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PHOS-CHEK® Fire Retardants for the Use in Preventing and Controlling Fires in Wildland Fuels

TOXICOLOGICAL AND ENVIRONMENTAL SAFETY

PSCL'S COMMITMENT TO SAFETY

Perimeter Solutions Canada Ltd is a strong advocate of the U.S. Chemical Manufacturers Association's Responsible Care initiative. Through the Responsible Care initiative and its Product Stewardship program, and those similar trade organizations throughout the world, PSCL strives to design, develop, manufacture and market our products in a manner which meets societal needs while posing no undue risk to human health or the environment during all stages of the product's life cycle. In addition, PSCL continuously works with customers to ensure that these principles are followed during the product's use and ultimate disposal.

These principles are of particular importance when dealing with wildland fire retardants which, during their expected use, come into contact with people, wildlife and the environment. PSCL encourages the practice of good industrial hygiene during handling of the PHOS-CHEK® Fire Retardant concentrates and solutions and good commonsense practices in their end use in fire prevention and control. The Material Safety Data Sheet (MSDS) should always be consulted as the primary source of health and safety information. This document provides additional guidance of the handling and use of PHOS-CHEK® wildland fire retardants.

WHAT IS IN THE PHOS-CHEK® WILDLAND FIRE RETARDANTS?

PSCL'S PHOS-CHEK® brand fire retardant concentrates, which are supplied for use on wildland fuels (vegetation), are offered as two general types, i.e., dry powders and fluids. The dry powder concentrates consist of primarily of a blend of ammonium phosphate and/or sulfate which function as an active fire retarding component. In addition to these fire retardant salts, PHOS-CHEK® retardants generally contain relatively small quantities (5 to 15%) of performance additives including one or more of the following: a gum thickener, a flow conditioner, a coloring agent and/ or corrosion inhibitors. These dry powder concentrates are mixed with water to form relatively dilute (10 to 15%) solutions prior to use in fire prevention, prescribed burning or suppression.

The fluid concentrate type retardants are essentially identical to the dry powder concentrates except that a portion of the mix water is incorporated in the formulation at the time of manufacture. These fluids are then supplied to the user as low viscosity liquids which are easily diluted to use concentration prior to application for their intended use.



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The retardant solutions obtained by dilution of the fluid concentrates are virtually identical to those obtained from a comparable dry-powder concentrate.

There are grades of PHOS-CHEK® wildland retardant which are supplied for application to fire hose, helicopters equipped with either buckets or fixed tanks and for fixed-wing aircraft. These different grades are very similar to each other. They vary primarily in the ration of the components which are necessary to alter the solution characteristics dependent on the mode of application, e.g., higher or lower viscosity, presence, absence or type of color, etc.

HOW DO PHOS-CHEK® WILDLAND FIRE RETARDANTS WORK?

The retardant solution is applied to vegetation in the form of a chemical fire break before the arrival of an approaching fire. This solution coats the fuel and then, as the fire gets closer and its contained water evaporates, the fire retardant component reacts with the cellulose present in the woody material, grass, needles and other matter which normally provide fuel for the fire. (The water contained in the fire retardant solution functions only as a carrier for the fire retardant evaporating before arrival of the fire and, consequently, contributing little in terms of fire retardancy.) As heating continues, the fire retarded cellulosic material decomposes in a manner which gives off water vapor (cooling the fire) and leaving behind a black, graphite-like, non-flammable carbon coating which both insulates and restricts air flow to any residual fuels. When this occurs, the intensity of the fuel-starved fire decreases and control is much easier to achieve.

Any fire retardant residue which is not consumed in the fire will continue to be effective in preventing and controlling fuel ignition and flame spread until removed from the fuel by either flexing or rainfall.

ARE PHOS-CHEK® RETARDANTS HAZARDOUS?

Prior to mixing with water, PHOS-CHEK® retardant powders are generally classified as hazardous under criteria established by the United States Occupational Safety and Health Administration (OSHA) because of their potential to form dust during manufacture and when handling in windy conditions. The PHOS-CHEK® dry-powder concentrates contain a mixture of powdered and granular components. That portion of the product which is present in powder form is subject to being picked up and entrained in the air when windy conditions exist. Most dust are considered to be respiratory irritants. Basically, this is because excessive amounts of dust can deposit in and inhibit flow through the respiratory tract and this is a potential “hazard” according to most regulatory criteria. Hazard classifications may, however, differ in other world areas and the MSDS applicable to your country or jurisdiction should be consulted. The dry-powder retardant mixing systems which are recommended and used by PSCL are designed to minimize the generation of dust, however, under even severe use conditions. The potential respiratory effect of generated dust is the only identified hazard which has been associated with the PHOS-CHEK® retardants.



