MATERIALS FOR WASTEWATER SERVICE VALVES

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The purpose of this report is to compare various materials used for valves in wastewater applications. The comparison will include austenitic stainless steels, cast iron, ductile iron, and carbon steel.

Stainless Steels

Stainless steels are iron-based alloys that contain at least 11% chromium. Chromium is the primary ingredient that gives the alloys corrosion resistance. The austenitic stainless steels also contain nickel. The addition of nickel in these alloys results in an austenitic structure, improves the passivating effect of the chromium in oxidizing conditions and increases the resistance to reducing conditions.

Alloys 304 (CF8) and 316 (CF8M) are considered to be the all-purpose corrosion resistant stainless steel alloys. Both of these alloys contain about 18% chromium and 8% nickel. At temperatures below about 140ºF alloys 304 and 316 are both almost impervious to most common corrosive environments.

Alloy 316 (CF8M) was originally developed for use in sulfite pulp mills to resist corrosion by sulfurous acid compounds. It is also more resistant to strong halide solutions, such as chlorides and fluorides. Since wastewater does not generally have high concentrations of these compounds there is no real advantage to using 316 in that service. The difference between 304 and 316 is the addition of 2-3% molybdenum in the latter.

Cast Iron

Cast iron (ASTM A126, Grade B) valves are quite commonly used in water treatment and wastewater applications that do not contain high concentrations of corrosive compounds, particularly acids. In oxidizing conditions a coating of iron oxide forms on the exposed surfaces of the cast iron. That coating tends to protect the underlying material from further oxidation. If the oxide coating is removed another layer of iron oxide forms on the newly exposed surface. Cast iron valves can be used successfully in wastewater conditions that do not contain harsh chemicals or abrasive slurries that can remove the protective coating.

Ductile Iron

Ductile iron (ASTM A536, Grade 65-45-12) is similar to cast iron in the manner in which it corrodes. However, ductile iron has the advantage of having about one half the oxidation rate of cast iron, so it is thought to be more resistant to corrosive attack than cast iron. Ductile iron castings have significantly greater strength than cast iron and are not as brittle. Therefore, valves of the same design made of ductile iron can be used at higher operating pressures than the cast iron valves.

Carbon Steel

Carbon steel (ASTM A216, WCB) valves are used primarily for high pressure and/or high temperature services. They have the poorest corrosion resistance of the common valve materials because they oxidize very rapidly. The oxidation coating on carbon steel is not as tenacious as the oxidation on cast iron or ductile iron. Because of this carbon steel valves should only be used in a mildly corrosive service and where the valve is full all or most of the time. Cycles of wet and dry periods of time that allow the surfaces to be exposed to oxygen more often will tend to cause excessive corrosive attack on carbon steel. Carbon steel valves can be used successfully in wastewater systems, but only in certain limited conditions.

Conclusions

Austenitic stainless steel valves -- either 304 (CF8) or 316 (CF8M) -- can be used in virtually any wastewater treatment or handling condition, including applications with the presence of relatively harsh chemical compounds, with the expectancy of good service and long life.

Cast iron or ductile iron valves will give acceptable service in most wastewater systems that do not contain harsh chemical compounds.

Carbon steel valves should only be used in limited applications and with the expectancy that the usable life of the valves will be significantly shorter than valves of more resistant materials.