EUROPEAN COMMISSION

Research Executive Agency

SME Actions

Project No: - 243737

Project Acronym: - EZLine

Project Full Name: - Ezline – Novel Technology for Low Cost Re-Lining of Pipe Infrastructure

Final Overview Report

Period covered: - 30/09/2010 to 30/09/2013

Start Date of project: - 30/09/2010

Project co-ordinator name: - Sergio Bianchi

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Final Report

Project Final Report

Grant Agreement Number: - FP7-SME-2008-2-243737

Project Acronym: - Ezline

Project Title: - Novel Technology for Low Cost Re-Lining of Pipe Infrastructure

Funding Scheme: - FP7-BSG-SME

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Executive Summary

Existing infrastructure is ageing in European cities and the need to undertake repairs is becoming increasingly urgent. However, the repair of pipe infrastructure is expensive, time consuming and disruptive, thus remedial works are progressing slowly and will take many years to complete. Tight margins, large liabilities and rising insurance costs are putting pressure on SMEs working in the pipe lining sector, further delaying the undertaking of remedial works.

Compounding these problems, increasingly stringent European legislation on drinking water quality is creating significant demand for pipe rehabilitation programs to be undertaken across the whole of Europe. To date, such programs have been most extensively undertaken in the North Western regions of Europe (e.g. UK, Scandinavia, Germany, Netherlands and France).

However, activities are costly and in some cases incomplete in these areas while in many of the eastern and accession states they have yet to start. Hence, despite growing demand for repairs, techniques are labour intensive, slow and expensive and demands are failing to be met.

Rising costs are putting pressure on members in this sector, causing margins to decrease and works to be delayed until economic conditions become more favourable, compounding the problem. The situation is now largely regarded as unsatisfactory by the industry sector and there is on-going political demand for efficient infrastructure, and subsequently, demand for suitable processes and solutions.

The Italian Association for Trenchless Technology (IATT) and the partner associations represent SME members across Europe engaged in pipe rehabilitation, water management and technical textiles. The members include companies involved in many aspects of ground works including installation, cleaning, pipe rehabilitation and technical textile development.

Overall, pipe related activities (new construction and rehabilitation sectors) within Europe, comprises some 32,500 SMEs of which an estimated 1,600 SMEs work in pipe rehabilitation, directly employing 14,000 people and rehabilitating some 4,900km of water and sewerage pipes per year (25% of the total market).

The total European market potential for pipe rehabilitation is estimated to be €2.5-3.5 billion pa, equivalent to about 20,000km of pipe relined every year; however, there is a small number of primary suppliers in the pipe relining business such as Insituform, Saertex and Brandenburger. Traditionally, members have been unable to match the technological developments made by these organisations and their association SME membership has been unable to compete effectively within the pipe rehabilitation market, particularly when tendering for rehabilitation contracts.

Although the pipe rehabilitation market is mature, it has failed to develop cost effective, rapid relining solutions that are capable of solving the aforementioned problems, leaving European pipe infrastructure largely unable to cope with current demands.

The pipe rehabilitation sector has traditionally been a low technology area and has seen few significant technical developments in the last 30 years.

Some have attempted to meet market needs and devised solutions which attempt to address the key problems, but all such solutions exhibit drawbacks, most notably slow production rates, high

labour costs and the risk of chemical contamination from the liner when using resin based repair methods.

Moreover, the extensive use of asbestos in water piping and in pitch fibre drains means that remedial works are difficult to undertake from a health perspective and better relining techniques are critical in achieving cost effective solutions.

To survive and meet market needs, the SME members need access to rehabilitation technologies that can meet the demanding requirements of pipe repair whilst providing a fast, versatile and cost effective method for undertaking this work.

Though many technologies are currently employed for rehabilitation, the primary technique used is Cured in Place, where resin soaked materials are cured in-situ.

