ENVIRONMENTAL ASSESSMENT

1. **Date:** January 15, 2014

2. **Name of Applicant:** Troy Corporation

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4. Description of the Proposed Action

The action requested in this submission is the notification of the use of the "reaction product of paraformaldehyde and ethylene glycol" as an in-can stabilizer for commercial biocides used in the production of food-contact paper and paperboard. We hereafter refer to this reaction product as the "FCS". The FCS is primarily a mixture of ethylene glycol and formaldehyde adducts of varying chain lengths.

The FCS is intended to be used as a stabilizer for biocides used to preserve filler or additive mixtures in the production of food-contact paper and paperboard. The FCS will be added at levels up to 150 parts per million (ppm) to filler or additive mixtures that are used prior to the sheet forming process at the wet-end of the papermaking process. The FCS is also intended to be used as a stabilizer for biocides used to preserve paper coating solutions at levels up to 75 ppm, relative to the coating solution.

Commercial biocides formulated with the FCS have been shown to more fully retain their activity throughout storage and transport. The enhanced stability of the biocide provides significant improvements in efficacy as compared to biocides formulated without the FCS.

The FCS is intended to function solely during the pre-use transport and storage of the biocide formulation in which it is used. It is not intended or expected to remain in the commercial biocide following storage, nor to be present in the filler/additive mixture, the coating solution, or the finished paper or paperboard.

Troy Corporation produces the FCS and sells formulated biocide products that contain the FCS to its customers. These customers, in turn, will use the biocide products in filler and additive mixtures and/or coating formulations that will be employed in the manufacture of paper and paperboard.

Food-contact articles made from paper or paperboard produced with the FCS will be utilized in patterns corresponding to the national population density and will be widely distributed across the country. As to disposal, according to U.S. Environmental Protection Agency (EPA) data for 2010, approximately 54.2% of municipal solid waste is currently deposited in land disposal sites, 11.7% is combusted, and 34.1% is recovered (a combination of waste recovered for recycling and for composting). The types of environments present at and adjacent to the disposal locations are the same as for the disposal of any other food-contact material in current use. Consequently, there are no special circumstances regarding the environment surrounding either the use or disposal of food-contact materials prepared using the FCS.

5. Identification of Chemical Substance that is the Subject of the Proposed Action

The subject of this notification is the reaction product of paraformaldehyde and ethylene glycol (no CAS Registry Number). The FCS is a complex mixture, with the majority of substances best described as adducts of formaldehyde and ethylene glycol. One of the primary components of the FCS is (ethylenedioxy)dimethanol (CAS Reg. No. 3586-55-8), also known as ethyleneglycol bis(semiformal); the remaining substances are similar in structure, and may include higher order oligomers of the ethylene glycol and formaldehyde reaction products

6. Introduction of Substances into the Environment

a. Introduction of substances into the environment as a result of manufacture:

Under 21 C.F.R. § 25.40(a), an environmental assessment should focus on relevant environmental issues relating to the use and disposal from use, rather than the production, of FDA-regulated articles. Information available to the Notifier does not suggest that there are any extraordinary circumstances in this case indicative of any adverse environmental impact as a result of the manufacture of the FCS. Consequently, information regarding the manufacturing site and compliance with the relevant emissions requirements is not provided here.

b. Introduction of substances into the environment as a result of use/disposal:

Upon addition to water, the FCS hydrolyzes to yield formaldehyde (CAS Reg. No. 50-00-0) and ethylene glycol (CAS Reg. No. 107-21-1) as byproducts. Formaldehyde is the active stabilizer whereas ethylene glycol does not serve an ongoing function. As the FCS is expected to undergo 100% hydrolysis before there is any opportunity for its release into the environment, only the environmental impact of the hydrolysis products has been evaluated.

Data demonstrating the complete hydrolysis of the FCS are set forth in **Attachment 8** of this notification. In that testing, an aqueous solution containing 0.315% of the FCS in 0.1 M borate buffer (pH 8.5) was analyzed by ^{13}C NMR spectroscopy. Analyses were conducted after 2, 4, 6, 8, and 24 hours at 25°C. At all analysis intervals, only formaldehyde and ethylene glycol were detected, and complete hydrolysis was confirmed by quantification of the hydrolysis products by external calibration. Thus, the hydrolysis of the FCS in dilution aqueous solution is rapid and complete.

