

# Phosphate Ester Base Hydraulic Fluid

PHOSPHATE ester base hydraulic fluid, used aboard ship in weapons handling and elevator systems, can present material problems and health hazards. Material problems come about because it destroys and/or deteriorates most seal compounds and causes leaks, removes paint, and softens tile. Health hazards result from its toxicity. And troubles at sea are usually inherited by a repair activity.

In view of recent reports concerning aircraft carriers with phosphate ester hydraulic fluid problems, the Naval Safety Center has recommended to COMNAVSHIPSYSCOM that 1) a search for a suitable substitute for phosphate ester base hydraulic fluids be undertaken on a priority basis; 2) the NAVSHIPS *Tech Manual* article on the subject be modified to stress positively the health hazards associated with phosphate ester base fluids; and 3) hydraulic weapons handling and elevator systems in other types of ships be investigated for similar problems.

With regard to 1) above, NAVSHIPS has indicated in its message 051513Z Apr 73 that it has commenced a comprehensive study of hydraulic fluids for use in shipboard systems. Physical, chemical, and mechanical characteristics involving toxicity, fire resistance, corrosiveness, lubricity, etc., will be compared. The study will consider available service experience in NAVSHIPS, NAVAIR, and industry.

The phosphate ester base hydraulic fluid Cellulube (trade name) was brought into service originally to replace petroleum-type hydraulic oil to reduce the fire hazard. The MILSPEC (MIL-H-19457A [Ships] 30 Aug 1961) leaves the door open, so to speak, to other manufacturers. It calls for the material to be dyed green, but the organic phosphate composition can be varied within the confines of the MILSPEC.

Regarding the toxicity of this material, the principal chemical (liquid) used in phosphate "safety-type" hydraulic fluid is generally referred to as tri aryl phosphates. The aryl phosphates evidently have a wide range of "degree of toxicity." Some are noted to produce pain and paralysis and some not.

One of the more toxic tri aryl phosphates (not necessarily in the MILSPEC material) is tri(ortho) cresyl

phosphate (TOCP) - a definite neurotoxin, a substance which is poisonous or destructive to nerve tissue. Absorption of TOCP can be by ingestion, by inhalation of mists or vapors, or through the skin. Excess absorption can lead to paralysis, especially of the feet and legs.

A concrete example of the hazard potential of TOCP is a report indicating that in 1960 almost 10,000 persons in Morocco became ill following ingestion of cooking oil which had been adulterated with an oil containing 3 percent TOCP. More than 6000 of them suffered paresis (slight or partial paralysis) of the legs.

Important in this discussion is that the MILSPEC material may contain some of the more hazardous aryl phosphates since the permissible toxicity is based on a relationship to TOCP. The MILSPEC states that the fluid shall not have a toxicity equivalent greater than 25 percent of TOCP.

The MILSPEC calls for a warning label "on each shipping container, each container packed therein, and each container requiring no overpacking." The warning is to read:

WARNING: TOXIC. CONTAINS TRI ARYL PHOSPHATE. AVOID INHALING, SWALLOWING, OR CONTACT WITH SKIN. IN CASE OF CONTACT, REMOVE SOILED CLOTHING AND THOROUGHLY WASH EXPOSED SKIN.

Inhalation of phosphate ester base hydraulic fluid - breathing mist from any spray from pipe leaks, reclaiming processes, etc., or breathing vapors from hot oil - is hazardous. The vapor pressure is low at normal temperatures and with normal ventilation vapor exposure is not considered a significant problem. The TLV (threshold limit value) for TOCP is .1 mg/m<sup>3</sup> air, and for triphenyl phosphate it is 3 mg/m<sup>3</sup>. For other tri aryl phosphates, which may be in the MILSPEC, material data are lacking. If mist or vapor situations occur, exhaust ventilation over the source or respiratory protection is needed.

