

Flexible and rigid sewer pipes in Europe: Comparing performance and environmental impact

Report on the TEPPFA-PLASTICS EUROPE *Sustainable Municipal Pipes Project*

Executive summary

In the document below you will find the summary of the Sustainable Municipal Pipes project. Further details and analysis of the observed defects in sewer pipelines of rigid and flexible materials, can be found in the report of [Stein & Partner](#).



October 2005

EXECUTIVE SUMMARY

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Background to the study

Leaking sewers are a continuing problem that affects the whole of Europe – with consequences that can have a significant impact on the environment.

Until now, there has been no study of buried sewer pipelines in service that has specifically set out to:

- Examine the environmental impacts of sewer defects and leakage
- Analyse and compare the performance of major pipe materials used in sewer networks
- Determine how these pipe materials compare in terms of implicit risk to the environment
- Reach conclusions that have Europe-wide relevance in these respects

All these objectives lie at the heart of this *Sustainable Municipal Pipes* study.

Overall aim and purpose

To determine which pipe material type(s) can better fulfil the requirements of sustainability in its broadest sense – operational and environmental.

The study is a joint initiative of **The European Plastic Pipes and Fittings Association** [TEPPFA] and **Plastics Europe** [formerly APME – Association of Plastic Manufacturers in Europe]. However, particular importance has been attached to ensuring that all procedures and conclusions are objective and tenable (see **Measures to ensure validity of findings** *overleaf*).

Project description

The study was based on examination of CCTV video footage of approximately **1800 km** of buried concrete, clay and plastic sewer pipelines in service. This footage was accompanied by original inspection reports reporting observable defects.

The core sample was from **Germany** with a statistically representative mix of sewer pipe types. Other video footage samples from the **Netherlands** and **Sweden** were used to provide checks on the relative performances of pipe types within each country for comparison with the relative performance of pipe types within the core sample from Germany.

The study assessed the typical environmental impact of these defects, based on the nature and frequency of their occurrence, as observed in pipelines of the respective materials. Detailed analyses and data modelling were carried out, using the inspection data, to determine how each pipe category (see **Basic assumptions** *overleaf*) compares in terms of potential risk to the environment.

EXECUTIVE SUMMARY *continued****Measures to ensure validity of findings***

External **Technical Consultants** were appointed to collate the quantitative data, and to conduct the necessary analyses and evaluative techniques.

In addition, a multi-national **Independent Consulting Board** of sewer and drainage specialists contributed significantly to the study, as well as ensured the objectivity and validity of the study's findings.

No member of this Independent Consulting Board has any contractual or vested interest in any pipe material.

Basic assumptions

- Because of similarities in characteristics between concrete and clay pipes, and between the various plastic types (including PVC-U, Polyethylene and Polypropylene), data has been combined into two grouped categories: **rigid** and **flexible**
- The sewer pipelines inspected on CCTV videotapes as the foundation of this study were all installed *no less than 3 years* and *no more than 30 years* ago – and were *no greater than 800mm* nominal diameter (the limit for non-man entry)
- The average installation age of pipes inspected was:
 - Rigid: 11.5 years
 - Flexible: 6.8 years
- All observed defects have been classified in accordance with the definitions contained in **EN 13508-2***
- Consideration of environmental impact has been confined to buried pipelines *in service*. The production/installation and disposal/recycling phases of pipelines are outside the scope of this study
- Infiltration and exfiltration are recognised as the principal causes of environmental impact during the service life of a sewer network
- Accordingly, there is particular focus on those defect types which are likely to lead to leakage

* **EN 13508-2** *Condition of drain and sewer systems outside buildings. Part 2. Visual inspection coding system.*
A full listing of these codes and definitions is included as **Appendix C** in the full CORE REPORT document

EXECUTIVE SUMMARY *continued*

From the analysis of CCTV video footage, and associated sewer pipeline condition reports, the following statements can be made:

General observations

- Many defects – for both rigid and flexible pipes – can be attributed to defective installation, due to poor techniques or workmanship, and/or lack of supervision
- Flexible pipes are significantly less likely to have defects than are rigid pipes (see [Primary results](#) below)
- A high proportion of the defects observed in rigid pipes are those likely to cause infiltration and exfiltration

Primary results

- The environmental impact of the average section caused by infiltration or exfiltration for flexible pipe systems is **15% (less than one-sixth)** of that for rigid pipe systems. Especially in scenarios with sensitive ancillary conditions, flexible pipes show a better environmental performance than rigid systems.
- Considering the number of defects in reference to the installed length of all sewers of the particular material groups analysed in this study, flexible pipes have, on average, just **20% (one fifth)** of the defect rates of rigid pipe systems.
- When considering defective sections with defect types that are the main causes of infiltration and exfiltration – such as fissures (BAB[†]), break/collapse (BAC[†]) or defective connection (BAH[†]) – defect rates of flexible pipe systems are, on average, **25% (one quarter)** of the defect rates of rigid systems.

These are the three core statements from the Conclusion of the Technical Report of this study*

[†] BAB, BAC, BAH: These are codes for defect categories as defined in EN 13508-2. A full listing of these codes and definitions is included as [Appendix C](#) in the full CORE REPORT document

* TECHNICAL REPORT: *European study of the performance of various pipe systems, respectively pipe materials for municipal sewage systems under special consideration of the ecological range of effects during the service life* - prepared by the Technical Consultants, Prof.Dr.-Ing Stein & Partner GmbH, Bochum, Germany, August 2005.

EXECUTIVE SUMMARY *continued***Main implications**

- Cracking and leakage is relatively rare in flexible pipes in service whereas rigid pipes are more sensitive to changing ground conditions
- Flexible pipes are less liable to lose their integrity because, under excessive loading, they use their flexibility to help distribute the load and avoid leakage
- Excessive loading on buried rigid pipes is concentrated on the pipe itself and typically leads to cracking, collapse and leakage

Evaluation of the environmental impact of defects that typically cause infiltration or exfiltration indicates that

- There are significantly fewer environmental risks from installed flexible pipes in service than there are from installed rigid pipes

Key conclusions

In the light of analysis and evaluation of the observed data, this report has reached the following key conclusions:

- ▶ **In service, flexible pipes perform better than rigid pipes**
- ▶ **Buried pipelines need flexibility**
- ▶ **Fittings for flexible pipeline systems have tighter dimensional tolerances and therefore ensure more reliable connections**
- ▶ **Installation of flexible pipeline systems significantly reduces risk to the environment (see chart below)**
- ▶ **When choosing which type – rigid or flexible – offers better sustainability, flexible sewer pipelines are the sound, long-service option**

