Resurrecting Sleeping Giants
Rebuilding the Maple Grove Lime Plant

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Building a new lime plant today can be an expensive proposition. Long-term supply contracts, which usually provide the justification for these large capital expenditures may just not be economical if the initial investment is too high. One alternative is to purchase an existing plant, possibly dormant, and reconstruct the operation. But how can you be sure that the purchase is a good deal and will it suit your purpose? The following highlights the Maple Grove lime plant reconstruction and specifically those issues important in renovating a dormant facility.

The Maple Grove Lime Plant is located near the town of Bettsville in Ohio. It once was a symbol of productivity in the industrial age. Built in the 1950's by Basic Incorporated, the plant was equipped with many features not found in the plants of today. It had an extremely large burner building equipped with a freight elevator big enough to move equipment from the basement and the firing floor to grade. All the silos were concrete, divided into many chambers, and were equipped with elaborate pivot bucket elevators as well as man elevators. Even the quarry main crusher was 60 feet below grade with a pivot bucket elevator to bring the crushed stone to grade before heading toward the kilns in an underground conveyor system. The plant produced a dead burned dolomite product and employed approximately 200 people in the busiest years.
The plant was later purchased by Combustion Engineering and eventually sold to Premier Services Corporation. The plant was in operation until the late seventies before it was shut down. It is unclear how the plant was shut down as much of the product storage equipment was still in operation in 1998.

Plant Survey
Ferenco was awarded the contract in April of 1998 to reconstruct the Maple Grove Lime Plant. But before this happened an initial plant survey took place. This was done to quantify the project and to associate a cost with the reconstruction. It was also a chance to develop the flowsheet, general arrangements, and construction schedule, which together with the project estimate are the cornerstones of any successful project. Maple Grove was unusual in that many records and detailed construction drawings were kept in good order at the plant. However, it is important to note that when relying on old drawings they should be field verified to ensure that the actual construction matched that of the detailed drawings. It was discovered at Maple Grove that the rock, on which the burner building basement was built, was actually granular fill. Obviously, for heavy loads this discovery had significant impacts on the design of foundations.

Photo #1 – Completed Plant

Another valuable resource often over looked during the survey is the people who used to work in the plant. The Maple Grove project team had the benefit of discussing many issues with the staff who worked next door at the company from which the plant was purchased. The information obtained was specifically useful when trying to unravel the complicated maze of wiring that

connected the lime plant from the plant on the adjacent property.

Photo #2 - Condition Survey of Kiln Trunnions

Engineering Considerations

The engineering began on this project as many do with a review of the process and calculations for the major process elements. The Owner supplied some new and existing technology, which was to be incorporated into the design of the plant. This in itself provided some obstacles, as certain physical dimensions of either the equipment or the structures were incompatible.

The plant was originally constructed with the kilns exhausting into dust chambers which were directly connected two a large stacks. During the early 70's, this system was revised and an electrostatic precipitator was installed with two ID fans. After a careful review of the merits of refurbishing the precipitator, outfitting the precipitator with bags, or replacing the precipitator with a baghouse it was decided to install a new baghouse for each kiln. Given that the precipitator was built on a very sturdy structure which was elevated over the rail tracks, and that space was at a premium around the kilns a plan was developed to save the structure and install the new baghouses where the precipitator chamber was installed. Additionally, the layout of the ducting was considered so that in the event of a future upgrade to a preheater, both kilns would not have to be shut down.

The original plans also did not provide for the reuse of the twelve existing stone silos. It was felt that the elevating of the stone up from the silos, which were very close to the kiln feed, would cause too much stone degradation. However seeing value in those silos ten of the twelve silos were converted to product storage. The remaining two silos were converted to kiln feed surge bins by cutting the sides out of the silo walls and creating new bottoms above the kiln feed conveyors. This shortened the fall height, produced 200 T surge bins, and eliminated the re-elevating of the stone from the existing outlet elevations.

The above are but two of many design decisions that both reduced costs and saved time on the project. When reconstructing an old plant it is best to carefully study the options to make the right choices both for the present and the future.

Planning is very important when reusing existing structures. New process equipment must be installed yet the process is hindered by the fact that buildings, silos, etc. are already constructed. Therefore, it is important when designing those new pieces of equipment to consider how they will be installed.

