**THE WORLD’S LARGEST CEMENT STORAGE DOME**

Mike Hunter, DOMTEC® International, LLC, USA, and Rex Wood, Cambelt International Corp., USA, describe the construction of a 90 000 t cement storage dome, the world’s largest, at Holnam Inc.’s Clarksville plant, USA.

*Additional information supplied by Holnam, Inc., USA, and River Consulting, Inc., USA.

---

**Introduction**

Cement storage domes are now being constructed larger and larger. Holnam Inc.’s new 90 000 t capacity dome at its Clarksville, Missouri plant, USA, is currently the world's largest.

The Clarksville plant, one of Holnam's most efficient and profitable plants, is located on the Mississippi River, north of St. Louis (Figure 1). The additional storage benefits the Clarksville plant in at least three ways: Firstly, due to the additional capacity offered by the new storage facilities, the plant is able to use the winter months to grind clinker and build up a large stockpile of cement to start the peak season each year, in readiness for the heavy summer demands. Secondly, grinding through the winter costs less due to electrical rates being approximately 50% lower than summer season rates. Finally, less clinker has to be stored outside on the ground, reducing environmental impact and improving cement quality.

**Design**

During the latter part of 1997, Holnam hired River Consulting Inc. to develop a preliminary design and project budget. The conceptual design was developed in association with Holnam’s technical and plant personnel. Two basic schemes were considered: either two smaller domes or one larger dome, capable of storing up to 90 000 t. It was understood that this would be the largest cement storage dome ever constructed. Foundation design was a major issue, since the storage dome was to be constructed over what was then a channel, leading to the plant’s retention ponds.

After evaluating all the issues, including filling and the reclaim system options, the recommendation was made to proceed with a single dome. The dome would be filled using an existing pneumatic conveying system (Figure 2). Cement is withdrawn by a Cambelt mechanical reclaim system, which feeds a belt conveyor in a tunnel underneath the floor of the dome (Figure 3). The reclaim conveyor delivers cement.
to an airlift which feeds a MODCO pneumatic transport
system or discharges directly into an auxiliary truck
load-out station situated above a truck scale.

River Consulting's study and recommendations
provided Holnam with the necessary information to
move forward. Holnam then hired the company to
provide detailed engineering and to manage the
project's complete construction, including site and
budget management and quality control.

This design and construction management
approach had been successfully executed by River
Consulting at Holnam's import terminal at Reserve,
Louisiana, in 1997. This approach allowed the
Clarksville facility to be completely designed and
constructed within a 12 month schedule. It also gave
Holnam complete control over selection and
procurement of equipment and subcontractors. As a
result, the project was completed in accordance with
the conceptual design, on schedule and within River
Consulting's original proposed budget.

Concrete Storage Domes
Concrete domes have proven to be effective for
storage of many bulk materials, including cement
(Figure 4). The primary advantages of concrete domes
include:
• Superior protection of the stored material.
• Strength and durability.
• Low cost per ton construction cost.
• Excellent environmental control and containment
  of dust.
• Rapid construction, regardless of weather.

Domtec International was selected to construct the
large 90 000 t cement storage dome. Before
construction of the dome began, a drilled pier
foundation and sub grade reclaim tunnel were built,
and a heavily reinforced concrete slab poured to act
as the roof of the tunnel and the floor of the dome.
Domtec International's work then began as
construction equipment and reinforcement bars were
stockpiled on the concrete mat. The large dome
shaped air form, made of single ply roofing fabric, was
then attached to the edge of the concrete foundation and
inflated. Once inflated to its near hemispherical shape,
polyurethane foam was sprayed to the interior surface.
Reinforcement bars were next tied in place as required
by the structural engineer. Finally, skilled Domtec
nozzlemen sprayed shotcrete to properly
embed the rebars and achieve the designed concrete
thickness.

As the dome neared completion, concrete curbs
were formed at the top of the dome to accommodate a
head house and dust filters. Meanwhile, a large drive-in
doorway, including a hydraulically operated structural
steel door, was constructed.

DOME FROM DOME
Successful dome construction requires both proper
engineering and quality control of the construction
process, and Domtec International's technicians have
now been involved with the construction of approximately
70% of the world's cement storage domes, including all
of the six largest.

With the popularity of domes increasing, prospective
clients should be aware that not all domes are the same.
They can be constructed out of aluminum, steel or, as
at Clarksville, reinforced concrete. Metallic domes perform
merely as covers, while concrete domes can also perform
as containers, allowing materials to be piled high against
the walls. Different storage applications require different
storage solutions. The performance requirements of each
application usually determine which type of dome is most
suitable.

