

WILDFIRE CHEMICAL USAGE SURVEY

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This report is restricted to the Canadian Interagency Forest Fire Centre Aviation Working Group and participating wildland fire agencies.

FPInnovations has developed a wildfire chemical roadmap to determine the cost and effectiveness of the wildfire chemicals used in Canada.

As part of the roadmap, a survey was developed to gather wildfire chemical use data from Canadian wildland fire agencies. The objective of this survey was to gather information on the current use of wildfire chemicals in Canada and to provide an overview of the state of the practice among Canadian wildland fire agencies.

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TECHNICAL REPORT— 3

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INTRODUCTION

At the request of the member agencies of FPInnovations' Wildfire Operations Research group and the Canadian Interagency Forest Fire Centre (CIFFC) Aviation Working Group, FPInnovations has developed a wildfire chemical roadmap to determine the cost and effectiveness of the wildfire chemicals used in Canada. Figure 1 is a visual representation of the roadmap.

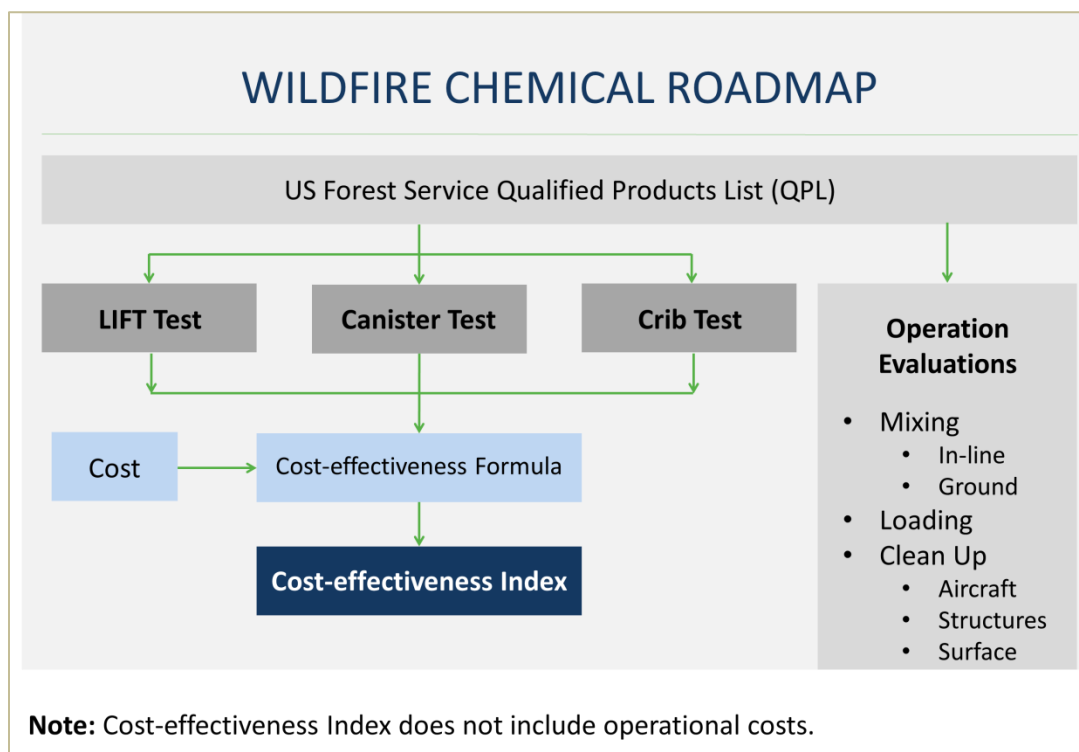


Figure 1. FPInnovations' wildfire chemical roadmap. (LIFT Lateral ignition flame spread test).

FPInnovations has identified three test methodologies to evaluate the performance of wildfire chemicals in a repeatable laboratory setting: the lateral ignition flame spread test (LIFT), thermal canister test, and crib test.

- The US Forest Service's LIFT test focuses on time-to-ignition as a performance evaluation metric.
- The thermal canister test focuses on heat release rate and evaluates the ability of a wildfire chemical to suppress combustion.
- The crib test focuses on re-ignition time and evaluates the properties of chemicals when used in simulated direct attack operations.

Each test has its own performance scale. A cost-effectiveness formula will combine the results from the three tests with the aim to standardize the performance scales; it will also account for the cost of the chemical. The output for the cost-effectiveness formula will be the cost-effectiveness index, which is an indicator of the cost and performance of the wildfire chemicals relative to one another.

Depending on these results, methodologies for proposed operational evaluations will be developed.

As part of the roadmap, FPInnovations developed a survey to gather data on wildfire chemical use among Canadian wildland fire agencies. The survey was designed to capture information on both aerial and ground-based wildfire chemical applications.

SURVEY RESULTS

FPInnovations developed an online survey consisting of 15 questions and distributed it to 13 Canadian wildfire agencies, including Parks Canada, in April 2018. All agencies responded to the survey. Individual agencies are not identified in this report to respect confidentiality.

Question 1: Does your agency use wildfire chemicals?

The survey identified that 11 agencies use wildfire chemicals and two do not.

