by freezing of atmospheric moisture within the coldbox; and
- leakage of perlite from adjacent coldboxes via coldbox interconnections.

Never enter the enclosure until all confined space entry requirements have been met. These requirements are not defined within this publication (see OSHA requirements in 29 CFR 1910) [2]. (Additional references: AIGA

005/10 Fire hazards of oxygen and oxygen enriched atmospheres [3] and AIGA 008/11 Hazards of inert gases [4]).Consult local authorities for additional procedures.

Whenever possible, remove all perlite and sweep or wash down the casing to eliminate dust and slippery surface hazards. When a person is required to work on or above a perlite mass, an adequate working platform should be erected.

# 5 Inspections and precautions

## 5.1 Atmospheric check

An atmospheric check should be completed periodically to verify that the insulation gas composition is the same as the purge gas. The use of oxygen monitors indicates only the presence or absence of oxygen.

NOTE—For argon production plants where hydrogen is used to remove oxygen in the crude argon, it is possible for the hydrogen to leak into the coldbox. Periodic analysis of the coldbox annular space atmosphere for hydrogen should be completed.

## 5.2 Ice formation

External ice formation can indicate improperly installed perlite, inadequate coldbox maintenance, or a cryogenic gas or liquid leak. To eliminate ice buildup towards the top of the coldbox, the perlite level should be checked after perlite is added, when a problem is suspected, and/or during routine coldbox maintenance. The insulation will settle, especially after perlite is added to the coldbox, and the insulation level might need to be topped off.

***CAUTION:*** *Use caution when checking the perlite level. The insulation space contains perlite and the purge gas, which is an asphyxiant.*

## 5.3 Perlite abrasion

Perlite is abrasive. When entrained in a gas jet, perlite can cut through metal piping and equipment, damaging the equipment and allowing perlite to enter the process. The primary sources for such gas jets are either process leaks or damaged or broken piping inside the coldbox.

# 6 Perlite removal

***CAUTION:*** *Take steps to reduce the number of personnel in the work area. If possible, rope off the area and post warning signs to keep nonessential personnel away.*

## 6.1 Before perlite removal

Perform the following steps before perlite removal:

a) Shut down the cryogenic process;

b) Drain all cryogenic liquids from the process equipment and piping;

c) Warm the process equipment and piping to a safe working temperature. If liquid pooling is potentially present, precautions shall be taken to protect personnel from at minimum: perlite eruption; engulfment; cryogenic exposure; and asphyxiation;

d) After the piping and equipment have been warmed, stop the warming process and depressurize the equipment to a safe working pressure;

e) Stop the purge gas flow to the coldbox insulation space and physically isolate the purge gas supply. This can be accomplished by the removal of a section of the piping or the insertion of a blind flange; and

NOTE—For HYCO facilities, all flammable and toxic materials shall be purged from the coldbox and process piping.

f) Open a top manhole before removing perlite to protect against a possible casing collapse by developing a vacuum during the perlite removal process.

## 6.2 Coldbox perlite removal

### 6.2.1 Monitoring

The insulation space gas composition should be monitored continuously for the presence of excessive oxygen, combustible gases, or both. The composition should be checked along the height of the coldbox. If a high concentration (oxygen greater than 5% when purging with nitrogen or greater than 23% when purging with dry air) is detected, the manhole should be closed and a purge reinstated. Continue the purge until the oxygen concentration in the vent gas drops below these levels.

### 6.2.2 Removal process

To lessen the risks of uncontrolled perlite releases, removal of perlite should take place from the top of the coldbox and proceed downward. This reduces both the potential for perlite bridging (agglomeration of the powder into a solid mass) and the amount of perlite that might be expelled from the casing should an uncontrolled release occur.

Perlite eruptions can be caused by, but are not limited to the following:

- coldbox overpressurization due to equipment or process line failure, including purge gas overpressurization;
- local overpressurization due to rapid vaporization of liquid that can occur when cryogenic liquid is pooled in the perlite, and the perlite is physically disturbed or the pool of liquid is suddenly warmed;
- structural failure of the insulation containment device due to operating conditions (such as vacuum), embrittlement, or external loading; or
- mishandling during emptying operations.

Perlite removal nozzles should be used if they are provided. If cryogenic liquid is known to have collected in the perlite, it should not be withdrawn from the bottom of the coldbox; flashing in a fully perlited coldbox will result in an uncontrolled release.

An open-top perlite collection box should be used if perlite is removed using equipment not designed for oxygen service (for example, vacuum blowers found on commercial vacuum trucks). This allows for degasification of the perlite (escaping gas or vaporizing liquid) and prevents a possible oxygen-enriched atmosphere, which is a fire hazard.

Proceed cautiously if the perlite is suspected of containing cryogenic liquid that might lead to a hazardous atmosphere in the perlite collection box.

The insulation space pressure at ground level and at the level from which perlite is being withdrawn should be monitored using a manometer or gauge. If the pressure starts to increase, it can be an indication of an imminent perlite release and perlite removal should be stopped immediately.

