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ATTN: FYI Coordinator
Office of Pollution Prevention
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U. S. Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460

Re: Possible Adverse Bovine Effects from Molybdenum

Dear FYI Coordinator:

Thiokol Corporation is submitting the enclosed preliminary findings collected in a recent investigation regarding possible adverse bovine health effects from molybdenum (CAS 7439-98-7). This information is being submitted as an FYI notice to apprise EPA of these findings. However, Thiokol does not believe this information reasonably supports the conclusion that the substance involved presents a substantial risk to human health or the environment.

As background, in 1956 Thiokol purchased approximately 10,000 acres of high desert land in a remote area north of the Great Salt Lake for use as an industrial manufacturing site for solid propulsion products. (The grazing rights to a majority of these acres were, however, reserved to the rancher who sold the property to Thiokol.) On this 10,000 acres, Thiokol has approximately 500 buildings, some of which are used in manufacturing operations; others of which are used for office activities, storage and testing. Two areas designated for thermal treatment of waste reactive

materials are also located on this acreage. High energy, reactive wastes are treated at these sites by burning them, in accordance with federal, state and local requirements. The area adjacent to the boundary of one of these thermal treatment units, M-225, is the subject area of our investigation. In this particular thermal treatment unit, one of the reactive wastes treated is gas generant which is a product used to inflate automobile safety air bags.

Our investigation centers around the dispersion of molybdenum around M-225 from this disposal activity. The rancher who grazes his cattle in the area surrounding M-225 informed Thiokol this spring that six of his cows (out of a herd of 273) had died and a few others had become ill. The rancher's veterinarian had a necropsy conducted by a local university lab on a cow that was sacrificed for this purpose after becoming seriously ill. The rancher reported to Thiokol that higher than expected levels of molybdenum were detected in the cow's liver and stomach contents. Accordingly, Thiokol tested soil, grass and forb (bush) samples and the cows' drinking water sources in a wide area surrounding M-225. Various levels of molybdenum were detected in the soil, grass and forb samples; however, no traces were detected in the cow's drinking water sources.

We believe that some correlation may exist between molybdenum released to the air during the thermal treatment of the gas generant and the elevated levels of molybdenum that were detected in soil, desert grass and forbes in the surrounding areas. Molybdenum disulfide is a component of this gas generant. When it is burned, molybdenum disulfide is oxidized to molybdenum trioxide. As this molybdenum trioxide is deposited onto the alkaline soil it converts to molybdate (ionic form of molybdenum). Molybdate is soluble and is absorbed by various plant root systems. Some of the levels detected, according to scientific literature, appear to be sufficiently elevated to cause illness in cattle. Our analysis of the molybdenum levels and their associated health and environmental effects is the subject of the enclosed preliminary findings.

Thiokol has ceased further thermal treatment of the waste gas generant. This material is currently being recycled. In addition, we are presently discussing with the rancher some appropriate fencing of the impacted area.

We will continue to monitor this situation. If anything of import is discovered, we will keep you informed. Should you wish any additional information or should you desire to discuss this matter, please address inquiries to:

J. D. Thompson, Director
Safety, Environmental & Support Services
Thiokol Corporation
Mail Stop 300
P. O. Box 689
Brigham City, UT 84302-0689
Telephone (801)863-5928

Sincerely,

J. D. Thompson, Director
Safety, Environmental & Support Services

Enclosure

cc: Dennis R. Downs, Executive Secretary
Utah Department of Environmental Quality
Division of Solid and Hazardous Waste

PRELIMINARY FINDINGS

Possible Adverse Bovine

Effects from Molybdenum

May 1995

01 Investigation

The investigation into the dispersion of molybdenum is centered around M-225. In order to characterize the extent of this molybdenum plume, grab samples were collected at several sites around M-225, outlying areas and background locations. In most cases, three samples of soil, forbes (bushes) and annual plants, including grasses, were collected from each site. The sample locations were pinpointed using a Global Positioning System (GPS) and plotted on a site map. The samples were then analyzed at an EPA certified CLP Laboratory using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP) following EPA method 6010. The results were converted to a dry weight basis. The cows' drinking water sources surrounding M-225 were sampled and analyzed as well.

