General Description

Fire suppression chemicals are used in a variety of situations that seldom start or end according to human plan or prediction. It is typical for a fire season to very quickly become serious and just as quickly end with a change in the weather, bringing rain or snow. All too often the sudden end of the fire season also means that airtanker bases are at full inventory of retardant on hand, both concentrate and mixed for use. In order to avoid waste and make the best use of the retardant, it must be effective over a long period of time despite storage in adverse conditions. Product stability tests ensure a minimum level of stability and effectiveness following storage.

Chapter 1. Outdoor Storage

All components and mixed retardant prepared from fresh or stored components will be stored outdoors as described below. The results of the specified laboratory tests performed on the stored components, mixed retardant prepared from the stored components, and on stored mixed retardant will be compared to the results of tests performed on fresh components and freshly mixed retardant prepared from the fresh components.

The test duration and specific conditions depend on the type of product being tested, although the basic design is similar in all cases.

Dry Components

Dry components will be stored in the plastic buckets that were used to ship the product to the Forest Service. Unopened containers will be stored outdoors at Missoula, Montana, and at San Dimas, California, for 1 year. Storage racks are located so that the product is exposed to natural light and temperature fluctuations. The racks may be covered to protect the containers from rain and snow. Following the test period the plastic buckets will be shipped to the Wildland Fire Chemicals Systems Program (WFCS) in Missoula.

The components will be mixed according to manufacturer directions and established laboratory procedures. The salt content, viscosity, density, and pH values will be measured and compared to the corresponding values for retardant prepared from the fresh component.

Wet Components

Wet components will be stored in 5-gallon polyethylene carboys (Nalgene 2210-0050). Three buckets of the wet component will be mixed to ensure homogeneity and poured into 2 carboys to a depth of 16 inches. A mild steel coupon, 2 inch by 12 inch by 0.13 inch (5 cm by 30 cm by 0.3 cm), previously cleaned with a solution of 50 grams of $SnCl_2$ and 20 grams of $SbCl_3$ in one liter of concentrated HCl will be suspended in the retardant, by a length of 90 to 100 pound-test braided dacron fishing line, in such a way that the bottom edge of the coupon does not touch the bottom of the carboy. A rubber stopper is used to close the top of the carboy. The carboy lid is screwed in place over the stopper.

Carboys will be stored outdoors at Missoula, Montana, and at San Dimas, California for 1 year. Storage racks are located so that the product is exposed to natural light and temperature fluctuations. The racks may be covered to protect the containers from rain and snow. Following the test period, the carboys will be shipped to the Wildland Fire Chemicals Systems Program in Missoula. Each carboy will be mixed at low shear, 1800 rpm with a 3-bladed agitator, for 1 minute.

The components will be poured through a 0.25-inch (0.64 cm) sieve. Samples of these components will be used to prepare mixed retardant according to manufacturer directions and established laboratory procedures. The salt content, viscosity, density, and pH values will be measured and compared to the corresponding values for retardant prepared from the fresh component. Uniform corrosion tests will be performed on the mixed retardant prepared from the stored component.

If the mixed retardant prepared from the wet components is a gum-thickened retardant, the mixed retardant prepared from the stored components must then be tested for outdoor stability for 30 days as described below.

Storable, Mixed Retardant

Storable, mixed retardant will be stored in 5-gallon polyethylene carboys (Nalgene 2210-0050). The freshly prepared mixed retardant will be poured into two carboys to a depth of 16 inches (41 cm). A mild steel coupon 2 inch by 12 inch by 0.13 inch (5 cm by 30 cm by 0.3 cm) previously cleaned with a solution of 50 grams of $SnCl_2$ and 20 grams of $SbCl_3$ in one liter of concentrated HCl will be suspended in the retardant, by a length of 90 to 100 pound test braided dacron fishing line, in such a way that the bottom edge of the coupon does not touch the bottom of the carboy. A rubber stopper is used to close the top of the carboy. The carboy lid is screwed in place over the stopper.

Carboys will be stored outdoors at Missoula, Montana, and at San Dimas, California for 1 year. Storage racks are located so that the product is exposed to natural light and temperature fluctuations. The racks may be covered to protect the containers from rain and snow. Following the test period, the carboys will be shipped to the Wildland Fire Chemicals Systems Program (WFCS) in Missoula. Each carboy will be mixed at low shear, 1800 rpm with a 3-bladed agitator, for 1 minute.

