37TH INTERNATIONAL NO-DIG FLORENCE 2019

Fortezza da Basso • FLORENCE (Italy)

30th September • 2nd October 2019

DESIGN&BUILDING CONTRACTS AS A PERFORMING OPPORTUNITY TO C.I.P.P. SEWERS REHABILITATION – BRIANZACQUE CASE STUDY

Simone M. Cellitti
Mauro Pozzi
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What we are going to see Today

Important sewer rehabilitation done whit C.I.P.P. (Cured In Place Pipe)

1 - AREA - densely populated area in the north of Milan

2- LENGTH and SIZE: 2.5 km of a large ovoid-shaped sewer

3 - BUDGET: 3 million euro

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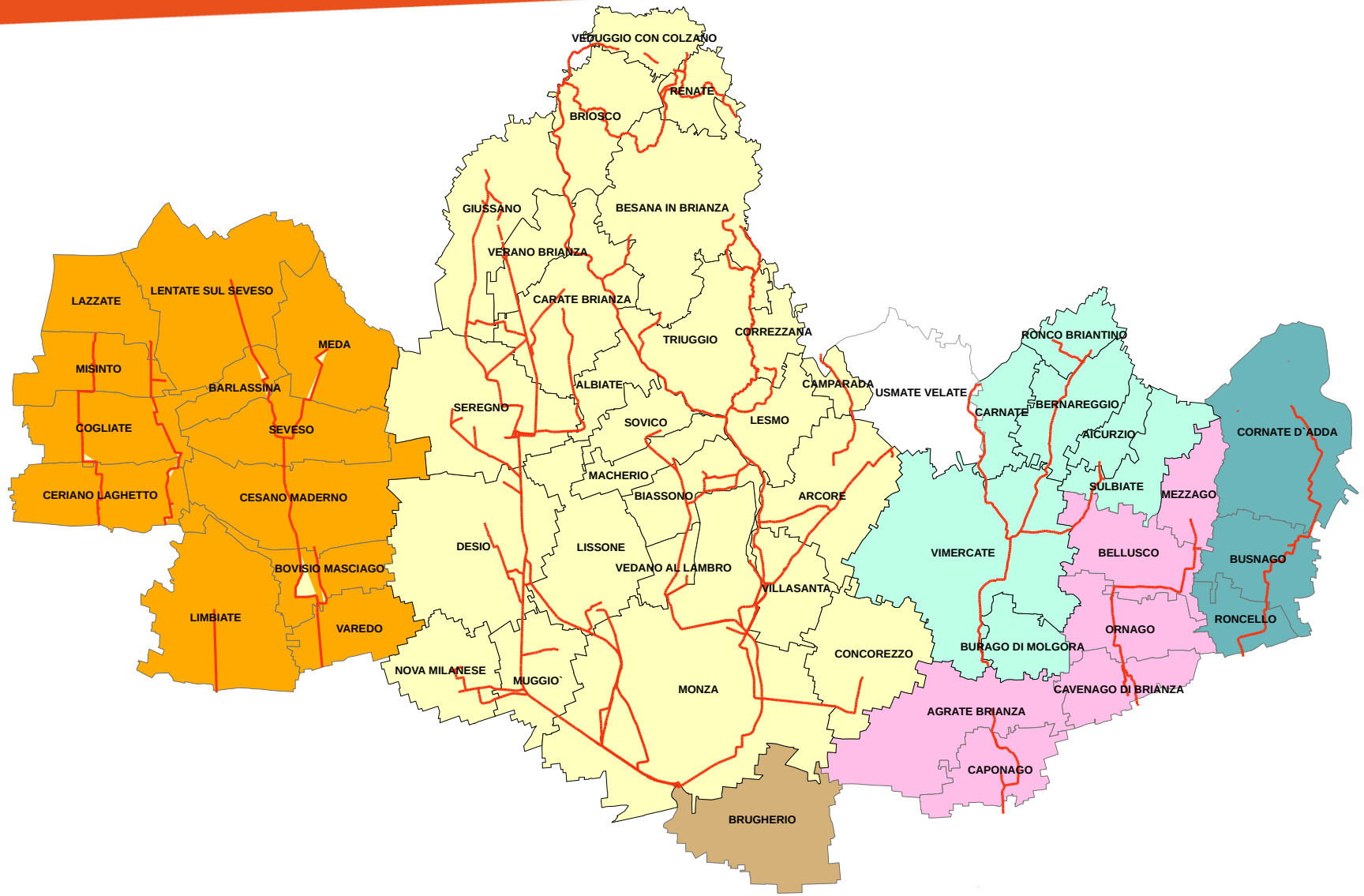
BrianzAcque



