Chapter
3

Use of Corrugated HDPE Products

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USE OF CORRUGATED HDPE PRODUCTS

Corrugated HDPE Pipe Characteristics

High-density polyethylene (HDPE) is a versatile material and has some ideal characteristics for use in underground structures. HDPE pipe is relatively lightweight allowing for easier and less costly transportation and installation costs. It is not brittle and therefore not susceptible to cracking during pipe handling and installation activities. Once formed into a pipe, HDPE has a smooth surface, which is resistant to abrasion, corrosion and chemical scouring. The smooth surface provides excellent pipeline flow characteristics. HDPE pipe is structurally strong and has the ability to support large loads.

HDPE has the ability to relax under stress. This characteristic provides advantages for underground structures and also helps define limitations of use. As HDPE pipe is loaded, the pipe relaxes immediately, and over time, allows the load to be transferred to the adjacent soil. This characteristic allows the pipe to off-load points of local stress. Stress relaxation may result in slight pipe reformation over time to accommodate in-place loading conditions. Such re-formations are believed to cause long-term structural stability.

Corrugated HDPE is an excellent choice for gravity flow or low-head pipeline situations. The structural stability of corrugated HDPE pipe is produced by three pipe designs. According to AASHTO M294, they are defined as:

- Type C – This pipe shall have a full circular cross section, with an annular corrugated surface both inside and outside.
- Type S – This pipe is a full circular dual-wall cross section, with an outer corrugated pipe wall and a smooth inner liner.
- Type D – This pipe is a circular cross section consisting of an essentially smooth inner wall joined to an essentially smooth outer wall with annular or spiral connecting elements.

Figure 3-1

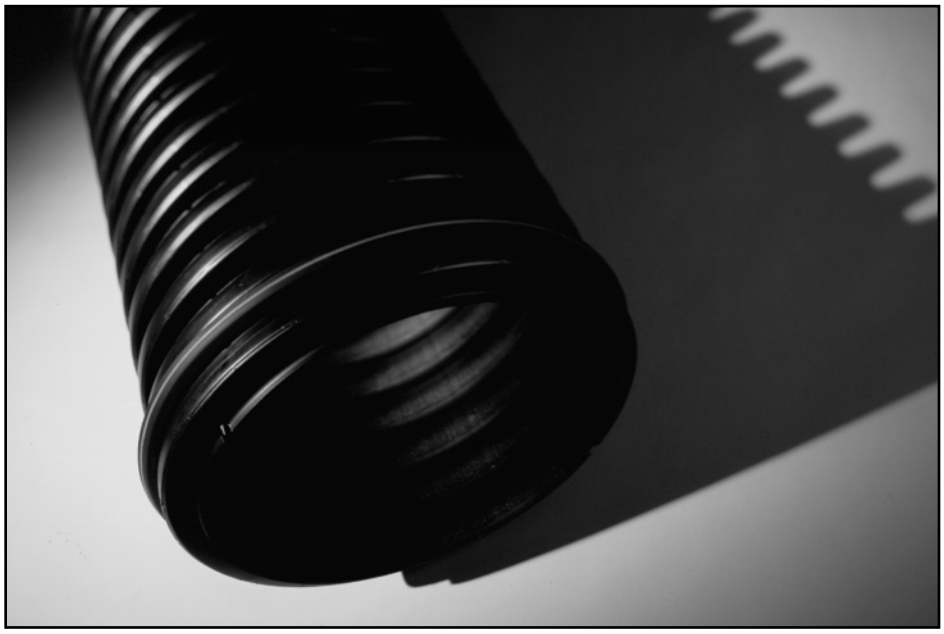

Figure 3-1: Type C HDPE Pipe with Interior and Exterior Corrugations

Typically, Type C pipe with interior and exterior corrugated walls is available in 3-inch through 24-inch diameters. Interior and exterior corrugated pipe in smaller diameters are connected with separate snap-on connections with no gasket. In larger diameters, the connections are made with corrugated bands secured with plastic ties.

The specific design of the pipe as shown in Figure 3-1 varies by manufacturer. Each section is associated with specific structural properties and performance characteristics. Those characteristics are available from the manufacturer for use in load calculations.

