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STATE AIRCRAFT UNIT VICTORIA

Investigation of water enhancing polymer products injected into a helicopter belly tank during flight - October 2011.

Introduction

The State Aircraft Unit (SAU) has undertaken a number of trials testing the ability to inject water enhancing polymer products into a helicopter belly tank during flight.

The investigation was a joint initiative between the SAU and Kestrel Aviation, Victoria.

Successful trials using pre mixed polymers have been previously conducted in Victoria using single engine air tankers and more recently multi engine air tankers.

The supervised field assessments were conducted in a modified grassland environment at Mangalore Airport, Victoria.

The SAU Evaluation involved a number of drops delivered using a Bell 412 helicopter fitted with an Australian modified Simplex 304 belly tank.

The Bell B412, HTK 334 fitted with the 1400 litres Simplex 304 belly tank.

Aim

The aim of the joint initiative was to develop, test and implement a successful integrated on board polymer injection process to reduce the reliance on batch mixed polymer products and still maintain an aggressive and sustained initial attack.

Background

Water enhancing polymers which are mixed with water forming a gel-like mixture which has the ability to retain large quantities of water.

The mixed product can be a slightly thicker than water appearance or a coagulated mass depending on the concentration and the water quality.

Generally polymer products are pre-mixed with water prior to loading into a fire bombing aircraft which requires significant investment in infrastructure and personnel to support the operation.

Products

Currently, only two polymer products have been evaluated during the trial program. An additional product will be tested when adequate quantities of the product are available locally.

Two products were tested during the field assessment, BioCentral Blazetamer 380, an Australian product and Thermo-Gel®.

Both products used in the investigation have been qualified by USDA Forest Service in accordance with Forest Service Specification 5100-306A (June 2007).

The overall results have varied with the two different products.

HTK 334 releases 1400 litres of mixed polymer at 0.2% concentration.

Evaluation method

Only approved water enhancing products were to be assessed.

Only agricultural ground water sources were to be utilised to provide a realistic expectation of the water quality that may be encountered.

The drops and distribution of the polymer pattern were to be visually observed and then measured for average width and length.

Drop pattern distribution and coverage was to be measured using the open field recovery technique using a cup and grid process.

Coverage within the grassland structure and ground surface fuels was to be noted and analysed.

Infra-red imagery was to be captured to provide a clearer representation of treated areas versus untreated areas.

Drop heights and delivery speed were to vary taking in to account ambient weather conditions.

Samples of mixed polymer product were to be collected from each of the drop zones to provide evidence of the variation in concentration levels.

Mixing

For the investigation the polymer concentrate was mixed using an in line adjustable flow valve and the use of the high pressure flow rates of water from the hover filling pump.

Critical analysis of the mixed polymer product indicated that there was no unmixed concentrate or large areas of free water within the drop footprints which indicated a thorough mixing process.

For confidentiality reasons and protection of intellectual propriety no images are being made available for public distribution which shows the injection equipment and processes.

Image shows the distribution of the mixed polymer product within a drop footprint.

Evacuation process

The mixed polymer products demonstrated an increased control of the drop evacuation showing a reduced stripping of the drop cloud and significantly less drift.

Drop 1 27 Oct 2001, image #1, HTK 334 releases 1400 litres of water and mixed polymer at 0.6% concentration.

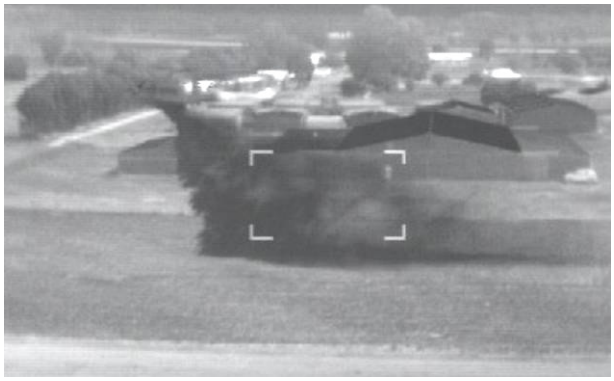
Drop 1 27 Oct 2001, image #2, HTK 334 releases 1400 litres of water and mixed polymer at 0.6% concentration.

The evacuation process through the drop doors appeared to be slower than other aerial suppressants, which may be attributed to the combined functionality of the tank and characteristics of the mixed product.

Drop cloud

Both visual and infra-red imagery indicated that the drop cloud remains relative intact with minimal amounts of free water and drift of low velocity sections of the drop cloud when compared to a water drop.

Extracted 90° horizontal infra-red image of 1400 litre mixed polymer drop.



Extracted 90° horizontal infra-red image of 1000 litre water drop.