- 55 City
- 405 km² (square kilometers)
- 870.000 people
- More then 2.600 km of Sewer pipes

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INCREASE KNOWLEDGE

Brianzacque to develop the knowledge of the geometric and hydraulic characteristics of the sewerage network, realized THE RIMODEL PROJECT

Video-ispection

Modeling

Measures

Sewerage Plan

System able to provide a global board of the problems to be solved, to identify the consequent rehabilitation interventions, as well as to define their priority and the related cost

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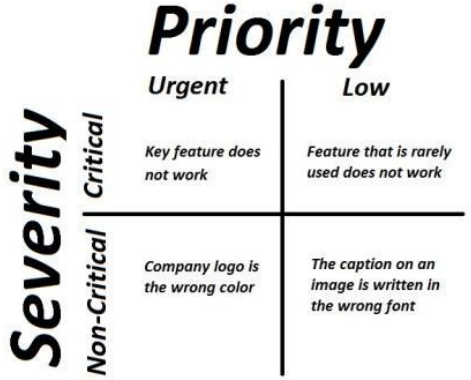
1 Problems related to the hydraulic insufficiency of the pipes, which causes flooding and superficial flooding;

2 Problems of structural criticality and water tightness, connected to the age of the pipes;



Identification of priority based on gravity

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CONTEX

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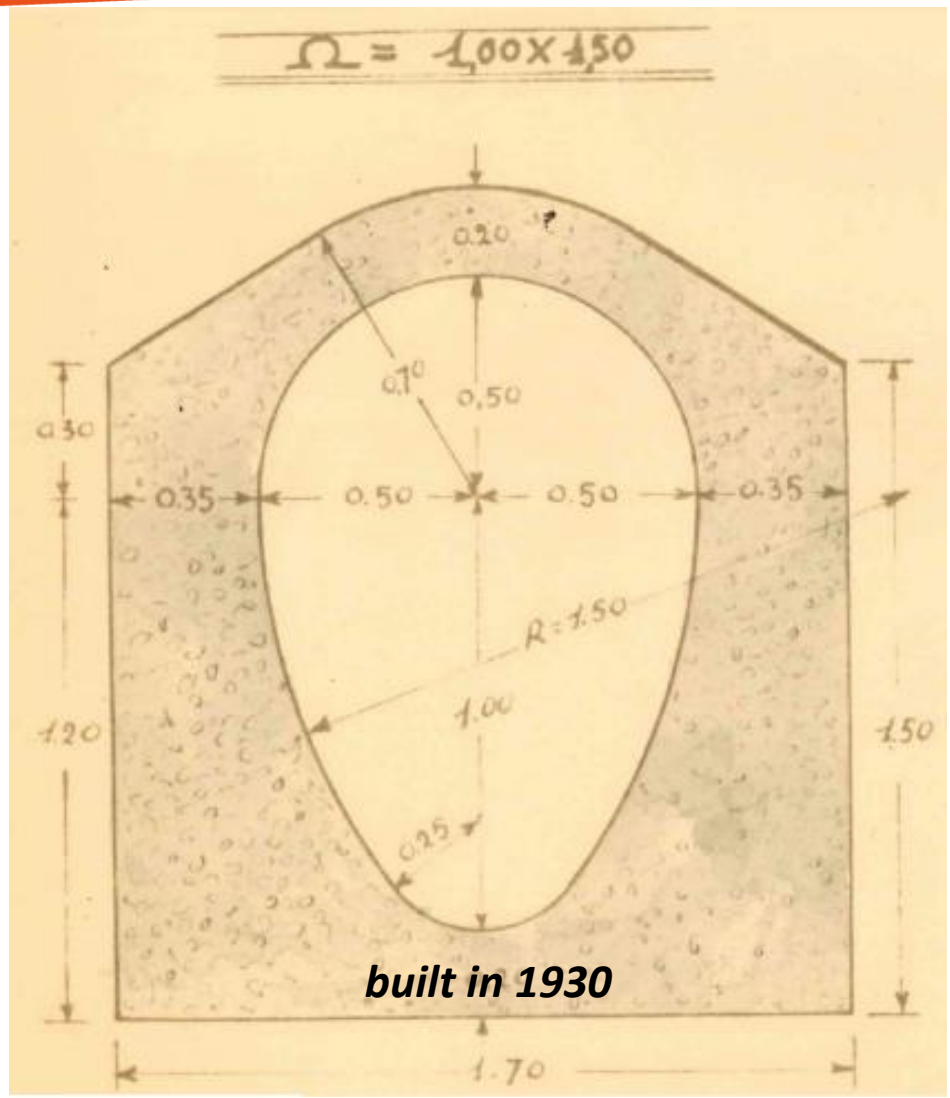

built in 1930

Structural problems

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Punctual Collapses

Differente Diameters

Problems with video-inspection

Important wastewater flow

Not all the pipelines was investigated

How is the best practise to solve the structural problem?

