Attachment 10 – AMG-HCO ENVIRONMENTAL ASSESSMENT

1. **Date:** June19, 2007

2. **Name of Submitter:** Danisco A/S

3. **Address of Submitter**
   565 Taxter Road – Suite 590
   Elmsford, NY 10523

4. **Description of Proposed Action**

a. Proposed Action

Danisco USA respectfully requests FDA to approve the use of a new food contact substance in food packaging articles.

The proposed food contact substance (FCS) is a technical formulation of fully acetylated monoglycerides of fully hydrogenated castor oil (AMG-HCO). The FCS will be used as a plasticizer and colorant carrier in plastics. As a plasticizer in plastic food-packaging articles, the FCS will be used as follows:

- in polyvinyl chloride (PVC) sealing rings for bottle closures at bulk concentrations not to exceed 34 percent-by-weight of the finished product in contact with all foods (aqueous, acidic, alcoholic, and fatty foods) for single use under Conditions of Use B through H;

- in molded storage containers made from food-packaging polymers such as ethylene/vinyl chloride copolymers, ethylene/vinyl acetate copolymers, polyolefins, polystyrene, polyesters, nylon, acrylics, and polylactic acid polymers at bulk concentrations not to exceed three percent-by-weight of the finished product for repeat use in contact with all foods stored at temperatures at or below room temperature and reheated to temperatures achieved by microwave preparation.

As a colorant carrier/dispersant in plastic food-packaging articles, the FCS will be used:

- in molded storage containers fabricated from food-packaging polymers such as ethylene/vinyl chloride copolymers, ethylene/vinyl acetate copolymers, polyolefins, polystyrene, polyesters, nylon, acrylics, and polylactic acid polymers at bulk concentrations not to exceed 0.5 percent-by-weight of the finished product for repeat use in contact with all foods stored at temperatures at or below room temperature and reheated to temperatures achieved by microwave preparation.

b. Need for Action

The proposed use relates to compositions comprising thermoplastic polymers and AMG-HCO, which acts as a plasticizer. The properties of thermoplastic polymers are often modified or enhanced by the addition of plasticizers. Because of safety considerations in certain applications, there is a need for effective replacements of traditionally used phthalate and adipate plasticizers. AMG-HCO is produced from fully renewable vegetable sources, which have a comparatively improved safety profile, and functions effectively as a plasticizer in a range of food-contact polymers.

AMG-HCO will also be used as a dispersant/carrier agent for pigments and dyes contained in liquid technical formulations of colorants. Such formulations are added to impart color during manufacture of molded plastic food-packaging articles. AMG-HCO provides functional properties necessary to reduce the viscosity and to improve the mixing characteristics of high-solids colorants in liquids thereby providing uniform pigment and dye dispersion in plastic articles without disruption of commercial molding processes and without introduction of commercially unacceptable appearance defects, such as specks and streaks, in the finished food-packaging articles.

Performance details of polymer formulations containing AMG-HCO are given in Part II D of this document. Since the AMG-HCO is intended to be a replacement for phthalate and adipate plasticizers, it is anticipated that significant use of AMG-HCO will lead to a reduction of the amount of phthalates and adipates entering the food supply and the environment.

c. Locations of Use

(Note: The phrase "Locations of use" refers to where the FCS is used to make flexible polymers and food packaging therefrom and not to the locations where the FCS itself is produced or manufactured)

Danisco does not intend to produce compositions comprising polymers and AMG-HCO or the finished food-packaging materials fabricated from such compositions. Danisco will sell AMG-HCO to manufacturers engaged in the production of such compositions, and the food-contact materials using AMG-HCO will be incorporated into plastic food-packaging at production plants located throughout the United States. Finished food-packaging containing AMG-HCO is expected to be utilized in patterns corresponding to national population density and to be distributed widely across the country.

An MSDS for the product is appended in Attachment 21. Further details are given below.

d. Locations of Disposal

Primary disposal of AMG-HCO is expected to occur nationwide as a component of food-packaging materials such that the materials containing AMG-HCO will ultimately be deposited in municipal solid waste landfills, incinerated, or, if possible, recycled.

Secondary disposal of AMG-HCO is expected to occur for that material that has migrated from food-packaging into food and following consumption of that food. Any ingested substance and its metabolites are expected to enter publicly owned treatment works (POTW) or septic systems for collecting and treating excreted human waste products. The replacement of traditionally used plasticizers by AMG-HCO in finished food-packaging materials is not expected otherwise to alter the utilization and subsequent disposal patterns of such plasticized materials themselves.

