Mighty oaks from little acorns grow

Eighty-five years ago, the first PVC pressure pipes were being installed in the Olympic Stadium area in Berlin for the 1936 Olympic Games. Today, they are widely used.

By Mike Smart*

When first introduced to South Africa 60 years ago, PVC pipes were not enthusiastically received. Initially, heavy-duty PVC was only specified for 150 mm diameter pipes laid at grades flatter than 1:5. Now, more than 95% of domestic sewer reticulation pipes are PVC.

Similarly, HDPE SANS 4427 remains the preferred material for slurry pipeline applications and dominates water supply house connections.

Thermoplastic evolution

Thermoplastics are continuously improving, thanks to scientists, polymer technologists and processing engineers. The allowable design stress (σ) for HDPE, since its introduction into South Africa, has increased from 5 MPa to 8 MPa – a substantial 60% increase, unknown in other materials.

The increase in PVC's strength is even more substantial. The σ-value of PVC has increased from 10 MPa to 36 MPa – an incredible 260% increase. The first PVC-U (unplasticised polyvinyl chloride) SANS 966-1 pipes had an σ-value of 10 MPa that increased to 12.5 MPa for larger pipes – 110 mm to 630 mm in diameter.

In the 1970s, the PVC industry wanted its pipes used for underground mining services. But the brittle failure characteristic of PVC-U first had to be eliminated. A project, led by Dr Ken Hart, produced a high-impact pipe, PVC-HI SANS 1283, which satisfied mining industry conditions and enabled PVC pipes to be used underground.

As a result of this development, in the mid-1990s, PVC-M (modified polyvinyl chloride) SANS 966-2 was developed in a project led by Mike Osry by adding impact modifiers, commonly CPE (chlorinated polyethylene), or rubber toughened acrylics, or a combination thereof, to the material to increase its impact strength – thereby enabling the material to exhibit 'tough' characteristics.

This facilitated the reduction of the design coefficient (C) from 2 to 1.4, which increased the σ-value from 12.5 MPa to 18 MPa.

Introducing PVC-O

About 40 years ago, the PVC industry developed PVC-O (oriented unplasticised polyvinyl chloride) SANS 16422. This uses molecular orientation, which results in the improvement of physical and mechanical properties.

In the intervening 40 years, there have been improvements in PVC-O material itself, from classification 315 to 500 – based on the minimum required strength (MRS).

The latest PVC-O material, classification 500, has an MRS of 50 MPa and a C-value of 1.4, giving a σ-value of 36 MPa, where σ = MRS/C. This is a substantial improvement – twice the allowable design stress of PVC-M – made possible by improved in-line production technology.

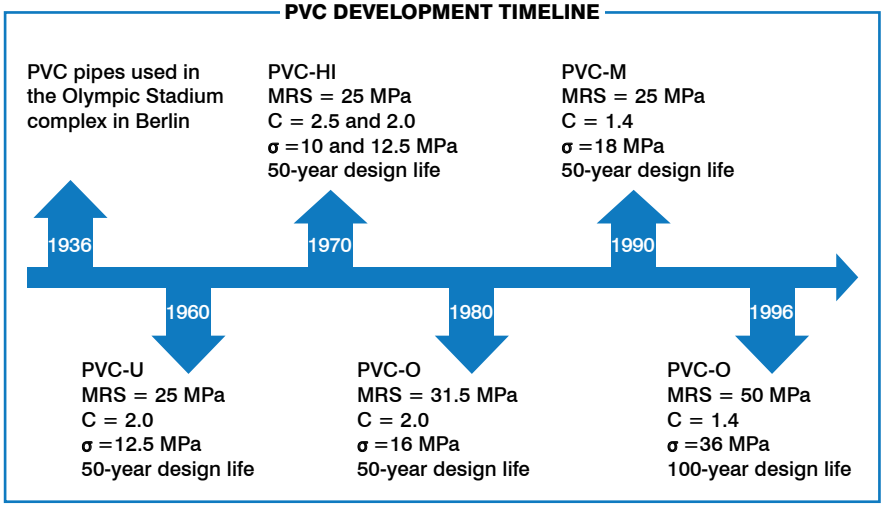
Sizabantu Piping Systems' technology partner Molecor excels at this. Molecor has increased the range of PVC-O pipes from the previous limit of 315 mm diameter class 16, to 630 mm class 25, to 800 mm class 20 in 2015, then to 1 000 mm class 16 in 2020 and now to 1 200 mm class 16, which will be available in 2021.

For the thermoplastic pipe industry, these are exciting developments that have made the previously inaccessible large-diameter, high-pressure pipe market an arena industry members can compete in.

Continuous improvement

The ISO protocol specifies that the design service life of thermoplastic pipes shall not be less than 50 years. However, with the latest high-technology polymers, the service life of thermoplastic pipes is not less than 100 years.

PVC technology has improved substantially, and continues to do so, giving the pipeline industry proven materials to use for large-diameter, high-pressure, bulk supply pipelines historically dominated by steel and ductile iron. 3S



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