02 Results

Typical background levels for molybdenum in the area range from 2 to 5 ppm in the grass, <2 to 3 ppm in the forbes, and <2 ppm in the soil. The highest levels of molybdenum detected are approximately 2,930 ppm in the soil, 2,441 ppm in the grass and 1,949 ppm in the forbes, all of which are in areas directly adjacent to M-225. These levels drop to approximately 78.6 ppm in the soils, 620 ppm in the grasses and 222 ppm in the forbes within a 1,000 foot circle of M-225, with most measured levels decreasing rapidly outside of the circle as distance increases. The grass molybdenum concentration in the affected areas range from 10 ppm to 2441 ppm. No traces of molybdenum were detected in the cows' drinking water sources.

03 Potential to Affect Human Health

Primary exposure to humans is low, since M-225 is in a remote location on a 10,000 acre industrial manufacturing site. The risk-based soil cleanup levels for human exposure in an industrial location based on IRIS data are calculated to be 10,000 ppm. Our maximum measured soil levels were 2,930 ppm, well below that standard.

A secondary route of human exposure considered was the ingestion of beef having elevated molybdenum levels. It is known, from the literature, that molybdenum accumulates primarily in the liver and that muscle tissue has the lowest levels of molybdenum accumulation (compared to all other tissue types). Therefore, ingestion of bovine liver would provide the highest potential dose of molybdenum. A tissue sample obtained by the rancher's veterinarian from one of the dead cows which grazed on the area of highest molybdenum concentration indicated a liver level of 23 ppm. IRIS data

establishes that the only measurable adverse effect from molybdenum ingestion in humans is a rise in uric acid levels. The literature states that the lowest level at which an observed adverse effect is seen is at ingestion levels of 10-15 ppm molybdenum/day which after many years of exposure may show a manifestation of gout. However, the literature states that molybdenum does not bio-accumulate and is quickly eliminated from cattle once they are taken off the high molybdenum diet. In fact, the biological half life of molybdenum is described in terms of hours. In order for an individual to have a potential for a 10-15 ppm exposure, an individual would need to ingest at least a kilogram of highly contaminated liver per day for many years. It is highly unlikely that any individual would be exposed to such a dosage for several reasons: 1) any cows that die on the pasture would never be used for human consumption; 2) cattle are on this pasture for a few months in the spring and fall (no long-term exposure); and 3) young bulls are typically sold to a feed lot for fattening in preparation for slaughter during which time any high liver molybdenum levels would quickly be eliminated.

Based on this information, we believe there is no threat to human health.

04 Potential for Animal and Environmental Effects

Cattle are more susceptible to molybdenum exposure than any other animal. From the literature, Molybdenum levels in pastures in excess of 10 ppm dry weight are known to cause a disease called teart, primarily characterized by chronic severe scours, with anorexia, anemia, lameness and connective tissue problems. Complex interactions occurring between copper and inorganic sulfate also play a role in the severity of the symptoms. Little is known about the mechanism of acute toxicity. Cattle grazing in the M-225 area have the greatest potential for demonstrating these classical ill effects (scours, lameness, anorexia, etc.); however, paradoxically, these cattle do not seem to exhibit some of the classical signs of molybdenum toxicity. The only classical symptom which they seem to exhibit is that of slight lameness or lethargy which has only been noted during early spring grazing, not during fall grazing in this same area, and could be a symptom of most any illness. An elevated blood urea nitrogen level (BUN) and kidney damage were discovered in an necropsy performed by the Utah State Diagnostics Laboratory on one of the dead cows. The rancher's veterinarian also measured BUN levels on some of the other ill and dead cattle and these were elevated as well. It was the laboratory's opinion that the most likely cause of that cow's death was kidney failure. Kidney failure has not been cited in the literature as an effect caused by overexposure to molybdenum. It is, therefore, inconclusive as to what extent the death or illness of the cattle is related to exposure to molybdenum.

Literature indicates that, unlike cattle, other ruminants (with the exception of sheep) and non-ruminants are highly resistant to molybdenum toxicity.

Due to the desert environment, there are no lakes, streams or any other receiving waters that are impacted by the minimal runoff from the site.

The most shallow aquifer at the treatment site is 620 feet below the surface. This water source is used for manufacturing.

Molybdenum is an essential nutrient for plant growth; plants are not adversely affected by high levels.

References

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