PRESS RELEASE

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NEW EVIDENCE TELLS US TO THINK IN CENTURIES, NOT DECADES, FOR PE PIPES' EFFECTIVE LIFETIMES

By Derek Muckle, BPF Pipes Group

Plastic pipelines, beyond 50 years

There is a popular myth that plastic pipes have a lifetime of 50 years but they actually have reliable working lifetimes that are much longer than this. Even if they do start to fail, it is not a sudden loss of the asset, but rather a gradual wear process that can be managed. What does that mean in practice? Quite simply plastic pipes are capable of operation measured in hundreds of years, not tens of years.

So, it is useful to understand why people talk about 50 years. It is usually in connection with two phrases, depending on their level of knowledge: 'lifetime' or 'design point'. The latter is correct, the former is the misinterpretation. To keep it simple, it is a 50-year design point, and the design point is used as a classification index for different strength materials. It has nothing to do with lifetime.

One of the great things about plastic pipes is that they do not suffer from corrosion related defects. That's obvious to many but the issue with corrosion is not that it occurs but that its occurrence is very hard to predict. Many variables affecting what will happen need measuring on a job by job basis which makes predicting failure in corroding pipes very difficult. And predicting failure is important when you are managing critical long term investments.

Predicting failure

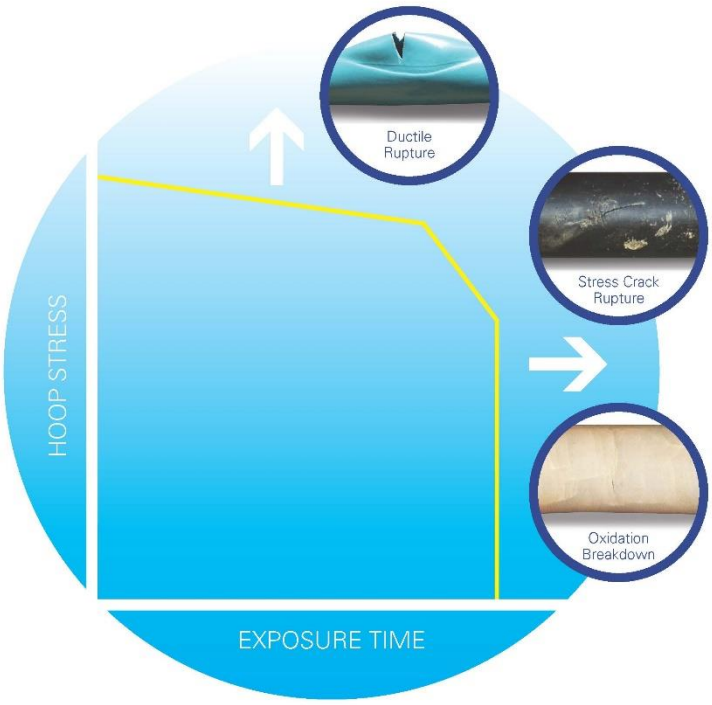
The failure modes of a plastic pipe system, particularly a welded system such as that achieved using polyethylene (PE) materials for example, are predictable. And they are predictable from knowledge of the polymer used, the transported fluid in the application, and the pressure regime used for a pipe network. With that knowledge, a well-constructed pipeline can have predictable performance measured in hundreds of years.

A science example can clearly illustrate the pipe classification system. Polyethylene pipes (in our example) have three time-dependent failure modes. These are variously referred to as ductile rupture, stress crack rupture, or oxidation breakdown.

For ductile rupture, independent of time, a very high internal pressure can exceed the strength of the pipe causing it to stretch and fail in a ductile way. With stress cracks, at lower pressures but much longer timescales, the reliable lifetime limit could be brittle crack grown through the material. With oxidation, largely independent of pressure, at very long timescales, the likely reliable lifetime limit will be as a result of polymer oxidation.

