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DYK’s newly developed automated beadblasting process uses steel beads to clean and etch the tank wall instead of conventional abrasives like sand. The steel beads are recycled by the machine and the dust from the operation is collected and prevented from escaping into the environment. This process provides better quality control than manual applications and is much quieter than conventional nozzle blasting. The machinery is interfaced to allow the beadblaster and dust collector to be carried, powered and controlled by DYK’s strandwrapping machinery for maximum efficiency.

DYK CORPORATION

Exterior beadblasting of concrete core wall in preparation for shotcrete application and circumferential prestressing.
During the last seventy years, many improvements have been made in the prestressed concrete tank industry. A significant technological advancement has been the machine application of tensioned, galvanized, multiple-wire strand, in lieu of single wire, to supply the circumferential corewall compression. Machine strandwrapping systems have proven to be an extremely durable and efficient method of circumferentially prestressing tank walls. The benefits of current strandwrapping versus wire wrapping include increased bond, improved efficiency, higher force tolerance, electronic spacing, fewer welds and splices, a greater safety factor and a higher breaking strength.

The advent of strandwrapped systems has been a necessary improvement in the prestressed concrete tank industry and has basically made wire wrapped systems obsolete. Because of the superiority of strand and its predominance of use, many other advancements in prestressing technology have been coupled to the use of strand. Since there are no known patents which exist for the machine application of strand, any competent prestressing company having the necessary resources can develop strandwrapping technology.

During the last twenty-five years, strandwrapping has become the preferred method of application for almost all of the municipalities and consultants in the West. Just as an Owner would not be expected to accept smooth conventional reinforcing steel from a mill unwilling to buy equipment to produce deformed rebar, no tank owner should be required to lower their standards solely to appease prestressing companies unwilling to make the necessary commitment towards improved technology.

Vertical prestressing of tank walls is an important element of producing a durable, crack-free, leak-free liquid storage structure. Early tanks that relied solely on conventional vertical reinforcing to resist vertical bending due to differential dryness would frequently develop horizontal cracks and subsequent leaks. Vertical compression of the walls has proven extremely effective in preventing concrete cracking and subsequent deterioration caused by leakage.

DYK feels that high strength threadbars meeting the properties of ASTM A-722 Type 2 have the best attributes of any of the readily available prestressing material to provide vertical compression in tank corewalls. The threadbar is essentially a high strength piece of all-thread with a positive screwed-on nut as the anchorage. The nut anchorage eliminates the stress concentrations typically associated with the razor sharp teeth of wedges used to bite into strand tendons.

DYK recommends a “ball and socket” type joint at the end of the nut to allow for construction tolerances during the installation in the field. Without this feature, any misalignment would produce bending stresses additive to the tensile stress thereby overstressing the bar. With a threadbar, it is also possible to eliminate any seating loss by completely tightening the anchorage nut down. By placing a single bar in a rigid PVC pipe, problems associated with multi-strand tendons, such as bunching and friction losses, are also eliminated.
Continuous electronic recording and instantaneous force application correction is essential to ensure the proper stress is applied to the prestressed materials. Over-stressing, although not visually altering its appearance, can result in stress corrosion and hydrogen embrittlement of the prestressing material. Under-stressing the prestressing material will make the tank prone to cracking and leakage. To date, the most sophisticated, reliable and field-proven recording technology is being utilized solely for strandwrapping systems.

The shotcrete curing process, utilizing DYK’s innovative technology, encapsulates the entire tank wall in plastic sheeting shortly after the final shotcrete layer is applied and soaked with water. The plastic sheeting is lapped and sealed as necessary to properly cure the shotcrete. This procedure provides a very cost effective cure method and greatly improves the moisture retention of the shotcrete during its curing period.

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Electro-servo strandwrapping with continuous electronic recording.

Electronic recording of all applied circumferential post-tensioning forces ensures that the allowable design stress tolerances are not exceeded.

Close-up of strip chart recording of the applied force while strandwrapping is in progress.
The most significant development in improving shotcrete quality has been the introduction of the automated shotcrete application by DYK. This enhanced technology will preserve the integrity of DYK’s structures in the new millennium.

DYK has found that an automated shotcrete application greatly enhances the protective function of the shotcrete covercoat when compared to hand-applied shotcrete. Hand-applied shotcrete is subject to numerous variables, such as distance from wall, applied thickness and the shooting angle up and down and shooting angle side to side, that if not correct can only diminish the final quality.

The only practical method to help control these variables for the entire project is an automated shotcrete process. The task of properly applying shotcrete by hand, especially when considering the large surface area and number of layers required for the typical prestressed concrete tank, is particularly daunting. With hand-applied shotcrete, the tendency is to build up thick layers and move on. However with automated equipment, numerous thin layers, as typically specified, can efficiently be built up which provides for a better, more uniform cure. An automated procedure also increases productivity thereby protecting the Owner from operational problems or penalties if the tanks are not completed on time.

DYK pioneered the use of the wet-mix shotcrete system using concrete batched under the tight quality controls of a ready mix plant.

Wet-mix shotcrete is applied from a nozzle mounted on a mechanized tower which travels around the circular wall or dome-ring at a controlled speed. The nozzle, always held at the proper angle and distance, slowly moves around the tank circumference and up the wall in a uniform spiral path. To obtain a uniform cure and prevent shrinkage cracking, the full cover is built up in numerous layers. In addition to improved structural quality, a beneficial side effect of the automated application is that the efficiency of the system has reduced cost.

DYK’s sophisticated shotcrete machinery. Continuous nozzle travel ensures uniform coating thickness and maximum quality control of the shotcrete.
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Vertical prestressing tendon ducting is pressure grouted with an approved 2 part water insensitive epoxy by DYK’s technologically advanced epoxy grouting equipment. Epoxy will not settle, has superior flow characteristics, is dielectric and has other advantages when compared to cement grout. This provides corrosion protection of the threadbars well into the next millennium.

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