Consultations with members had indicated that the following features & benefits were needed in a newly developed technology:-

- A trenchless technology with low maintenance requirements and fast production rates
- Less labour intensive processes resulting in lower labour costs
- More rapid production rates resulting in less disruption and faster repair
- Technology capable of relining longer runs of pipe in a single operation
- Capability of a wider range of repairs than existing technologies allow
- Capability of achieving rehabilitation even in pipes with significant structural defects
- Improved versatility - capable of relining a wide variety of pipe diameters and types
- No risk of chemical contamination from the liner (unlike resin based methods)

Participant organisations assembled to create the consortium for Ezline were as follows:-

1) (Coordinator) IATT - Italian Association for Trenchless Technology, Italy - SME-AG

2) PFTT - Polish Foundation for Trenchless Technology, Poland - SME-AG

3) TechniTex, UK - SME-AG

4) Sirris, Belgium- RTD

5) UKMatRI - UK Materials Technology Research Institute, UK - RTD

7) Centrocot - Centro Tessile Cotoniero e Abbigliamento Spa, Italy - RTD

8) Gadmon Industries, UK – SMEP

9) CEPA - Controllo Energia e Protezione Ambiente srl, Italy – SMEP

10) Longrock Ground Works Ltd, UK - SMEP (replaced Timco in 2012)

11) Eurocarbon B.V., Netherlands – SME

12) Medworks srl, Italy RTD

Summary Description of Project Context and Objectives

The project vision was to create an innovative rehabilitation process designed to meet the needs of the pipe rehabilitation market and the SME-AG members:-

- A low cost system (33% reduction in total costs compared to cured in place resin lining)
- A high production rate system (2 x the production rate of cured in place resin lining)
- A low maintenance solution with suitable operational characteristics (long life time and flexible use for fresh and waste water)
- Reduced energy use (a 15% reduction over cured in place resin lining)
- Ready ability to deliver c. 250m contiguous lining runs
- No increase in infrastructure cost
- Integration with existing working equipment and tools

The EZ-Line solution comprises a conformable solid thermoplastic composite liner with integral fibre re-enforcement, which is supplied in a collapsed format, pulled through the host pipe, and pushed and consolidated against the inner surface of the pipe to be relined with a heated novel install PIG design.

During consolidation in the host pipe, the liner fabric will re-assume its original circular shape to form a smooth, water tight solid 'sheet' of reinforced plastic.

The EZ-Line system would use standard commercially available pressure water jet cleaning technology to clear debris in the pipe and clean it prior to the lining process.

The EZ-Line system will use a unique heated, articulated pig design to ensure rapid processing and relining of the damaged pipe; placing the liner in situ and consolidating the structure as it traverses along the length of the pipe. This simplifies the design to produce a very robust device.

The EZ-Line system will not require water pressure to 'push' a sock into the pipe (as required for thermosetting resin impregnated felts); neither will EZ-Line need hot water or steam to carry out any chemical curing process.

The lining technology will allow longer relining runs to be undertaken using a trenchless technology. The liner will take the form of a star-formed collapsed reinforced thermoplastic composite, envisaged to be spooled on a reel for delivery on-site.

Compared to existing processes, infrastructure requirements would be minimised. The benefits to include faster, lower cost, efficient repairs, with reduced labour, reduced risk and no smell or chemical hazards typically associated with thermosetting resins in the cured in place process.

The consolidation head will provide electrical heating for liner softening and re-forming and a cooling method for retrospective consolidation, these provided by an umbilical cable fed from a control and power unit.

General Project Objectives

The overall objective then was to design, develop and create a novel trenchless pipe relining solution for:-

- Renovation of underground non-pressure drainage and sewerage networks
- Renovation of underground drainage and sewerage networks under pressure
- Renovation of underground water supply networks
- Also for consideration, renovation of underground gas supply networks and industrial pipelines

Standards were to be represented by the related ISO norms, in line with cured-in-place pipes, using ISO EN 13566- 4:2002 as a benchmark and as the standard used for this project.

SME Member Benefits

The technology was envisaged to deliver the following benefits to the SME-AG members: -

- Trenchless technology with improved safety
- Ability to reline longer runs of pipe
- Less labour intensive with lower labour costs
- Potential to :-
    - Use recycled materials in manufacture
    - Recycle liner materials attend of life
- Reduced costs and faster repairs and less civic disruption
- Suitable for wide range of market sectors, pipe types, pipe sizes and construction materials
- Ability to cope with pipes with significant defects, different shapes and irregular diameters and forms

To achieve the overall objective of the project, the following scientific, technical and economic objectives highlighted on the following page were being addressed.

The Work Programme had then been developed to achieve the objectives.

