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DOME RECLAIM SYSTEMS

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Biography

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Mike Hunter has been in the dome business for more than 20 years. Currently he is the Director of Marketing and a Managing Member of ***DOMTEC® International,*** constructing concrete domes worldwide primarily for the bulk storage applications, especially for the cement industry.

Hunter is a member of the American Concrete Institute. He has authored/presented papers at several trade conferences; and has written numerous articles which have been published in various trade journals serving the cement and other industries.

Professional Summary:

1995-present: Founder and managing member of *DOMTEC® International, L.L.C.*

1994-present: Founder and President of Domes International Corp. dba DOMTEC International

1989 - 1995: Co-founder and President of Dome Technology. Vice President of Allstar Industries, Inc..

1982 - 1989: In house sales representative for Monolithic Constructors, Inc. (concrete domes)

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Reclaim Systems for Concrete Domes

Mike Hunter, *DOMTEC® International*

1. Introduction

Concrete domes are storing large quantities of bulk cement, clinker, flyash, and other products. One of the keys to the success of concrete domes has been advances in automated systems for withdrawing materials from them. This article compares various reclaim systems presently being used in domes.

2. Why a Concrete Dome

Concrete domes usually provide cement companies the right balance between function, timely delivery and cost, especially for storing large quantities, such as 30,000 to 100,000 tonnes. Some of the main reasons for selecting concrete domes are:

- **Better Storage:** Concrete domes are tight enough to keep products dry even through hurricanes or typhoons. They also prevent fugitive dust emissions.
- **Efficiency:** In most instances a dome can be filled by conveying to a single opening at the top. The dome's compactness results in filling conveyors being shorter in length and simpler than would be needed to fill a silo or flat storage warehouse. Automated reclaim equipment is also simplified. Or in the case of reclaiming with front end loaders trips are fewer and shorter.
- **Strength and Durability:** Properly constructed concrete domes are strong enough for materials to be piled high against the walls. They are also designed to support heavy conveyor loads. Concrete doesn't burn. It doesn't oxidize. It isn't eaten by insects. Concrete domes are able to withstand hurricane force winds and earthquakes better than other structures.
- **Cost:** Concrete domes are cost competitive, especially in large capacities. They also require relatively simple foundations. Pilings and other expensive deep foundations are often avoided.

Concrete domes function most efficiently as *containers* rather than *covers*. This distinction refers mainly to how much of the storage is filled. Traditional storage halls, flat storage warehouses and metal domes function basically to merely *cover* piles of materials. They are not typically designed capable of withstanding the pressure of materials piled against them.

The obvious disadvantage is that more land space is required. Concrete domes on the other hand function more like silos, allowing product to be piled high against the walls, thus *containing* the material on a relatively small foot print.

3. Reclaim Systems

As domes have become more popular, several equipment manufacturers have begun offering various types of systems to automatically withdraw the stored materials. The dome and reclaim system are integrally related, and the reclaim system selected almost always impacts the shape, size and cost of the storage dome significantly. Many people assume that all reclaim systems work equally well in any dome. This simply is not the case.

In this presentation we will discuss a few reclaim systems from the perspective of a storage dome builder who has built domes for many different types of systems. All of the systems discussed here are real working systems. Most have been installed in concrete domes. The author acknowledges that there may be other systems not mentioned which either could be or perhaps even have been installed in domes. Our discussion here will be only in *broad,* general terms of the most common dome reclaim systems. Precise cost data is purposely avoided in this presentation, since each project is unique and it would be difficult to make cost comparisons that would be meaningful for every project. For more specific information, including pricing we recommend that you contact the equipment manufacturers.

Even though systems often include both pneumatic and mechanical components, in general reclaim systems for cement storage domes can be divided into two basic categories, mechanical and pneumatic, *DOMTEC*® is often asked which of these two types is better. The answer depends on many things, often issues which are project specific. Sometimes either type of system could work and the choice simply depends on the client's preference. When considering a storage dome for any given project the client should evaluate the following issues:

- Site constraints (available land area as well as any height limitations)
- Geotechnical conditions (including soil bearing capacity and the depth to the water table)
- The length of time product is to remain in storage
- The importance of 100% reclaim
- The importance of *first in, first out*
- Initial capital cost (including *all* costs associated with installation of the system)
- Operating costs (including the cost of electrical energy)
- Maintenance costs

By determining the relative importance of each of the above issues and understanding the actual site related conditions, the most logical type of reclaim system will often become evident. The enclosed table *(table 1)* can help clients evaluate between different types of equipment in selecting the reclaim system that will be right for a particular project.

