

A GUIDE FOR THE BULK HANDLING OF EXPANDED PERLITE



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Reported by
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1. Scope

The purpose of this guide is to inform producers and users of expanded perlite about the methods available for loading, transporting, unloading and storing expanded perlite in bulk.

In the past, bags have been the principal method of storing and shipping perlite, because the principal use was in plaster, where the material is used in relatively small quantities on any one job. New uses requiring large quantities have been growing more important each year, and therefore it has become necessary to develop more economical methods for storing and transporting the expanded perlite. Bulk handling of expanded perlite and expansion of perlite at the job site are two methods of delivering expanded perlite to the customer without the use of bags.

2. Advantages

a) *Advantages as compared with bags*

Bulk handling saves the cost of bags.

It eliminates the labor of filling the bags at the plant and emptying them at the point of use.

It eliminates the problem of disposing of the empty bags. Burning bags is not possible in many areas because of prohibitions against air pollution and fires. The use of disposal services can be costly. Just the labor to gather, tie and load is costly, not to mention the cost of handling and dump fees.

Bulk perlite is often more compact than perlite in bags. Therefore less space may be required in storage areas and transport vehicles.

Bulk storage and transportation systems are usually moisture-proof. Therefore perlite delivery

to bulk facilities in a warm dry condition will ordinarily remain free of moisture until it can be used. Bulk storage and handling systems are generally more weather-proof than bags.

The use of bulk shipments often reduces the time required to service a job by 50% or more.

b) *Advantages as compared with portable furnaces*

The job may be done on a piece-meal basis to a customer's convenience. During any interruption in job progress, the plant production can be shifted back to bagged perlite for other customers.

There are no set-up charges required and therefore small jobs which are uneconomical for portable plants can be handled much more efficiently with bulk shipments.

It is much more convenient to expand perlite in one's own plant than out in the field.

There is no wasted ore. Any surplus ore left over from a job remains in the plant, and may be used for other purposes.

There are no expense accounts for operating personnel working out of town if the perlite supplier is not acting as an installation contractor.

3. Disadvantages

a) *Disadvantages as compared with bags*

Bulk handling requires extra equipment which may be costly, complicated or troublesome.

Bulk handling usually requires an investment in storage bins in the plant and possibly at the point of use.

Close control of quality is difficult because the furnace is often allowed to operate for long

periods of time without the type of representative sampling which is automatically provided when the expanded perlite is bagged.

Job scheduling is more difficult because the cost of the in-plant bulk storage silos makes it difficult to store up enough perlite at the plant so that installation can be done at a faster rate than the production rate of the furnace equipment. One problem to watch for is settlement in the transportation vehicles. The trucks have to be very carefully loaded and shaken as they are being loaded, in order to settle the perlite as much as possible. Otherwise a full payload is not delivered to the job and the freight costs go up.

Perlite stored and transported in bulk is subject to segregation of the various particle sizes. This can be reduced but most likely never completely eliminated.

Another problem is the availability of commercial transport trucks. Most of these trucks are used for other purposes and sometimes it is hard to find them. It would not generally be advisable to buy bulk trailers when first beginning with bulk handling, however.

b) *Disadvantages as compared with portable furnaces*

Transportation and storage expenses are higher because expanded perlite is voluminous.

There is a double expenditure for handling and storage of the materials, first for the raw material and then for the expanded perlite.

For these reasons, bulk handling is usually a more expensive method of servicing a job than using a portable furnace.

