

**SIT – Project**

**(Sewer Installation Time)**

**30% ‘installation time’ saving when using a plastics sewer system.**

By

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TEPPFA stands for The European Plastic Pipes and Fittings Association. It is a trade association representing the key manufacturers and national associations of plastic pipe systems. TEPPFA is actively involved in the promotion and acceptance of plastic pipe systems for all applications.

**ABSTRACT**

Several scientific studies underline benefits that plastic sewers have over traditional materials like clay and concrete. A few scientific studies which confirm that statement are for example:

➤ **Teppfa SMP project**

The SMP [explanation?] project showed that plastic systems have 75% fewer leaks than concrete. The full story can be found on the Teppfa website.

➤ **EPD Studies**

On average, plastic pipes have 30% less impact on the environment than alternative materials. Compared to concrete, plastic sewers have a comparable environmental impact. The full story can be found on the Teppfa website.

➤ **Lifetime expectancy**

PVC sewers have a lifetime expectancy of at least 100 years. The full story can be found on the Teppfa website. (Lifetime expectancy study for Polyolefins is under construction).

The installation time is, in these studies, an unimportant parameter which is especially for the EPD study has been set equal for sewer and concrete.

Assumptions about the speed of installation were: “It has long been clear that installing a plastic sewer system can save time over the installation of a concrete sewer system”, but never investigated.

By using parameters out of the three scientific studies mentioned above as the starting point, we managed to prove by a non-scientific (field test) study that contractors can save installation time by using thermoplastic sewer pipes and fittings.

**Most important parameters:**

- Independent contractor with plastics and concrete installation experience

- Trench: Length 90 meters, Depth around 2 meter, Diameter system 300mm, Two chambers.
- Identical site logistics for both systems.

And, on top of that, the results of the study are summarized in a video, which shows all details of the field test / study and the most important fact:

**The plastic installation was over 30% faster (3 hours and 19 minutes vs 5 hours and 12 minutes) than concrete.**

This document contains the starting point, approach, used parameters from the scientific studies, the field test, results and the video.

## SYNOPSIS

Plastics Piping Systems have proven, over the many years of usage, to be an excellent system (material?) for sewer applications. Especially the thermoplastic materials PVC-U, PP and PE. Furthermore, plastic piping systems for sewers have been applied successfully all over Europe.

Nevertheless, many advantages of plastics sewer systems (like “the installation time”) are underestimated, never thoroughly investigated and documented in detail. One of the main reasons for this lack of interest is the enormous variety of installation techniques depending on the project limitations.

This paper does not report on a scientific investigation of the installation comparison between plastics and alternative materials, but reports on a non-scientific field test which shows an enormous difference between the installation time of a plastics sewer system if compared with a concrete sewer system under exactly the same installation conditions.

Attention will be given to the limitations of the field-test project. The advantages of using thermoplastic pipes, such as PP, PE and PVC-U, versus pipes made from alternative materials will be highlighted.

## INTRODUCTION

Several scientific studies underline benefits that plastics sewers have over sewers of traditional materials like clay and concrete. These benefits can be found in the environmental, sustainability and performance time area. A few scientific studies which confirm that statement are for example:

- **Teppfa SMP project**  
**Sustainable Municipal Pipes,**  
(What are the environmental impacts of sewer defects and leakage?)  
The SMP project showed that plastic systems have 75% fewer leaks than concrete.
- **Teppfa EPD Studies**  
**Environmental Product Declaration,**  
(*integral environmental burdens encountered during the life-span of particular pipe system applications*)

On average, plastic pipes have 30% less impact on the environment than pipes made from alternative materials. Compared to concrete, plastic sewers have a comparable environmental impact.

- **Teppfa Lifetime expectancy study**  
**Thermoplastics, PVC-U and Polyolefins,**  
PVC sewers have a lifetime expectancy of at least 100 years.

The full story of these studies can be found on the Teppfa website. (Lifetime expectancy study for Polyolefins is under construction).

The 'were installation time' is in all these studies mostly an insignificant parameter, which especially for the EPD study has even been set equal installation time for plastics sewer and alternative materials. This, even though positive assumptions about the speed of installation were there: "It has long been clear that installing a plastic sewer system can save time over the installation of sewer systems of traditional materials", but this assumption was never investigated.

