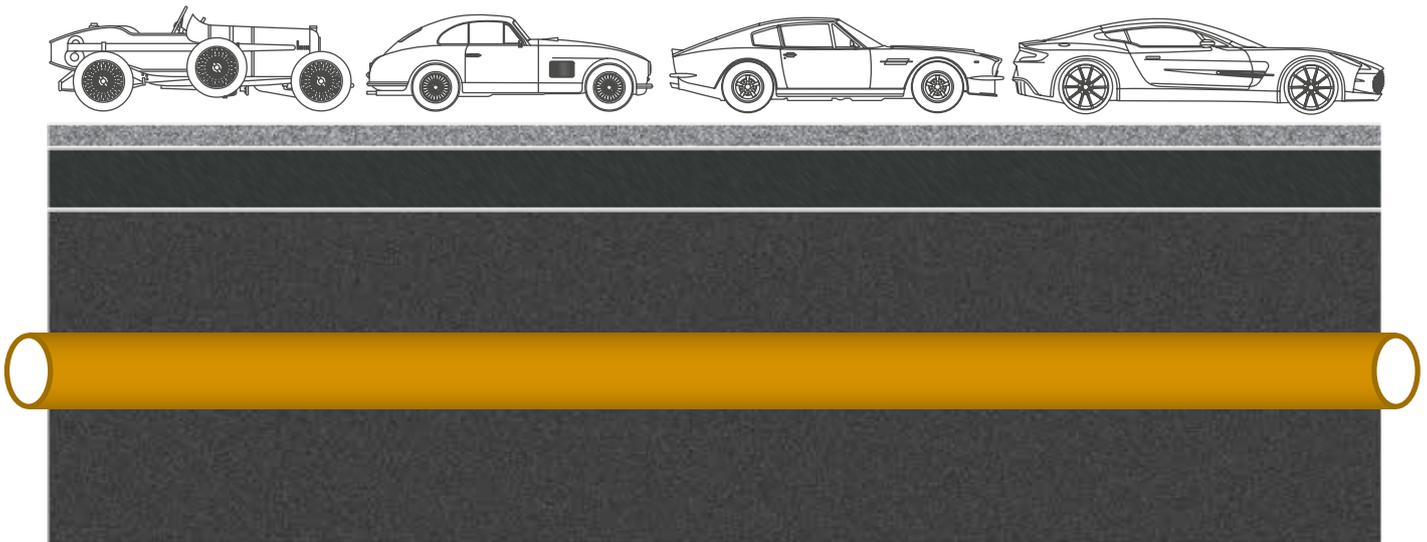


# 100 Year Service Life Of Polypropylene and Polyethylene Gravity Sewer Pipes



**“Polyolefin Sewer Pipes, standing the test of time.”**

## Introduction

Polypropylene and polyethylene (collectively known as polyolefin) sewer pipes have been widely used for over 40 years and have an established track record for reliability, integrity and trouble free service. However their predicted overall life expectancy has been discussed for many years without a definitive answer becoming available.

Following the conclusion of a major two year project co-ordinated by TEPPFA in conjunction with LyondellBasell, Borealis and TGM (Austria) that situation can now be changed and:

**Designers, owners and operators can now be confident that polyolefin sewer systems will have an in-service life of at least one hundred years when materials, products and installation practices meet the appropriate requirements.**

The outcome of this project is vitally important for material suppliers, pipe manufacturers and the designers and operators of sewer systems. Allowing polyolefin sewer pipes to continue to be specified with increased confidence in their asset life.

The basis for confidence in the conclusions from this project is explained in this guide.