Question 2: How is your agency applying wildfire chemicals?

Most wildfire chemicals are being used in conjunction with aerial operations (Figure 2).

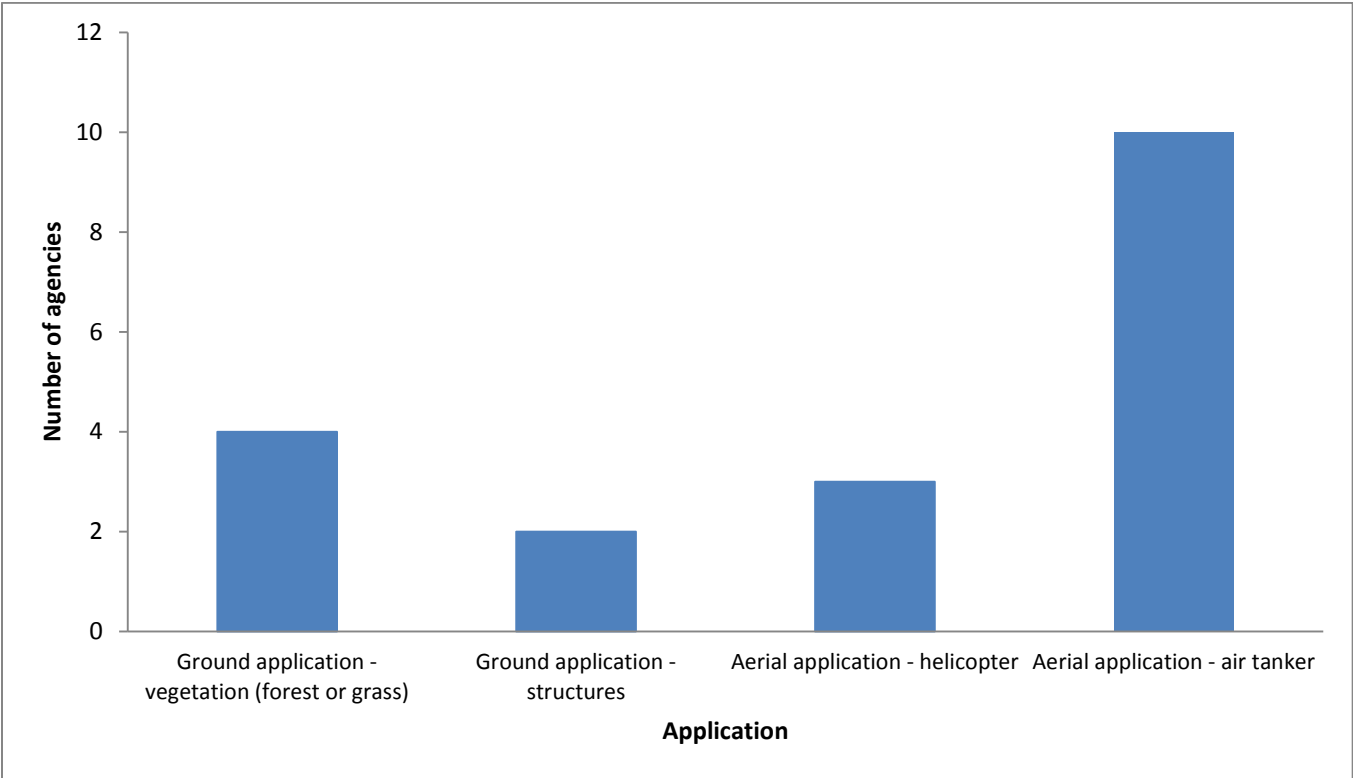


Figure 2. How wildfire chemicals are used in Canada.

Question 3: Which wildfire chemicals are being used by your organization, not including trial-based, short-term contracts?

Most responding agencies use either Phos-Chek 95A long-term retardant or Phos-Chek WD881C Class A foam. Water-enhancing gels are not widely used in Canada. Of the Canadian wildfire agencies that currently use water-enhancing gels, the products used include Thermo-Gel 200L, Firelce 561, and Phos-Chek AquaGel-K. One other wildfire chemical identified in Figure 3 (under “Other”) is Fire-Trol 931 retardant, which was used by one agency but is no longer in production.