Permitting Issues

If time permits, an environmental audit of the plant should be conducted at the plant survey stage. This will identify all the known and potential risks of hazardous materials before demolition begins. It is important to know this to prevent lengthy delays to both the project and the contractor. These delays can add significant costs to the project.

The audit at Maple Grove turned up, asbestos, lead paint, and chromium. More importantly, it was now known where these problems were located so that the appropriate planning could take place.

Another benefit of reusing an old plant is that many have existing operating permits, which if the same stack discharge point is used usually limits the amount, if any modeling that must be conducted. This can save both time and money for the project. One point to consider however in this approach is that according to the EPA to be

exempt from reapplication for permit, the cost of the reconstruction must be less than fifty percent of the cost of constructing a new plant. Obviously any new sources of emission such as housekeeping dust collectors must have the appropriate permits.

One other area that often is ignored is the building permit. It is often felt that modifications made to a plant do not require a local building permit. This is usually not the case and the local building official should be consulted for advice. The building inspector can be very helpful in making the project proceed smoothly. Ignore the inspector and the risk is very high that the project will be stopped unexpectedly until the proper permits are acquired.

Concrete Problems

During the early stages of the survey, it was observed that the concrete around the plant was crumbling and primarily the kiln piers. There was a brown/yellow stain to many sections of the concrete suggesting that the rebar was deteriorating from within the concrete. Large pieces of concrete had fallen off and if the concrete was hit with a hammer, a hollow sound could be heard.

Photo #3 – Kiln Pier Concrete Degradation

It was determined that this problem was serious enough to engage a specialist to examine the concrete and to advise what possible repair could be done. During the site visit each face of the kiln piers, which were the worst concrete problem by far, was mapped out in a grid pattern. A copper copper-sulphate half cell potential survey was conducted for each pier face. From this data it was possible to determine whether corrosion was taking place. The conclusion was that significant problems lay beneath the surface.

The initial repair method selected was to chip away the delaminated concrete, repair the rebar mat, and reface the piers with shotcrete. A contractor was hired with the experience necessary to complete the work both professionally and in a timely manor, as the kiln work could not effectively begin until the work was completed. During the repair work however two of the piers were far worse than expected, to the point if the removal process proceeded any further the structural integrity of the pier would be compromised. It was decided at this point that the repair method had to change to one of forming a concrete jacket around the pier. This method was, by no means, easy. High forces from the pour of high walls around the pier deflected the forms and caused a slight bow in the first wall. However on the remaining wall the form bracing was increased dramatically thus minimizing the deflection of the form. The concrete repair work took at least four months to complete.

Demolition

The demolition contract for this project included cleaning as well. Given the condition of the plant when construction began, lime deposits in all the tunnels and passage ways, debris, other materials stored in the silos, and remaining, lime/limestone and brick in the kilns had to be removed from the work area.

Photo #4 – Plant Condition before Cleaning

The silos had to be cleaned by cutting holes in the concrete sidewalls. The new equipment at that time was not installed and the old equipment was of no use as the silo material did not flow anymore. Augers mounted on bobcats were used to work their way into the material from the side, while a team from above used a proprietary "mole" device from above to dislodge the old material. The process of cleaning the silos took at least 3 months. When completed access doors were placed on the sides of the silos, in the event they ever had to be cleaned again.

Demolition had begun during the cleaning process. When reconstructing a plant it is very important to mark carefully those items, which are to be saved, and those to be demolished. This should be done in different colored paints to be sure there is no misunderstanding. It is very easy when a large demolition crew is working to cause a significant set back if demolition is not controlled. Additionally safety is of utmost concern when demolition is taking place. At Maple Grove, the services to the plant were completely cut off, except for construction power, to the demolition area to ensure the safety of the workers.

During demolition, additional hazardous materials were discovered that did not turn up in the original environmental survey. This will happen and it is important to take care of these issues when they arise in a timely manor to prevent a delay in the project. At Maple Grove one case was the asbestos discovered between the steel housing and the refractory lining of the kiln feed hood. This was a very difficult situation as the brick was somewhat unstable, specifically the roof of the chamber. An asbestos removal contractor was brought in who received advice from the local EPA inspector as to how to best deal with the matter. In the end, the steel sidewalls were cut away and the asbestos removed from between the brick and now missing steel. Once the majority of the asbestos was removed the roof was collapsed and the contaminated brick was removed to a certified landfill. This entire process took place behind a plastic shield. It is important to allow a generous contingency for the demolition contract, as the unknown will occur no matter how much pre-planning is done.