By using the available parameters from the three scientific studies mentioned above as starting point, we managed to execute a non-scientific (field test) study which shows that contractors can definitely save installation time by using thermoplastic sewer pipes, fittings and chambers/manholes instead of alternative materials. And even more, contractors can save on labor and equipment costs as well.

Scope of the study: To provide clear evidence of the potential saving in installation time and cost of installation of plastic (thermoplastic) sewers compared to concrete (traditional material) while avoiding the controversial area of direct price comparison.

Deliverables of the project: To provide a summary report with accelerated video to be used a) as a sales aid to demonstrate the degree of cost saving and b) to promote plastics with a short video message on YouTube.

Additional advantage: If the installation of plastics is faster than the installation of traditional materials, it can influence the TEPPFA EPD studies (sustainability) in a positive way for plastics.

## **SIT PROJECT, RESTRICTIONS**

Before performing the field-test it was needed to limit the project variables and to set the installation conditions. The installation conditions are, if possible, based on information from the TEPPFA studies mentioned above. The five most significant installation conditions are explained:

- a) Selection sewer system;
- b) Selection pipe characteristics;
- c) Two days, same site logistics;
- d) Installation technique;
- e) Site conditions and preparation.

### **a) Selection sewer system.**

Due to the fact that it is not possible to install a complete sewer system, it was agreed to use a 'Functional Unit' (FU) for the field test. This FU is adapted from the TEPPFA EPD study.

During the TEPPFA EPD study it was needed to prepare a functional unit which is described as an average, representable segment of a total sewer system. This FU was used as well for plastics sewer

EPDs as for the concrete sewer EPD and therefore also applicable for the “Sewer Installation Time” project.

The Functional Unit is closely related to the function(s) fulfilled by the to-be-investigated sewer systems. The function of the plastic sewer pipe systems and the concrete sewer pipe systems is to transport (gravity discharge) a certain amount of sewage from the entrance of a public sewer system to the entrance of the waste water treatment plant. The functional unit for the comparative TEPPFA EPD study, and now also for the SIT project, for sewer pipe systems has been defined as:

*“the below ground gravity transportation of sewage over a distance of 100 m by a typical public European thermoplastic pipe (e.g. DN/ID 300 mm) and its alternative concrete sewer pipe system (e.g. DN 300 mm) from the entrance of a public sewer system to the entrance of the waste water treatment plant, over its complete service life cycle of 100 years, calculated per year” Both sewer systems are designed for a minimum discharge capacity of 162,5 m<sup>3</sup>/h and are available on the market.*

The basic conditions to define the FU of the thermoplastic and the concrete sewer pipe systems were:

Basic conditions	Value condition
Residential area	12500 inhabitants
Discharge per person	130 l/day (13 liter/hour, over 10 hours)
Total discharge capacity sewer system	162.5 m <sup>3</sup> /hour (or 45.1 l/s)
Speed discharge	Between 1 and 1.2 m/s
Slope trench	1/200 m/m
Length trench	100 meter (at test site last 10 m excluded)
Depth trench	2 meter
Pipe systems	Widely available on the European market

#### b) Selection pipe characteristics



Selecting the pipes, taking into account the chosen sewer system, it was decided to install for thermoplastics DN/ID 300 mm and for concrete DN 300 mm pipe system in the FU. The hydraulic capacity calculations show that both, thermoplastic and concrete sewer pipe systems oversized but due to the best running sizes for the thermoplastic and the concrete sewer pipe system the next available sizes were selected.

The design of the FU related to thermoplastic sewer pipe system includes the following products:

Quantity	Products	Dimensions (characteristics)
16 pcs	Pipes PVC socketed (one pipe used for adapters)	DN/ID300 L = 6m Smooth wall Virgin material Fixed seals in socket
2 pc	Chamber / manhole PP base Chamber / manhole shaft (excluding cover solution)	Ø600-300 Height 2 meter

The design of the FU related to concrete sewer pipe system includes the following products:

Quantity	Products	Dimensions (characteristics)
43 pcs	Concrete socketed (not reinforced))	DN300 L = 2 m Separate seals
45	Seals	DN300
1 pcs	Transition piece (pipe – manhole)	DN300 L = 0.5 m Spigot-spigot
2 pcs 2 pcs	Chamber / manhole base Chamber / manhole shaft (excluding cover solution)	Ø 1000-300 Height 2 meter

**c) Two days, same site logistics;**

The field-test site needs to be chosen and organized in such a way that both installation field-tests can be executed under exactly the same conditions, but at a different day. Therefore a check list was arranged to set the main site conditions.