Scientific and Technical Objectives

To achieve the project objective of establishing EZ Line as a technology, to benefit the SME-AG members, the partners needed to address the following scientific and technical objectives : -

Scientific

- Enhanced scientific knowledge of thermoplastics for the liner
- Enhanced understanding through experimental analysis of textile solutions
- Enhance understanding of polymer forming, heating and consolidation processes
- Enhanced understanding of fabrics development and consolidation of requirements

Technical

- Development of former tool
- Development of install PIG and head, consolidation, monitoring and umbilical systems
- Validation of mechanical properties for the consolidated liner
- Integration of components and fabrics to produce a prototype demonstration system

Economic Objectives

On behalf of pipe rehabilitators (represented in the consortium by CEPA and Gadmon):-

- Total savings in relining costs of c. €279 million pa in the EU by 5 years post project

On behalf of machinery manufacturers (represented in the consortium by Longrock):-

- Direct sales of machinery of up to a cumulative value of c. €10.2million in the EU and c. €5million into the Rest of World market by 5 years post project with an additional revenue of some €2.5m pa from year 6 onwards

On behalf of textile/fabric manufacturers (represented in the consortium by Eurocarbon):-

- Direct sales of liner materials in excess of c. €41.5 million pa 5 years post project

On behalf of communities, and other employment factors, within the EU:-

- The protection/creation of c. 337 jobs pa within EU SME companies
- Creation of sustainable employment and protection of communities

Description of Main Work Packages/R&D Results/Foregrounds

WP1: Materials Selection & System Specifications

WP1 primarily focused upon the selection and development of materials for construction of the fabric liner through research into production methods, handling, processing, environmental impact, sustainability, recycling and performance in service.

Work led to the selection and specification of materials to be used in the prototype production of the liner and specifying the overall system requirements to ensure that subsequent work packages were capable of meeting the technical objectives, throughout the programme.

WP2: Fabric Liner Development

WP2 developed the manufacturing route to produce prototype liner materials, and to optimise mechanical and handling properties with respect to end-user requirements and the operational envelope.

The structure and property relationships of liner construction and materials was be identified, and used to ensure prototype liner materials met cost-performance models relative to the application/market.

Techniques for the pre-collapse of a liner into a multi-lobed star shape, along with the optimal configuration of the formed shape, were essential to create a conformal liner that could be readily inserted into a host pipe that required rehabilitation.

WP3: Consolidation Head & Install PIG System Development

WP3 involved developing the heating and consolidation head, including the umbilical cabling, and sensor networks associated with PIG control.

Tasks included ensuring effective heating and consolidation of prototype liner constructions whilst maintaining re-lining speed through the pipe.

Determination of how heating and consolidation was delivered to the head by the umbilical system (carrying electricity supply for the heating and also techniques for cooling post the re-forming).

Optimisation of install PIG operation parameters ensured maximally effective transition rates and re-formed shapes consistency.

WP4: Integration & Validation

In WP4 laboratory trials were performed, using the EZ-line install PIG and the development fabric liner constructions, to ensure operational objectives could be achieved.

Additional considerations were that consolidation head could be capable of dealing with small variations in pipe diameters, and some analysis of capability of traversing around bends in the pipe.

Here it was ensured that sub-systems were interfacing correctly and that specifications were consistent with the requirements of the pipe rehabilitation market, and that the relining standards/performance of liner constructions could be achieved.

A final project trial had a simulation of a live environment with clay host pipe buried in wet soil, such that real-world data could be collected.

WP5: Training, Dissemination & Demonstration

WP5 was to disseminate project objectives and the research/technology development results through the SME-AGs to their membership.

The aim of this phase of the project was to draw the attention of the SME pipe relining and rehabilitation market (both the members and the wider industry) by proving and promoting the technology and giving industry the confidence to take up the EZ-Line solution.

Training and dissemination is known to play an important role in the exploitation strategy, i.e. as a means of demonstrating the potential of the EZ-Line solution through the IAGs and their membership post project. Significant industry exposure to the technology had been achieved particularly by the association members, via exhibitions, web-sites, marketing and meetings.

WP6: Innovation Related Activities

WP6 was to identify, protect and exploit project results/IP generated through the project. The voting mechanism of the Exploitation Board and the Exploitation manager developed a broad exploitation strategy and post-project business plan, with full enactment intended once the programme closed and full project results and achievements could be analysed.

Demonstration and dissemination activities were specifically targeted towards the exploitation of results with the intention that in the fullness of time they would be used to facilitate effective uptake of the EZ- Line product within the trenchless pipe relining industry and non-competitive industries.

WP7: Consortium Management

WP7 coordinated the project progress and facilitated the flow of information between the EC and the Consortium. Co-ordination included the collation of deliverables and milestones, cost statements, partner payments, consortium agreements, reviewing progress against objectives and targets and resolution of administrative, contractual and partner issues, including IP aspects.