As for scheduling, the demolition plan should center around those areas which are first in the construction plan so that work rebuilding those areas may begin as soon as possible. The work order should be discussed in detail with the demolition contractor before the contract is awarded. This is to ensure that the project schedule is not adversely impacted by the schedule the contractor may wish to follow because it is more cost effective for them.

Reusing Existing Structures

There can be a lot of value in reusing existing structures. First, they were already constructed. Second, many older structures built in years gone by were generous in size where as if they were built today, given competitive pressures, would be much smaller and more specific in design. Before beginning to renovate these structures however a careful inspection of the structures should be conducted to determine if any dangerous situations exist. These dangers can come in the form of deteriorated steel members, steel plates that have worn thin, cracks in foundation walls etc. Many times some of the members could be below concrete in which case the concrete must be removed to examine the structure. This was the case in one of the conveyor galleries at Maple Grove. An interim repair was done to the truss section of a gallery allowing the concrete to be removed and the steel eventually repaired.

Another problem was a large crack discovered in the building wall, which developed most probably because at some time the gap between the wall and the kiln pier was filled with earth. Repeated freeze thaw cycles of the soil between the wall and the pier may have caused the building wall to fail. Since this building was being put back in service, the wall had to be repaired. The wall that had shifted 6" could not be pulled back into the original position therefore the only answer was to stabilize the wall. This was done be installing rods from the building to kiln pier. The rods were then tensioned thus stabilizing the wall.

Many other situations existed and were treated at Maple Grove and not all were discovered during the initial inspection.

Refurbishing Old Equipment

Reusing existing equipment can be a blessing or a curse. There are two ways to approach the use of existing equipment in an old plant. One is to do as little as possible to get the equipment running and expect to do maintenance/upgrading

on a regular basis. The second is to return the equipment to an "as new" a condition as possible.
Time should be spent up front examining the value of equipment to be reused. If the cost of reusing the equipment after repair is close to what it would have cost new it should not be used. Besides the comparative costs of the equipment, usually the design of the plant is based on the location of the existing equipment. Had that piece of equipment been replaced then new design layouts may have been possible.

At Maple Grove, equipment was both reused and replaced. The most obvious pieces of equipment that were reused were the kilns. Each kiln is eleven foot three inches in diameter by three hundred ninety feet long. A survey of the two kilns was conducted along with an alignment check to verify the condition of the tubes. The survey included a complete review of the drive train. The kiln one girth gear was in poor condition but the pinions were good. Kiln two had poor pinions but the girth gear was in usable condition. Fortunately there was a spare girth gear purchased years ago lying in a field at the far end of the plant. Consequently, the kiln one girth gear was removed and replaced with the spare gear. Kiln one also received new pinions. The pinions that were removed from kiln one were installed on kiln two and the existing girth gear was cleaned and inspected. All the gearboxes were rebuilt and every kiln trunnion was shop repaired with new seals installed.

The shell sections of both kiln one and two needed work. The feed and discharge ends of the kilns were replaced. Additionally some other sections of the kilns were replaced including two heavy tire sections.

Photo #5 – Installation of New Kiln Shell Section

The bowl mills were another substantial equipment repair item. The mills at first glance looked usable. However once torn down the years of operation, specifically on a dead burned product with iron added at the feed end, was clearly visible. The housing on mill number one was replaced complete with a new inner cone. The mill on kiln two also required a new inner cone but the housing was reused. Many of the internal components were replaced and all new wear liners and rolls were installed. The gearboxes as well were completely torn down and parts replaced.

Originally many of the conveyors were going to be reused as is, but during the course of the project, it was decided to rebuild these conveyors to a newer condition. Most of the belts and idlers were replaced. All of the gearboxes were replaced and in many cases all new bearings were installed. Guarding also had to be addressed, as what was acceptable fifteen years ago was not acceptable today.