Based on stoichiometric considerations, and using (ethylenedioxy)dimethanol (molecular weight = 122 daltons) as a representative example of the FCS, we calculate that complete hydrolysis of the FCS results in approximately 49% formaldehyde and 51% ethylene glycol, relative to the starting concentration of the FCS.

$$C_4H_{10}O_4 \rightarrow 2CH_2O + HOC_2H_4OH$$

Formaldehyde

$$(1 \text{ mol}_{FCS}/122 \text{ g}_{FCS})(2 \text{ mol}_{Form}/\text{mol}_{FCS})(30 \text{ g}_{Form}/\text{mol}_{Form}) = 0.49 \text{ g}_{Form}/\text{g}_{FCS} = \mathbf{49\%}.$$

Ethylene glycol

$$(1 \text{ mol}_{FCS}/122 \text{ g}_{FCS})(1 \text{ mol}_{EG}/\text{mol}_{FCS})(62 \text{ g}_{EG}/\text{mol}_{EG}) = 0.51 \text{ g}_{EG}/\text{g}_{FCS} = \mathbf{51\%}.$$

Ethylene glycol may also be present as a residual impurity in the FCS at levels up to approximately 6%. Thus, total ethylene glycol based on complete hydrolysis is 57% (51% + 6%).

The primary route of potential exposure to the environment based on the intended use of the FCS involves the discharge of the FCS hydrolysis products (*i.e.*, ethylene glycol and formaldehyde) from the paper mill wastewater system to adjacent receiving waters.

When the FCS is used as a stabilizer for biocides used to preserve coating solutions, no aqueous releases are expected, as coating solutions are applied directly to paper. Thus, FCS hydrolysis product residues will remain with the finished paper or paperboard at trace levels.

When used as a stabilizer for biocides that are used in the wet end of the papermaking process, there exists the potential for the FCS hydrolysis products to enter the wastewater system of the paper mill, where the effluent may ultimately be discharged to receiving waters. However, given the large water demands of paper mills and the subsequent cost and burden associated with the use of fresh "make-up" water, wastewater recycling has become widespread throughout the paper industry. For paper mills that recycle all process water, there would be no environmental release of the FCS hydrolysis products because these substances would not be introduced to the water supply. To account for those mills that do not recycle 100% of their process water, we have estimated the potential release of the FCS hydrolysis products based on discharge to receiving waters. Even though the potential for impact to the environment is minimal, we have addressed wastewater discharge in section 6.c, below.

Minimal environmental release is expected based on the potential presence of trace levels of the FCS hydrolysis products in the finished paper and paperboard. Food-contact materials manufactured with the FCS are expected to be disposed of either by conventional rubbish disposal (*i.e.*, sanitary landfill) or incineration. Ethylene glycol and formaldehyde are simple hydrocarbons that consist only of carbon, oxygen, and hydrogen. Formaldehyde is endogenous to both man and the environment, and its potential presence at trace levels in finished paper or paperboard will pose no additional environmental burden. Formaldehyde is a natural breakdown product of organic matter, and is also a natural product of wood and paper combustion. The potential levels of formaldehyde contributed by the FCS are dwarfed by the background levels of formaldehyde in the environment. Ethylene glycol is known to pose minimal environmental impact, as it readily degrades to carbon dioxide and water. Further, ethylene glycol is non-volatile and does not pose an issue with regard to air quality. Both formaldehyde and ethylene glycol are discussed further, below.

Only extremely small amounts, if any, of the FCS hydrolysis products are expected to enter the environment as a result of the landfill disposal of food-contact articles, in light of the 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 leachate collection systems to prevent leachate from entering ground and surface water, as well as groundwater monitoring systems.[1] 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 leachate collection systems, they are required to monitor groundwater and to take corrective action as appropriate.

c. Introduction of substances into the environment through discharged process water:

We estimate here the worst-case levels of the FCS hydrolysis products (*i.e.*, ethylene glycol and formaldehyde) that may be discharged from the wastewater treatment plant. The Notifier has indicated that a representative paper mill employing the FCS produces about 500 tons of paper per day, and that approximately 10,000 gallons of water are used per ton of paper.[2]

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1 40 C.F.R. Part 258.