Project and Public Website, and Relevant Contact Details

The Ezline project website is available to the members of the Project Consortium.

A general website is available for public viewing and access:-

www.ezline.info

The project co-ordinator for the Ezline project is:-

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Report on Societal Implications

B. Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? **No**

If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final reports?

2. Please indicate whether your project involved any of the following issues:

RESEARCH ON HUMANS

Did the project involve children? **No**

Did the project involve patients? **No**

Did the project involve persons not able to consent? **No**

Did the project involve adult healthy volunteers? **No**

Did the project involve Human genetic material? **No**

Did the project involve Human biological samples? **No**

Did the project involve Human data collection? **No**

RESEARCH ON HUMAN EMBRYO/FOETUS

Did the project involve Human Embryos? **No**

Did the project involve Human Foetal Tissue / Cells? **No**

Did the project involve Human Embryonic Stem Cells (hESCs)? **No**

Did the project on human Embryonic Stem Cells involve cells in culture? **No**

Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos? **No**

PRIVACY

Did the project involve processing of genetic information or personal data (e.g. health, sexual lifestyle, and ethnicity, and political opinion, religious or philosophical conviction)? **No**

Did the project involve tracking the location or observation of people? **No**

RESEARCH ON ANIMALS

Did the project involve research on animals? **No**

Were those animals transgenic small laboratory animals? **No**

Were those animals transgenic farm animals? **No**

Were those animals cloned farm animals? **No**

Were those animals non-human primates? **No**

RESEARCH INVOLVING DEVELOPING COUNTRIES

Did the project involve the use of local resources (genetic, animal, plant etc.)? **No**

Was the project of benefit to local community (capacity building, access to healthcare, education etc.)? **No**

DUAL USE

Research having direct military uses **No**

Research having potential for terrorist abuse **No**

C. Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		
Work package leaders		
Experienced researchers		
PhD student		
Other		

4. How many additional researchers (in companies and universities) were recruited specifically for this project?

Of which, indicate the number of men:

D. Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project? **No**

6. Which of the following actions did you carry out and how effective were they?

Design and implement an equal opportunity policy **Not Applicable**

Set targets to achieve a gender balance in the workforce **Not Applicable**

Organise conferences and workshops on gender **Not Applicable**

Actions to improve work-life balance **Not Applicable**

Other:

7. Was there a gender dimension associated with the research content - i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed? **No**

If yes, please specify:

E. Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)? **No**

If yes, please specify:

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)? **No**

If yes, please specify:

F. Interdisciplinary

10. Which disciplines (see list below) are involved in your project?

Main discipline

Associated discipline:

Associated discipline:

G. Engaging with Civil society and policy makers

11a. did your project engage with societal actors beyond the research community? **No**

(If 'No', go to Question 14)

11b. if yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

11c. in doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?

12. Did you engage with government / public bodies or policy makers (including international organisations?)

13a. Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

H. Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals? 4

To how many of these is open access provided? 0

How many of these are published in open access journals? 0

How many of these are published in open repositories? 0

To how many of these is open access not provided? 4

Please check all applicable reasons for not providing open access:

- publisher's licensing agreement would not permit publishing in a repository
- no suitable repository available
- no suitable open access journal available
- no funds available to publish in an open access journal
- lack of time and resources
- lack of information on open access

If other - please specify

15. How many new patent applications ('priority filings') have been made? ("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant). **1**

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).

Trademark **0**

Registered design **0**

Other **0**

17. How many spin-off companies were created / are planned as a direct result of the project? **0**

Indicate the approximate number of additional jobs in these companies: **0**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

Difficult to estimate / not possible to quantify, in small and medium-sized enterprises

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:

Difficult to estimate / not possible to quantify

I. Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations? **No**

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public? **No**

22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

Press Release **Yes**

Media briefing **Yes**

TV coverage / report **No**

Radio coverage / report **No**

Brochures /posters / flyers **Yes**

DVD /Film /Multimedia **No**

Coverage in specialist press **Yes**

Coverage in general (non-specialist) press **No**

Coverage in national press **No**

Coverage in international press **No**

Website for the general public / internet **Yes**

Event targeting general public (festival, conference, exhibition, science café) **No**

23. In which languages are the information products for the general public produced?

Language of the coordinator **No**

Other language(s) **No**

English **Yes**

Attachments **No**

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