Project Name:	Formadrain liner development (WIN)	**Start Date:**	2017-09-19
Project Number:	1705	**Completion Date:**	2019-11-29

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Thickness (mm)	7	4	No
Steaming time to activate (min)	120	60	Yes
Open time (days)	30	60	Yes
Cost ($/m)	80	65	Yes
Diameter range (cm)	15	15	Yes
Weight (kg/m)	3	2.6	Yes
Stress resistance (kg/mm)	5	11	Yes
Disposable mandrel (yes = 1 / no = 0)	0	1	Yes
Access points for mandrel (number)	2	1	Yes

This project is based on the ruling case is based on the Tax Court of Canada Ruling for Formadrain Dossier: 2016 1658 (IT) I

[2] The appellant operates a company engaged in the development of technologies for the rehabilitation, without excavation, of underground conduits and industrial process conduits. Formadrain sells its technology in Canada and the United States.

[3] Established in 1994, the appellant initially developed a system that involves firing a pre impregnated fiberglass and epoxy sheath into an existing pipe through existing accesses to repair underground conduits without excavating. In other words, a new pipe is made inside the old one, without digging [1].

[4] To do this, the underground ducts are sheathed with a system baked in place, better known under the English name "Cured in Place Pipe" [2] .

[5] In 2012, the appellant team is working on two projects that involve the development of products for which SR & ED ("investment tax credit") expenditures are claimed:

1) The development of a latent resin ("resin");

2) The development of equipment to facilitate the installation of the Formadrain sheath, ie a lightweight single use chuck ("mandrel") allowing installation in a single access instead of two.

[6] The context of these two projects is as follows. It is difficult for some clients of the appellant, either sewer repair contractors, to implement the appellant's technology. Often, sewer lines can reach up to 200 feet long. Small contractors lack the space required to uncoil the sheath and apply the resin solution to such a surface.

[7] The appellant decides to develop a turnkey technology. Thus, the sheath, including the mandrel, would be sold preimpregnated with resin. The appellant's clients, the contractors, would receive a product ready to repair a sewer.

[8] To achieve this objective, the appellant must develop a resin with an open time of 60 days and can be steamed in 60 minutes or less, regardless of soil conditions such as water and temperature Variables.

In 2012, the resin was only four hours long. To that end the appellant's external chemist told the appellant that she would not be able to develop a resin that would have an open time of 30 days and still less than 60 days.

[9] to develop a turnkey technology, in addition to the resin, the appellant also wanted to develop a new mandrel, a lightweight one use
chuck. This new mandrel would allow the appellant to repair the underground duct without digging and to do so by accessing it only through access, or the
"cleaner" inside the building rather than accessing the street either through The "manhole". In addition, a lightweight mandrel would allow it to be
pushed in place instead of being pulled.

[11] If the appellant succeeded in developing these two products that go hand in hand, this would make it possible to sell this turnkey technology.
Thus, the resin impregnated sheath having an open duration of 30 days to 60 days, including the new mandrel, would be transmitted to the client contractors.
The contractor would only have to make the repair.

[12] These projects began in 2010, but the technology was still not up to date in 2103. So during the 2012 and 2013 tax years, the appellant con nued
its research and development activities with respect to resin and mandrel One-time use.

[13] In 2013, a third project was added to its SR & ED actvities, namely, the development of equipment and a method to connect the service inlet
connection to the municipal main sewer, T mandrel

[71] Mr. Therrien indicated that the appellant did not have a detailed plan in advance. However, research and testing were always done according to their overall objective: to develop a single use chuck capable of responding to mechanical stress (pressure, heat, mechanical deformation) both at insertion and at extraction and able to mold different configurations Sewers.

Effectively the work involved developing a single-use light mandrel (tube) to install a sheath from inside the drains from a single access point from inside a building.

Standard devices used heavier nondisposable mandrels that required two points of access in order to pull rather than push it.

[28] The idea of repairing sewers without excavation matures for ten years, before Marc Aurèle decides in 1993 to associate with the engineering
firm Deblois Engineering, Île d'Orléans.

[29] At that time, the "no excavation" system was already in use at the city level, but the idea of transposing this system to residential sewers was
farfetched given the complexity of access to sewer and Changes in direction and changes in the diameter of these ducts.