2 These values were supplied by a customer of the notifier with extensive experience with the paper industry. The notifier considers the identity of the customer to be confidential business information, so the customer is identified in **Attachment 13**, Confidential Attachment to Environmental Assessment. The 500 ton/day value is considered to be typical (average), and is consistent with information in the literature. See, e.g., *Toxicity of pulp and paper mill effluent: a literature review*, Floyd E. Hutchins, Western Fish Toxicology Station, Environmental Protection Agency, Office of Research and Development, Corvallis Environmental Research Laboratory, 1979, which indicates daily production for kraft paper of 200-600 tons; source available at http://books.google.com/books?id=uS4XvWUowpgC&pg=PA6&dq=how+many+tons+of+paper+are+produced+per+day+at+a+paper+mill&hl=en&sa=X&ei=SSPMUt3AHa3NsQSU8YLwDA&ved=0CEYQ6AEwAw#v=onepage&q=how%20many%20tons%20of%20paper%20are%20produced%20per%20day%20at%20a%20paper%20mill&f=false. Also see, *Environmental considerations of selected energy conserving manufacturing process options*, Volume 3, United States. Environmental Protection Agency. Office of Research and Development, Industrial Environmental Research Laboratory (Cincinnati, Ohio), Arthur D. Little, Inc (1976), citing a total net water usage of 8-10,000 gallons per ton; source available at http://books.google.com/books?id=xpkF6_ZLeVsC&pg=PA74&lpg=PA74&dq=%2210,000+gallons+per+ton+of+paper%22&source=bl&ots=JSLcpMkt7d&sig=UlsbtR_ybGx-wW7hL2LT-XJL6vU&hl=en&sa=X&ei=VCLMUtmpEOO-sQSyloK4DA&ved=0CCkQ6AEwAA#v=onepage&q=%2210%2C000%20gallons%20per%20ton%20of

(footnote continued)

We will assume that all of the paper produced at such a facility will be made using additive/filler mixtures or coating preparations to which the FCS was added (i.e., "treated" paper). On this basis, approximately 5,000,000 gallons of water per day are used to produce paper treated with the FCS.

To estimate the amount of the FCS hydrolysis products that may potentially be discharged to receiving waters, we first need to determine the amount of the FCS used per weight of paper, as follows:

The anticipated use level for the FCS in wet-end applications corresponds to 150 parts per million (ppm) in the filler or additive mixture. The solids content of mineral slurries can vary. However, the Notifier submits that a typical mineral slurry contains on the order of 70% solids. Based on this value, the use level of the FCS in the additive mixture on a dry weight basis is calculated, as follows:

$$\text{FCS per dry filler} = (150\ \text{ppm}_{\text{wet}}) \div 70\%\ \text{solids} = 214\ \text{ppm}.$$

The addition rate of filler in commercial paper can also vary. We have assumed that paper contains, on average, 15% filler. Thus, the amount of FCS per weight of paper can be estimated as follows:

$$\text{FCS per paper} = (214 \times 10^{-6}\ \text{g-FCS/g-filler})(0.15\ \text{g-filler/g-paper}) = 32 \times 10^{-6}\ \text{g-FCS/g-paper} = 32\ \text{ppm}.$$

As indicated above, we estimate a daily production volume of 500 tons of treated paper per day for a typical paper mill. Expressed on a "grams" basis, this corresponds to 4.5×10^8 grams. Thus, the amount of FCS used per day may be calculated as follows:

$$\text{FCS per day} = (32 \times 10^{-6}\ \text{g-FCS/g-paper})(4.5 \times 10^8\ \text{g-paper}) = 14{,}400\ \text{g-FCS}.$$