5. Identification of chemical substances that are the subject of the proposed action

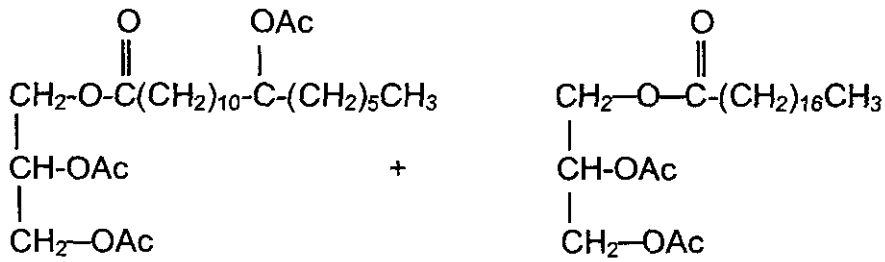
a. Chemical Composition

The proposed FCS AMG-HCO has been assigned the CAS RN 736150-63-3 and is further identified as follows:

CA Index Name – Glycerides, castor oil mono-, hydrogenated, acetates
Generic Name – Acetylated monoglyceride of fully hydrogenated castor oil (AMG-HCO)

Trade Name - GRINDSTED® SOFT-N-SAFE

The chemical structures of the main components (total ~94%) are shown below. The product is a clear yellowish liquid with a bland taste.



CAS RN	330198-91-9	33599-07-4
Molecular formula	$C_{27}H_{48}O_8$	$C_{25}H_{46}O_6$
Molecular weight	500.7	442.6
Ratio of acetylated 1-monoglyceride: acetylated 2-monoglyceride	~2:1	~2:1
Total of two isomers	~84%	~10%

Including impurities, AMG-HCO has the following approximate composition:

Compound	Abbreviation	Content
1-(12-acetoxystearoyl)-, 2,3-diacetyl glycerol	mono 2Ac 18OAc	~ 56 %
2-(12-acetoxystearoyl)-, 1,3-diacetyl glycerol	mono 2Ac 18OAc	~ 28 %
1-stearoyl-, 2,3-diacetyl glycerol	mono 2Ac 18	~ 6.7 %
2-stearoyl-, 1,3-diacetyl glycerol	mono 2Ac 18	~ 3.3 %
1-(12-acetoxystearoyl-, 2-hydroxy, 3-acetyl glycerol	mono 1Ac 18OAc	~ 2 %
1-(12-ketostearoyl-, 2,3-diacetyl glycerol	mono 2Ac 18O	~ 2 %
1,3-(diacetoxystearoyl)-, 2-acetyl glycerol	di 18OAc 1Ac	~ 1 %
1-stearoyl-, 2-hydroxy, 3-acetyl glycerol	mono 1Ac 18O	~ 1 %
diglycerol tetra-acetate	DIGL-4Ac	~ 0.3 %

b. Physicochemical Properties of AMG-HCO

The physical and chemical properties of AMG-HCO are similar to those of normal triglyceride oils. Like these materials, AMG-HCO will hydrolyze upon exposure to aqueous alkaline or acidic conditions yielding its component parts - glycerol, acetic acid and 12-hydroxystearic acid.

The **octanol/water partition coefficient** of AMG-HCO was determined to be 2.5 x 10^6 (log Ko/w = 6.4) by reverse phase HPLC [OECD Guidelines, method 117 (1989); see Attachment 22]. Log Ko/w was also estimated to be 6.42 by the method of Hansch and Leo (1979).

The **water solubility** of AMG-HCO was determined to be less than 0.33 mg/L at RCC Ltd, Itingen, Switzerland, by the shake flask method according to guidelines in OECD 105 (Attachment 23). Test article concentration in water was determined by silylation/gas chromatography. An EPA program called WSKOWWIN v1.40 (EPI Suite v3.11) estimates aqueous solubility from log Ko/w values. For AMG-HCO, this gave a value of 0.0475 mg/L. Estimates using other published algorithms were 0.0603 mg/L (Hansch et al 1968); 0.332 mg/L (Yalkowsky and Valvani 1980); 0.138 mg/L (Tewari et al 1982);

0.217 mg/L (Wakita et al 1986); and 0.000205 and 0.000937 mg/L (Klopman et al 1992) (see Attachment 25).

The **soil adsorption coefficient** Koc of AMG-HCO was estimated to be 240,000 (log Koc = 5.4) based on HPLC testing at RCC Ltd, Itingen, Switzerland, according to guidelines in OECD 121 (see Attachment 26). This value classifies the product as "immobile."