[30] Mr. Therrien indicated that as of 1994, the appellant's team has engaged in research and development to develop functional technology. It
was no small task. In 1996 97, the technology was lame.

[30] However, gradually a manual containing the procedure was developed by the appellant in order to gain a better understanding of the
terrain and to better control the wide range of uncontrollable elements attached to it. The witness gave as an example the infiltration of water and
the dissipation of heat.

[32] However, it was only in 1998 that the appellant began to allow sewer repair contractors to use its technology through licensing throughout North America.

[33] The appellant is now a leader in the sewer repair industry without excavation. In addition, 36 licenses to use the technology developed by the appellant were awarded to entrepreneurs, including 6 in Quebec, 20 in the other provinces of Canada and 10 in the United States. [4]

[34] In 2012, the appellant had approximately 20 employees, including three engineers, and its turnover was in the order of $ 1.75 million.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Commercial Facility, Lab
Key Employees:	Stephane Therrien (Civil - PEng (1993) / President), Carl Marc-Aurèle (Chemical - PEng (1999) / VP)
Evidence types:	Records of resources allocated to the project, time sheets; Project records, laboratory notebooks; Design of experiments

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[85] The technological uncertainty was the fact that the chosen material must be thin, affordable and withstand mechanical stress to the insertion and extraction. In addition, the material must be flexible enough to mold configurations or changes in diameter and changes of direction up to 45 degrees and to adapt to the heat.

[86] In addition, the material must have a certain resistance to tearing as sewer repair are not smooth, they are often very rusty and it may be rough and tubers that are important. As M. Therrien has indicated, there is no doubt that the thin rubber existed on the market, but there was no thin rubber that can adapt to these constraints.

[24] Mr. Therrien has been employed by the appellant since 1994. He became a partner in 1999 and since September 30, 2016, he is the appellant's president. He succeeded Mr. Gérard Marc-Aurèle, the founder and former president of the appellant, who died in 2016.

[25] Mr. Therrien is a civil engineer. He testified about the research activities related to the development of the new lightweight chuck.

[26] Mr. Carl Marc-Aurèle is also employed by the appellant. He is Vice-President of the Appellant and is a Chemical Engineer. He testified about the development of the resin.

[27] The appellant was created in 1994 by Mr. Gérard Marc-Aurèle. Marcus Aurelius was not an engineer, but he had the soul of an inventor withan avant-garde vision.

The most significant underlying key variables are:

composition of form, chuck design, mandrel configurations & composition, push vs pull deployment, resin formulation (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	3 Articles	AUTHORS NOTE: THE IDEAL COURT DESCRIPTIONS WOULD PROVIDE DETAIL ON DUE DILIGENCE, COMPETITIVE & PRIOR ART ANALYSIS.
Similar prior in-house technologies	4 products / processes	proprietary in house process

Activity #1-1: Activity 1 (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	460 alternatives
Trials:	23 runs / samples
Physical prototypes:	8 samples

(1) 2012 project: development of a method / equipment to install the Formadrain duct by a single access instead of two accesses [7] .

[43] Trials conducted by the appellant during her 2012 tax year are recorded in a laboratory workbook, in a 62 page document submitted to the Court containing descriptions and photos. Mr. Therrien testified to the effect that the notes found there were always inscribed in a contemporary way.

[44] In 2012, the work was oriented towards the design of a mandrel:
- thinner;
- More flexible;
- lighter;
- Capable of resisting the stress caused by the installation of a sheath by push in place and by its extraction;
- Disposable, therefore at a lower cost than a reusable mandrel.

[45] Several tests were first made with a new nylon chuck, designed already full diameter, and that did not need stress to stretch.

[46] However, the deployment did not proceed uniformly throughout the trials. Some specific areas were not sheathed, and as a result they swelled prematurely and disproportionately.

[47] The appellant's team modified a number of parameters to counter the problems of sheath deployment due to breakage of the release agent. For example, it tried to change the swelling rate, use various types of lubricants to reduce friction, and coat the silicone chuck.

[48] For this purpose, the nylon mandrel has worked in the factory. The appellant then decided to conduct an "in situs" trial in the field. Therrien explained that the team is attempting to replicate field conditions in the field, however, it is very difficult to reproduce all the variables offered by the field trial. For the appellant, field trials are important and part of the experimental development. During these trials, only labor related costs were billed to customers, including equipment and time required for installation.