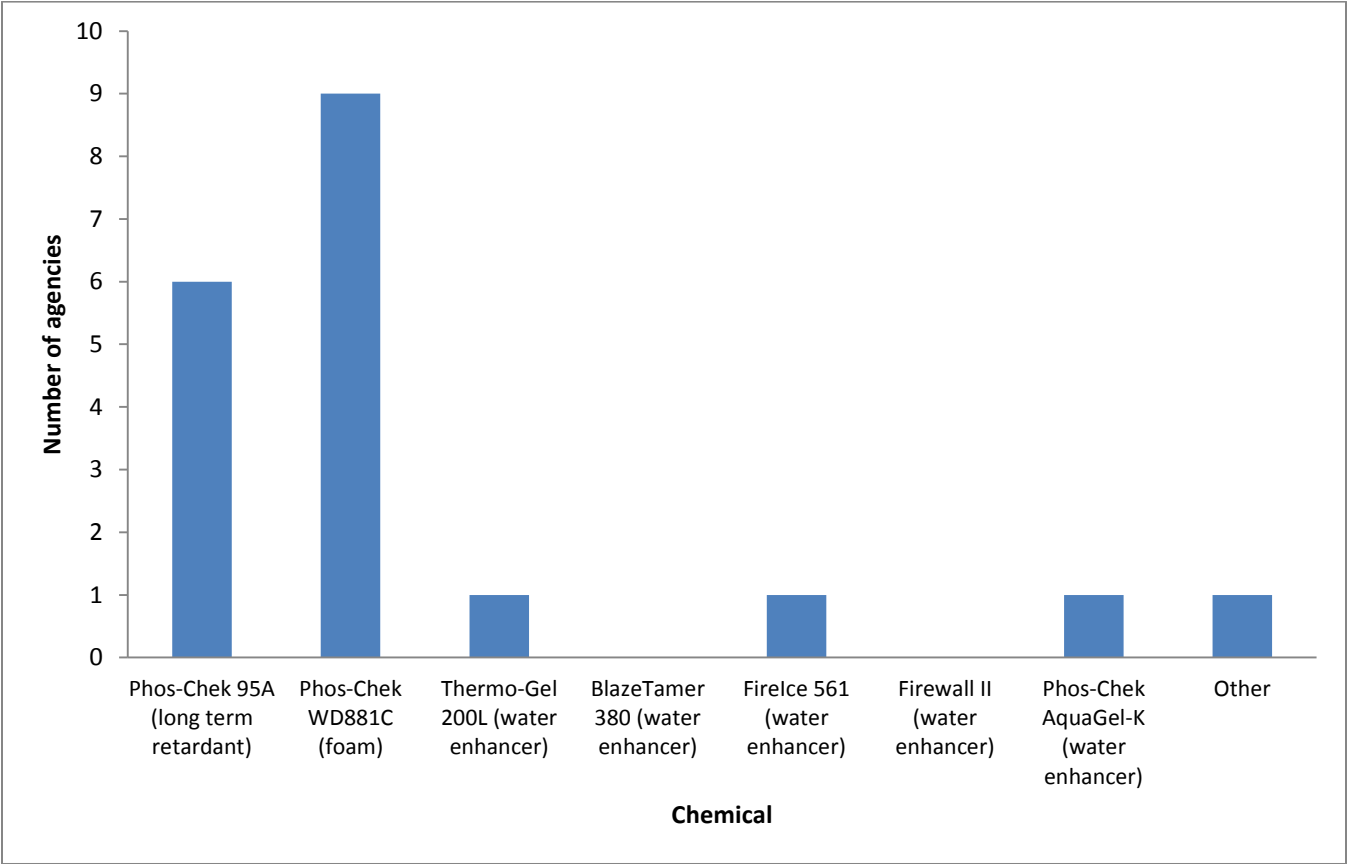


Figure 3. The wildfire chemicals that Canadian agencies use.

Question 4: Please rank the considerations in your agency's selection of wildfire chemicals.

This question tried to determine the priority that agencies placed on certain considerations when selecting a wildfire chemical. Agencies were asked to assign a score of 1 through 8 for each consideration. A score of 8 represented the most important criterion and a score of 1 represented the least important criterion.

The individual scores assigned by the agencies were added to arrive at a cumulative score for each criterion. The highest score can be interpreted to indicate the highest priority consideration among the agencies for selecting a wildfire chemical. The results are shown in Figure 4.