4. Equipment

a) *Handling systems for loading and unloading*

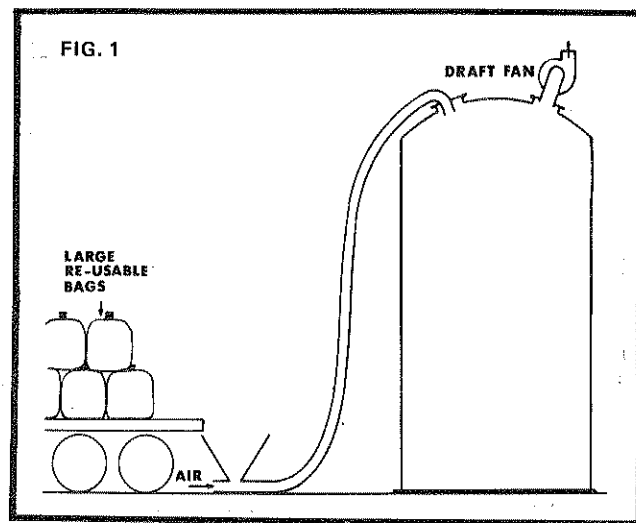
Handling systems can be pneumatic, mechanical or manual. The pneumatic conveyors can be divided into three classes:

(1) Low-pressure, high-air-volume systems where the perlite-to-air ratio is very low (1-6 ozs., ratio of 1/50 through 1/500)

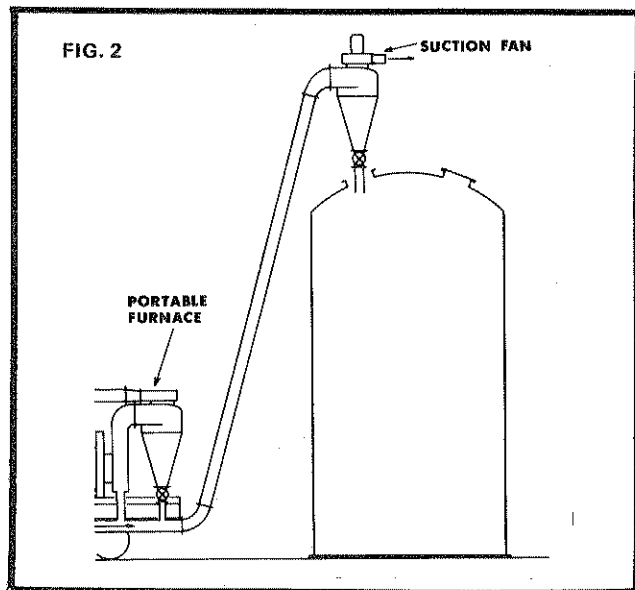
(2) Intermediate systems

(3) High-pressure, low-air-volume systems with high ratio of perlite to air (1-15 psi, ratio of 1/3 through 1/10).

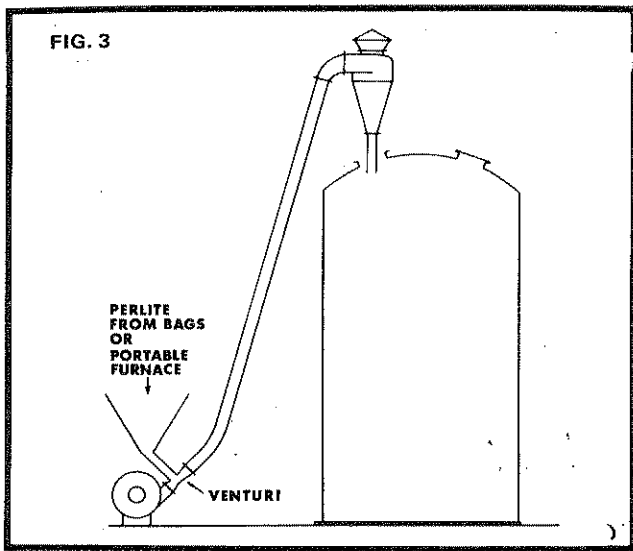
A vacuum can be drawn on a storage silo or cryogenic vessel (Fig. 1) and the perlite is pulled through a hose or pipe, to be settled out in the tank without the use of a cyclone. As shown here, this is a low-pressure system. It is the simplest method, but unfortunately there is danger of collapsing the outer shell of even a stoutly built tank. Technically, this problem can be overcome by using a very low-vacuum fan, and providing a vacuum breaker or rupture disc on the line. However, tank manufacturers are reluctant to allow even a two-ounce vacuum on a vessel, so this method is seldom used.



