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Assessing the performance of Barricade II using the Crib Test Methodology

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The relative performance of various wildland fire suppressant products had previously been assessed using the *Crib Test Methodology*. This InfoNote presents an addition to the dataset wherein the performance of Barricade II, a Qualified Product List (QPL) approved water-enhancer product, is reviewed.

Introduction

The *Crib Test Methodology* provides a repeatable means of testing the relative performance of suppressant products used for direct attack from aviation assets (Refai and Paskaluk, 2021). The test method involves the application of a pre-determined quantity of suppressant directly on to a burning wooden crib of stable flame height. The reduction and re-growth of flames is used to differentiate between the suppressive capabilities of various products. To date, several water-enhancer products such as Thermo-Gel 200L, FireIce 561, Firewall II, and Blazetamer 380 have been run through the test method to better understand their relative performance as compared to water and foam (WD881C). To further this dataset, this study aims to review another water-enhancing product, Barricade II, under the same test methodology.

About the product

Barricade II is a product currently on the U.S. Forest Service's Qualified Product List (QPL) (USDA , 2020). Approved mix ratios for this product range from 1% to 3%. The product is qualified for use in fixed-wing airtankers (excluding large airtankers) at a mix ratio of 1% only and bucketing from helicopters at 1 to 3%.

Performance assessment process

Since the *Crib Test Methodology* was designed to yield a relative comparison of product performance, water and foam (WD881C) were selected as two baseline suppressant products. The mix ratio for foam selected for this study was 0.3% while the mix ratios selected for Barricade II was 1%, 2%, and 3%. The following was the sequential process followed to execute the *Crib Test Methodology*:

1. Coverage level tests - Water, foam, and Barricade II at pre-determined mix ratios
    a. Obtain new water and foam coverage level data
    b. Compare new coverage level for water and foam to original dataset to check for repeatability of test conditions
    c. Conduct drop testing for pre-determined mix ratios of Barricade II to determine volume of Barricade II that yields target coverage level accepted by the test methodology (i.e., coverage level 5)
2. Performance evaluation tests – Flame suppression tests for water, foam, and Barricade II

A water quality check was also done because:

1. The test method and associated original dataset used a specific water hardness range (i.e., 150-170 ppm). It was desired to use a similar water hardness range for this study

2. Previous research has suggested that some water-enhancers have notable changes in viscosity due to variation in water quality (Refai et al., 2020). Response to water quality was deemed as useful information in the overall operational feasibility assessment of a product.

Results

Coverage level tests

Coverage level tests were conducted using City of Edmonton tap water (crib test standard) that measured at 180 ppm. Following are the key findings from the coverage level test:

- Test for water were found to be repeatable and reproducible in relation to the original crib test data
- Barricade II at 2% and 3% were unable to be dropped due its notably high viscosity. A notable portion of the suppressant was stuck to the drop tank door (Figure 1) while much of the product landed outside the drop zone
- Barricade II at 1% was tested with 2-litre and 2.2-litre fluid volume. The respective coverage level yield was only 2 and 3.6, respectively. Again, a notable amount of product landed outside the drop zone
- Two accommodations to the test setup were considered – increasing fluid volume and/or adjust the location of the drop zone. Given no such accommodations were made for any of the other products tested, it was decided that no adjustments to the test protocol were to be made.

Performance evaluation tests

Due to the inability to obtain useful coverage level data within the bounds of the crib test protocol, it was determined that there was limited value in conducting the performance evaluation tests for all three mix ratios.

Figure 1. Barricade II at 2% mix ratio had a notable quantity of product stuck to the drop tank door.

Water quality response tests

A simple water quality response test was conducted on Barricade II using three different water sources – spring water (50 ppm), tap water (180 ppm), and well water (1100 ppm). Time required for the prepared fluid to pass through a Marsh funnel was recorded. The following were the results:

- At 1% mix ratio, the recorded time was 26 minutes, 7 minutes, and 55 seconds for spring water, tap water, and well water respectively
- At 2% and 3%, the mixed product was unable to pass through the Marsh funnel when using spring water or tap water. 2% mix ratio with well water produced a time of 16 minutes. 3% mix ratio with well water was not recorded

Discussion

- Given the notably high viscosity of Barricade II at 2% and 3%, it is reasonable to suggest that the product is not suitable for dropping from an aircraft that these mix ratios.
- Barricade II at 1% was unsuccessfully assessed for performance using the crib test methodology due to limitations in suitable coverage level data
- Water quality response tests suggested that Barricade II is highly susceptible to changes in viscosity due to variation in water hardness
- Combining information on high viscosity and susceptibility to water hardness, it is reasonable to extrapolate and suggest that operational drop footprints may not be predictable.

Disclaimer

References

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