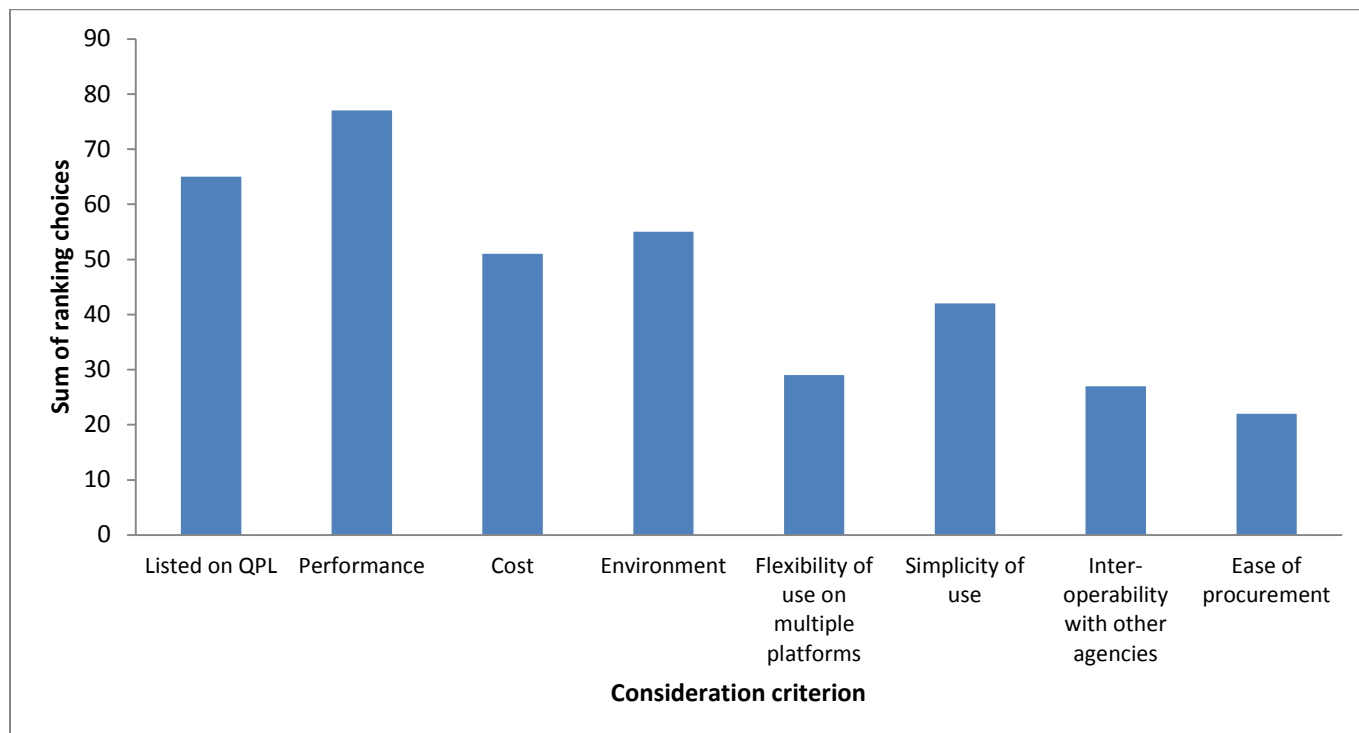


Figure 4. Agency considerations for using wildfire chemicals.

Agencies were given the option to provide any other criteria (that were not offered in the survey) that they consider when selecting a wildfire chemical. The following criteria were recorded:

- Evaporative loss after release from an aircraft when contacting the flame front.
- Comparative field test data.
- Products limited to those approved for use in the Canadair CL-215/CL-415 (as stipulated by Viking Aviation, which acquired the aircraft from Bombardier). As such, the aircraft maintenance manuals must follow the manufacturer's direction unless direction has been provided as to what other chemicals can be used.
- Impacts to ground crew (e.g., slipperiness, safety issues with physical contact with the product).
- Ability of a company to deliver the product within 48 hours of the order being placed.

Question 5a: Has your agency completed internal wildfire chemical performance tests or economic analyses as part of the procurement or any other process?

Three of the 11 agencies that are using wildfire chemicals have completed internal wildfire chemical performance tests or economic analyses as part of procurement or any other process.

Question 5b: Can these documents or reports be shared with the Canadian Interagency Forest Fire Centre?

Two of the three agencies that have conducted wildfire chemical performance tests or economic analyses indicated their willingness to share the documents or reports with the CIFFC, and one agency indicated that they would not.

Question 6a: Has your agency used water-enhancing gel products (please include trial-based, short-term contracts)?

Five agencies that use wildfire chemicals have used, or conducted trials with, water-enhancing gel products.

Question 6b: Are there any particular reasons not to consider the gel products?

This question attempted to understand some of the barriers to using water-enhancing gels in Canada. As shown in Figure 5, of the six agencies that do not use water-enhancing gels, three indicated that there is no clear evidence of the benefits of using gels over water or foam, and two agencies identified the challenges of mixing, delivery, or cleaning equipment as a barrier to using them.