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Once the dry-powder concentrate is dissolved in water to prepare a fire retardant solution, it no longer has the capacity to generate dust and is no longer considered hazardous according to these criteria.

Acute (single exposure) toxicity test data have been obtained on the dry-powder concentrates and on their solutions by an independent laboratory using protocols established by the United States Department of Agriculture's Forest Service (USFS). These data show that the retardants are not toxic by ingestion or dermal application and are not significantly irritating to the eyes or skin.

Fluid concentrate type retardants are supplied in liquid form and consequently do not have the potential to generate dust. As explained previously, fire retardant solutions prepared from dry powder and fluid type concentrates are essentially identically. Therefore, the acute toxicity data for solutions from the two concentrate types are essentially the same.

ARE HAZARDOUS COMPONENTS PRESENT IN PHOS-CHEK® RETARDANTS?

PSCL discloses, on the MSDS, the potential hazard posed by any of the components in its fire retardants, even those considered trade secret, if the ingredient is considered hazardous under applicable regulatory criteria. Under most world area regulatory criteria, hazardous components present in a mixture at levels below 1% (0.1% for identified carcinogens) are not considered to contribute to the hazards of the overall formulation.

The concentrates used to prepare PHOS-CHEK® retardant solutions consist primarily of a blend of diammonium sulfate and/or ammonium phosphates. These salts function as the active fire retardant component in the composition. Diammonium sulfate is used as a primary source of nitrogen in many agricultural fertilizers and is considered safe. The ammonium phosphates are used, also, in agricultural fertilizers as sources of nitrogen and phosphorous. The industrial grade phosphates used in the PHOS-CHEK® retardants are considerably more pure than the fertilizer grade phosphates which contain many and varied impurities such as arsenic and heavy metals.

Diammonium sulfate is considered hazardous because of its dust irritation potential, as discussed previously. However, both diammonium sulfate and the ammonium phosphates have been approved by the U.S. Food and Drug Administration (FDA) as Generally Recognized As Safe (GRAS) when used in small quantities as direct human and animal feed additives. Diammonium sulfate is approved, also, for use in small quantities as a drinking water additive under National Sanitation Foundation (NSF/ANSI) Standard 60.

In addition to the fire retardant salts, relatively small quantities of performance additives are included in the various fire retardants formulations. For example, a guar gum thickener, which is extracted from cultivated guar beans holds the retardant solution cloud together during free fall from the aerial application platform to the fuel so that the applied solution lands in the target area and then clings to the fuel where it will be effective. This thickener is used, also, as a component in food products such as ice cream. Guar gum is a dry-powder, however, and is therefore considered hazardous under some regulatory criteria because of its potential respiratory irritation properties (see discussion below on respiratory sensitization). Guar gum is affirmed as GRAS by the FDA.



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A small amount of a flow conditioner is also included in many formulations as a performance additive. This component provides free flowing characteristics to retardant powders so that they can be easily transferred and mixed to form retardant solutions. The flow conditioner which is present in the PHOS-CHEK® retardants is used for the same purpose in common table salt. It has no significant hazards and is affirmed as GRASS by the FDA.

It is important that the fire retardant solution be visible to the applicator so that a continuous fire break can be prepared. Wildland fire retardant solutions generally contain color pigments which provide a bright red color which is visible to the pilot and fireman. Colored PHOS-CHEK® retardants contain either permanent or fugitive color pigments. Permanent pigments will remain visible for long time (years) whereas the fugitive pigments will disappear after a relative short (weeks) exposure to natural sunlight. The permanent color pigment in the PHOS-CHEK® retardants is red iron oxide, i.e., finely ground, water insoluble iron rust. The fugitive pigments used in the PHOS-CHEK® products are very small particles composed of a light-sensitive dye in a biodegradable resin matrix. Neither type of pigment is considered hazardous although the visual aesthetics of the permanent color pigment is usually considered undesirable near population centers and in scenic areas.