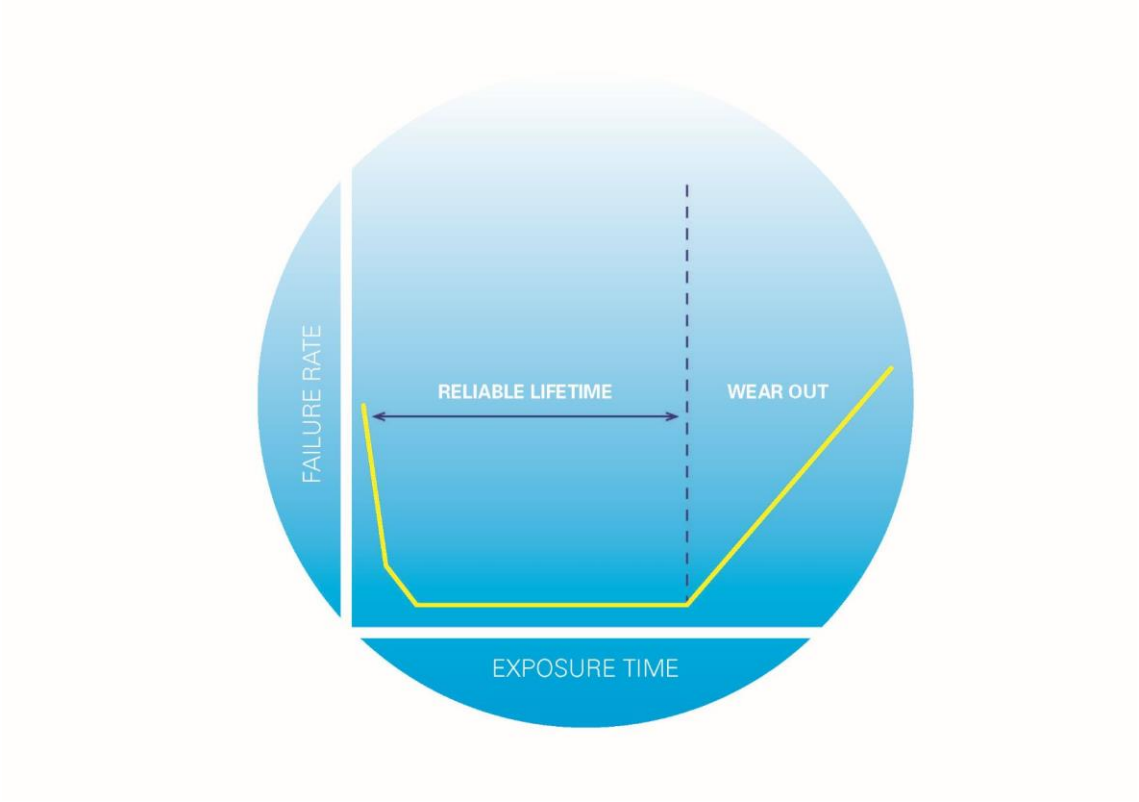
Predicting performance

Each of these failure modes occurs at a point in time which can be predicted, and is a function of the stress applied to the material by the internal pressure in the pipeline and the operating temperature. With a clever bit of science from a learned chap called Arrhenius[1] we can construct an envelope of performance describing when these failure modes can occur in time.



That science, as an aside, has been validated with more than 50 years of continuous testing and with real installations also more than 50 years old.

This brings us to the 50-year design point. We have to pick a point in time to classify polyethylene pipes. In the UK, in common with much of the world, we chose 50 years. Some countries use different times. What we do is work out the predicted strength at 50 years for a pipe working at 20°C. And the first thing we do is round the strength down to a convenient value. So if the true strength is 10.8MPa, we round it down to 10.0MPa and call that a PE100 pipe. That's a safety factor built in straightaway.