Parameters	Remove the old pipeline and lay the new pipeline	trenchless technology
useful life of the pipeline	60/80 years	50 years
Cost of the work	€ 12 milion	€ 3 milion
execution times	2 years	5 mouth
social costs	VERY HIGHT	LOW
environmental advantage in terms of reducing CO_2	2.394.048 Co2 [kg]	84.917 Co2 [kg] **-96%**

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Choose the type of Contract

INCREASE KNOWLEDGE

Highly specialized work

INTEGRATED TENDER

Use the skills of people who work with technology

ROTECH
risanamento e rinnovamento tubazioni

MPM Spurghi Videoispezioni Collaudi

J+S

Politecnico Milano

DOTT. ING. MARIO VALDEMARIN
DR. ING. DIETER SCHÖLZHORN

ingutis

DESIGN&BUILDING CONTRACTS

30 days for the Project
103 days for the rehabilitation

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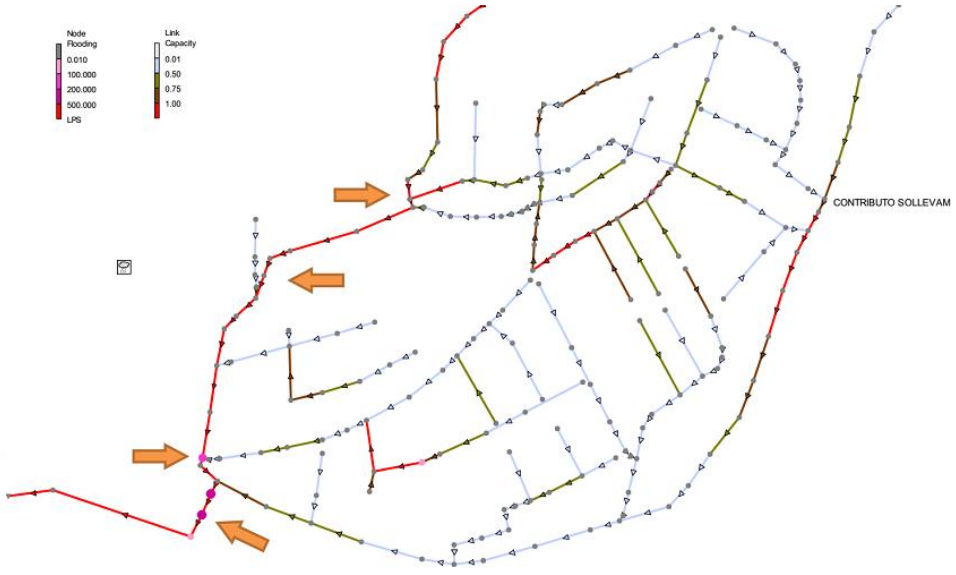
Criticity to solve



Change Flow of the waste water

The management of wastewater during all the Sewer rehabilitation

Mathematical Model → 3 Pumps 110 l/s

By-pass

The static calculation in order to determine the thickness of the liner to be inserted into the existing pipeline.

Section (mm)	Position	Damage class	DWA-A 143-2 Software EasyPipe:	UNI 11681 Diametro equivalente formula FALTER	ASTM 1216	DWA-A 143-2 Software: FEM	Liner thickness chosen
800/1200	Road/Green area	Partially deteriorated	Not considered	Not considered	Not considered	Not considered	Not considered
800/1200	Road/Green area	Completely deteriorated	9.5 mm	11.81 mm	10.2 mm	9.5	12.1 mm
800/1200	Railway	Completely deteriorated	9.5 mm	14.10 mm	13.73 mm	12.5 mm	14.2 mm
1000/1500	Road/Green area	Partially deteriorated	Not considered	Not considered	Not considered	Not considered	Not considered
1000/1500	Road/Green area	Completely deteriorated	12.5 mm	13.65 mm	12.89 mm	12.5	14.2 mm
1000/1500	Railway	Completely deteriorated	12.5 mm	16.04 mm	14.95 mm	12.5 mm	16.3 mm

we decided the most precautionary solution

How we are able to control the execution? We built a Control Plan

1 check – Datasheets

Technical datasheets and certifications are compared with the static project report.