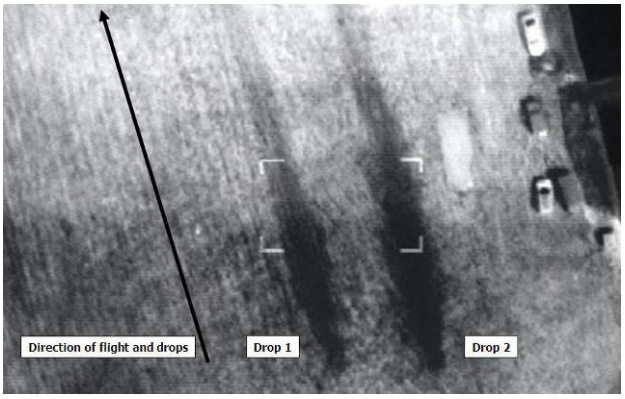
Image shows 1400 litre mixed polymer drop under the influence of a 16 knot partial cross wind.

Footprint distribution

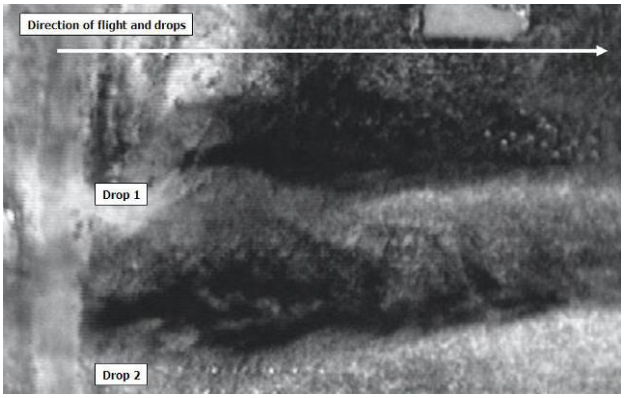
Consistently the drop footprint shapes appeared to be shorter in length and narrower in width.

The drop footprints showed distinct and defined edges and a greatly reduced area of marginal coverage on the perimeter.

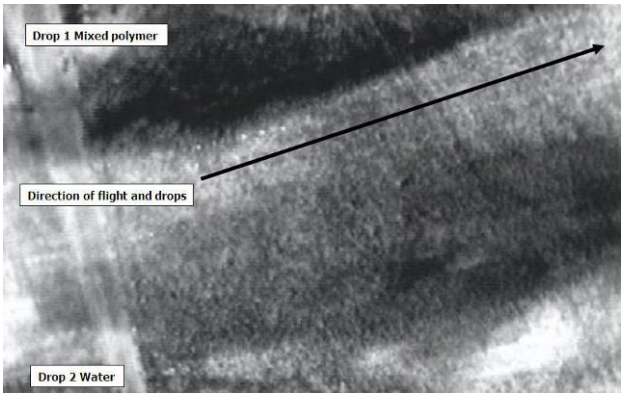
Generally the drop footprints demonstrated to have improved uniformity and more consistent coverage.



Extracted infra-red image of sequential mixed polymer drops with a five minute turn around.



Extracted infra-red image, comparison of two polymer drops with a five minute turn around.



Extracted infra-red image, comparison of mixed polymer drop and water drop with a five minute turn around.

With a correctly mixed ratio some drop footprints were measured indicating effective average dimensions of: length ≥ 45 metres and width ≥ 4 metres.

Footprint coverage

The coverage within the drop footprint is more uniform and has heavy concentrations.

Image of mixed polymer product located within a drop footprint.

Sample of mixed polymer product collected by hand scooping the grassland fuels.

Sample of mixed polymer product collected from the open field cup and grid test.

Comments

The modified Simplex 304 belly tank was selected as part of the assessment because of the inherent restrictive internal lateral flows of suppressant within the tank which adversely affects the full evacuation process.

Previous field evidence has show that the internal flows within the Simplex 304 belly tank and the door opening actions allows for a increased sheering and break up and drift resulting in a deterioration of the drops delivered.

The introduction of the polymer product enabled the dropped load to hold together with reduced break up and drift and provided a more uniform and continuous flow through the belly tank doors.

All of the loads that were delivered during the field investigation contained volumes of concentrate contrary and well below the manufacturers recommended rates for the application of polymer products.

The aggressive mixing characteristics of the equipment used had the ability to "sheer" the polymer concentrate and allow for a more thorough mixing process.

Both mixed products provided a uniform mix which provided a good general coverage and penetration through the grassland fuels.

Digital and infra-red images collected indicated that there was a significant reduction in the misting characteristics within the drop cloud and it was noticed the time after evacuation in the air was reduced.

Observations indicated a minimal amount of free water and water run-off on in and around the ground fuels within the drop zone.

The mixed polymer product demonstrated adherence to all living and desiccated fuels which subsequently provided an increased wetting time and cooling effect.

Documentation of the water hardness was not recorded; therefore the depletion qualities of the polymer products were not assessed.

After each field assessment all of the mixing equipment, belly tank and aircraft required immediate wash down and or flush to prevent equipment blockages or malfunctions.

Further Information

- Hayden Biggs, State Aircraft Unit, Victoria.