### 6.2.3 Residual perlite

When the majority of perlite has been removed, residual perlite removal might be required. If removal of residual perlite requires entry into the coldbox, follow regulatory and safety procedures including the following:

a) Monitor the annular space for safe oxygen content;

b) Check the interior for ice blocks and remove large blocks by thawing, either mechanically or by judicious use of steam;

c) Remove residual perlite by brushing, shoveling, or, *if only absolutely necessary,* washing surfaces with water; and

d) Take care not to disturb or break small bore lines in the vicinity of the perlite clean-up operation.

# 7 Perlite installation

## 7.1 Packaging

For small coldboxes or where only small quantities of perlite are required, either siloed or bagged perlite may be charged directly through manholes at the top of the coldbox. Bulk shipments of expanded perlite can be made in closed-type tanker trailers equipped with a transfer hose to discharge the perlite directly into the coldbox or into the annular space of a tank. The tanker shall be equipped to prevent moisture entry into the perlite during transport. The inside of the tanker should be clean.

For a large coldbox, expansion “popping” of the perlite ore at the plant location can be more efficient. A knowledgeable contractor should complete this operation and provide all the necessary equipment and services.

## 7.2 Perlite quality

Perlite deteriorates each time it is handled. Before reuse, the perlite should be inspected for the following properties:

- loose density;
- compacted density;
- sieve analysis;
- free moisture content; and
- organic material content.

NOTE—If the perlite is reused, there is normally some attrition and the coldbox should be topped off with fresh perlite.

## 7.3 Filling to avoid insulation space voids

There are several methods to fill coldboxes without creating pockets or insulation voids:

- Perlite may be introduced in stages to help reduce voids. First, add perlite at lower levels. Then, proceeding up the coldbox, add perlite through higher fill ports;
- Top fills are used when staged fills are not used or when topping off the insulation space; and
- When practical, vibration equipment or rubber mallets used to tap on the coldbox exterior can be used to induce perlite settling, thus avoiding pockets or voids.

## 7.4 Purge gas supply

Once the insulation space is filled with perlite, all column entry points shall be closed and the purge gas supply should be immediately placed into service.

## 7.5 Settling

After coldbox cool down and operation has commenced, settling of perlite normally occurs. The top of the coldbox should be inspected and topped off with additional insulation as necessary.

***CAUTION:*** *Use caution when checking the perlite level. The insulation space is pressurized with the purging gas, which is most likely to be nitrogen (an asphyxiant). A self-contained breathing apparatus might be needed to ensure the safety of the inspection personnel from asphyxiating gas discharged at them from the opening. A standby person also might be needed in the event of an emergency. Depending upon the size of the opening used to make the inspection and the potential for falling into the cryogenic enclosure, fall protection gear also might be used. If inspection personnel must break the plane of the coldbox penetration to make the inspection, a permit-required confined space entry might have to be conducted.*

## 8 Disposal of perlite

Disposal of perlite might be governed by national or local environmental regulations. If contamination is suspected, conduct appropriate testing to determine whether the material is hazardous or not, as defined by applicable national or local hazardous waste regulations. Nonhazardous contaminated perlite may be regulated as industrial solid waste in certain states. Check with local authorities for applicable regulations.

Noncontaminated perlite can be disposed of or recycled as governed by national or local environmental regulations.

## 9 Emergency plan for perlite releases

Facilities that use perlite should have an emergency plan that addresses perlite releases. The emergency plan should address who is to be called if there is a perlite release. The emergency plan should be reviewed periodically to ensure that the information is accurate and up to date. The plan can list several companies with local disposal sites. Many landfills require prior approvals so that when disposal is required, the paperwork has already been completed and perlite can be accepted quickly.

Personnel shall receive training on the emergency plan and shall be notified when substantive changes to any emergency response procedures are made.

At a minimum, the emergency plan should include the following procedures:

a) Secure the plant processes as required;

b) Evacuate personnel and conduct a headcount;

c) Check perlite material safety data sheets (MSDS) for any required first aid/emergency procedures;

d) Contact emergency response agencies and offsite neighbors, as required;

e) Vacuum clean or wet sweep to avoid dusting;

f) Take necessary measures to prevent migration of any spilled perlite into a waterway via wind or storm water releases;

g) Secure adjacent processes from perlite ingestion; and

h) Contact qualified clean-up and perlite disposal contractors.

## 10 References

Unless otherwise specified, the latest edition shall apply.

[1] AIGA 079/12, *Safe Design and Operation of Cryogenic Enclosures,* Asia Industrial Gases Association

[2] *Code of Federal Regulations,* Title 29 (Labor), Superintendent of Documents, U.S. Government Printing Office, 732 North Capital Street, NW, Washington, DC 20401. www.gpo.gov/fdsys

[3] AIGA 005/10 *Fire hazards of oxygen and oxygen enriched atmospheres*, Asia Industrial Gases Association

[4] AIGA 008/11 *Hazards of inert gases*, Asia Industrial Gases Association