Static project

Modulo di elasticità tangenziale $_{\text{a breve termine}}$	=	21.209	N/mm²
Tensione a flessione $_{\text{a breve termine}}$	=	380	N/mm²
Coefficiente di Poisson	=	0,22	
Fattore di riduzione A_1	=	1,23	
Modulo di elasticità tangenziale $_{\text{a lungo termine}}$	=	17.243	N/mm²
Tensione a flessione $_{\text{a lungo termine}}$	=	309	N/mm²

Certification of the liner

Liner "Alphaliner 1800" e "Alphaliner 1800 HP" con resina PU:

Modulo E anulare a breve termine secondo DIN EN 1228[12]:	21.209 N/mm^2
Modulo E anulare a lungo termine:	17.243 N/mm^2
Sforzo fessionale a breve termine σ_{fB} secondo DIN EN ISO 11296-4[2] o DIN EN ISO 178[13]:	380 N/mm^2
Sforzo fessionale a lungo termine σ_{fB}:	309 N/mm^2
Fattore riduzione A dopo 2.000 h:	1,23

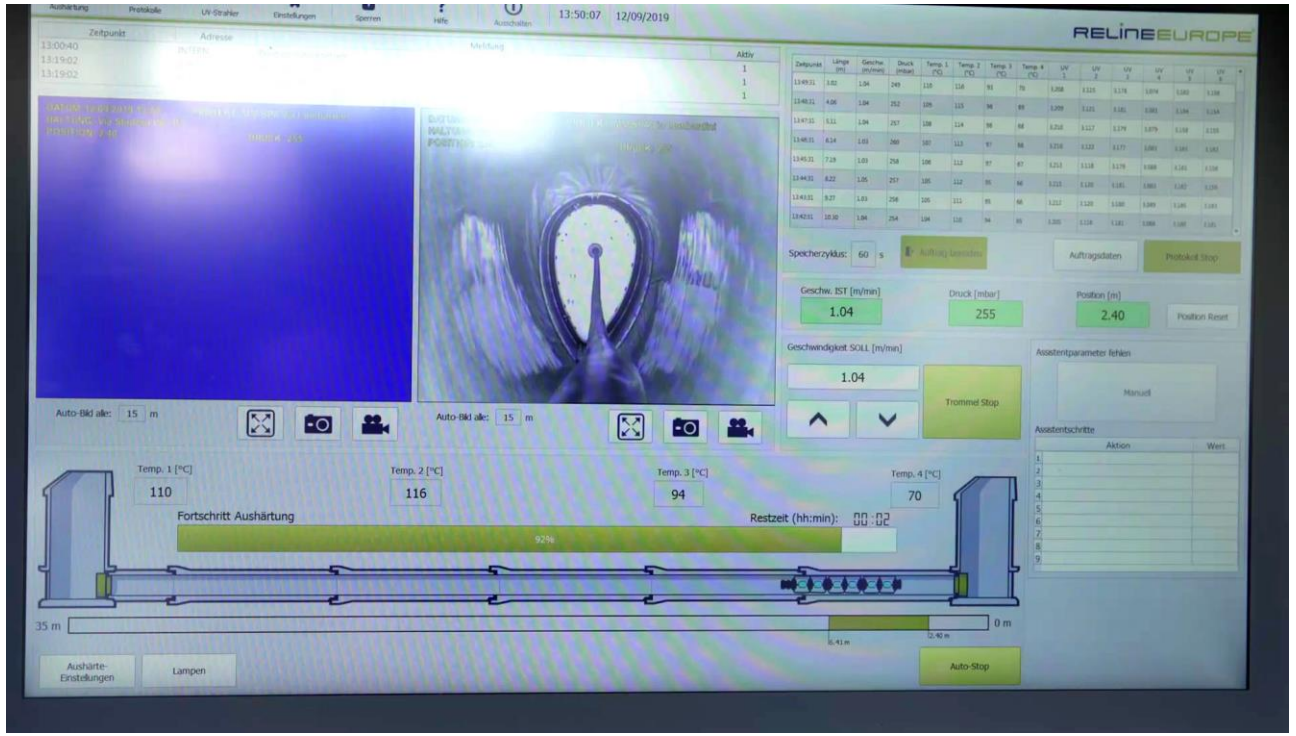
In the building site – **2 check before inserting the liner**

After the cleaning

Before the insertion

In the building site – **3 Check duriung the insertion and the catalysis of the liner**

we supervise the processes and procedures - guidelines UNI EN 11296/4



Software for checking the process of catalysis

In the building site – **4 Check the report**

At the end of the insertion process, we analyze the report.

