Project Name:	Airzone - WIN Optimizing Passive Monitoring of Low-Concentration Compounds	**Start Date:**	2022-02-01
Project Number:	2211	**Completion Date:**	2022-10-31

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Detectable compounds (number)	44	52	Yes
single protocol for 8 items (protocols)	8	1	Yes

The following example is based on the Tax Court of Canada judgement AIRZONE ONE LTD., and HER MAJESTY THE QUEEN, Feb 21, 2022.

[37] In prior years, Airzone had success in establishing a detection protocol for a suite of 44 types of airborne compounds that may be present in a home environment at low levels of concentration.

[38] According to Mr. Fellin, Airzone undertook the experimental work on this project to increase the range of detectable compounds from 44 to 52. Airzone did so to stay abreast of its competition in this highly specialized field.

Field of Science/Technology:

Meteorology, atmospheric sciences & climatic research (1.05.07)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Research Facility
Key Employees:	Mr Fellin (Airzone) (Chemistry - BSc. (1972) / Airzone One President)
Evidence types:	Test protocols, test data, analysis of test results, conclusions; Records of resources allocated to the project, time sheets; Design, system architecture and source code; Design of experiments; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Technological uncertainty

[39] To obtain reliable measurements of these additional eight compounds, Airzone believed that it could not rely on the extraction and identification protocol that it had established for the initial 44 compounds.

41] Extraction techniques are known to fail because compounds are not separated from each other in a way that allows for the measurement of the concentration levels of each compound.

After failing to obtain reliable data through a variation of extraction times, Airzone decided to test the hypothesis that a more polar solvent would improve measurement of the concentration levels of the additional eight compounds.

47] The evidence shows that standard methods, procedures and equipment may reach their detection limits when contaminants are present in low levels of concentration. Some compounds have similar attributes.

In other cases, the attributes of compounds in an air sample may be quite diverse. Extraction procedures can cause compounds to co-elute, which prevents reliable identification and quantification of each sample.

According to Mr. Fellin, this was the challenge that Airzone sought to resolve. An improved extraction and identification process was required. This new process could not be established without systematic scientific investigation.

49] Additionally, part of the uncertainty itself was creating a single protocol that could detect all 52 compounds. As Mr. Fellin explained, had Airzone used a separate device or protocol for the eight additional compounds, it would have doubled the cost for any potential client.

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In this regard, rather than use a new solvent specifically for the eight additional compounds, Airzone purposely sought to modify the solvent used for its existing suite of 44 compounds. This came with its own host of challenges.

The previous 44 compounds were simple aromatic hydrocarbons. Therefore, they could all be treated in the same way. Conversely, the eight new compounds had different properties (such as polar groups). This meant that the different compounds could not be extracted from the same medium with the same efficiency.

Additionally, because the previously used solvent had been modified, Airzone had to adjust the chromatographic conditions for both the existing suite of 44 compounds and the eight new additional compounds. It was not simply a matter of adding new protocols to its existing methodology. Airzone had to develop a completely new protocol.

The most significant underlying key variables are:

extraction times, chromatographic variables, solvent polarity vs. aromatic hydrocarbons

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes
Internet searches	5 Articles	46] Data on how to extract the full slate of compounds was not publicly available.
Suppliers	1 products	3M methodology referred to by CRA

Activity #1-1: Activity 1 (Fiscal Year 2022)

Methods of experimentation:

Method	Experimentation Performed
Trials:	10 runs / samples

40] Airzone first experimented with extraction times. The hypothesis that the work was conducted under was that the modification of the
solvent used to extract the additional eight compounds would compromise the analysis of the existing suite of compounds.

each set of tests for each compound included modifying extraction times, solvent mixtures, solvent modifiers (to alter polarity), and chromatographic conditions with different chromatography machines.
. . .

41] Mr. Fellin explained that Airzone, rather than replace the solvent that it typically utilized, experimented with modifying the solvent with additives to attain the desired extraction efficiency for the additional compounds while retaining detection efficiency for the other 44 compounds.

While this proved successful overall, further analysis of the experimental data led Airzone to conclude that butanol proved most successful because of the higher recovery efficiency. Airzone continued experimentation with a solvent combining carbon disulphide with 5% butanol to confirm that the solvent would work efficiently for the full suite of compounds.

42] Mr. Fellin indicated that additional experimentation was then necessary to adjust the chromatographic variables typically utilized to analyze each compound.

These variables include temperature, column length, column type, flow rate through the column, carrier gas, and injection volume.

Airzone carried out experiments with each variable to improve its detection abilities.

Results:

- Detectable compounds: 52 number (100% of goal)

- single protocol for 8 items: 1 protocols (100% of goal)

CRA argument for denial:

43] After completing his technical audit, Mr. Melnyk recommended that Airzone's SR&ED claim be disallowed for this project for the reasons set out below

"The work involved optimizing established detection techniques and applying commercially available passive monitoring tools (3M brand) ....
methods rather than the development of new methodologies to detect each compound. ....

there was no generation of new scientific knowledge or advancement in technology related to airborne contaminant detection."

49] In the end, Airzone was successful, except for two compounds.

Conclusion:

Judges ruling & Rationale:

45] I was surprised when I read the CRA's reasons for disallowing Airzone's SR&ED claim considered in light of what CRA's published guideline describes as eligible experimental development. The most recent CRA guideline is dated August 13, 2021.

The "Why" requirement in the context of experimental development

46] .... There were too many variables or unknowns for Airzone to be able to accurately detect and measure the full slate of 52 compounds.

Data on how to extract the full slate of compounds was not publicly available. Airzone did not have this technical knowledge at the outset. It conducted tests to establish a reliable identification and quantification method.

Significant variables addressed: chromatographic variables, extraction times, solvent polarity vs. aromatic hydrocarbons

Documentation:

- Offline Documents: docs

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