Figure 3-2

Figure 3-2: Type S HDPE Pipe with Corrugated Exterior and Smooth Interior

Pipe manufacturers provide various pipe joining methods depending on the pipe style and project requirements. Coupling bands, with or without a gasket, wrap around the pipe and are secured with plastic ties. Gasketed bell and spigot joints are also widely used. Nonrated and nonpressure tested watertight joints are suitable for the majority of nonpressure (gravity flow) drainage applications and typically do not experience significant leakage. For environmental and other reasons, most manufacturers also have a pressure-rated watertight joint suited for nonpressure applications. Joints are rated at either 10.8 psi or 5.0 psi when tested in accordance with ASTM D 3212.

Figure 3-3

Figure 3-3: Use of a Gasketed Coupling for HDPE Sewer Pipeline Application

Although HDPE pipe products are versatile, the primary use of corrugated HDPE is for gravity flow water management. Examples of these water management systems include:

- storm drainage
- subsurface drainage
- sanitary sewers
- leachate collection
- detention/retention stormwater management systems

Storm Drainage

Corrugated HDPE has become the pipe of choice for many of these drainage applications. Stormwater systems require a wide range of pipe sizes and cover requirements in both landscaped and parking areas. Corrugated HPDE is a durable and cost-effective pipe material for these on-site drainage facilities.

The pipe materials approved for drainage conveyance in public rights-of-way are determined by the jurisdiction responsible for maintenance of such facilities. HPDE has been used for highway and roadway drainage culverts and storm drainage

systems for more than 20 years. Most state Departments of Transportation, cities and counties have included HDPE in their Departments Standard Construction Specifications. Installations have included culverts under very high fills and under minimal cover. Many installations have been monitored and have demonstrated satisfactory to exceptional performance. Concerns of insufficient strength, cracking and deterioration over time have proven to be unwarranted.

Figure 3-4

Figure 3-4: Highway Drainage Culvert with HDPE Flared End Section

Subsurface Drainage

Corrugated HDPE pipe can also be produced with perforations. The perforations allow subsurface water to be collected and transplanted to favorable locations for discharge. Subdrainage systems are used to collect leachate under landfill sites. Subdrainage systems also are used to control and direct underground water transport and to encourage proper surface water percolation in golf courses, athletic fields, hillside development projects and in agricultural fields. Often, subdrainage systems are used to lower the groundwater table. For athletic field development, subdrainage systems have been connected to air vacuum systems to encourage the downward movement of surface and subsurface water.

Perforated corrugated HDPE pipe is often used to control water levels in agricultural land. Perforated pipe is installed to collect and transport subsurface drainage and/or groundwater or to control the depth to groundwater.

Sanitary Sewers
HDPE pipe is an ideal septic system leach pipeline material. One type of HDPE pipe has been specifically designed with special perforations to allow percolation.

Leachate Collection
The mining industry has a special application of subdrainage that is ideal for corrugated HDPE perforated pipe. A technique called *heap leaching* is used to recover low-grade deposits of copper, gold and silver. A cyanide solution sprayed over soil containing gold or silver converts the minerals to a chemical compound. The solution is collected in a perforated pipe subdrainage system and transported to ponds. The gold or silver is recovered from the ponds using carbon absorption or precipitation. HDPE is well-suited to this process because it is highly resistant to chemical attack. Tests have shown little or no degradation of HDPE with long-term exposure to a pH range from 1.5 to 14.0.

Detention/Retention Storm Water Management Systems
Current regulations in most areas limit the rate of storm water runoff as well as the level of pollutants allowed in discharged storm water. Urbanization of land can dramatically alter the natural movement of water. When runoff is transported away from critical areas, it can cause problems where recharge of aquifiers is necessary to maintain a steady groundwater supply. To counter these problems, storm water retention systems hold runoff until the surrounding soil can accept it via percolation, allowing aquifiers to be recharged. In other cases, the existing storm drainage trunk system is not designed to accept increased peak flow and the runoff must be retained until the peak flow has subsided.

Many jurisdictions require developers of projects to assure that downstream peak storm discharge flows remain the same *after* development.

Storm water retention and detention systems can be either above-ground ponds or subsurface piping. Ponds are the least prone to early siltation and clogging, but could present child safety and long-term aesthetic problems such as insect breeding, weed growth, odor and refuse control. Subsurface retention/detention systems use available land efficiently at a low maintenance cost, while posing little or no public safety or aesthetic problems. Underground storage facilities developed by placing several pipes in series is a common use of corrugated HDPE pipe.

Figure 3-5

Figure 3-5: On-Site Storm Water Detention Facilities

Other Systems

Corrugated polyethylene pipe is used in a wide variety of other applications, several of which are described below. Contact the manufacturer for detailed information for these and other applications.

