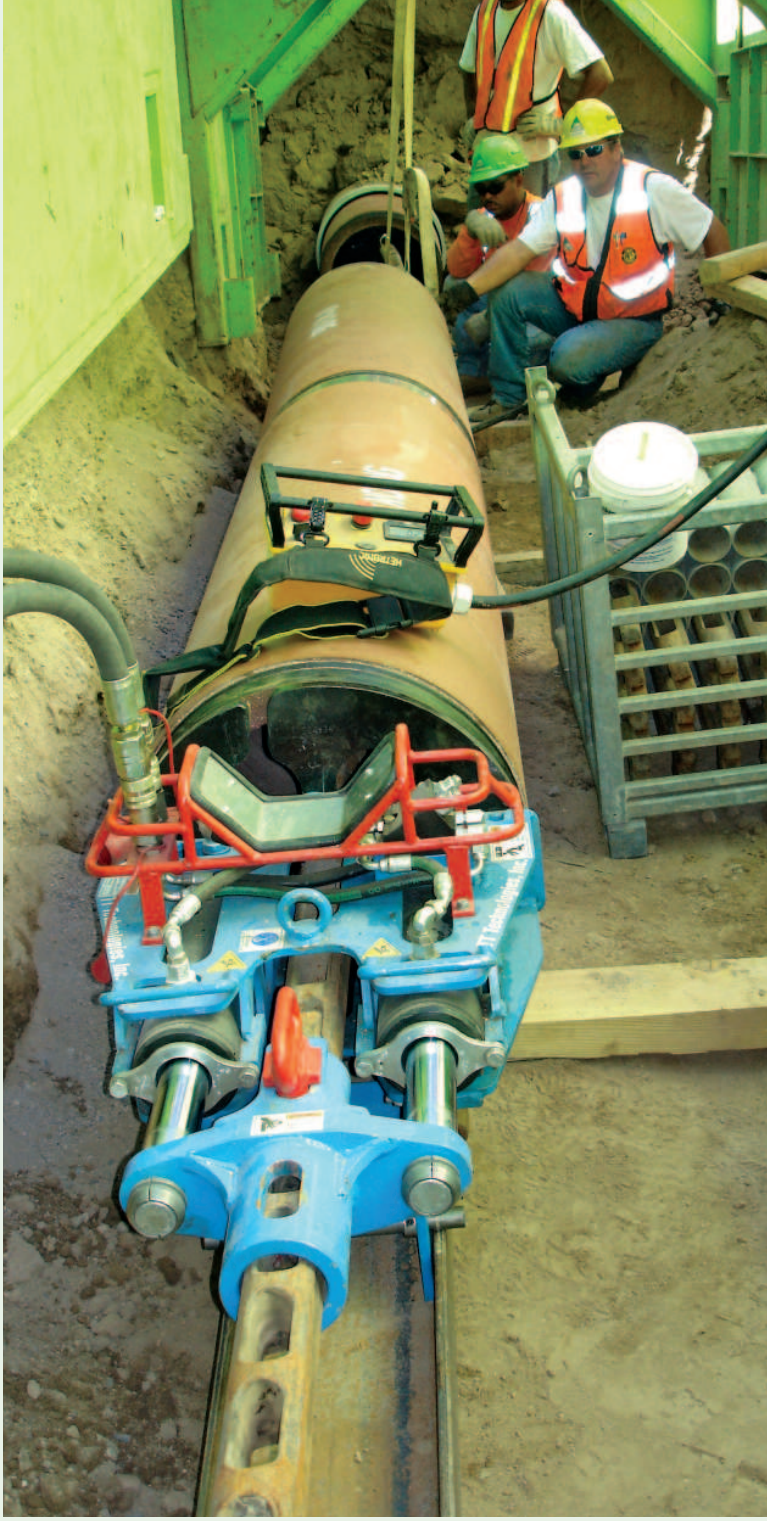
Vitrified Clay Pipe in the Trenchless Industry

By Jeff Boschert



Vitrified Clay Pipe (VCP) has become the material of choice for some trenchless installation processes for many reasons, but the most commonly sited are a robust compressive strength, superior abrasion resistance and the longest lifecycle available. VCP is uniquely suited to pilot-tube microtunneling (PTMT), slurry microtunneling and static pipe bursting.

Pilot Tube and Slurry Microtunneling

Vitrified clay jacking pipe has been the predominant direct-jacked product pipe material used in the 8- to 36-in. size range. Clay pipe, in the typical 1- or 2-m lengths is ideally suited for use with compact jacking frames and the small shaft sizes of pilot tube and slurry microtunneling installations. Tunnel equipment tooling is often sized to match the outside diameter and pipe lengths of VCP. Clay pipe has an average compressive strength of 18,000 psi to stand up to the considerable jacking force of installation. The vitrified nature of the pipe also provides the needed abrasion resistance to prevent external damage as the pipe is pushed or pulled through the surrounding ground. In these installation processes, the greatest load the pipe will ever encounter is the axial force incurred during installation.