The same method can be used to draw perlite from a non-pressurized trailer or a portable furnace with the same advantages and limitations. Cryogenic vessels where the insulating space is to be evacuated are often filled with perlite using a vacuum of more than 14 psi, which makes this a high-pressure-differential system. A filter must be used to keep perlite out of the more sensitive air pump used in this application.

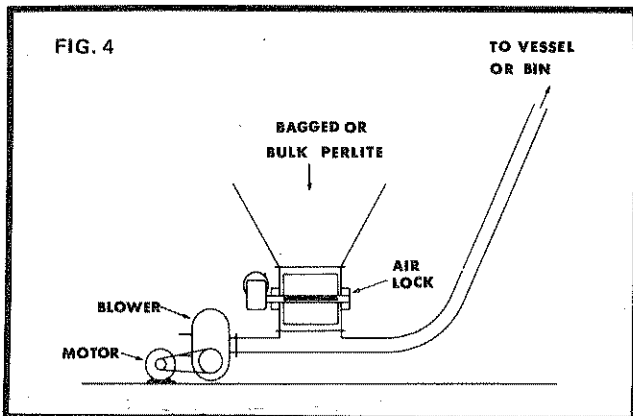


To avoid the question of the danger of collapsing the tank, a cyclone can be erected on top of the tank (Fig. 2), with a draft fan to create suction and an air lock to discharge the material into the tank. This is a low-pressure-differential system. A cyclone can also be used on low-positive-pressure systems to obtain better collection efficiency than might be obtained by settling alone.

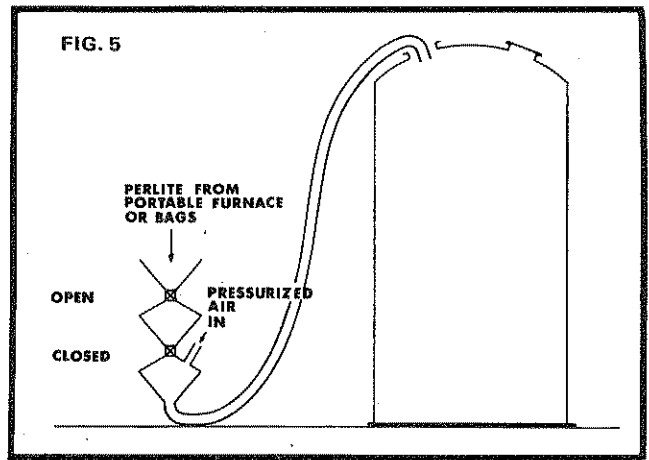


One low-positive-pressure system (Fig. 3) employs a venturi to draw the perlite into the stream of air coming out of a blower. Often a cyclone is used on top of the tank. No air lock is required because the cyclone is under pressure.

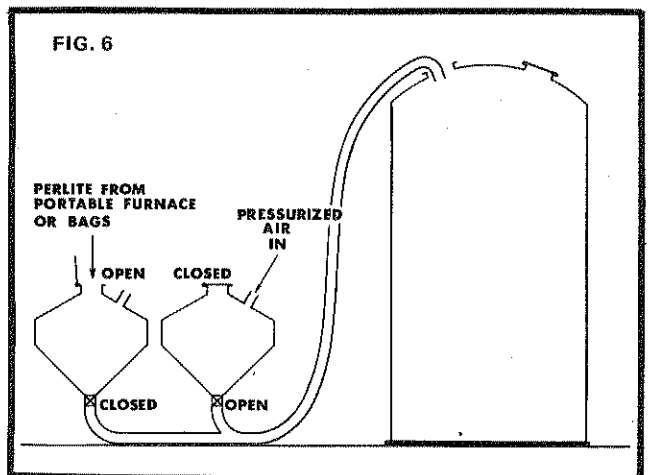
A typical intermediate pressure system (Fig. 4) uses a rotary air lock to feed perlite into an air stream from a positive displacement blower. Smaller diameter hose or pipe can be used, and no cyclone is needed at the end of the hose to separate the perlite from the air. Great care must be taken to keep the equipment in good condition and to adjust the air volume and limit the pressure, or the air lock will not feed the perlite. Poor adjustment may also cause blockages in the hose.