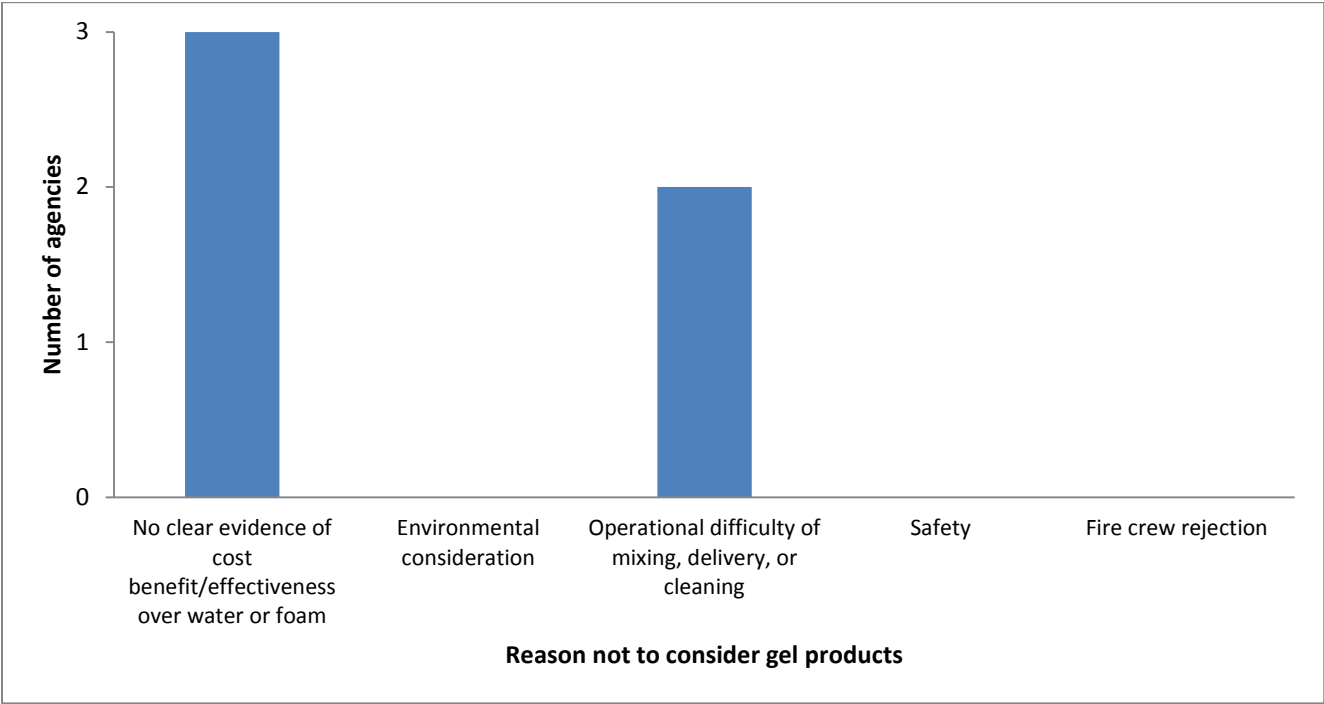


Figure 5. Reasons why Canadian agencies do not use wildfire chemicals.

Agencies were given an option to provide any other reasons (not offered in the survey) for not using water-enhancing gels. The following reasons were recorded:

- Agency inter-operability
- Ground penetration/saturation depth
- No evidence of cost/performance benefit over long-term retardant

Question 6c: How was the gel product that was being used contracted?

Figure 6 shows that of the five agencies that have used water-enhancing gels, three used gel products through a demo or trial, one used it through a short-term contract, and one purchased their own product for use.

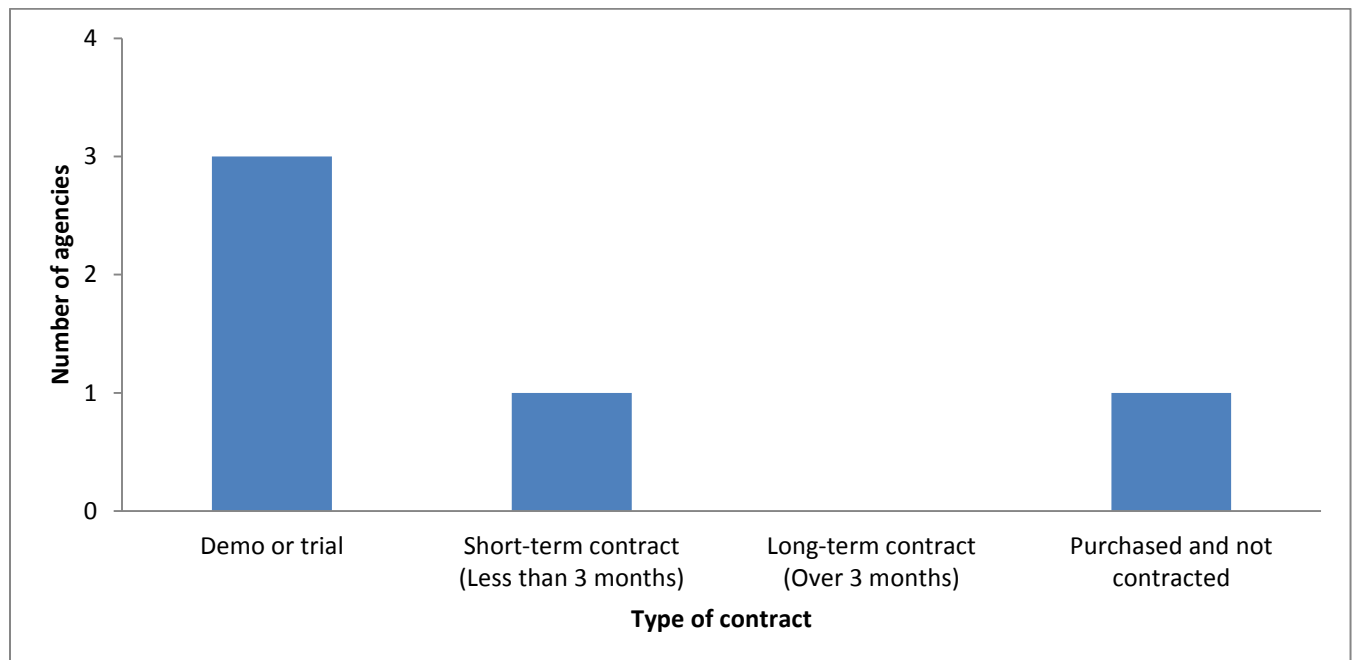


Figure 6. How Canadian agencies contract gel products.

Question 6d: How was the gel product used?

Figure 7 shows that agencies that use water-enhancing gels use them for various purposes. Most common was the use of gels during initial-attack operations. Gels are also being used for sustained action, performance testing (the ability of the product to penetrate a canopy), and for demonstration purposes (controlled setting in an open field).

