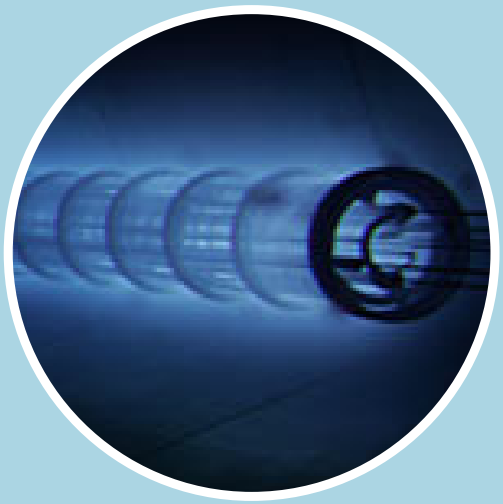
STUBBORN LUBRICANTS FOR TOUGH APPLICATION

MOSIL LUBRICANTS

GAMMA IRRADIATION TESTS FOR INDUSTRIAL LUBRICANTS

ABSTRACT



The Gamma radiation is generated by the decay of radioisotope cobalt 60, with the resultant high energy photons being an effective sterilant. The high penetration capability of gamma radiation allows the delivery of target radiation dose to the areas of products that may be higher in density.

The unit of absorbed dose is kiloGray (kGy). Delivery and absorption of dose by the product are determined by product density, pack size, dose rate, exposure time, and facility design. The Gamma irradiation process is effectively used in Medical Devices, Pharmaceuticals, Cosmetics, and toiletries, etc.

NECESSITY OF IRRADIATION TEST

Many of moving components like Elastomeric O-rings & sliding mechanisms in accelerator and target environments require lubrication. Lubricants in such environments are exposed to high fluxes of secondary radiation. Industrial Lubricants are radiation-sensitive polymeric materials. The study of Lubricants resistance to radiation is, therefore, necessary for the construction of new generation accelerators and target systems.

Mixed neutron and gamma doses ranging from 0.1 MGy to 0.9 MGy are delivered on greases to be tested. Radiations affect polymers mainly through the basic mechanisms of cleavage and cross-linking of macromolecular chains [1, 2, 3]. Therefore, significant radiation effects on physical and mechanical properties can be induced, which might lead to premature failure of the components.

The result represents an original and useful reference in selecting radiation-resistant Specialty greases for accelerator and target applications.

TESTING METHODOLOGY

Greases are semi-fluids formed by the dispersion of a thickener in the liquid oil. Standard greases contain 85% base oils and 10% thickener and 5 % required additives. The radiation resistance of base oils is reported to predominantly depend on the aromatic content present in the formulation.

Specialty Greases based on aromatic and the polyether oils are mostly considered more resistant against radiations than mineral oil-based lubricants.

Radiation effects in the greases are complicated by the interaction of the base oil with the thickener and the additives and the overall effect is expected to depend not only on the effect on its bulk components but also on their complex interaction.

Moreover, grease is tested in the air atmosphere and at atmospheric pressure, while in some applications it is tested in vacuum or in absence of oxygen. The temperature in the irradiation facility is higher than the temperature expected for most types of applications. Damage mechanisms in polymers are expected to depend on several parameters as the radiation fields, the dose rates, the oxygen diffusions, and the temperature.

MARKET RESEARCH COMPLETED TO SELECT-

- Experienced Grease manufacturer companies certifying quality control on specialty grease production.
- Specialty Greases differ in the chemical compositions of their components.
- Industrial Lubricants that are declared as radiation-resistant by the producer and generic products.
- Specialty greases having different features like vacuum compatibility, extreme pressure, and duration are selected for wide and qualified spectrum of products to be tested.

These criteria led to a selection of high-quality specialty greases suitable for distinct applications in the accelerator and target environments.

OBSERVATIONS

- The doses absorbed by the greases in a fast neutron field highly depends on its light element composition, as it is proportional to hydrogen content.
- Neutron dose is related to the hydrogen content, which is also measured.
- Up to 10%, Consistency variation is observed in the grease which is tested, because of the increased viscosity of its base oil due to polymeric chain cross-linking.
- The color of the grease is also darkened by the irradiation.
- The chemical composition of the lubricants alone is not representative of the grease radiation sensitivity. Specific additives are expected to influence radiation stability.
- MOSIL grease SAM - 9140 did not exhibit significant consistency variation.

INFERENCE AFTER TESTING

Experimental studies of radiation hardness in reactor mixed fields of materials to be employed in the construction. A study of elastomeric materials to be used for vacuum O-rings was completed and the main results are documented. A study of MOSIL SAM-9140 grease has been initiated and the Perfluoro polyether-based MOSIL SAM-9140 is reported to be more radiation-resistant than the other mineral oil-based lubricants.

MOSIL SAM-9140, This specialty grease can be considered as safe and radiation-resistant lubricant for the applications in the new generation accelerators and target systems.