The main site conditions are listed in Table beneath .The following picture of the site shows the position of all the different elements at the beginning of the field-test as mentioned.

Conditions	
Location identical	Pipes, seals, manholes / chambers (plastics and/or concrete) Backfill sand Compaction equipment Digging buckets for excavator
Equipment identical	Hand tools (saw / spa / laser) Excavator (including hoisting material) Compaction
Trench identical	Width, length, depth No groundwater Bedding (material and layer thickness) 10 meter signs + 45 meter sign for manhole 2
Weather identical	Same temperature, partly sunny, partly clouded but no rain.
Contractor same	The same by both installations
Video shots identical	Crew
	Equipment

	Positions (including height)
	Focusing details

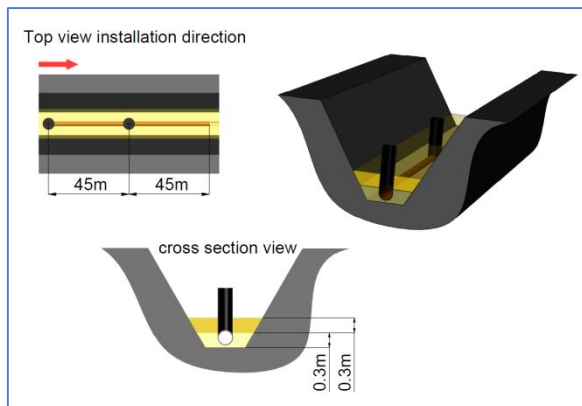


Picture Fixed conditions

**d) Installation technique.**

The installation of both pipe systems is executed according the applicable EN standards. For both sewer materials EN 1610 (Construction and testing of drains and sewers / CEN TC165) is used. Additional for the thermoplastic system CEN/TR1046 (Practices for underground installation / CEN TC155) is used as far as applicable.

For the installation an ‘open trench’ is used according following drawing and picture. Wherein the starting point is a manhole / chamber and the end of the system (FU) an adapter (plastics) or a last complete pipe (concrete) to complete the 90 meters.





## Drawing and picture Installation technique.

### e) **Site condition and preparation**

Both installation days the field test site is prepared in the same way by the same contractor with the same equipment.

The trench was prepared on forehand and excavated in such a way to ensure correct and safe installation of pipelines. Trench support systems were not needed and excluded in the project.

The trench is prepared completely, including 10 meter interval marks at the right side of the trench, a single mark at the left side for the second manhole at a distance of 45 meter (SMP study). See following picture. A 10 cm bedding of standardized sand is prepared. The groundwater level was no issue.



### Picture trench lay out including marking

Pipes and components and jointing accessories were inspected on delivery to ensure that they are appropriately marked and comply with the design requirements.

For leveling according the design equipment (infrared level) is installed at the end of the trench.

The possible routes, at the field-test site, for the excavator or other equipment are for both installations equal.

### THE INSTALLATION

The SIT project covers the following field-test actions in the sequence below. The general preparation of the site / trench is out of the scope of the time registration:

nr	Activities*	effort
1	Everyone / everything positioned	
2	Transport first manhole / chamber base to trench	excavator
3	Installing manhole / chamber base	man for plastics excavator/man for concrete
4	Collecting pipes from stock	excavator
5	Transport pipes to the trench	excavator
6	Prepare trench bottom per pipe	man
7	Installing all pipes leveled and in line	man for plastics excavator/man for concrete
8	Jointing of pipes	man for plastics excavator/man for concrete
9	Prepare a pipe segment and install segment Transport and install adapter	man for plastics excavator/man for concrete
10	Transport second manhole / chamber base to trench	excavator
11	Installing manhole / chamber base	man for plastics excavator/man for concrete
12	Collecting pipes from stock	excavator
13	Transport pipes to the trench	excavator
14	Prepare trench bottom	man
15	Lay all pipes leveled and in line	man for plastics excavator for concrete
16	Jointing of pipes	man for plastics excavator for concrete
17	Placing shafts on top of manhole / chamber bases	excavator
18	Backfill 15 meters around manhole / chamber	excavator
19	Compact with compactable backfill sand around pipe	man

\*

Installation notes concrete:

- No lubricant used for any seals in concrete installation;
- Seals put on pipe while held in place by excavator before laying them in the trench;
- Pipe seals located in box at end of trench;
- Every 2 meter height check needed.