The elevators were virtually all replaced with new standard bucket elevators. However, one of the original pivot bucket elevators was kept for

unloading solid fuel. Since this silo system was virtually separated from the other areas and the silos were so compartmentalized it was more cost effective to reuse the old system. The old system has a moving tripper car that allows the pivot bucket elevator to distribute fuel to the twelve silos (six by two). The chain and buckets were replaced along with the pivot tripper car drive. The cost of repairing the equipment was far less than that of installing a new system.

Power

The power system at Maple Grove needed extensive work. Not only was the equipment in a bad state of repair, the power system was complicated by the connection to the operating plant next door. The decision was made early on to replace the entire electrical system.

The first thing to determine was where the power was coming from and where the power was going too. The power comes from an AEP substation on site. From there, it travels to a distribution pole before heading underground. It was at this pole that the separation begun to take place. A new fused disconnect system was installed at the pole and the two plants became permanently separated.

It was established that the underground feeders which went to the plant substation, located between the kilns, were suitably sized and in acceptable condition for the new service. The entire plant substation was gutted and two new transformers complete with switchgear were installed.

From this point, the entire distribution system was replaced. New MCC's, cables, tray, etc. took the place of the old wiring. Many of the old electrical rooms were used for the new system. Additionally many old small maintenance shops were converted to electrical rooms. This practice reduced the cost of the work.

Grounding is one issue that needs to be addressed when renovating an old facility. A ground grid may or may not be present. If a ground is not visibly present possibly the grid was embedded in the concrete. In this case old drawings may provide the answer. If the answer is that no grounding is present, a new system must be installed to comply with the National Electric Code, which governs virtually all construction in North America today.

During the installation of the lighting it was possible to use the existing conduit embedded in the concrete to pull cables to the new lights being installed. This did save some time and cost to the lighting project. An existing underground tunnel contained large distribution conduits, which were reused for motor control center feeders. Other existing conduits were also reused where ever possible.

The original DC based drives which were used to control the ID fans and the kilns have been replaced by AC variable frequency units. There are two AC variable frequency drives on each kiln controlled by a load-sharing unit to maintain constant load on each pinion.

Controls

The previous control system was both inadequate and inoperable and therefore had to be replaced. The original plant had two small rectangular glass paneled control rooms. Mimic panels were installed in each room with a series of analog gages and chart recorders.

The control system was replaced with a PLC based system. The plant was divided into three PLC systems all using the Allen Bradley PLC5 family of controllers. There is one PLC for each kiln and the third PLC handles all raw material and product control. The software used to interface with the PLC is Wonderware. The PLC’s are controlled by five computers, three located in the control room, one at the truck loadout, and one in the main office which is primarily reserved for development work.

Photo #6 – Plant Control Room

The kilns are equipped with cameras looking into the firing zone, which can read and display up to six different temperatures at the same time. Additionally a shell-scanning camera keeps track of the kiln external shell temperatures so that any

brick degeneration can be detected long before it becomes a serious problem.

Commissioning

Construction was planned so that one kiln would be completed before the other thus allowing a staged commissioning program. This was not only beneficial from the engineering/construction side but also from the operations side. The delay in the commissioning of the second kiln allowed operators to become familiar with operating the system before they had to deal with two kilns together.

Raw material and product systems were commissioned before the start up the first kiln. Kiln two was the first commissioned, as the renovation to this system was less significant than that of kiln one. It is recommended that where ever possible equipment systems should be allowed to run for at least eight hours to establish if any problems are going to occur. It is also very important to check and recheck that all necessary lubrication has been completed. There is no better way to destroy a new piece of equipment than forget to lubricate the necessary parts, not to mention voiding any warranties.

Having equipment vendors on site during commission is also highly recommended. These people, usually the local representatives, have a vested interest in seeing that their equipment performs properly. The cost to have them come out to assist is usually nominal and it will provide dividends both in establishing a working relationship and ensuring that your new equipment is started properly.

Conclusion

There is a lot to be said for the recycling of these old plants. Properly done, they can be much more cost effective than building a new plant. Conditions have to be right however, as they were at Maple Grove. Research into what is being purchased and the cost to reconstruct is of major importance. It is always advisable to invest some time and money up front to determine if resurrecting sleeping giants is the right choice or whether to let sleeping dogs lie.