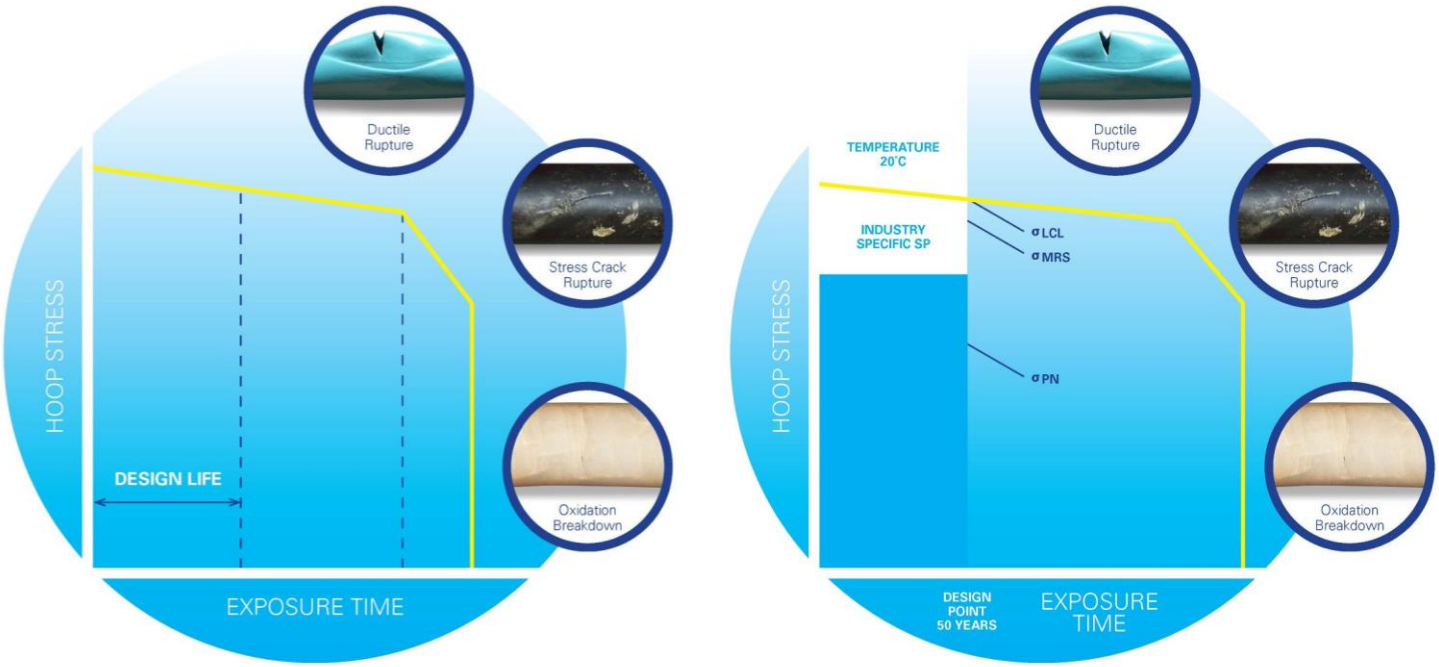


Then we apply an industry safety factor. In the UK, the minimum safety factor for gas pipes is 2.9, for water pipes it is 1.25; all of which mean our operating conditions are a long way from the known point of ductile rupture of a pipeline. So in our envelope of performance, the 50-year classification system means we are operating within the envelope a long way from the predicted failure points. This means it is knowledge of the probable stress crack and oxidation onset failure modes that prescribe the transition to a wear-out mode for pipeline owners.

Designing a reliable product

The bathtub reliability engineering model is one way to talk about the design lifetime of a polyethylene, or other plastic pipe system. From the predicted failure modes it is possible to see where the transition from the reliable lifetime morphs into the wear-out mode. As any

pipeline engineer will advise, this is usually a different management phase, not necessarily the point of replacement. So, plastic pipelines continue to operate into the wear-out mode.



In the experience of the UK, it is likely drinking water pipes will exhibit the late life failure modes soonest. This is because chlorine ultimately initiates an oxidation degradation mechanism. Research by water utilities and manufacturers shows that for earlier generation materials the transition to wear-out mode will likely start at around 235 years.[2] For other applications like natural gas or hydrogen, oxidation onset should take considerably longer.

All this means real lifetimes for plastic pipes can be achieved that are measured in hundreds of years, not tens of years. And the great news is that the industry continues to invest in innovation to extend these lifetimes further into the future by improving resistance to stress crack and oxidation effects in new materials. That means if you specify wisely, use welded connections of compatible materials, you should be able to construct pipe assets with genuine lifetimes measured in hundreds of years; surely a great benefit when specifying plastic pipes for critical long-term assets.