T E C H N I C A L B U L L E T I N

PHOS-CHEK® RETARDANTS FOR WILDFIRE CONTROL

IC/SCS-312

PHOS-CHEK®

FIRE RETARDANT COMPOUND BY Monsanto

Monsanto

INTRODUCTION

The Monsanto Phos-Chek® family of retardant chemicals and hardware has been tailored to yield lowest total suppression costs in terms of time, money and values lost. Yet product performance objectives of effectiveness, reliability and simplicity have not been compromised.

In many situations, chemical fire retardants offer a faster, more economical way to combat wildfire than do traditional techniques. Although they are never expected to replace the man on the scene, every year they are making his job easier, less uncertain, and reducing the numbers of men required to do a specific suppression job. Phos-Chek® retardants are tailored formulations based on ammonium phosphate, the most effective, safe and economical chemical agent known for retarding burning of cellulose, the primary component of plants.

WHAT DO WE MEAN BY RETARDANT?

In the case of ammonium phosphate, we mean that it alters the chemistry of the preheating stage of burning. Normally, during preheating, the fuels are changed to combustible gases and ash. In the presence of Phos-Chek they are changed to carbon and water during preheating. The water absorbs heat in being boiled off, and the fire-fighter feels an immediate cooling effect from the water formed in the bone-dry fuel when the retardant is present. Carbon that remains is almost impossible to burn. Thus the Phos-Chek ABSORBS HEAT AND DEPRIVES THE FIRE OF FUEL. Because of this double action, our trademark shows the fire triangle broken on two sides.

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WHAT DO WE MEAN BY SAFE?

Phos-Chek is relatively non-toxic. Ammonium phosphates are essentially fertilizers, although substantial quantities are used in cattle feeds for their bone and protein building capability.

Laboratory tests have shown Phos-Chek can be toxic to fish when introduced at high levels directly into small, stagnant ponds. However, based on 10 years experience and many tests, no other significant detrimental effects on the ecology are anticipated. Residues on land are chemically very similar to those in any burned over area.

WHY FORMULATE?

To take advantage of the retardant effect, it is necessary to coat the fuel with a sufficient quantity of ammonium phosphate. Formulation modifies the physical and chemical properties of the retardant solution so it will reach and coat the fuel properly from various delivery and application vehicles without damaging them. Retardant applied through a nozzle must have different flow properties than a retardant which will be dropped from an airplane in a high wind (sometimes found in the vicinity of serious fires). The retardant solutions should not damage application vehicles and should be visible so treated areas can be recognized.

Phos-Chek products contain corrosion inhibitors which minimize damage to aluminum, copper (and its alloys bronze and brass), magnesium and iron. Phos-Chek does remove the zinc coating from galvanized iron, but does not harm the iron structure underneath.

Phos-Chek retardants contain carefully controlled amounts of thickeners to provide the proper consistency for use in the application vehicle for which they are designed. Over the years, changes have been made in this property as the requirements of aircraft and ground tankers have become better understood and as better thickeners have been found.

Grinding and the addition of flow conditioners have made it possible to mix Phos-Chek in high speed continuous equipment such as the Phos-Chek® Hamp mixer without excessive caking in dry storage.

Stabilizers and color are added as needed for the use.

HOW IS PHOS-CHEK TAILORED?

Phos-Chek chemicals are tailored with respect to concentration (retardant salt) and consistency for specific missions and vehicles. New grades are continually under development to satisfy the requirements being defined for new application vehicles and systems. Two grades, Phos-Chek®XA and Phos-Chek®259 are currently operational.

Phos-Chek XA has the same retardant concentration as the original 201 grade introduced in 1962, but it is a different formulation incorporating improved technology developed in subsequent years. It uses a different thickener, which has a sheeting and sticking behavior not present in the original. Its consistency (apparent viscosity) was selected from drop characteristics of formulations with a wide range of consistencies. These drops were conducted at Monsanto's expense and evaluated by personnel of the Northern and Riverside Fire Laboratories and the California Division of Forestry. The specification under which it is produced is based upon their evaluation as to optimum drop characteristics and coverage.

It is tailored to give optimum performance on the fire line when dropped from today's air tankers using today's tanks, vents, and gates.