The **vapor pressure** of AMG-HCO was found to be 1.05×10^{-4} Torr (1.4×10^{-2} Pa) at 123.6 °C based on gas saturation testing at RCC Ltd, Itingen, Switzerland, according to guidelines in OECD 104. Extrapolation of the results using the modified Clausius-Clapeyron equation gives an estimated vapor pressure of 3.6×10^{-10} Torr (4.8×10^{-8} Pa) at 25°C (Attachment 27).

6. Introduction of Substances into the Environment.

a. As a Result of Manufacture

The AMG-HCO is manufactured solely at Danisco's manufacturing plant in Grindsted, Denmark, and will be imported into the US from there, thus no substances will be introduced into the US environment as a result of manufacture. This site has 94 acres of land where both technical development and production of various emulsifiers, flavor ingredients and pharmaceuticals take place. The AMG-HCO production facility in Denmark operates in compliance with the environmental regulations of Denmark. Any waste streams from the manufacturing process will be treated at the wastewater plant that is located on the Grindsted site.

Export of AMG-HCO to the US will initially be limited to (*Confidential item 3*). Depending on the market response to this product, the maximum amount of future US imports of AMG-HCO could reach *(Confidential item 4*).

Under NEPA (National Environmental Policy Act) US federal agencies must consider environmental impacts abroad [Council on Environmental Quality memorandum (http://ceq.eh.doe.gov/nepa/regs/transguide.html)]. NEPA's 1998 implementing procedures do not require FDA to routinely inquire about environmental introductions resulting from production of an FDA-regulated article unless extraordinary circumstances exist that apply to the manufacturing site. No extraordinary circumstances apply to the manufacture of AMG-HCO at the Grindsted, Denmark, facility.

b. As a Result of Use

Little or no introduction of AMG-HCO into the environment will result from its use in polymers at processing sites or at sites where such processed polymers are subsequently incorporated into packaging materials. In these processing applications, the AMG-HCO and the polymers containing the AMG-HCO will be almost completely incorporated into finished food-packaging materials. Any waste materials generated in these processes, e.g., spills or plant scraps, are expected to be very little in quantity and will be disposed of as part of the processor's overall non-hazardous solid waste in accordance with established environmental and occupational safety requirements.

c. As a Result of Disposal from use in Food-Packaging Material

AMG-HCO is expected to be disposed of primarily as a component of food-packaging materials, discarded after their use into municipal solid waste. According to the United States Environmental Protection Agency (EPA), about 80% of municipal solid waste collected in the United States that is not recovered is ultimately disposed in landfills and about 20% is ultimately incinerated (US EPA 2006).

Because of the nature of its use and its physicochemical properties as discussed above, volatile emission of AMG-HCO into the atmosphere is very unlikely after its disposal from use. Proper incineration of AMG-HCO, like that of other common vegetable fats and oils, is expected to produce carbon dioxide and water.

Only extremely small amounts, if any, of AMG-HCO or its related substances are expected to migrate or leach from food-packaging materials and to enter the environment as a result of disposal of food-contact articles in landfills. Even if very small quantities of AMG-HCO and its related substances were present in leachable emissions from landfills, the introduction of these substances into the environment is not anticipated to violate or threaten to violate EPA's regulations governing municipal solid waste landfills. EPA's regulations require new municipal solid-waste landfill units and lateral expansions of existing units to have composite liners and collection systems for leachate to prevent leachate from entering ground and surface water and to have ground-water monitoring systems. Although owners and operators of existing active municipal solid waste landfills that were constructed before October 9, 1993, are not required to retrofit liners and collection systems for leachate, they are required to monitor groundwater and to take corrective action as appropriate

To the extent that AMG-HCO may become a component of food in contact with packaging materials, a proportion of the AMG-HCO used in food-packaging applications may be disposed secondarily in POTW or septic systems for collecting and treating excreted human waste products. AMG-HCO will be used principally as a plasticizer in PVC. The use of PVC sealing rings or other plasticized plastic, molded, storage articles in contact with fatty food may result in significant migration of AMG-HCO into food. We assume that the major factors controlling the extent of secondary disposal are:

- 26% of all packed food is fatty food,
- 22% of all fatty food is packed in polymeric packaging,
- 10% of all polymeric packaging for any food is PVC;
- 50% of PVC food-packaging is plasticized.

The above percentages are drawn from data tables for consumption factors and food-type distribution factors found in US FDA 2002. The listed percentages are categorically dependent upon the relative number of distinct consumption and food-type distribution factors.