Installation notes plastics:

- Lubricant used for (added on) all seals;
- Pipes can be cut for exact fit;



- Every 2 meter height check needed.

The activities are derived from the Field-test ‘Time registration’, which is not included. A few times it was needed to change the bucket of the excavator for a new activity. That is not marked above as a special activity.

## INSTALLATION RESULTS

Both installations were executed by the same contractor, who is experienced in installation of both materials, although 300 mm concrete is **not** a runner for the contractor.

The Sewer Installation Time field-test resulted in some remarkable outcomes listed below in the table where a summary of the time registration is given.

Concrete installation			Installation Plastics		
Activity	Time in minutes		Time in minutes		Activity
	Per activity	Sum	Sum	Per activity	
Start	0	0	0	0	Start
First chamber	12	12	9	9	First chamber
Pipes (1-21)	133	145	63	54	Pipes (1-7)
Second chamber + extra socket piece	26	171	88	25	Second chamber + adjusted pipe (8)
Pipes (pipe 22-43)	102	273	141	53	Pipes (9-15)
No adequate piece			151	10	Adjusted pipe (16)
Cones	7	280	169	18	Cones and seals
Backfilling	32	312	199	30	Backfilling
<b>90.5 meter ← 5h 12min</b>			<b>3h 19min → 90 meter</b>		
<b>30% time saving when using plastics sewer system.</b>					

The full detailed time registration information will be available at the TEPPFA website. Both systems could be installed over 90 meters. The last 10 meters (according to the TEPPFA EPD study, 100m was suggested) needed to be skipped due to site limitations.

Total length of Plastics sewer system at the end at the installation:

pcs	Installed system parts	Distance in meters	Distance in meters sum
1	chamber	00.80	00.80
7	pipes	42.00	42.80
1	adapter	02.60	44.60
1	chamber	00.80	45.40
7	pipes	42.00	87.40

1	adapter	02.60	90.00
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Total length of Concrete sewer system at the end of the installation:

pcs	Installed system parts	Distance in meters	Distance in meters sum
		Distance in meters	Distance in meters sum
1	chamber	01.00	01.00
21	pipes	42.00	43.00
1	adapter	00.50	<b>43.50 !</b> (45.00)
1	chamber	01.00	44.50
23	pipes	46.00	<b>90.50 !</b> (90.00)

## CONCLUSIONS

### Main conclusions (under project conditions)

- Installation time plastics 30 % less than for alternative material;
- The installation of concrete depends on the excavator speed;
- The installation of plastics is more or less depends on the man in the trench.

### Additional conclusions (under project conditions)

- Less site transport needed for the installation of plastics due to benefit pipe length;
- Positioning in between chamber/manhole more precise possible in plastic system;
- Positioning last manhole/chamber easier to realize in plastic system;
- When installing plastics, the excavator was always waiting for man in the trench to finish leveling, bedding, and adding lubricant in the socket for the next pipe to join;
- When installing concrete, the man in the trench was always waiting for the excavator. The excavator had to collect the pipes and was also needed for jointing the pipes;
- Plastic chambers can be installed without excavator;
- Concrete manholes can only be installed with excavator;
- Plastics needs direct support from sand, which is time consuming and difficult to arrange. Easily you de-level the pipe by adding sand support left and right of the pipe;
- Lifting and grabbing of concrete pipes by excavator, due to stiffness and weight: very easy;
- Lifting and grabbing of plastics pipes by excavator, due to flexibility and almost no weight: not easy;
- Backfill activities and time for both pipe systems identical;
- Less energy needed for installation plastics system;
- The installation of concrete depends on the excavator speed;
- The installation of plastics more or less depends on the man in the trench;

- If the man in the trench had some help, the difference in installation time was even be bigger. The shafts of the plastic system were not easy to install. Plastic base has almost no stability on its own, it needs to be stabilized by material from the trench.