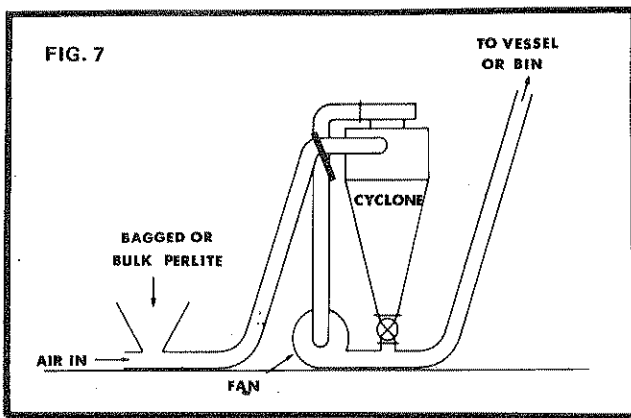
One high-pressure system (Fig. 5) employs three tanks and two valves. Both valves are never open simultaneously. Air pressure is put on the bottom tank. Perlite is put into the top tank and it progresses by gravity into the bottom tank, from which the air blows it through the hose into the vessel. The perlite can be carried in so little air that it flows out of the end of the hose like a stream of water.



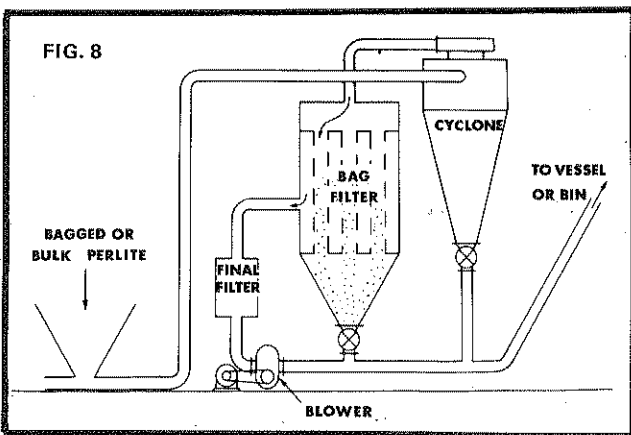
A variation of this method uses two pressure tanks side-by-side (Fig. 6). While one tank is being filled through an open port, the other tank has its port closed and air pressure is being applied to convey the perlite. Shut-off valves are provided at the bottom of each tank to keep the line air pressure from blowing up through the tank being filled. The last two methods often employ aeration pads to fluidize the perlite. Valves should have rubber seats for tight shut-off and abrasion resistance, but if the perlite is hot, this is not possible.



Where the perlite must be picked up from a point near the ground or from several points, or if it must be drawn out of a trailer under suction, a "pull-push" system can be used (Fig. 7). This illustration shows a low-pressure device where the air and perlite are drawn by the suction created by a centrifugal fan, which also blows the material into the vessel. The material, however, is prevented from passing through the fan by a cyclone and air lock which separate out the perlite on the vacuum side and drop it back into the air stream on the pressure side.



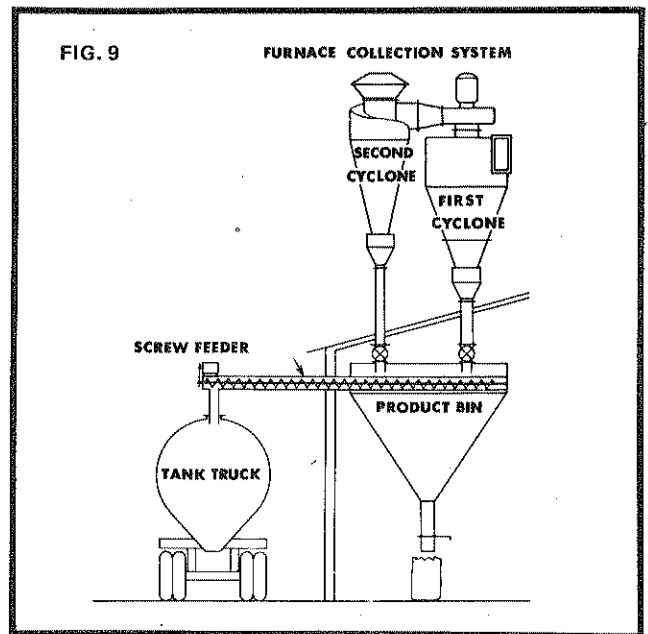
A high-pressure, small-hose variation (Fig. 8) of the previous system has a cyclone and a positive displacement blower. This type of blower will wear out quickly if much perlite dust passes through it, so a bag filter must be supplied, along with a final filter in case a filter bag breaks.



