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Understanding MOSH & MOAH when Selecting Lubricants for Use in Food & Beverage Facilities

MOSH and MOAH are terms that have entered the food manufacturing industry and have become a trending topic internationally. MOSH and MOAH contamination comes from a variety of sources, including lubricants, packaging materials, fuels and more. The significance of this contamination as related to lubricants should be considered alongside NSF H1 guidelines and the established maximum allowable levels.

Definitions

- MOSH: Mineral Oil Saturated Hydrocarbons
- MOAH: Mineral Oil Aromatic Hydrocarbons

Background & Testing

Contamination from mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH) poses significant challenges to the international food manufacturing and packaging industry. Concerns about this type of contamination were initially raised in 2009 by the German Federal Institute for Risk Assessment (BfR), particularly in situations involving direct food contact with materials like cardboard in cereal and rice packaging. In 2012, the European Union expressed similar worries about hydrocarbon oil migrating into food products through various sources, including food packaging, adhesives, lubricants used in manufacturing equipment, and food additives. This paper primarily focuses on MOSH and MOAH contamination in manufacturing equipment.

In 2017, the European Union began providing guidelines for monitoring MOSH and MOAH levels during food manufacturing and packaging processes. While there's insufficient toxicological evidence to suggest that MOSH poses a significant health risk to humans, MOAH has been confirmed as more consequential due to its carcinogenic properties. Therefore, MOAH must be limited to negligible levels in any equipment used in food and beverage manufacturing, packaging and storage facilities.

Mineral oil, in its basic chemical form, is a mixture of saturated hydrocarbons (MOSH) and alkylated aromatic hydrocarbons (MOAH). These mineral oils consist of carbon chains, primarily within the C10 to C50 length range. The BfR has played a crucial role in developing methods for determining the content of MOSH and MOAH in lubricant formulations. The presence of MOSH and MOAH in lubricating oils depends on the type and cut of base oils (Group I, II, III, IV, V) and the processing methods used during production.

While MOSH levels may vary slightly based on the base oil cut used, it will always be identified through laboratory analysis if a mineral oil (Group I, II, or III) or a polyalphaolefin (Group IV) is employed. Currently, mineral and PAO base oils are indistinguishable from each other in the test method recommended by BfR, GC-FID. This explains why many PAO base oils show up as positive to high levels of MOSH during testing.

In most cases, MOSH-free lubricants are not necessary, especially if the lubricated application is not in direct contact with the process material. In most industries, acceptable MOSH levels are higher than what the NSF H1 spec allows, which is 10 ppm. Following is a table that describes the MOSH levels allowed in finished products, according to the Belgian Food Safety Authority.

MOSH Action Limits

Products	Allowable MOSH level per kg of food
Milk and milk products	5 mg
Cereals	15 mg
Vegetable products, snacks and desserts	20 mg
Products of animal origin, sugar and confectionery	30 mg
Fish and fish products	60 mg
Spices and herbs	70 mg
Animal and vegetable oils	100 mg
Vegetables, tree nuts, oilseeds and egg products	150 mg

Source: Belgian Food Safety Authority, C16-C35, 2017

While MOSH has been found to be inconsequential to production processes, MOAH continues to be a concern. A study conducted by the European Food Safety Authority based on research involving rats has suggested that the inflammatory response in the livers of the test subjects may not be relevant to humans. However, the study indicates that some MOAH are mutagenic and carcinogenic, primarily those with three or more aromatic rings. Thus, contamination of food, especially those with MOAH containing three or more aromatic rings, should be minimized.

Lubricant Selection

Careful consideration must be given when using mineral or synthetic lubricants in food and beverage manufacturing processes to prevent lubricant contamination.

MOSH-free lubricants are rare, even among NSF H1 lubricants, and some countries' food safety authorities set MOSH contamination limits higher than the recommended guidelines provided by the NSF H1 label. Even so, H1 lubricants should not be used in direct food contact applications, but rather limited to situations with an incidental food contact possibility. Precautions should be taken to prevent lubricant contamination in the food processing. The United States Food and Drug Administration (USDA) – in 21 CFR § 178.3570 – specifies a maximum threshold of 10-ppm contamination limits of lubricants in food if there is unavoidable direct contact.

In contrast, MOAH contamination must adhere to extremely low limits, often below 1 mg/kg of food. When using lubricants in applications with direct or incidental food contact, it is essential to use high-quality lubricants that contain little to no detectable MOAH. This can be verified through laboratory testing or by consulting the lubricant manufacturer.

Reference: BfR "Questions and Answers on Mineral Oil Components in Food" – https://www.bfr.bund.de/cm/349/questions-and-answers-on-mineral-oil-components-in-food.pdf

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