The mixed retardant will be poured through a 0.25-inch (0.64 cm) sieve and tested to determine the standard physical properties. The salt content, viscosity, density, and pH will be measured and compared to the corresponding values for retardant prepared from the fresh component. Uniform corrosion tests will be performed on the stored, mixed retardant.

Not Storable, Mixed Retardant

Not storable, mixed retardant will be stored in 5-gallon polyethylene carboys (Nalgene 2210-0050). The freshly prepared mixed retardant will be poured into two carboys to a depth of 16 inches (40 cm). An aluminum coupon 2 inch by 12 inch by 0.13 inch (5 cm by 30 cm by 0.3 cm) previously cleaned with a solution of concentrated nitric acid will be suspended in the retardant, by a length of 90 to 100 pound test braided dacron fishing line, in such a way that the bottom edge of the coupon does not touch the bottom of the carboy. A rubber stopper is used to close the top of the carboy. The carboy lid is screwed in place over the stopper.

Carboys will be stored outdoors at Missoula, Montana, and at San Dimas, California, for 30 days. Storage racks are located so that the product is exposed to natural light and temperature fluctuations. The racks may be covered to protect the containers from rain and snow.

Following the test period each carboy will be taken into the laboratory without disturbing the stored retardant it contains. A 250-milliliter sample will be taken from near the top, within 1 inch (2.54 cm), of the stored retardant. A second 250-milliliter sample will be taken from near the bottom, within 1 inch (2.54 cm), of the stored retardant. The remainder of the retardant in the carboy will then be mixed at low shear, 1800 rpm with a 3-bladed agitator, for 1 minute and a 250-milliliter sample of the homogeneous retardant taken. The carboys containing the remainder of the mixed retardant and the 3 samples from the retardant will be shipped to the Wildland Fire Chemicals Systems Program in Missoula. The contents of the carboy will be mixed at low shear, 1800 rpm with a 3-bladed agitator, for 1 minute and then poured through a 0.25-inch (0.63 cm) sieve. The 3 samples taken from each carboy will be tested to determine the standard physical properties. The salt content, viscosity, density, and pH of the

homogeneous, mixed samples will be measured and compared to the corresponding values for retardant prepared from the fresh component. The top and bottom samples must have a salt content within the required variation from the freshly mixed retardant.

If the retardant is gum thickened, the viscosity must also be within the required variation from the freshly mixed retardant. Any separated layers in the carboy following storage must reconstitute into the mixed retardant with no agitation beyond the specified low-shear mixing.

Chapter 2. Laboratory Separation

All mixed retardant will be tested for laboratory separation. The duration of the test and the alloy the test coupon is made from will vary with the type of product.

Storable, Mixed Retardant

Storable, mixed retardant will be stored on a laboratory shelf in a 1-quart, wide mouth glass jar with straight sides. The test sample, 800 milliliters of mixed retardant, will have an approximately 1 inch by 1 inch by 0.13 inch (2.5 cm by 2.5 cm by 0.3 cm) mild steel coupon previously cleaned with a solution of 50 grams of $SnCl_2$ and 20 grams of $SbCl_3$ in one liter of concentrated HCl suspended on a length of braided dacron fishing line until the coupon is totally immersed in the retardant. The jar will be closed with a Bakelite screw cap, firmly tightened by hand to control evaporation.

The retardant will be stored, undisturbed, for 1 year at room temperature, approximately 70 °F (21 °C) Once a month the sample will be examined and any changes in color, opacity, or other visual characteristics will be noted. At the same time the height of any visible layers in the retardant will be measured, to the nearest 0.1 inch (0.25 cm), including the total height of the retardant in the jar. The percent of separation will be calculated using the height of each layer and the total height.

Not Storable, Mixed Retardant

Not storable, mixed retardant will be stored on a laboratory shelf in a 1-quart, wide mouth glass jar with straight sides. The test sample, 800 milliliters of mixed retardant, will have an approximately 1 inch by 1 inch by 0.13 inch (2.5 cm by 2.5 cm by 0.3 cm) aluminum coupon previously cleaned with a solution of concentrated nitric acid suspended on a length of braided dacron fishing line until the coupon is totally immersed in the retardant. The jar will be closed with a Bakelite screw cap, firmly tightened by hand to control evaporation.