The high-pressure, low-gas-volume methods have the advantage of permitting the use of reasonable quantities of dried air, dry nitrogen, or any other gas which may be specified. They also allow more precise deposition of the perlite.

The most conventional automatic conveying method is mechanical as contrasted with pneumatic handling. A typical application (Fig. 9) is a screw conveyor being used to convey expanded perlite from the furnace collection system into a bulk tank trailer. Other applicable mechanical devices are belt conveyors and bucket elevators. Belt conveyors might seem to be best because of less abrasion on the equipment and less breakdown of the perlite. However, the perlite tends to blow off the belt, and if the unit is enclosed to avoid this, perlite settles in the enclosure and gets into the idler bearings.

Bucket elevators are not very often used with expanded perlite because light material floats around in the housing and may leak out of small openings in the enclosure. Screw conveyors have had the reputation of breaking down expanded perlite, but quite a few companies are successfully using them. With proper design, breakdown and abrasion can be kept within reasonable limits.



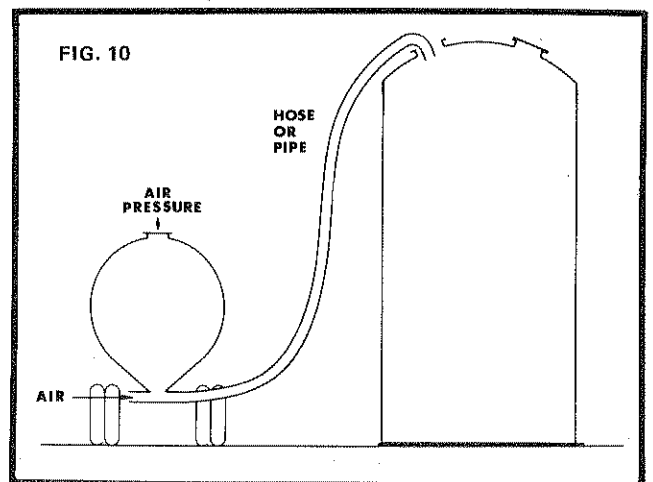
Manual methods can be employed in conjunction with bulk handling in the following ways:

Perlite stored in a silo at the plant can be subsequently put into bags for shipment. The principal disadvantage of this system is that particle size segregation which occurs in bins becomes all the more apparent when the material is put into bags.

Perlite stored in bags at the plant can be used to fill bulk vehicles. This is a costly and time-consuming procedure and should probably not be used except in an emergency.

b) Trailers

One of the tidier ways of transporting expanded perlite is by the use of a pressurized tank trailer (Fig. 10), shown here in the process of filling a vessel. These trailers were originally available only in the small sizes used for transporting heavy powders like cement. Singles now have capacities up to 1900 cubic feet and doubles hold 2500-3000 cubic feet, which makes them economical for carrying perlite.

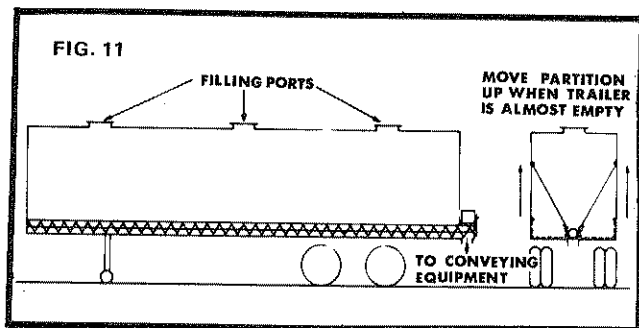


To discharge a load of perlite, a hose is connected to one hopper bottom and pressure is built up until the material begins to flow. Aeration pads are usually used to fluidize the perlite. Most trailers have blowers capable of reaching 15 psi, but this pressure is not usually needed with perlite. Air is often used at the entrance to the hose in order to avoid blocking the hose. Too much air can cause excessive breakdown of the perlite. As soon as the perlite begins to flow, the pressure will usually drop well below the pressure required to start the flow.

