SULFIDE COMPOUNDS CONTRIBUTE TO LEAKS IN CAST IRON PIPE

In July 1967 Mr. William "Bill" Hargrave, superintendent of Kankakee Country Club, experienced several leaks in his cast iron irrigation system. Cast iron pipe was installed at Kankakee Country Club in 1963. Several of these leaks appeared under greens and tees. Bill decided to bring the "Cast Iron Pipe Research Association" in.

After all the tests were conducted Bill was quite relieved to find that soil conditions, which caused a leak under his 16th green, were not present in all cases.

The following test procedures and conclusions were made by the "Cast Iron Pipe Research Association".

Procedure

Representative test locations were selected by Mr. Hargrave near tees and greens. At each location, certain basic soil analyses were accomplished. Soil samples were removed for the following analyses: pH, oxidation-reduction potential (Redox), sulfides, soil and moisture description and other examinations. In addition, earth resistivity on the subsoil was determined at each location. Soils encountered at the selected locations and depths were generally moist to saturated. In turn, the adequate soil moisture placed soluble soil salts into solution so that the resistivities measured represent the lowest values to which such meaurements would decline.

Earth resistivity is a measure of the ability of the soil to serve as an electrolyte, and is an important means of assessing the corrosivity of the soil relative to the development of local corrosion cells or the transmission of stray direct current.

pH is used to indicate the balance of acidic or basic constituents in the soil. pH seems to be important in three general ranges:

0.0-4.0 6.5-7.5 8.5-14.0

In the first, or acid range, soil serves well as an electrolyte when moisture is sufficient. The neutral range is optimum for bacteriological sulfate reduction if other conditions are appropriate. In the high, alkaline range, dissolved salts are prevalent and a low resistivity is normally observed.

The oxidation-reduction potential (Redox) of the soil is important because the most common sulfate-reducing bacteria thrive under anaerobic conditions.

An increasing redox potential above +100 mv. indicates increasing soil aeration and a decreasing support for the life processes of the sulfate reducers. As the redox potential decreases from +100 mv. to 0 mv. the oxygen level of the soil approaches near anaerobic conditions with increasingly favorable conditions for the growth of the sulfate-reducing bacteria. Negative redox values definitely indicate anaerobic conditions under which sulfate-reducers may thrive providing other conditions are also favorable.

Sulfides in a soil sample catalyze a reaction between sodium azide and iodine. One of the results of the reaction is free nitrogen which evolves in the test tube with resultant bubbling or foaming. The results of the sodium-azide iodine test are placed in three catagories for reporting purposes: Negative, trace, and positive.

When sulfates in soil are reduced by sulfate-reducing bacteria under anaerobic and near neutral pH conditions, the by-products of the metabolism of these bacteria include sulfide compounds which serve as excellent electrolyte material conducive to development of corrosion cells. They also serve as depolarizing agents furthering the continuance of activity of such local cells. Anaerobic sulfate-reducing bacteria thrive best at soil temperatures above 50 degrees F. and at a pH of 7.0. They become less active at lower temperatures and as pH departs from 7.0.

Each soil sample is described in the report in order to develop any correlation between soil type and corrosivity. The moisture content is noted because prevailing moisture is extremely important to all soil corrosion.

Conclusion

The soil description varies considerably over the golf course. This is due to the greens and tees being built up of material either dug from a nearby pond or brought in from a clay borrow pit. They range from a brown clay to a dark gray to black clay. All of the samples were moist to wet at pipe depth. Earth resistivities were very uniform over the entire project. Sulfides were present at several locations on the course. The soil at these locations evidently was taken from the pond during the construction of the new tees and greens. The material from the pond has not been placed around the pipe on all of the new greens and tees as had originally been thought to be the case.

Pipe corroded at two locations due to the presence of sulfides, neutral pH and low oxygen level.

The irrigation system is a closed system, that is, there is no tank on the system to take the initial surge during the start up of the pump or stopping of the pump.

Recommendations

Therefore, it can be concluded that the frequency of breaks should decrease. If actual field conditions prove to the contrary several steps can be taken.

First, the system should be provided with a tank or slow opening and closing valve. This would prevent water hammer damage to the system, since the two breaks to date have been in dead end portions of the system. If the breaks continue to occure at a rate wherein the greens and tees are being torn up, then replacement of the pipe should be considered. If the pipe is replaced, it should be wrapped with an 8 mil thick polyethylene tube.