The retardant will be stored, undisturbed, for 30 days at room temperature, approximately 70 °F (21 °C). Once a week the sample will be examined and any changes in color, opacity, or other visual characteristics noted. At the same time, the height of any visible layers in the retardant will be measured, to the nearest 0.1 inch (0.25 cm), including the total height of the retardant in the jar. The percent of separation will be calculated using the height of each layer and the total height.

Immediate Use, Mixed Retardant

Immediate use, mixed retardant will be stored on a laboratory shelf in a 1-quart, wide-mouth glass jar with straight sides. The test sample (800 milliliters of mixed retardant) will have an approximately 1 inch by 1 inch by 0.13 inch (2.5 cm by 2.5 cm by 0.3 cm) aluminum coupon previously cleaned with a solution of concentrated nitric acid suspended on a length of braided dacron fishing line until the coupon is totally immersed in the retardant. The jar will be closed with a Bakelite screw cap, firmly tightened by hand to control evaporation.

The retardant will be stored, undisturbed, for 24 hours at room temperature, approximately 70 °F (21 °C). At 1 hour, 4 hours, 8 hours, and 24 hours following mixing, the sample will be examined and any changes in color, opacity, or other visual characteristics noted. At the same time the height of any visible layers in the retardant will be measured,

to the nearest 0.1 inch (0.25 cm), including the total height of the retardant in the jar. The percent of separation will be calculated using the height of each layer and the total height.

Chapter 3. Viscosity Loss

All mixed retardant will be tested for viscosity loss. The duration of the test and the alloy the test coupon is made from will vary with the type of product.

Storable, Mixed Retardant

Storable, mixed retardant will be stored on a laboratory shelf in a 1-quart, wide mouth glass jar with straight sides. The test sample, 800 milliliters of mixed retardant, will have an approximately 1 inch by 1 inch by 0.13 inch (2.5 cm by 2.5 cm by 0.3 cm) mild steel coupon previously cleaned with a solution of 50 grams of $SnCl_2$ and 20 grams of $SbCl_3$ in one liter of concentrated HCl suspended on a length of braided-dacron fishing line until the coupon is totally immersed in the retardant. The jar will be closed with a Bakelite screw cap, firmly tightened by hand to control evaporation.

The retardant will be stored, undisturbed except for the scheduled testing, for 1 year at room temperature, approximately 70 °F (21 °C). Once a month the sample will be stirred and the viscosity measured. Compare the measured viscosity with the viscosity of the freshly mixed retardant.

Not Storable, Mixed Retardant

Not storable, mixed retardant will be stored on a laboratory shelf in a 1-quart, wide mouth glass jar with straight sides. The test sample, 800 milliliters of mixed retardant, will have an approximately 1 inch by 1 inch by 0.13 inch (2.5 cm by 2.5 cm by 0.3 cm) aluminum coupon previously cleaned with a solution of concentrated nitric acid suspended on a length of braided dacron fishing line until the coupon is totally immersed in the retardant. The jar will be closed with a Bakelite screw cap, firmly tightened by hand to control evaporation.

The retardant will be stored, undisturbed except for the scheduled testing, for 30 days at room temperature, approximately 70 °F (21 °C). Once a week the sample will be stirred and the viscosity measured. Compare the measured viscosity with the viscosity of the freshly mixed retardant.

Immediate Use, Mixed Retardant

Immediate use, mixed retardant will be stored on a laboratory shelf in a 1-quart, wide mouth glass jar with straight sides. The test sample, 800 milliliters of mixed retardant, will have an approximately 1 inch by 1 inch by 0.13 inch (2.5 cm by 2.5 cm by 0.3 cm) aluminum coupon previously cleaned with a solution of concentrated nitric acid suspended on a length of braided dacron fishing line until the coupon is totally immersed in the retardant. The jar will be closed with a Bakelite screw cap, firmly tightened by hand to control evaporation.

The retardant will be stored, undisturbed except for the scheduled testing, for 24 hours at room temperature, approximately 70 °F (21 °C). At 1 hour, 4 hours, 8 hours, and 24 hours following mixing, the sample will be stirred and the viscosity measured. Compare the measured viscosity with the viscosity of the freshly mixed retardant.