On the Waterfront

by Jim Reed

Back in the middle of May, I had a conversation with Rick Hahn of Marriott's Lincolnshire Golf Club. He related how he had determined that Chicago weather patterns ran in 10 week cycles. His expectation was that our cool, dry weather would change around the first week in July. Superintendents have been thankful that the change was not too hot and wet.

This month's topic is a continuation of last month's article on "PVC Strength Characteristics and Typical PVC Fitting Failures" by Ron Bliesner.

Burst Failures

Burst failure in PVC pipe and fittings is usually rather dramatic. It may begin a point of stress concentration or weakness and may continue by splitting through fittings and pipe for some distance. Sometimes, the failures will completely shatter a fitting and the adjacent pipe.

Burst failures usually occur during hydraulic transient conditions that create large pressure variations in the system. These include rapid valve closure, pumps starting or stopping, rapidly escaping entrapped air, or an air pocket shifting within a pipeline. Burst failure will, sometimes, occur in a pipe of fitting that was damaged during installation or that is subject to external loads. In these cases the failure may occur at pressures well below the expected burst limit of the product.

Long Term Pressure Failures

Long term pressure failure occurs when the system operates continually at a pressure that will eventually cause failure. The failures may occur within a short time after system installation or after many years. The failures will usually appear as slits or small cracks or in an area of stress concentration. Some yielding of material will usually be evident.

Cyclic Surge Failure

Cyclic surge failure can occur in systems that are subject to frequent changes in flow and/or pressure. Modern golf course systems with computerized controllers are prime candidates for cyclic failures. A typical system may experience from 40,000 to 100,000 cycles per year of magnitudes from 10 to 80 psi. H. W. Vinson indicates that is is not uncommon to see cyclic failures in golf course systems after 2 to 5 years of operation.

Design standards have been proposed by Vinson to consider cyclic surges. However, the standards apply to pipe and not fittings. It appears that fittings, due to the stress concentrations and extra forces placed on them, will not withstand as many cycles, although their burst strength may be equal to that of the same class pipe. Limited testing completed by Keller-Bliesner Engineering also indicates that there may be marked reduction in burst strength after subjection to a period of cyclic pressure conditions. Used tees that had been subject to cyclic conditions sufficient to cause failure in some fittings were removed before failure and tested for burst strength against new fittings. The used tees exhibited only about 56% of the burst strength of the new tees ...

Of all the operating conditions that can create problems, cyclic pressure appears to be the most critical, especially in golf course systems. Given the cyclic nature of irrigation system operation and their limited capacity to handle cyclic pressure conditions, fittings are the weakest system components. Serious consequences may result if this fact is not adequately considered at the design stage.