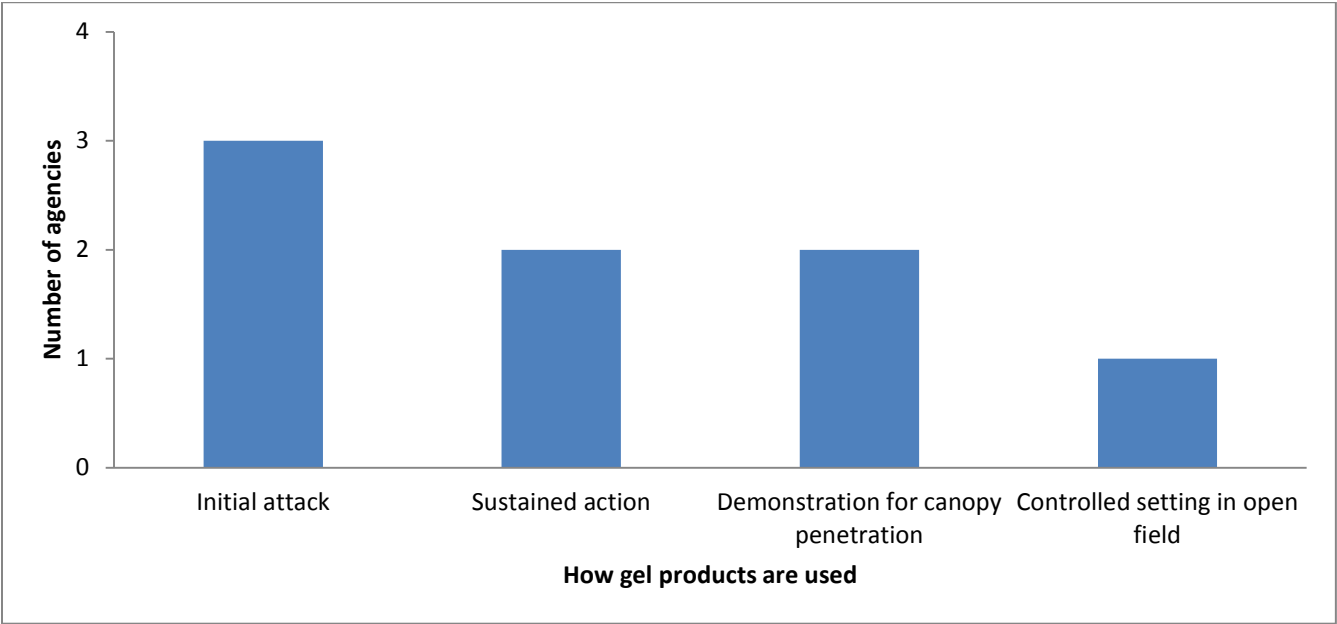


Figure 7. How Canadian agencies use gel products.

Question 6e: What were the factors that influenced the decision to discontinue the use of gel products?

This question attempted to understand the reasons that agencies had for discontinuing the use of water-enhancing gels, if they did so. Multiple factors influenced this decision, as shown in Table 1. Three of five agencies indicated that they discontinued them due to the lack of clear evidence of the benefits of using gels over water or foam.

Table 1. Factors that influenced the decision to discontinue the use of gel products

Factor	Number of agencies
No clear evidence of cost benefit/effectiveness over water or foam	3
Environmental consideration	0
Operational difficulty of mixing, delivery, or cleaning	2
Safety	1
Fire crew rejection	0
Other: Still in trials	1
Other: Air tanker manufacturer approval	1

Question 7: In general, who mixes and applies wildfire chemicals for your agency?

This question was intended to examine the logistics behind the use of wildfire chemicals. Based on the 11 agencies that use wildfire chemicals in Canada, internal agency staff members tend to do their own mixing and application of long-term retardant and Class A foam, while only a few agencies hire external contractors for the job. In contrast, the agencies that use water-enhancing gels tend to contract the mixing and application of the product to external companies. Only a couple of agencies stated that they mix and apply water-enhancing gels. The summary of responses is shown in Figure 8.