Wildland fire retardant solutions also contain inhibitors to protect handling, mixing and delivery hardware from corrosion. Very small quantities of several different additives are used to protect the various types of metal with which the solutions come in contact. These additives might be considered hazardous when handled in bulk or when used in large concentrations because of their potential to cause eye, skin and respiratory irritation. However, all are present in the PHOS-CHEK® retardants in quantities too low (less than 1.0%) to be considered as hazardous ingredients or to lead to classification of the overall formulation as hazardous. None of the components, including the corrosion inhibitors, used in the PHOS-CHEK® retardants contain known carcinogens or toxic materials such as arsenic, cyanide or heavy metals. Further, no known adverse long term or chronic health effects have been attributed to any of the PHOS-CHEK® retardant ingredients.

DO PHOS-CHEK® RETARDANT SOLUTIONS BIODEGRADE?

When a material can be consumed, or degraded, by bacteria it is referred to as biodegradable. Inorganic compounds, such as the fire retardant salts, cannot be digested by bacteria but may provide nourishment for plant life. It needs to be remembered that about 88% of the PHOS-CHEK® retardant solution is water. Of the 12% retardant components which are present in the solution, most provide nourishment for plant life rather than bacteria, i.e., they are not biodegradable but are consumed by vegetation. The gum thickener and other inorganic compounds are, however biodegradable or will breakdown via other means in the environment.



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WHAT HEALTH, SAFETY & ENVIRONMENTAL TESTING HAS BEEN DONE ON THE PHOS-CHEK® RETARDANTS?

PSCL manufactures and offers for sale only products that are considered safe when used responsibly. In order to assure this, prior to offering any new product for sale, PSCL conducts a safety and environmental compatibility assessment. At this time, test data is generated to answer any questions raised during the assessment. The MSDS is primary means of communicating the results of that assessment, including a presentation of all known health, safety and environmental data.

In addition, the composition of all qualified PHOS-CHEK® wildland fire retardants is revealed to the United States Department of Agriculture's Forest Service (USFS) prior to commercial use. The USFS reviews the composition and conducts performance, health, safety and environmental testing under government auspices by an independent laboratory using protocols which they have established for the purpose. Testing including acute oral ingestion, dermal application and eye and skin irritation. This testing is conducted on both the retardant concentrates which will be handled and mixed at using locations and the retardant solutions which will be applied in wildland fire fighting operations. Successful completion of these test is a prerequisite for commercial use. The result of the health and safety testing of the PHOS-CHEK® retardants are summarized in their MSDS.

HAVE THE PHOS-CHEK® RETARDANT BEEN REVIEWED FOR SAFETY BY ANY REGULATORY AGENCIES?

PHOS-CHEK® retardants contain only ingredients that comply with the provision of the worlds various chemical control laws such as the United States' TSCA, Europe's Dangerous Substances Directive 67/548, Australia's Industrial Chemical (Notification and Assessment) Act, etc. All of PSCL's wildland fire retardant products have been evaluated and qualified by the United States Department of Agriculture's Forest Service as a described in the preceding paragraphs. Also, some States and local watershed districts evaluate wildland fire retardants for potential effects on water quality. The PHOS-CHEK® retardants have been approved in all instances where testing was conducted.

PSCL will disclose, to appropriate regulatory agencies, the complete composition of the PHOSCHEK® wildland fire retardants in order to facilitate health, safety, environmental and performance studies. Compositional information is, however, considered business confidential and must be maintained in a manner consistent with the protection of PSCL's proprietary technology.



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ARE MATERIAL SAFETY DATA SHEETS AVAILABLE FOR THE PHOS-CHEK® PRODUCTS?

Materials Safety Data Sheets are available, on request, in the format required by all counties in which PHOS-CHEK® retardants are available. It is PSCL's practice to provide MSDS's for all commercial products available to anyone who request one.

WHAT IS SARA SECTION 313 AND WHY ARE AMMONIUM SALTS REPORTABLE?