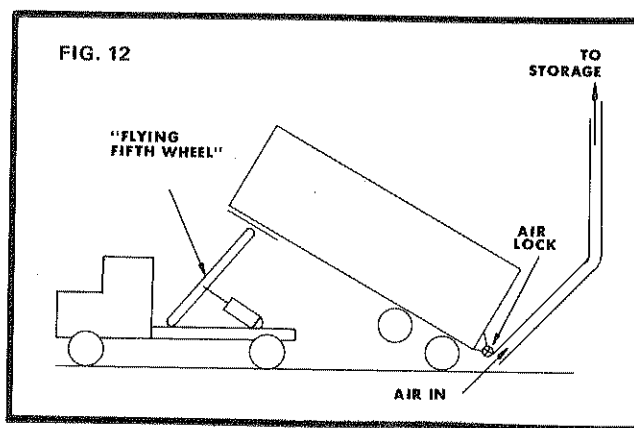
The cost of transporting bulk perlite by common carrier tank trailer is over twice the cost of transporting bagged perlite in trailers owned by the expander company. This freight cost, even for distances under 100 miles, can be as much as half the total delivered cost. If the pressure tankers are owned by the expander company, this method is substantially less expensive than the use of bags. During the filling of the tank, it is possible for the driver to hook up to a hose hanging from the side of the tank and blow the perlite into it without any other labor being present.

The limitation on the volumetric carrying capacity of the pressurized tank trailer is the fact that an essentially round cross-section is needed to withstand pressure. A cylindrical trailer body staying within the legal outside dimensional limits has about 70% of the volumetric capacity of a rectangular van of the same outside dimensions. This, combined with the fact that most perlite producers have their own bagged goods trailers, has led many producers to consider converting non-pressurizable trailers to bulk service.

A trailer (Fig. 11) can be equipped with a single screw conveyor located on the center of the trailer bed. The main difficulty with a single conveyor is that it tends to leave 1/4 of the product in the trailer because of the angle of repose of the perlite on both sides of the screw. This illustration shows a proposed method of reducing the dead space by raising up two sheets of canvas after most of the perlite has been discharged. This might be done, for example, by means of small winches located in the upper corners of the trailer, operated by hand cranks at the rear. The perlite is discharged out the rear of the trailer into subsequent conveying equipment.



It has been suggested that the problem of unloading a conventional non-pressurized trailer can be solved by the use of a tractor equipped with what is known on the west coast as a "flying fifth wheel". This equipment raises the front end of the trailer off the ground to provide sufficient slope for the perlite to slide to the rear of the trailer as it is being discharged. After the perlite has been discharged from the trailer, any of the mechanical or pneumatic methods previously described can be used to deliver it to the point of use. A typical combination is shown (Fig. 12,) where perlite emptying from a trailer elevated by a "flying fifth wheel" is being carried away by a pneumatic system involving an air lock and a pressure blower. This is the same system as shown in Fig. 4.