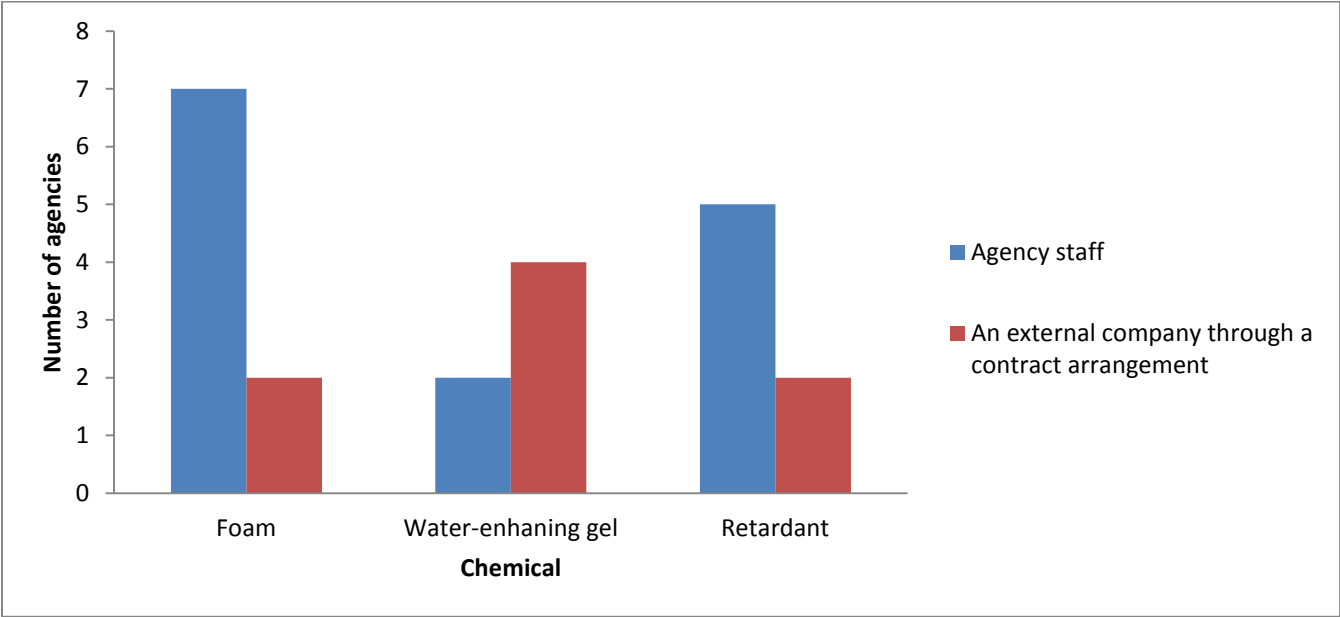


Figure 8. Who mixes and applies wildfire chemicals.

Question 8: Are there any particular reasons not to consider the use of wildfire chemicals?

The two agencies that did not use wildfire chemicals indicated that they did not because of environmental, operational, or safety concerns, as shown in Figure 9.

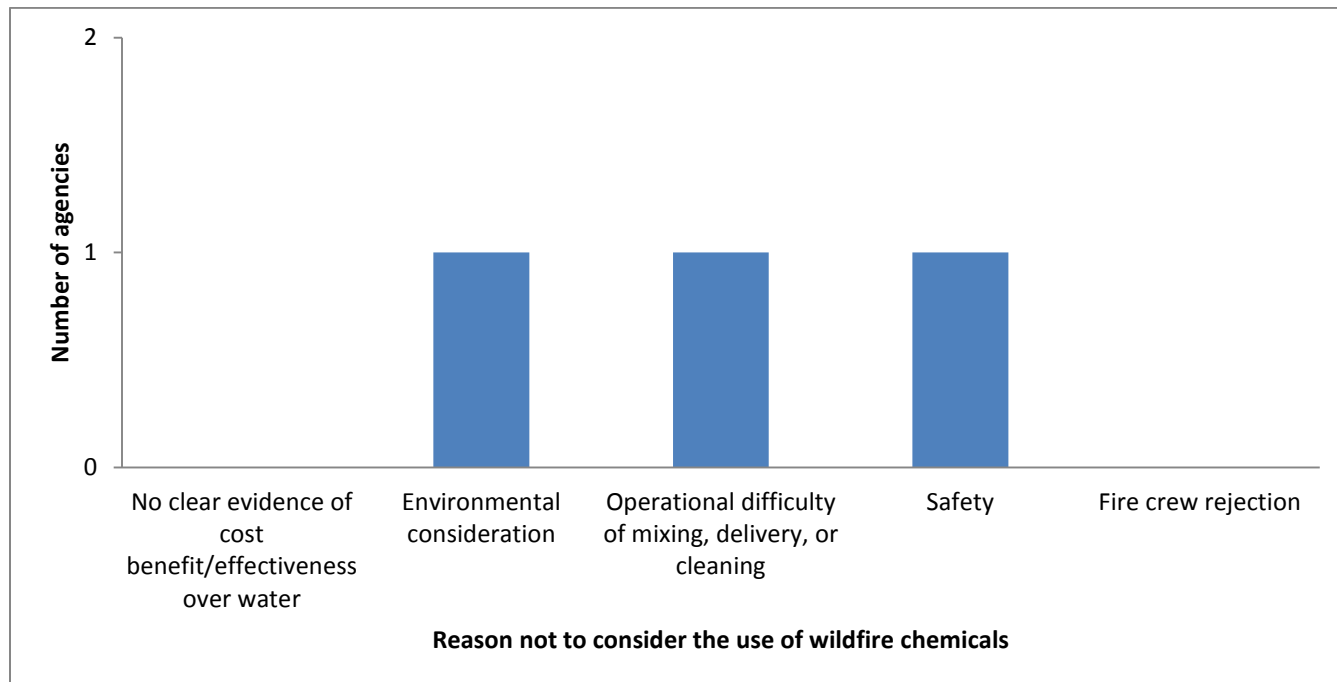


Figure 9: Reasons why agencies do not use wildfire chemicals.

Question 9: Are there any lessons learned that you can share regarding wildfire chemicals?