## 2. Project Scope

The extensive scope, rationale and content of the TEPPFA project allow a lifetime prediction for polyolefin sewer pipes to be made on a sound and robust scientific basis. Summarised below are just some of the reasons why:

### 2.1 Real time long term data

- The project includes tests on excavated pipes which have already been in service for up to 40% of the proposed in-service lifetime. These tests have demonstrated that no excessive deterioration or degradation has occurred over this time.
- Although the oldest of the excavated pipes were manufactured using “first generation” material formulations a residual lifetime of more than 50 years has been calculated. Current formulations offer superior performance to earlier materials
- All excavated pipes tested were found to fulfil the minimum performance requirements of current EN product standards



Solid Wall Sewer Pipe

### 2.2 Extended duration laboratory testing

- Constant deflection test durations have been extended to 18 months to provide greater confidence in extrapolations to one hundred years
- Correlation factors for measured data are in excess of 0.99

### 2.3 Use of high safety factors

- Various safety factors have been used across a wide range of tests and calculations. For example: Relaxation tests conducted at 15% deflection while

the long term deflection in buried pipelines is unlikely to exceed 5.5% (Safety factor 2.7)

- Tests carried out at elevated temperatures of 45° C when the maximum temperature in sewer systems does not generally exceed 30° C
- The allowable stress at 100 years (at 30° C) is 7.0 MPa while the actual stress at 8% deflection is only 2.6 (Safety factor 2.7). Even at 15% deflection the actual stress is 4.1 MPa (safety factor 1.7)



Structured Wall Sewer Pipe

### 2.4 Other investigations

Many other factors have been investigated, results clearly demonstrating they do not adversely affect the anticipated life expectancy, these include:

- The chemical composition of sewer water
- The temperature profile of sewer flows
- The higher stress concentrations which may be present in structured wall pipe configurations
- Variations in installation practices

### 2.5 Independent assessment

- The methodologies used, the test results and the conclusions drawn from the project have been independently reviewed by a leading expert in this field, Professor Heinz Dragaun, TGM, Vienna
- For transparency the results of his review have been made available with the project report

### 3. Requirements

In this study, it has been demonstrated that a 100 years lifetime for non-pressure sewage pipes manufactured from PE and PP-B can be expected , provided that following conditions are met:

a) The pipes shall meet the requirements of European product and system standards, EN 1852 for PP, EN12666 for PE and EN13476 for Structured Wall Pipes of PE and PP, and

b) The material, pipes and installation shall meet the requirements specified in the table below.

Category	Performance Characteristic	Condition	Requirements
Material Requirements	Thermo-oxidative degradation	PE: 95°C, $\sigma = 1.0$ MPa PP: 110°C, $\sigma = 1.0$ MPa	> 8760 h > 8760 h
	Max. allowable stresses derived from the available reference curves	45°C PE, $\sigma = 5.3$ MPa PP, $\sigma = 3.9$ MPa	100 years 100 years
		23°C PE, $\sigma = 7.4$ MPa PP, $\sigma = 7.9$ MPa	100 years 100 years
Pipe Requirements	Hydrostatic tests	PE: 80°C, $\sigma = 2.8$ MPa	1000 h
	EN 12666 and EN 1852	PP: 95°C, $\sigma = 2.5$ MPa	1000 h
	Product requirement acc. to EN 13476	Ring flexibility	30%
	Relaxation tests	PE & PP: Acc. to Janson	≥ 4000 h at 15% deflection
	Microscopic analysis of the strained pipe samples	PE & PP: At the end of ≥ 4000h Janson test	No crack initiation, no cracks or other damages
Installation Requirements	Pipe Installation	Acc. to CEN/TR 1046 Acc. to Teppfa study	Moderate or Well compaction Standard proctor > 87
	Maximum pipe deflection at commissioning	Acc. to CEN/TR 1046	Max. 8%

**Note:** The analysis and predictions within the scope of the project are valid for virgin materials. Modified materials such as foamed materials and mineral filled materials are not covered by the outcome of this report

## 4. Conclusion

Designers, owners and operators can be confident that polyolefin sewer systems will have an in-service life of at least 100 years when materials, products and installation practices meet the appropriate requirements.

- Supported by real time long term data
- Proven by extended duration laboratory testing
- Reinforced by the selection of high safety factors
- Confidence from the extensive scope of the project
- Verification of results by independent assessment

## 5. Acknowledgements

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To access other documents related to this project use the following links to the TEPPFA website:

Summary Technical Report: [www.teppfa.eu](http://www.teppfa.eu)

Full Technical Report: [www.teppfa.eu](http://www.teppfa.eu)

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