Liners for Large Diameter Pipe Rehabilitation

George A. McAlpine, President

President & CEO, Danby of North America, Inc. P.O. Box 5127, Cary, NC 27512
Tel: 919-467-7799; e-mail: danby@mindspring.com

Abstract

For purposes of this paper, large diameter pipe will be defined as pipe with internal diameters of 42 inches and larger. Generally these are person-entry pipes which allow personnel to install rehabilitation liners. The major differences between large and "small" (i.e., those not deemed "large") diameter pipes are discussed with respect to lining considerations.

Summary

Generally, the magnitude of rehabilitation variables, and therefore costs, increase with the square of the diameter of the host pipe. For example:

1. Flows requiring bypass increase with pipe cross sectional area,
2. For constant Standard Dimension Ratio (SDR), most liner cross sectional areas increase with diameter squared,
3. For CIPP processes using heated water for curing thermoset resins, energy and time required increase with diameter squared (assuming same boiler power), and
4. Large diameter pipes are, generally, buried deeper and required lower SDRs (thicker liners).

In addition, the number and nature of available rehabilitation products changes from small pipes to large diameter pipes. For example, Fold and Form thermoplastics liners and some Cured-in-Place thermoset plastic liner products are not available in large diameters (at normal pipeline lengths). Likewise, most Grouted-in-Place liner products (e.g., Danby, Beka Plast, Trolining and T-Lock) don't compete in the small pipe market.

Further, while small diameter built-in-place (brick or concrete) pipes are rare, many large diameter pipes now in need of rehabilitation were constructed with this method and materials. Very few such large diameter pipes exhibit well-controlled dimensions or grade; their major diameters vary considerably as do both vertical and horizontal alignment/grade. In many cases such large pipes are not circular but rather are oval, egg shaped, elliptical or semi elliptical. These differences from standard small pipe present challenges to the design engineer and specification writer that, if not properly addressed, may lead to constructability problems and/or cost overruns.

Grouted-in-Place liners (GIPL) using high strength cementitious grout result in fundamentally different rehabilitated structures from those using plastic liners without cementitious grout. The GIPL rehabilitated structure is a more rigid composite structure. Because plastic liners have elastic modulii of between 1/3 (glass fiber reinforced plastic or GRP) and 1/10 (unreinforced thermosets and thermoplastics) of concrete and generally do not bond to the host pipe, they do not form composite structures with their host pipe. Cementitious grout, on the other hand, has an elastic modulus nearly equal to the concrete (or brick) pipe material and does adequately bond to act as a composite. The principal consequence of these facts is that the GIPL resists flexural failure of the rigid host pipe while plastic liners resist deflection after failure (cracking).

Thus, rigid pipe design methods are required for GIPL and flexible pipe design is used for ungrouted plastic liners when designing for earth loads.

More recent product introductions to the US market from Europe are Channeline, a GRP slipliner-like liner that normally requires grouting, and Trolining, a formed-in-place HDPE liner that encloses a high strength cementitious grout. Both products appear aimed at the large diameter pipe rehabilitation market.