With the accuracy of a guided tunneling system, such as pilot tube or slurry microtunneling, there is no need for a larger diameter steel casing and the grade-adjusted inner carrier pipe. A larger diameter steel casing is required for a non-guided boring installation technique when installing a gravity flow line with a slope less than 3 percent. Eliminating this casing pipe saves the additional cost of excavation, transportation and disposal of spoil, as well as the purchase of two separate conduits, thus resulting in a lower overall project cost.

The longest slurry microtunneling drive on record with the National Clay Pipe Institute (NCPI) was a single drive of 892 ft using 36-in. clay pipe completed in Sacramento County, Calif., in 2009. This particular job is illustrative of the challenges that have driven the adoption of VCP in the trenchless industry with depths of up to 61 ft below grade and 40 ft below the existing groundwater table.

Static Pipe Bursting

Over the last several years, VCP has become more popular as the replacement pipe on static pipe bursting projects. Because the pipe sections have compression fit joints and

are designed to be 'jacked' during installation, a bursting system was designed to push each pipe joint "home," as well as keep the column of assembled pipe sections in compression during bursting. A ride-along hydrostatic machine (cylinder pack) attached to bursting rods inside the new pipe sections keep the column of assembled pipe segments in compression as the bursting progresses. As the bursting head is pulled forward splitting the existing pipeline and expanding the fragments into the surrounding backfill, the rear cylinder pack pressure plate keeps the assembled pipe sections in compression. Damage to the external wall is eliminated when using a replacement pipe material with a high resistance to abrasion.

This method of pipe bursting keeps the jobsite footprint, as well as shaft sizes relatively small and compact. Using any segmented jacking pipe eliminates the need for a long lay-down area on the project site as would be required with welded or fused pipe. This is highly beneficial in high-traffic urban settings where long strings of joined pipe can be problematic. Inhibited traffic flow, blocked driveway access and local business disruption before and during the bursting operation can be minimized using this method.

A recent example of a pipe bursting project using VCP was the Downtown Sewer Main Replacement in Riverside, Calif. This project replaced an existing 6-in. sanitary sewer line with a new 8-in. line to meet the needs of a growing community. A densely populated area required that the project footprint and the traffic disruption both be kept to a minimum.

Pipe Characteristics

VCP is manufactured from 100 percent natural materials, a blend of clays, shales and slate. After this mix is blended and ground to a fine particle size, water is added and it is extruded, dried and fired at temperatures reaching 2,000 F to achieve vitrification.

For jacking pipe, a recess is ground into both ends of each pipe section to accept the sealing gasket and collar while at the same time cutting the ends square. Each section is done individually on a lathe with diamond cutting tools to precision tolerances after the vitrification process. This 'end squareness' is necessary to allow the axial jacking force to be uniformly transmitted from the jacking frame through each succeeding pipe section. The wall thickness of the jacking pipe is generally thicker than the corresponding bell and spigot pipe size for open-trench construction.

Depending on the individual project conditions, a polyurethane, synthetic isoprene, EPDM or nitrile elastomer can be used for the gasket material. Each compression joint is then coupled with a Series 316 stainless steel collar. Particleboard or chipboard compression rings, for axial load transfer during installation, are also supplied and used at each joint. Clay jacking pipe meets the specification requirements of ASTM C1208/C; 1208M and EN 295-7.

The chemical resistance of VCP is unsurpassed by any other pipe material. Corrosion resistance is probably the single-most significant influence on pipeline longevity. The nature of the ceramic material prevents it from changing

with age, compared to limited life products, which experience degradation over time. The longevity of clay pipe in conjunction with the state-of-the-art gasket and stainless steel collar system will provide the owner with an "unmatched" service life. Clay pipe is the only sewer pipe material for which the United States Army Corps of Engineers assumes a 100-year life.

Vitrified clay jacking pipe was introduced to the U.S. trenchless market in 1992. Since that time, it has been specified and used on more than 200 tunneling projects, totaling 700,000-plus lf. This gravity flow corrosion-resistant sanitary sewer pipe has been used for pilot-tube microtunneling, slurry microtunneling, static pipe bursting and as a carrier pipe inside a cased bore.

Many U.S. cities have VCP sewer lines that are more than 100 years old and are still in service today. These pipelines perform and continue to serve their communities, despite having been manufactured and installed with outdated construction practices and little or no accepted standards governing the materials or installation practices.

Today's high-tech VCP jacking pipe, newer construction practices, more sophisticated machinery and exacting production standards are all leading communities around the country to explore the possibilities associated with a rigid pipe with high compressive strength and an expected service life of more than 200 years.

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