Most clients seem to prefer having the capability for fully automated, 100% reclaim. Indeed if it is important to regularly empty the storage *completely* several times each year, then such a system is probably warranted. On the other hand in some instances what may really be important is to have an adequate total storage capacity, but to able to reclaim only part of the total storage volume automatically. If the storage will never be emptied completely, or

perhaps only once or twice per year, then money could be saved by purchasing a system capable of reclaiming only a portion of the dome's capacity, and front end loaders could be employed to accomplish the occasional complete clean out.

If a client purchases a system capable of withdrawing only part of the stored material, when in fact they really need or expect complete automated withdrawal, then they are sure to be frustrated. This unfortunately happens sometimes. Why, you might ask? Usually it is because the client is lured by a system's lower price while not fully understanding the system's limitations, or capabilities which sometimes could be over represented.

When it comes to a system's capital cost, one should consider the complete overall cost of the dome plus the reclaim system. Some make the mistake of looking at and comparing only the cost of equipment as invoiced by the manufacturer. Many do not realize that depending on the system, there may be additional costs associated with the system's installation or dome design which may be as costly or more so than the equipment itself. For example as a result of how some systems are designed to operate, a larger or taller dome is required to achieve the same capacity as other types of systems. Some systems require more extensive civils work, such as specially sloped floors. All the costs associated with such extra work should be included in any cost comparison of systems.

3.1. Mechanical Systems

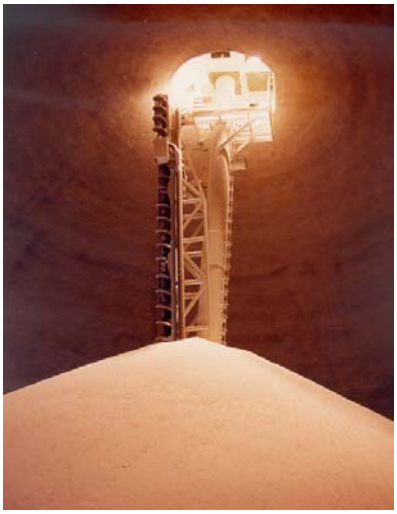

Figure Cambelt reclaimer

Perhaps one of the main advantages of mechanical reclaim systems is their ability to handle a wide variety of products, including some that are difficult to handle. Various mechanical systems have been installed in domes by companies such as Cambelt International, Starvrac, Decker Industries, Mid-West Conveyor, Ameco, BRP (offered through BMH), and others. Mechanical systems differ significantly in their design, construction, performance and cost.
To date the most popular of all systems (pneumatic or mechanical) has been Cambelt's open screw reclaimer. (*figure 1*) It has been installed in nearly 30 domes around the world and has proven effective reclaiming cement, fly ash, clinker, borax, synthetic gypsum, metal concentrates and other products. Cambelt's system is designed for virtually 100% reclaim and continuous heavy duty use. Cambelt systems have been installed in domes larger than 60 m diameter. They can reclaim at rates up to 1500 tph and handle particles up to 150 mm (6 inches).

Starvrac is another manufacturer offering open screw type extractors *(figure 2)* . Starvrac has installed over 4,000 machines in more than 250 different products. Most of these machines are working inside relatively small diameter silos. Only a few have been installed in domes. These, however, have included several machines in sugar storage domes up to 60 meters in diameter. Starvrac machines work on the bottom of the storage pile on a *first in-first out* basis. Starvrac extractors work best with materials that have a particle size of 60 mm (2.5 inches) or smaller. A Starvrac's reclaim capacity is usually limited to about 500 tph, however multiple machines can be installed in the dome when higher reclaim rates are required.