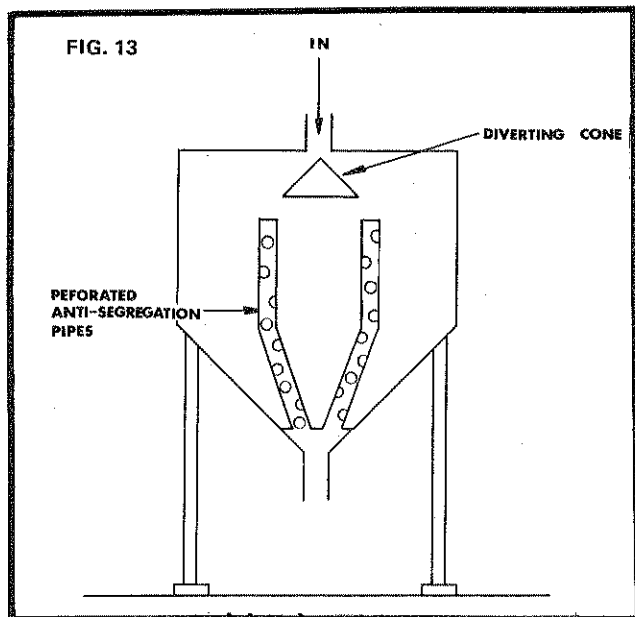
Another method of bulk handling without the use of special pressurized trailers is to use tote bins or containers loaded on a flat bed trailer. These containers can be made of metal, wood, or rubber, and should be fitted with doors for easy filling and emptying.

5. Storage

In order to employ bulk handling, it is practically always necessary to have bulk storage silos at the manufacturing plant or at the point of use, or both. It would, of course, be possible to load a bulk transport vehicle at the same rate as the furnace produces the expanded perlite. However, this would normally take several hours, and demurrage charges would be incurred. Practically the only case in which storage facilities would not be required at the point of use is when the use itself involved a large capacity vessel. Filling cryogenic vessels is the best example.

In order to prevent particle size segregation in an expanded perlite storage silo, the height should be great in comparison to the diameter. In this way the silo behaves more like a tube, and therefore little segregation occurs. Wherever the diameter is of approximately the same magnitude as the height, particle size separation will occur. This can be minimized by using perforated pipes.

located half way out from the center to the periphery of the silo. These perforated pipes tend to draw the perlite essentially uniformly from the upper layer and uniformly across the cross-section

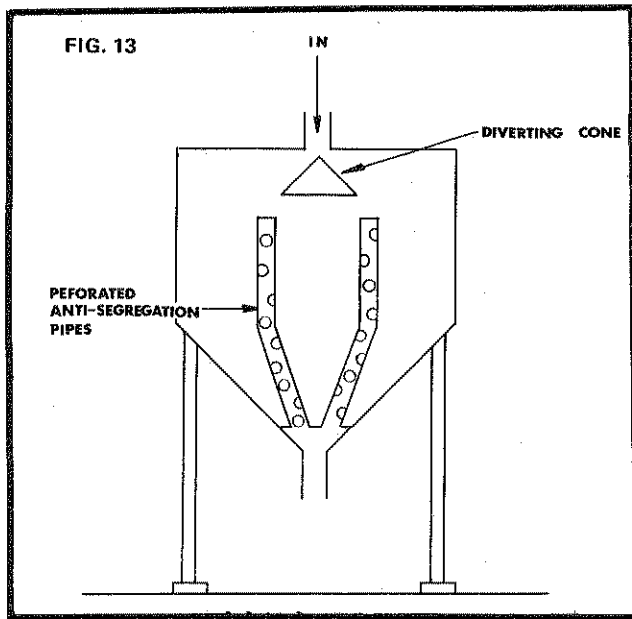


of the silo. A silo equipped with perforated pipe anti-segregation facilities is shown (Fig. 13).

Another type of separation which can occur is based on density. If the aggregate contains some particles which are substantially lighter than the other particles, there will be a tendency for these light particles to float on top. In this case, the first material to come out of the bin would be the heavier material, but at the end of the discharging of the bin, the expanded perlite would be nothing but "fluff". The best way of eliminating this, of course, is to try to produce as uniform a particle density as possible. Another method is to avoid any air being sucked upward through the material, such as through a leaky seal at the bottom. This air flow tends to make the lighter particles come to the top. If possible, the bin should be completely empty before it is filled again. Otherwise the bin will eventually fill up with a much higher percentage of "fluff" than was actually in the expanded product.

The filling and emptying of perlite storage silos can be performed with the same type of equipment, mechanical or pneumatic, which is used to fill and empty the trailers.

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