This question, as well as questions 10 and 11, were open-ended and meant to allow respondents to share any lessons they have learned using wildfire chemicals. Any references to a specific agency have been removed to respect confidentiality. The following comments (verbatim) were collected:

- Foam (WD881C) is effective at the cost/mix ratio of \$0.02 per mixed litre. Long-term retardant is effective and penetrates the forest canopy and [forest] structure with good wraparound qualities as well as ground seepage to limit fire burning underneath the laid retardant line. I foresee this as being an issue with gel products. Also, [need to understand the] cost benefit compared to [using] foam or retardant?
- Must be approved products. Must show clear performance/cost benefits.
- Given the number of products on the market today, I cannot stress the importance of doing your research and finding the best product for your needs. I think one of the most important lessons I have learned is to defer to expertise.
- We have discovered that Firelce gel is a cost-effective tool.
- Our agency has a vast area of protected watersheds, which makes using wildfire chemicals difficult.
- Because chemical use is a considerable cost driver, there is value in critically evaluating how the chemicals are used to ensure that they are cost-effective.
- Some Class A foam products used in the past did not perform well and [we] needed to double the injection rate to achieve adequate consistency.
- Effective and indispensable tool. Research must continue.

Question 10: Looking to the future, what changes or future needs do you anticipate related to the use of wildfire chemicals?

- Cost and benefit comparison needs to be completed. Infrastructure requirements and cost, cost of product, cost of mixed load, and evaporative loss details will further round out an agency's knowledge of the future considerations on wildland fire chemical usage.
- Little changes on wildfire chemical usage in the near future.
- [Need to evaluate the] cost versus [the] effectiveness.
- Perhaps a more proactive approach to public information on the benefits of various products, in addition to stronger agency guidelines on application of products. I also feel that some organized science-based field comparison of products would be truly beneficial for stakeholders.
- We plan to continue to upgrade and refine the gel loading process. Continue comparisons to 95-A.
- No change. We do not anticipate any wildfire chemical usage in my province.
- Continued testing of new products and working with aircraft manufacturers to support the use of new products in new aircraft as well as those aircraft already in service.
- More education is needed for field staff (firefighters, land-based managers, environmental groups) to ensure products are environmentally safe for use on the landscape.

- We need a single source to evaluate fire chemicals. There is no reason for multiple agencies to test the same products. If this cannot be completed, development of a standardized evaluation form is needed in order to consider the various inputs, parameters, or requirements from agencies across Canada and/or North America.
- Long-term fire retardant is not used by our agency because we are no longer contracting land-based single engine air tankers (SEATs), only operating water skimmer aircraft such as CL-215/415.

Question 11: What is your source of information related to the use of wildfire chemicals?

- Information provided by the sales folks for the vendors – ICL, Perimeter Solutions, GelTech Solutions, Earth Clean, BlazeTamer380. Also, from what I found online.
- 35 years of experience dealing with this area operationally and with various suppliers, USDA Forest Service Lab, CIFFC Aviation Working Group, approval process.
- QPL, web.
- I usually reach out to members to learn from their experiences, research the web for any available information, and the QPL.
- Trial and error and several different publications.
- Working Groups: CIFFC/Great Lakes Forest Fire Compact (GLFFC)/U.S. Forest Service, vendors, internet, and outreach to other agencies, and academia.
- We mostly follow the larger wildfire agencies on chemical use.
- Vendors, internal users, FPInnovations.
- Documents and experiences.

SUMMARY

The objective of this survey was to gather information on the current use of wildfire chemicals in Canada and to provide an overview of the state of the practice among Canadian wildland fire agencies.

This survey was sent to 13 Canadian wildfire management agencies. The survey results indicated that 11 agencies use wildfire chemicals. Of the agencies that use wildfire chemicals, 77% use them during aerial operations, and one agency uses the chemicals exclusively for ground-based applications. All agencies with fixed-wing air tanker programs use wildfire chemicals: foam, long-term retardant, and/or water-enhancing gels. Two agencies reported not using wildfire chemicals due to concerns about the environment, operational efficiency, and safety. Long-term retardant and Class A foam are the most commonly used wildfire chemicals in the country.

The top three considerations for selecting wildfire chemicals include performance, cost, and whether the product is listed on the US Forest Service QPL.

Five agencies have tried water-enhancing gel products either through trials or gel company demonstrations. One agency has purchased a gel product and is currently using it operationally. Based on the survey results, it appears that the barriers for agencies to consider the widespread use of water-enhancing gels include (but are not limited to):

1. The fact that there is no clear evidence of the benefits of using gels over water, long-term retardant, or foam.
2. The existing challenges of mixing (e.g., ensuring proper mixing ratios, gaps in on-board mixing system technologies), delivery (lack of science on the most effective use), or cleaning equipment after using water-enhancing gels before using the same aircraft for long-term retardant, foam, or water.

FPIInnovations' wildfire chemical roadmap project is well aligned with the agencies' desires to have clear evidence of the benefits of water-enhancing gels. The scheduled tests will allow for the creation of a cost-effectiveness formula and index. Should the cost-effectiveness phase yield positive results, the second phase, operational evaluations, should help identify and set the framework for addressing some of the operational challenges with using wildfire chemicals in Canada.



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