Phos-Chek 259 was formulated to be used in ground tankers using straight-stream and cone-spray nozzles. Its characteristics were developed after a year (1964) of experience with an experimental product (258). It is 50% more concentrated than XA to take advantage of accurate and thinner uniform application achievable by a man on the ground. It is slightly thickened to carry better and give a slightly thicker coating on the fuel.

It is the only long-term wildfire retardant we have tested which did not severely corrode copper, bronze and brass test coupons. Field experience is still on a limited scale, but no damage to tankers, pumps, valves or fittings has been observed by Monsanto personnel or reported to them, even after four years of use. As with XA, the zinc coating of galvanized metal will be stripped, but no attack will occur on the underlying iron and the inhibitors are effective in protecting aluminum fittings.

In short, it has been tailored for use in the tankers we have today. And it should work in those we build tomorrow.

Both Phos-Chek products have performed well when dropped from helicopters, and the choice has depended on the most likely secondary vehicle. In those situations where the chemical and support hardware assigned to helicopters might also be used with fixed-wing tankers, XA is used. When they might be used in support of ground tankers, 259 is used.

XA is unsuitable for use in ground tankers, because of its consistency and 259 is not recommended or currently approved for fixed-wing tankers because of potential drift problems in wind or high altitude drops.

PHYSICAL AND CHEMICAL PROPERTIES

Formula

Diammonium Phosphate $(NH_4)_2HPO_4$, plus additives

Appearance

Both grades are reddish, free-flowing mixtures of powdered and granular components.

Typical Analysis (not specifications)

	Phos-Chek®259	Phos-Chek®XA
% P_2O_5	48.5 minimum	47.0 minimum
Viscosity in CPS @ 75°F	50.0 minimum, 150.0 maximum (1)	1500 minimum (2)
Corrosion (3)		
On Aluminum	Less than 5 mils/year	1 mil/year maximum
On Copper	Less than 1 mil/year	1 mil/year maximum
Density (lbs/gal)	9.05-9.15	8.85-8.90

(1) Brookfield Viscometer, Model LVF, 60 rpm, spindle No. 2 on a 16% solution.
(2) Brookfield Viscometer, Model LVF, 60 rpm, spindle No. 4 on a 13% solution.
(3) Alternating 30-second immersion and drain cycles at room temperature for 72 hours in retardant solution mixed according to directions on package.

LOGISTICS AND SUPPORT

No bulletin on retardants would be complete without information on logistics and support requirements. Phos-Chek retardants are easily mixed from bulk or bags at very high rates in the Phos-Chek Hamp mixer systems described in Monsanto's technical bulletin, "Phos-Chek® Hamp Mixer Systems (IC/SCS-311). Both grades are easily and rapidly mixed from bags in all currently approved agitator or recirculating type mixers. Phos-Chek retardants require a substantially lower weight of concentrate than any nearly-equivalent or equivalent long term retardants in use today. This is shown by the comparison in the table below.

COMPARISON OF LOGISTICS OF WILDFIRE RETARDANTS

Retardant	Pounds of Retardant to make 2000 gallons of slurry or solution	Weight of 2000 gallons in pounds
Phos-Chek®XA	**2140**	17,800
Phos-Chek®259	**3000**	18,200
*Liquid Concentrate (10-34-0 base)	**4756**	18,200
*Ammonium Sulfate/Clay	**4760**	18,800

*Calculated from figures in George, Charles W., Liquids Fight Fires. Fertilizer Solutions, Nov.-Dec. 1971.

As the use of chemicals increases, support operations are expected to move closer and closer to the actual fire. The lower weight requirement for equivalent gallonage is of very great importance, since it minimizes tie up of critically needed transport.

The Monsanto Retardant Distribution Center

To properly serve the needs of fire control personnel, Monsanto has a "hot line" fire phone and distribution center and maintains warehouses with nearby supplies of chemical for locations depending upon Phos-Chek. For promptest shipment and delivery of retardants or equipment purchase, lease or rental, contact Monsanto through the "hot line" locations. **Phone 213-864-6220.** Written contact and confirming orders should be sent to:

Monsanto Company

810 East Main Street

Ontario, California 91761

Attention: Operations Superintendent, Wildfire Control