Wastewater treatment plants handle some of the most corrosive and aggressive liquids and solids known to process engineering. Pipes, tanks, pumps, and all the instrumentation that measures flow, level, pressure, temperature and other parameters are exposed to high concentrations of organic and inorganic compounds, sewage and industrial waste, corrosive chemicals, solids and microbiological organisms of all forms, as well as various gases. Even the infrastructure is subject to corrosion – one Danish plant suffered considerable, and expensive, damage to an aluminium bridge structure.

While most process plants in other fields strive to remove all biological organisms and the threats of corrosion that they pose, the fundamental basis of any wastewater treatment operation is to cultivate bacteria and various other microbiological organisms at their maximum growth rate. A wastewater treatment plant consequently contains just about the greatest possible potential for steel pipe and tank damage caused by microbiologically influenced corrosion (MIC).

The wide range of different wastewater components, in itself, makes it impossible to tackle the corrosion problems individually. Organic components of raw sewage are likely to include fats, greases, proteins, surfactants, oils, pesticides, phenols and many other aggressive compounds, some of which are likely to react with each other to create new substances. The inorganic components of raw sewage typically include heavy metals, nitrogen, phosphorus, sulphur, acids and a variety of strong alkalis – a veritable toxic soup.

Gases such as hydrogen sulphide, methane, ammonia, oxygen, carbon dioxide and nitrogen are commonly found dissolved in wastewater, among other corrosives. Anaerobic decomposition of organic materials containing sulphur and nitrogen produces odorous compounds such as hydrogen sulphide, amines and volatile fatty acids. Chlorine and ozone, disinfecting agents in the final phase of treatment, add further corrosion threats.

In addition, coagulants, flocculents, metal precipitants, emulsifiers, antifoaming agents, neutralizers, and odour control agents are added during wastewater processing. A wastewater stream therefore contains enough corrosive compounds to damage just about any part of the process plant.

The interaction of the primary components of sewage typically produces secondary chemicals and gases with even greater toxic and/or corrosive properties. Microorganisms cultivated at different stages throughout the wastewater stream produce a multitude of chemical and gaseous by-products - hydrogen sulphide (H2S) being a very common and particularly damaging by-product of MIC related bacteria.

Sulphur-reducing bacteria (SRB), for example, reduce sulphates to sulphites in an anaerobic environment to produce hydrogen sulphide - H2S gas. Other aerobes, most commonly different strains of Thio-bacillus, will oxidize the sulphur to sulphuric acid - producing pH values as low as 1.0, and attacking the concrete basins and most metals it comes in contact with.
So what are you going to do about it?

Corrosion is a major concern wherever steel or aluminium is used within a wastewater treatment plant, and can extend to piping unrelated to the movement of wastewater itself. Many waste related treatment tanks and piping systems are coated to protect against such corrosive environments. Cathodic protection is also provided in some instances as another means of reducing corrosion, thereby extending service life, and reducing maintenance costs. Even though holding, aeration, and sedimentation tanks are constructed of concrete, they inevitably suffer the damaging effects of corrosion and microbiological attack.

New waste treatment plants making use of extensive fabrication in stainless steel offer a solution to the infrastructure corrosion problem, although at extremely high cost. Galvanized steel is commonly used as a cheaper but less effective option. The likelihood is that, in time, fabrication in new engineering plastics will become the best solution.

Instrumentation options

The instrumentation that wastewater plants have to use to measure and control level, flow, temperature, pressure, pH and other parameters is obviously at the metaphorical sharp end of corrosion problems. At least some of just about any instrument used to quantify and manage these parameters has to be in contact with the process fluids, with obvious risks to process efficiency.

Fortunately, developments in high technology plastics, and higher grades of stainless steels have made this much less of a problem than it was formerly; and these developments have often happened in countries where water is a very valuable resource indeed.

Kelco, based in Sydney, Australia, make some of the best thermoplastic devices for measuring key parameters in wastewater plants yet developed and they now have an exclusive UK and Continental Europe distribution agreement with PVL Limited.

At www.pvl.co.uk, click on the parameter you need to measure – flow, pressure, level etc – and look for the devices in the alternatives offered that are described as ‘All Plastic’. Those are Kelco products, usually available from stock at PVL, and ideal for wastewater plant applications.

To talk to the qualified engineering team at PVL about your application and the corrosion problems that it presents, phone +44 (0)1892 664499. Or email info@pvl.co.uk.