R-Tank Compression Test Tech Note

BACKGROUND INFORMATION:

R-Tank modules are constructed of modular polypropylene panels and are designed to provide underground storage of stormwater. While the product has been installed and evaluated in several field applications, TRI-Environmental was tasked with developing a laboratory test method to determine the compressive strength of the R-Tank, R-Tank^{HD}, and R-Tank^{SD} modules. A photo of a field installation of the modules is shown in Figure 1.

Figure 1: R-Tank System Installation

TEST METHODS EVALUATED:

The flexible pipe and stormwater chamber industries typically utilize ASTM D 2412, *Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading*, to determine the compression behavior of these products under load. The test method involves compressing a test specimen between parallel plates at a constant rate until the load-carrying capability of the specimen is exceeded. The load at various deflection levels is recorded and the "pipe stiffness" (for pipes) or "arch stiffness constants" (for chambers) are typically determined by dividing the load per unit length (e.g. at a set deflection of 5%) by the deflection of the pipe (or chamber) in % of the test specimen. Additionally, buckling criteria are often specified at set deflection levels.

The rate of loading and length of the test specimen is dictated by individual product standards. For example, ASTM F 2306, *Standard Specification for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications*, gives specific test requirements for corrugated HDPE pipes and ASTM F 2418, *Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers*, gives test requirements for arch-shaped polypropylene chambers. There are also several other ASTM and AASHTO standards for other flexible pipe and chamber products, including specifications for PVC and fiberglass pipes and HDPE chambers.

Since the R-Tank modules are comprised of polypropylene materials, we felt that the parallel plate test methodology outlined in ASTM F 2418 was most appropriate for these products. It should be noted, however, that the arch stiffness constant requirements specified in ASTM F 2418 are only applicable to arch-shaped chambers meeting that specification and do not apply to the R-Tank modules.

TEST METHODOLOGY FOR R-TANK MODULES:

ASTM F 2418 requires a compression test to be conducted between two parallel plates on polypropylene arch-shaped chambers. The test is conducted to determine both the stiffness and the resistance to buckling of the chambers. ASTM F 2418 requires that the compression test be conducted in accordance to ASTM D 2412 with a loading rate of the parallel plates equal to 2.0 +/- 0.2% of the average rise of the chamber. It also specifies the length of the test specimens and requires that the foot of the chamber be restrained to prevent lateral spreading.

Similar methodology was applied to the R-Tank modules, though it must be noted that the product design and geometry are considerably different than arch-shaped chambers. As such, it should be emphasized that while the test methodologies are similar, the test results from the R-Tank modules cannot be compared directly to the arch-shaped chambers (or pipe, for that matter).

The R-Tank modules were installed between two parallel plates as shown in Figure 2. The R-Tank modules were not restrained on the edges. The dimensions of the aluminum loading plates were 22 in. x 30 in. and the rate of loading was 2.0% of the specimen height per minute. The specimens were loaded until failure (as defined by a decrease in the load-deflection curve).

Figure 2: Parallel plate loading of R-Tank module

A typical load-deflection curve of the R-Tank^{HD} product is shown in Figure 3.

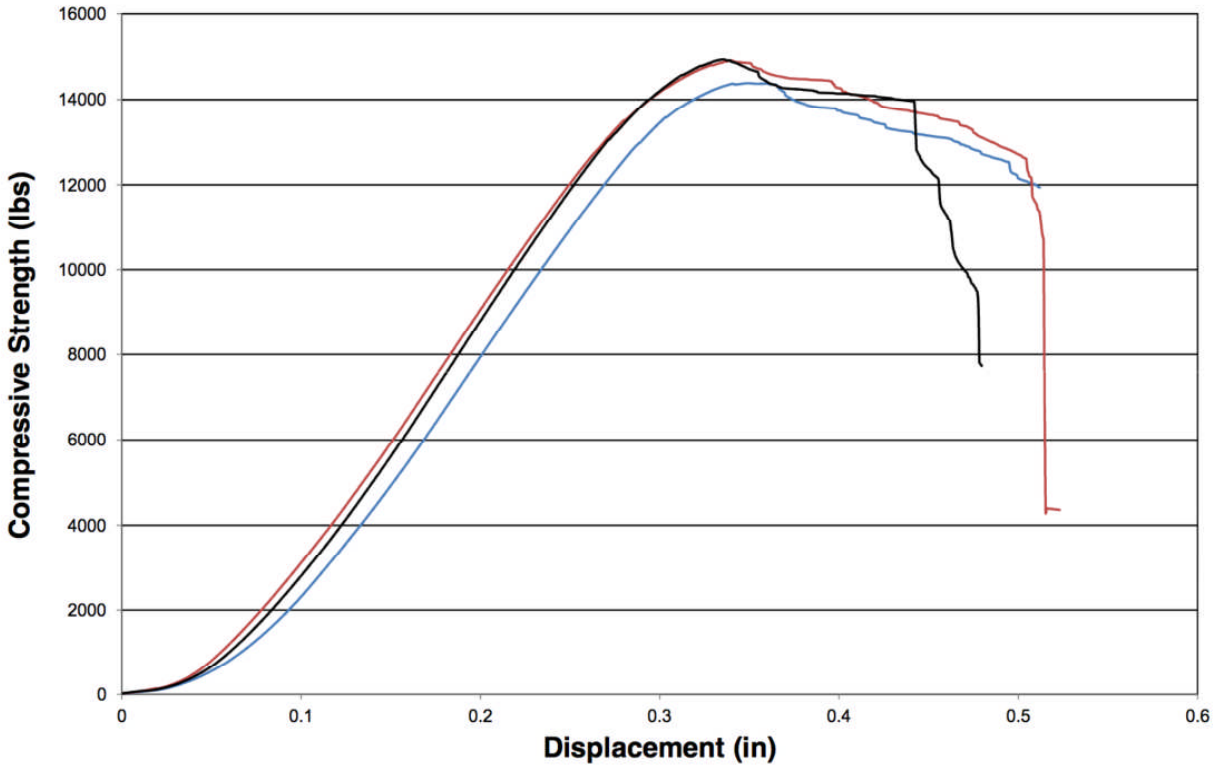

Figure 3: Typical load-deflection curve for R-Tank^{HD} product

As evident from Figure 3, the module started to lose its load-carrying capability at around 0.34 inches of deflection (2.0% of the chamber height), and the average peak load achieved for the module was around 14,748 lb. Similar load-deflection curves were established for the R-Tank and R-Tank^{SD} products.

CONCLUSIONS:

As with other flexible pipe and stormwater chamber products, the parallel plate test according to ASTM D 2412 can be used to evaluate the compression capacity of R-Tank modules. The peak load and deflection obtained for the module are useful parameters for design purposes.