Even concrete domes are not all the same. For example,
two concrete domes of identical dimensions could be
constructed using substantially different quantities of
Concrete and rebar, depending primarily on the structural
design. Holnam's Clarksville dome was designed and
constructed in accordance with established, proven
engineering standards which have been used for the
majority of the world's cement storage domes.

Figure 2 (left). Load in pneumatic conveying system
and auxiliary truck load out station.

Figure 3 (below). Load out belt conveyor located in
tunnel.
Automated reclaim system

The dome was installed with Cambelt International Corporation's automated mechanical system, of which there are now approximately 20 systems operating in the cement industry. This system allows the volume of the dome to be more efficiently utilised, as the reclaim system can be buried within the cement storage pile. The marriage of the dome and reclaimer provide the following advantages:

• Superior protection of stored materials.
• Major cost savings compared to other storage and reclaim systems.
• Maximum utilisation of the storage space inside the dome.
• Virtually 100% reclaim of the stored materials.
• High reclaim rates.
• Reduced operating and maintenance costs.
• No personnel working inside the dome: a major safety feature.
• Excellent environmental control.

The Cambelt reclaiming system consists of the following components (Figure 5):

• A mechanical load-in conveyor system.
• A centre column support base.
• A rotating centre column.
• A support bridge and rotating screw reclaimer.
• A cable hoist for raising and lowering the bridge.
• An observation and maintenance platform.
• Headhouse column drive equipment.
• Controlled discharge and mechanical load-out.
• Emergency discharge hoppers.

Automated reclaim of the cement is initiated by activating the fluidised bin bottom at the base of the rotating centre column. During the first phase, the reclaim cycle, cement flows to a rat hole by gravity, without the need for a reclaim screw (Figure 6). During the second phase, cement is reclaimed using a combination of gravity and screw reclaim. Only during the third phase does the mechanical screw pull the remaining cement to the discharge. The reclaimer column support base is mounted in beam pockets built into the tunnel walls. On its top side, the support base carries the entire load of the heavy reclaimer, while from below, it also supports the controlled discharge equipment.

Figure 5. Automated reclaim system.

Figure 6. Typical dome loading and gravity reclaiming (phase 1)
Rotation of the centre column is achieved by a drive assembly located inside the headhouse at the top of the dome. The drive equipment includes a large gear box supplied by Falk. The bridge truss supports an open reclamer screw and is attached to the rotating centre column with a pin connection. The entire bridge screw drive and reclamer screw were fully assembled and aligned, then disassembled for shipment (Figure 7).

An observation and maintenance platform was installed just below the headhouse at the top of the rotating centre column. Access is through a hatchway in the drive assembly platform in the headhouse floor.

Utilising the services of Trimax Systems Inc., Cambelt included a fully automated central control. A Modicon PLC is used to control the Cambelt reclamer. The PLC is interfaced with an IBM compatible PC, using the 'Wonderware InTouch' graphical man-machine interface, graphics control package (Figure 8).

The programmable logic controller, processing data received from sensors, automatically provides the required flow of material to the centre discharge. This is accomplished by adjusting the rotational speed of the column and the depth of the screw's cut into the cement pile. Modem support is provided, including the capability for 24 hr per day support, on-line training and troubleshooting.

Although the Cambelt reclamer is designed to reclaim virtually 100% of the stored material, additional emergency discharge openings are designed into each reclamer system as a precautionary maintenance feature. These allow partial reclaim by gravity, facilitating access to the screw through the large drive-in door (Figure 9).

Pre-assembly of the steel structures and preparation for installation of reclamer equipment took place outside during the final stages of construction. Installation then took place within a matter of weeks.

Cambelt's mechanical reclamer will remove all the stored cement to within a few inches of the dome floor upon command. Each dome discharge cycle is predictably the same as the previous one. The operation of the reclamer is not affected by the tendency of stored cement to compact into a cohesive mass as a reaction to pile pressures, humidity and time.

**Summary**

HolNam's new Clarksville dome is an environmentally friendly storage solution (Figure 4) providing HolNam increased capacity for improved plant efficiency, better quality and service for its clients. Design and construction management of the complete facility was performed by River Consulting, incorporating a high quality Domtec concrete dome and state of the art material handling equipment. This included Cambelt's mechanical reclamer system and other components selected not only for economic advantages but also for versatility and proven track record of effective performance in bulk cement handling.