We compute that any introduction into the environment resulting from AMG-HCO becoming a component of food will be less than about 0.3% of the total food-contact use of AMG-HCO. (100% AMG-HCO food-contact use x 0.26 fatty food distribution factor x 0.22 fatty food distribution in polymeric packaging factor x 0.10 polymeric packaging as PVC consumption factor x 0.50 PVC plasticized fraction consumption factor = 0.3% of all AMG-HCO food-contact use becoming a component of fatty food packed principally in contact with plasticized PVC.)

Therefore, virtually all (around 99.7%) of the total quantity of AMG-HCO in food-packaging may become a source of potential emissions introduced into the environment after disposal into municipal solid waste landfills. Very little (about 0.3%) of AMG-HCO is potentially introduced into the environment from treated wastewater discharged from POTW and septic systems.

However, we conclude that no significant introductions of substances—AMG-HCO or its decomposition products—are actually emitted into the environment from any one route or both routes of disposal because a) pharmacokinetic (Attachment 38), *in vitro* hydrolysis (Attachment 18) and rat fecal analysis (Attachment 19) studies herein demonstrate that such ingested material will be metabolized and digested rapidly via normal lipid metabolism pathways, resulting in negligible material entering sanitary treatment systems; and b) manometric respirometry data (Attachment 28) show the biodegradability of AMG-HCO in the environment. Physicochemical properties (listed in Item 5 above) significantly limit the degree and extent of ecological exposure from transport of AMG-HCO within and amongst the principal environmental compartments, and the projected market volume, which is provided as confidential information elsewhere in this notification, poses no threat to violate environmental regulations resulting from management of the quantities disposed into landfills or entered into POTWs.

7. Fate of substances released into the environment

No information need be provided on the fate of substances released into the environment as a result of use and disposal from use of AMG-HCO because, as discussed under Item 6 of this EA, only small quantities, if any, of substances will be introduced into the environment. Therefore, the use and disposal of AMG-HCO is not expected to threaten a violation of applicable laws and regulations, e.g., the Environmental Protection Agency's regulations in 40 CFR parts 60 and 258.

8. Environmental Effects of released substances

No information need be provided on the environmental effects of substances released into the environment as a result of use and disposal from use of AMG-HCO because, as discussed under Item 6, only small quantities, if any, of substances will be introduced into the environment. Therefore, the use and disposal of AMG-HCO is not expected to threaten a violation of applicable laws and regulations, e.g., the Environmental Protection Agency's regulations in 40 CFR parts 60 and 258.

9. Use of Resources and Energy

a. Basic information

The use of AMG-HCO is intended to compete with and replace certain phthalates and adipates already used in the production of food contact plastic articles, packaging and materials. Accordingly, no additional resources are expected to be consumed as a result of the approval of the proposed action. Furthermore, since the FCS is manufactured from a vegetable oil, the consumption of non-renewable petrochemicals would be reduced by the proposed action.

- **Market volume**

The maximum yearly market volume of the FCS for the proposed uses discussed herein is confidential (*Confidential Item 4*).

- **Types of food contact articles and food applications**

The FCS will be used as a plasticizer and colorant carrier in food packaging plastics such as PVC and polyolefins used in various commercial food contact articles, e.g. molded articles, bottle cap sealing rings, containers, etc. It is intended to be a 1:1 replacement for phthalate and adipate ester plasticizers

and colorant dispersants/carriers currently used in these articles and applications. The FCS will be used as follows:

	/ Plasticizer \		Colorant Carrier
Application (see pages 7 and 9 of FCN)	PVC sealing rings	Others	All Polymers
Type of Use	single	multiple	multiple
Max Use level	34%	3%	0.5%
Types of food – 21 CFR 176.170(c) Table 1	I, II, III, VI, VIII	I, II, III, IV, VII, VIII, IX	I, II, III, IV, VI, VII, VIII, IX
Use conditions – 21 CFR 176.170(c) Table 2	B-F	B-H	B-G

b. Potential for impacts on solid waste management strategies and on energy use:

The FCS is expected to replace competitively other currently authorized plasticizers such as phthalates and adipates already used in the production of food-contact plastic articles for packaging applications with all food types (aqueous, acidic, alcoholic, and fatty). Use of the FCS as a colorant carrier/dispersant is similarly competitive with other substances of identically functional effect. Such replacement will constitute a source reduction, especially in current uses of phthalates and adipates, and thereby may achieve advantages in applications facing exceptional toxicological constraints and environmental concerns about disposal. AMG-HCO has a) comparatively less ecotoxicity; and b) ecologically more sustainability in environmental conservation than substances that it competitively replaces. To the extent that the FCS efficiently replaces competitive substances having the same technical effect for packaging food and the same food-contact applications, demands on total resources and energy are expected either to remain virtually unchanged or to become diminished because the FCS is produced from fully renewable resources as compared, for example, to phthalate and adipate substances, which are produced from non-renewable petrochemical resources. Accordingly, no additional resources and energy are expected to be consumed as a result of the approval of the proposed action.