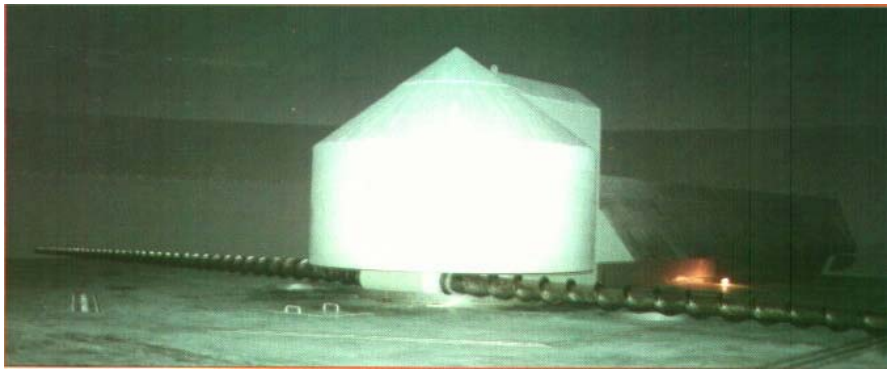

Figure Starvrac Symetrix

Another mechanical concept utilized in several domes is the *rotary plow*. So called systems are offered by companies including Decker Industries *(figure 3)*, Mid-West Conveyor, and Aumund (Louise). The basic design consists of a traveling rotating feeder installed above a belt conveyor. The feeder moves back and forth across the dome's diameter pulling material on to the belt conveyor as it goes. The systems are not designed to reclaim all the stored material out of a dome, however they reliably reclaim whatever material that they come in contact with. If the dome is constantly being filled and rarely needs to be cleaned out completely, this type of system could save the client some money. Once again, this would not be the correct system if what is really needed is complete, fully automated reclaim of the dome's total storage volume.

Figure Decker Industries Rotary Plow

For products other than cement and flyash, several companies such as Krupp, Koch, Aumund, Ameco, MVT and others have built circular reclaimer systems for many years, even before concrete domes became popular for bulk storage. They come in a variety of designs including some which are made specifically for blending materials. Many of these systems also include a circular stacker which usually allows for stacking operations to occur simultaneously during the reclaim process. These systems usually reclaim on a *first in-first out* basis, and are capable of reclaiming at very high rates. They also can handle almost any size material particles. Because many of the designs include an outside perimeter rail which cannot be buried in product, they are usually used under large diameter steel or aluminum dome covers, such as raw materials storage halls. Only a few of these types of systems have been installed in concrete domes.

Although to date none have been installed in domes, the Aumund Mole has proven effective and reliable for reclaiming clinker from round storage structures. Recently Aumund has introduced a less costly version of their proven machine, the Mole 2

3.2 Pneumatic Systems

Pneumatic reclaim systems work only for products which can be fluidized such as cement and flyash. Various types of pneumatic reclaim systems have been installed in domes. The first four cement storage domes ever constructed (some 20 years ago) were equipped with Fuller fluidized floors *(figure 4)*. All of these systems continue operating to this day, although over time some have decreased in effectiveness. Fuller has since added several more designs of fluidized floors to its repertoire.

Figure Fuller fluidized floor

The general concept of most pneumatic systems is to slope the dome's floor (typically between 6^0 and 10^0), and then install open topped aeration units (such as *Airslides*) on or within the sloped floor. Air blown up through a porous media causes the cement or flyash to fluidize and flow down hill to a pneumatic pump or other conveyor. Since the material is reclaimed from the bottom of the pile, it is generally reclaimed on a *first in-first out* basis.

Figure 5 Van Aalst fluidized floor

Several manufacturers including Van Aalst *(figure 5)*, Ibau, Fuller, BMH, Modco, DCL, Alesa and others offer a variety of pneumatic reclaim systems which can differ significantly in their general lay out, complexity, performance and cost. The effectiveness of these systems seems to be directly related to the percentage of the floor that is covered with fluidizing media. In general, a high percentage of coverage will result in high performance, while of course covering only a low percentage of the floor area will result in low performance.

The main advantage of pneumatic reclaim systems is that they have very few moving parts, thus maintenance costs are expected to be low. Also in most systems, to minimize the initial capital investment and reduce operating costs the dome's floor area is divided up into zones, with fluidizing air being cycled through the various zones. Under this approach the quantity and cost of blower equipment can be minimized as well as the operating costs reduced.

Set pack is probably the biggest challenge for fluidized floor systems. Cement or flyash left in storage for long periods of time will pack and harden or set up often to the point that it will no longer fluidize. If a client's operations will include storing their cement or flyash for extended periods of time, then they should select a fluidized floor system in which the entire

floor area is covered with fluidizing media, and is capable of completely cleaning out sections of the floor on a regular rotating basis. Otherwise, a contingency plan and method should be developed for getting in to manually clean out the dome if the set packed material which will not fluidize. For storage applications which involve very long periods of time perhaps a mechanical system would be more suitable.

4. Conclusion

Concrete domes are becoming more widely used for storing bulk materials. Prospective buyers should be aware that the storage dome and automated reclaim system are integrally related, and not all reclaim systems work equally well for any size and shape of dome. In order to select the correct storage and reclaim system and be satisfied with its performance, clients should become familiar with the various types of domes and reclaim systems available.

References:

M. Hunter, DOMTEC International, Global Cement & Lime, May 2002, *Domes and Automated Reclaim Systems*

M. Hunter, DOMTEC International, Intercem Americas 2002, Miami

F. Wuertle, FULLER, Intercem Americas 2002, Miami

A. Ligthart, CEMENT DISTRIBUTION CONSULTANTS, World Cement, October 2000, *A Unique Cement Terminal*