[55] As Therrien explained, thin rubber exists, however, in this case, the technological uncertainty was whether a thin rubber mandrel could withstand mechanical stress at insertion and extraction, if The rubber could mold different configurations, changes of direction up to 45 degrees and adapt to the heat.

In addition, the rubber must have some resistance to tearing since the sewers to be repaired are not smooth, they are often very rusty and there may be roughnesses and tubers which are important. Thus, the required rubber was not on the market.

[56] The appellant hired Pro Flex to produce the rubber tubes that would serve as its mandrels. Pro Flex is an expert in the manufacture of rubber products.

[57] Although the appellant is a research and development specialist, and Dr. Carl Marc Aurèle is a chemical engineer, the rubbers contain very complex chemical properties that exceeded the appellant's expertise.

Results:

- Steaming time to activate: 70 min (83% of goal)
- Open time : 62 days (106% of goal)
- Cost : 70 $/m (66% of goal)
- Diameter range: 15 cm (100% of goal)
- Weight: 3.1 kg/m (no improvement)
- Stress resistance: 9 kg/mm (66% of goal)
- Disposable mandrel: 1 yes = 1 / no = 0 (100% of goal)
- Access points for mandrel: 1 number (100% of goal)

(1) Was there a scientific or technological uncertainty? The Judge commented:

[87] The respondent, for its part, has given much importance to the fact that the appellant had used Pro-Flex for developing the chemical formula of rubber that was used to manufacture the mandrel.

[88] The respondent argues that the source of technological uncertainty of this project lay entirely in the chemical composition of the material, a task that was delegated to a rubber manufacturer.

[89] I have difficulty with the argument of the respondent because paragraph d) of the definition of research and development in subsection 248 (1) of the Act includes the development activities in Canada directly undertaken on behalf of the taxpayer.

[95] In this case, the factors and parameters to be checked by calling for the development of disposable mandrel were located both in the material composition of the mandrel at the level of the method allowing it to push up from a single access.

[96] It seems that the entire project reduce the relative appellant mandrel unique aspect of the search for the chemical formulation of the rubber is a simplistic view of work that has actually been made.

[101] In this case, it is clear that the appellant did not know initially how it would develop and install a disposable mandrel by pushing it inside a pipe. Seen as a whole, the project included the appellant multiple technological uncertainties residing both in the chemical composition of the core, thickness and length, as mechanical stress that allowed it to be inserted and removed from the leads.

[102] Engineers working on the projects had several years of experience in the field of repair sewer without excavation. Considering the expertise and knowledge in this area, it is clear that the factory tests and "in situs" were made because of a real technological uncertainty.

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115] At the end of 2012, the appellant made two field tests which were unsuccessful. However, research which it has engaged subsequently enabled him to understand the inflation mechanism and that it would be impossible to develop a mandrel in which there was already a diameter.

[116] In 2013, the technology was not yet developed, but it was better understood and better managed by the appellant. For example, the appellant returned to rubber after testing nylon and silicone. The appellant knew in light of the tests that rubber would work, since its current core work. However, the appellant had to use another rubber formulation being able to withstand the many constraints.

This thin rubber required for proper operation of the chuck did not exist on the market. To this effect, a rubber formulation satisfying all the criteria developed by the appellant had not been developed. The tests were all unsuccessful.

[117] At the hearing, M. Therrien stated that the appellant had now succeeded in developing a lightweight core using a thin rubber can be used for certain repairs by pushing instead of pulling it. In addition, the chuck 'T' was also developed by the appellant.

Conclusion:

Based onthe analysis performed the judge concluded

[123] Given that the respondent conceded that the research and development of the appellant as to the resin constitute SR & ED for tax years 2012 and 2013.

[124] Since I have concluded that the research and development of the appellant about the new chuck and chuck 'T', constitute SR & ED for tax years 2012 and 2103.

[125] Therefore, the call on the 2012 tax year is recognized in the amounts claimed for SR & ED of the resin and the mandrel.

Significant variables addressed: chuck design, composition of form, mandrel configurations & composition, push vs pull deployment

Documentation:

Uploaded to RDBASE.NET: 2017_CCI_42 Formadrain.pdf (278KB), Formadrain Technology - Formadrain _ Lateral & Spot Repair.pdf (236KB), Formadrain – improving process for repairing drains qualified as SR&ED.pdf (93.2KB)

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