Under the Superfund Amendments and Reauthorization Act (SARA), U.S. manufacturers and users are required to annually report emissions of certain chemicals. The U.S. Environmental Protection Agency (EPA), which administers SARA, reviewed the use of ammonium salts under this law in 1995. They concluded, at the time, that there were no known significant human health affects emanating from the use of aqueous ammonium sulfate solutions; however, the small amounts of free (un-ionized) ammonia present in water solutions of any inorganic ammonium salt may be harmful to aquatic organisms. In view of this, the EPA requires that environmental releases of free ammonia, for other than its intended purpose, be reported annually. Using EPA guidance as to the amount of free ammonia expected, about 2% of the PHOS-CHEK® dry-powdered retardants which are released to the environment through spills, airborne dust, or landfills (for other than their intended purpose) are reportable under this law. Ammonium salts and PHOS-CHEK® retardants which are applied in the manner, for which they are intended such as in an applied fertilizer or fire retardant solutions, are not reportable.

WHY IS THERE AN ALLERGIC RESPIRATORY WARNING ON THE PHOS-CHEK® RETARDANT MSDS?

The manufacturer of guar gum thickeners has determined that some individuals with a history of respiratory allergies may be aggravated by exposure to guar gum dust. While the results of the study conducted by the manufacturer were not conclusive, we feel it appropriate to convey that warning to our workers and to customers who may come in contact with dust generated by the dry-powder PHOS-CHEK® retardants. Once PHOS-CHEK® retardant powders are dissolved in water, there is no exposure to guar gum dust, thus the warning is no longer applicable.

CAN PHOS-CHEK® RETARDANT BE APPLIED AS FERTILIZER?

The components in PHOS-CHEK® retardants are safe for land application when applied in the recommended manner as a fire retardant. Even though the products provide sources of nitrogen and phosphorous, their uncontrolled application for other than their intended purpose is not recommended.



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IS PHOS-CHEK® RETARDANT RESIDUE DANGEROUS TO ANIMALS?

There are no known adverse effects to domestic or farm animals which eat small amounts of foliage covered with PHOS-CHEK® retardant. Reaction of animals, however, can vary amount species. A veterinarian should be contacted if your animals eat significant amounts or fire retardant coated vegetation.

Various PHOS-CHEK® retardants have been tested both by PSCL and by U.S. Government agencies for possible acute toxicity effects on small terrestrial wildlife (birds, rodents, earthworms). Reports emanating from these studies indicate that the PHOS-CHEK® retardants exhibit a comparatively low order of acute toxicity.

WILL PHOS-CHEK® RETARDANT HARM PLANTS OR FOLIAGE?

Like fertilizer, retardants which are not removed from vegetation, may cause the foliage to turn brown and plant to wither. After rain, however, the plant should return to normal and growth may be enhanced due to the added plant nutrients.

WILL PHOS-CHEK® RETARDANT HARM FISH OR OTHER WATER DWELLING ORGANISMS?

PSCL has tested PHOS-CHEK® retardants for toxicity to fish and water dwelling invertebrates. The result, presented in the MSDS, indicate a relatively low order of acute toxicity to these organisms. This indicates that runoff from the application of PHOS-CHEK® retardants is unlikely to pose a serious threat to aquatic life.

However, the free ammonia present in all fire retardant solutions can be quite toxic to aquatic life when directly applied. Care is recommended, and is exercise by the using agencies during application of the retardant, to minimize introduction into streams, ponds, and the like. Some contamination may occur, however, since bodies of water are often hidden by vegetative cover from the applicator. It should be recognized, also, that fish are quite sensitive to even minor changes in water temperature (such as may result from a fire) and to runoff of decomposition products from burning vegetation and other debris resulting from the denuded burned area. Thus, mortality of aquatic life is common in areas where large wildland fires have occurred, even when retardants have not been used.

HOW ARE PHOS-CHEK® RETARDANT SOLUTIONS REMOVED?

Wildland fire retardants are generally quite water soluble and can be removed with little effort prior to drying. When allowed to dry, however, the gum thickener can form films which tend to hold the dried retardant component rather tightly to that on which it lands. This is desirable when it lands on wildland fuels. It is less desirable, however, when trying to remove it from other areas. Retardant



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residues should consequently be removed as soon as possible. After drying, some scrubbing or power washing of structures and equipment may be required. A mild surfactant may assist in removal.

ARE THERE OTHER POTENTIAL HAZARDS?

Solutions in general can increase the slipperiness of most surfaces. Retardant solutions are not exceptions and care should be taken when working in and around spilled or applied retardant. Gum thickened retardant solutions may be even slipperier than solutions in general. Spills should be cleaned up as soon as possible to avoid possible falls. Care needs to be taken by personnel working in areas treated with wildland fire retardants.

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