There is not a great deal of data on human skin exposures, but it seems wise to assume that toxic

reactions through skin absorption are possible and wiser still to avoid skin exposure. Dermatitis from organic phosphate materials is uncommon. However, the material in question contains additives, and if it has been used it has seen heat and pressure which could generate a small amount of breakdown product which may be irritating. In the past, the Navy has reclaimed this type of fluid which is another possible source of introduction of foreign material.

In a message to one aircraft carrier querying BuMed on possible injuries due to Cellulube, BuMed stated:

"Subject hydraulic fluids contain tri aryl phosphate. Orthoisomer of these substances is a neurotoxin. Absorption can be (by) gastrointestinal, pulmonary, or percutaneous routes. Can lead to irreversible motor paralysis, especially of muscles of foot and lower leg. Hand may be affected. Clinical cases have been extremely rare. There is no evidence from your message that affected personnel exhibit neurological signs. No previous reports of dermatological problems are known.

"Suggest review of working habits and hygiene of affected personnel. Treat dermatitis symptomatically. Remove from exposure. Observe for neurological signs.

"Personnel exposed to Cellulube hydraulic fluid should be provided with skin protection: barrier creams, gloves, aprons, and/or splash shields as necessary. Cellulube should be washed off skin when contact occurs. Soiled clothing should be changed."

Men working with organic phosphates should be aware of the potential hazards. Patty's classic, *Industrial Hygiene and Toxicology*, emphasizes the necessity for prompt medical care at the onset of symptoms which may be related to overexposure.

"The onset of symptoms is rapid and maximum effects may develop within a few hours," it states. "It is thus important that medical care be obtained without delay. Since the early symptoms of headache, malaise, etc. are easily confused with other diseases, it is important that workers exposed to the organic phosphates be instructed to report any such indications." □

## Stowage and Handling Critical

(The following article from EPMU-2's newsletter, "Healthscope," was written for shipboard readers. Generally speaking, it also applies to naval shipyards.)

CALCIUM hypochlorite, if not properly stored and handled, is a dangerous toxic chemical and has the potential to produce a fire or an explosion. Improper stowage and handling can turn this potential into a critical reality.

NAVSHIPS Tech Manual, Chap. 9300.10, sets forth procedures for proper stowage of this material. This chapter states that stowage shall be in a clean, cool, dry compartment or storeroom which is not adjacent to a magazine and is at a safe distance from any heat source. It must be located so that there will be no exposure to moisture.

This material is to be isolated from any flammable material or any material that will support combustion. It is not to be stowed in the same compartment or storeroom with acids or any other chemicals.

The containers may be stowed in a storeroom or other suitable space above the waterline provided the foregoing provisions are met. Weather deck stowage in watertight lockers is also considered satisfactory provided that the above conditions are met and provided the location is sheltered and protected from the direct rays of the sun.

Periodic inspection must be made to ensure that all

stowed containers of calcium hypochlorite are tightly sealed and that the exteriors of the cans are free from corrosion. All defective containers must be removed from the stowage area and either used immediately or disposed of.

Remember, calcium hypochlorite is intended for use with water only. Never permit the liquid or granular form to come in contact with acid, grease, oil, fuels, detergents, or certain other chemicals (including paint). A fire and/or an explosion can result. Avoid skin contact with the powder or its solution.

EPMU-2 recommends the 6 oz. jar of calcium hypochlorite (FSN 6810-225-0471) because of convenient usage and storage.

(LIFELINE comment: The CHIL [Consolidated Hazardous Item List, NAVSUPPUB 4500 1 July 72], which gives storage codes for shore and stowage codes for ships, lists for calcium hypochlorite the hazard classification symbol 202, OXY. By CHIL definition this means degree of health hazard - 2 on a degree scale of 4; flammability - 0; and reactivity - 2 on a degree scale of 4. OXY means the chemical is an oxidizing agent. The storage code for calcium hypochlorite is X, meaning "separate storage [fire producers, not elsewhere classified]." The caution stipulated is "Keep away from acid, combustible, organic, and readily oxidizable material."