Recycling is minimal for glass jar lid sealing rings and for the kinds of polymers fabricated into molded storage articles in which the FCS is principally used, as identified and described above in Item 4.a for the requested action. AMG-HCO in food-contact articles is anticipated to be almost entirely (at least 99.7% of the market volume) disposed in landfills so that virtually no alteration from disposal patterns for articles currently plasticized with phthalates and adipates is expected by their replacement with AMG-HCO. Disposal from use of the FCS as a colorant carrier/dispersant in food contact articles, which is a minor use of AMG-HCO, is similarly included. Therefore, the agency's action to authorize use of AMG-HCO in contact with food has neither a potential to affect significantly any existing recycling programs for such materials in which the FCS is used or other materials with which it competes in uses nor to alter the proportions of discarded articles in municipal solid waste managed by combustion (about 20%) and by disposal in landfills (about 80%).

In particular, the proposed principal use of the FCS as a plasticizer in fabricating food-packaging material will not introduce an increase in the amount of concomitant PVC into commerce because the FCS is intended to replace competitively other substances already similarly used to achieve the same technical effect. Consequently, as a result of an action to permit use of the FCS, we expect no significant impact on the capacity of landfills and the management strategies at landfills for disposed PVC types of food-packaging (or other plasticized plastic articles).

10. Mitigation Measures

Based on this environmental assessment, there will be no adverse environmental impacts from the use or disposal of AMG-HCO or its degradation products. Thus, no mitigation procedures are needed.

11. Alternatives to the Proposed Action

No potential adverse environmental impacts have been identified for the proposed action, so no alternatives to the proposed action are contemplated.

12. Certification Statement:

The undersigned official certifies that the information presented is true, accurate, and complete to the best of the knowledge of Danisco A/S.

6/21/07
(Date)

(Signature of responsible official)

Michael H. Auerbach. Senior Science Advisor. Corporate Regulatory Affairs
(Name and title of responsible official, printed)

13. List of Preparers

Michael H. Auerbach, Senior Science Advisor, Corporate Regulatory Affairs, Danisco A/S (chemistry)
Diana Graham, Staff Scientist, Keller & Heckman LLP (chemistry)

14. References

1. Hansch C, Leo AJ. Substituent Constants for Correlation Analysis in Chemistry and Biology, John Wiley, New York (1979).
2. Hansch C, Quinlan JE, Lawrence GL 1968. The linear free-energy relationship between partition coefficients and the aqueous solubility of organic liquids. J. Org. Chem. 33:347
3. Klopman G, Wang S, Balthasar DM. 1992. Estimation of aqueous solubility of organic molecules by the group contribution approach. Application to the study of biodegradation. J Chem Inf Compu Sci 32:474-482
4. Tewari YB, Miller MM, Wasik SP, Martire DE. 1982. Aqueous solubility and octanol/water partition coefficients of organic compounds at 25.0 °C. J. Solution Chem. 11:435-445
5. United States Environmental Protection Agency. Municipal Solid Waste in the United States: 2005 Facts and Figures. EPA-530-R-06-011, Office of Solid Waste, Washington, DC, October 2006).
6. United States Food and Drug Administration, Guidance for Industry. Preparation of Food-contact Notifications and Food Additive Petitions for Food-contact Substances: Chemistry Recommendations, Center for Food Safety and Applied Nutrition, Office of Food Additive Safety, Rockville, MD, April 2002, Appendix IV)
7. Wakita K, Yoshimoto M, Miyamoto S, Watanabe H. 1986. A method for calculation of the aqueous solubility of organic compounds by using new fragment solubility constants. Chem Pharm Bull 11:4663-4681
8. Yalkowski SH, Valvani SC. 1980. Solubility and Partitioning I: Solubility of Non-electrolytes in water. J Pharm Sci. 69:912-922
9. Additional references on the safety of AMG-HCO and its components are given in Part III, Section 9 and Attachments 12-17, 29-31 and 34-38 of this FCN.