From this report we can understand if there have been executive problems

Datum & Zeit	Länge	Geschwindig.	Druck	Temperaturen				UV-Lampen									
Zeitstempel	(m)	(m/min)	(mbar)	T1 °C	T2 °C	T3 °C	T4 °C	1	2	3	4	5	6	7	8	9	10
18.04.19 14:49:12 W. Europe Daylight Time	117,20	0,20	255.000	83	60	69	40	3,222	3,147	3,174	3,142	3,188	3,207	0	0	0	0
18.04.19 14:50:12 W. Europe Daylight Time	117,00	0,21	252.000	86	64	74	41	3,218	3,151	3,174	3,141	3,188	3,191	0	0	0	0
18.04.19 14:51:12 W. Europe Daylight Time	116,77	0,39	252.000	87	68	78	42	3,229	3,156	3,179	3,133	3,184	3,187	0	0	0	0
18.04.19 14:52:13 W. Europe Daylight Time	116,37	0,40	254.000	89	71	77	42	3,221	3,148	3,170	3,136	3,182	3,189	0	0	0	0
18.04.19 14:53:13 W. Europe Daylight Time	115,97	0,40	255.000	91	75	78	43	3,218	3,155	3,174	3,139	3,188	3,186	0	0	0	0

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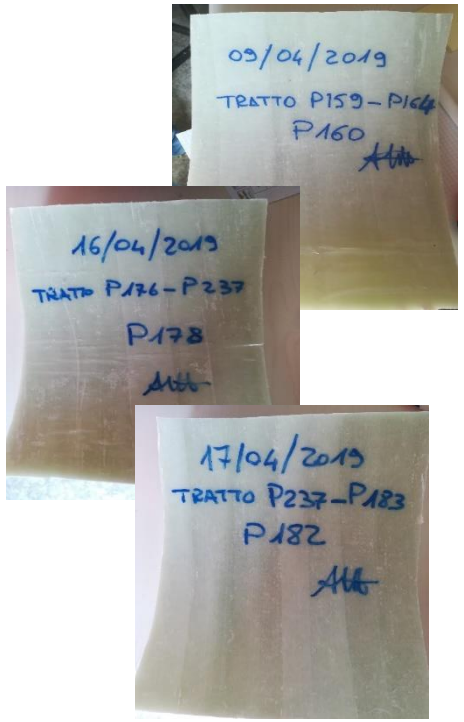
In the building site - **5 Check**



we take a sample for analysis – UNI EN 11296/4

short-term flexural

VS

Static project long-term flexural

reduction factor

Test

Procedura	Parametri	Unità di misura	Valore medio	Deviazione standard
#DIN EN ISO 178	Spessore del composito	mm	12,7	0,2
	Spessore complessivo	mm	14,0	0,2
	Modulo di elasticità alla flessione	MPa	20138	1201
	Tensoflessione	MPa	411,6	33,2

Static project

Modulo di elasticità tangenziale a breve termine	=	21.209	N/mm²
Tensione a flessione a breve termine	=	380	N/mm²
Coefficiente di Poisson	=	0,22	
Fattore di riduzione A_1	=	1,23	
Modulo di elasticità tangenziale a lungo termine	=	17.243	N/mm²
Tensione a flessione a lungo termine	=	309	N/mm²

How we can have the long term flexural of the material proposed?

UNI EN 11296/4

Annex C
(normative)

Cured-in-place pipes — Determination of long-term flexural modulus under dry or wet conditions

C.1 General

This annex specifies a method for determining the long-term flexural modulus of CIPP material subjected to a constant flexural stress under dry or wet conditions. The specified test period is 10 000 h, and the result of the test is expressed as a value of long-term modulus extrapolated to 50 years. The method of extrapolation used also, however, allows determination of long-term modulus at any other time between 10 000 h and 50 years.

Hydraulic seal and Quality - Connections and existing wells

finishing and sealing of the connections

finishing and sealing of the liner

Hydraulic seal and Quality - restoration of the existing wells

hydro-scarifying 400 Bar

stakeout the Walls

mortar spraying 2 times

Connections and restoration of the existing wells - **Hydraulic seal and Quality**

Wells restored

Tear test on grout for wells recovery

Problems on going: Erosion of the pipeline more than we thought

estimated in the project

20% of the pipelines

Reconstruction whit bricks and cement

Costs about 3% of the contract

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UNIVERSITY Politecnico di Milano and Rotech S.r.l. proposed a test with Optical fiber to measure the flow of the wastewater.

The goal is to correlate the recorded vibrations measured by the optical fiber to the measures of the fluid speed made by a flow meter

1) monitoring of piping condition
2) report waste water leaks
3) structural damage in the pipeline

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