Roof Leader and Landscape Area Drainage
Residential, industrial and commercial buildings all have demand for roof leader and landscape area drainage facilities. Small diameter corrugated interior and exterior HDPE is the most commonly used product available for these types of uses. The combination of flexibility, durability and strength is not offered by other materials.

Ventilation Systems
Perforated corrugated HDPE pipe also has become the product of choice for ventilation systems. Pipe placed in the bottom of grain storage bins introduce air via blowers to evaporate moisture from the grain piles.

Another application utilizes perforated HDPE pipe to collect air from the discharge of an air scrubber for disbursement under a filter media to remove contaminant particles.

Earth Cooling Tubes

Earth cooling tubes are a viable method for space cooling, and are being used as an alternative to conventional air conditioning. In these systems, warm air is moved through the cool earth via tubes. The air is then used to achieve a cooling effect. Corrugated polyethylene tubing is particularly suited for this application because the corrugations provide a greater surface area for the heat transfer process to take place.

Floating Systems

HDPE is resistant to corrosion and chemical attack. Those properties, along with its relative light weight, has allowed it to be used as a holding vessel for floats. Polystyrene-filled corrugated HDPE pipe is used as floats in various applications.

A common use of these floats is as pontoons for floating boat docks. Various dock materials are easily attached to the corrugated HDPE pontoons of any length to form the appropriately shaped floating dock. Similar floats also have been used to provide the support for polyurethane covers of liquid waste and chemical storage ponds.

Figure 3-6

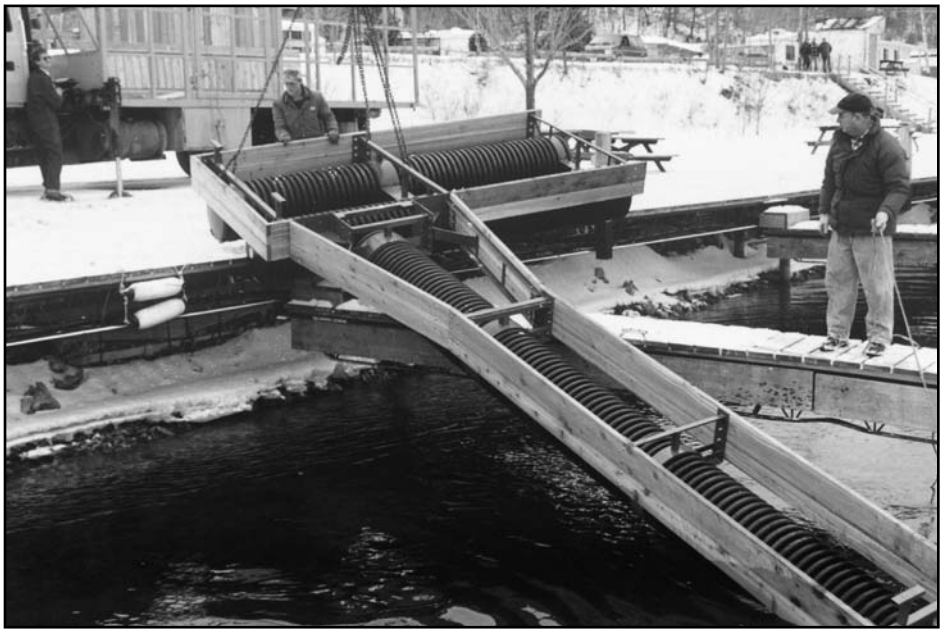

Figure 3-6: HDPE Pipe Used for Floating Dock Construction

Subsurface Irrigation and Drainage

Relining of Failed Pipes with Corrugated HDPE

Corrugated HDPE pipe can be used as a structural insert inside failing culverts, storm drains or sewers made of corrugated metal or concrete. The HDPE pipe becomes the load-bearing structure after the annulus is filled with grout. Corrugated HDPE pipe with a smooth interior must be inserted from a pit, or at the end of the existing culvert. The inserted HDPE pipe will reduce the original inlet area. If the reduction is too drastic, a short, specially designed HDPE taper may be attached to the inlet end to increase the inlet area.

Aeration in Sewer Sludge Composting

Perforated corrugated polyethylene pipe is an integral component when composting sewer sludge. The perforations allow controlled aeration of the sludge. Many communities have found that they can compost sewer sludge and market the finished compost.