To estimate the maximum possible amount of FCS hydrolysis products that may be discharged to receiving waters, absent consideration of losses of the FCS or reductions based on wastewater treatment or recycling, we first calculate the total mass of FCS used per day relative to the total quantity of water used in a given day (*i.e.*, 5,000,000 gallons or 1.9×10^{10} grams):

$$\text{FCS used per day relative to waste water discharged} = 14{,}400\ \text{g-FCS} \div 1.9 \times 10^{10}\ \text{g-water} = 7.6 \times 10^{-7}\ \text{g-FCS/g-water} = 760\ \text{parts per billion (ppb)}.$$

%20paper%22&f=false. For high-production mills that may produce more than 500 tons/day, the volume of water used in the process will be proportionally higher, so the calculations presented here are expected to be representative of such mills as well.

As shown in **Section 6.b** above, complete hydrolysis of the FCS produces approximately 49% formaldehyde relative to the initial concentration of the FCS. Thus, the maximum estimated concentration of formaldehyde discharged in the effluent is:

Max discharged Formaldehyde = 760 ppb-FCS x 49% Form = 370 ppb.

Similarly, ethylene glycol may account for as much as 57% of the initial FCS concentration following complete hydrolysis of the FCS. Thus, the maximum estimated level of discharged ethylene glycol is:

Max discharged Ethylene Glycol = 760 ppb-FCS x 57% EG = 434 ppb.

These values do not account for losses (evaporative, wastewater treatment, or other). Further, the estimate for formaldehyde does not consider the reduction of formaldehyde based on expected reactions with microorganisms in the process water at the paper mill.

7. Fate of Emitted Subjects in the Environment

a. Air

No significant effects on the concentrations of and exposures to any substances in the atmosphere are anticipated due to the proposed use of the FCS. As discussed previously, the FCS is expected to hydrolyze 100% before release, yielding ethylene glycol and formaldehyde as hydrolysis products.

Ethylene glycol is of low volatility (vapor pressure = 0.089 mm Hg at 25°C) and is miscible with water. The low Henry's Law constant (6.00×10^{-8} atm-m^3/mole) indicates that ethylene glycol released in waste water is unlikely to partition to the atmosphere via volatilization.[3] Ethylene glycol released to the air undergoes rapid photochemical oxidation, and the half-life for EG in the atmosphere has been estimated to be 1.4 days.[4]

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3 *See* Toxicological Profile for Ethylene Glycol. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR), November 2010, available at http://www.atsdr.cdc.gov/toxprofiles/tp96.pdf. For this information, ATSDR cites: (1) Simmons P, Branson D, Bailey R., 1976, 1,2,4-Trichlorobenzene: Biodegradable or not? In: Book pap, Int Tech Conf. Research Triangle Park, NC: American Association Text, 212-217; and (2) Thomas RG. 1990, Volatilization from water. In: Lyman WJ, Reehl WF, Rosenblatt DH, eds. Handbook of chemical property estimation methods: Environmental behavior of organic compounds. Washington, DC: American Chemical Society, 15-1 to 15-34.

4 *See* Toxicological Profile for Ethylene Glycol, ATSDR, *id.* The atmospheric half-life was calculated based on a measured reaction rate constant of 7.7×10^{-12} cm^3/molecule-second at 25 °C, assuming a 12-hour day and an average day-light atmospheric hydroxyl radical concentration of 1.5×10^6 radicals/cm^3. For information on half-life of ethylene glycol, ATSDR cites: (1) Atkinson R. 1989. Kinetics and mechanisms of the gas-phase reactions of the hydroxyl radical with organic compounds. New York, NY: American Institute of Physics, American Chemical Society, 140; and (2) EPA. 1993e. Determination of rates of reaction in the gas-phase in the troposphere. Theory and practice. 5. Rate of

(footnote continued)

With regard to formaldehyde, any formaldehyde released from the paper machine is controlled by air handling systems within the paper mill. Because formaldehyde is stable in aqueous solutions as methylene glycol, release of formaldehyde to the atmosphere from filler or coating solutions is unlikely.[5] If formaldehyde is released to the atmosphere, it is expected to be indirectly photodegraded by reaction with OH-radicals, with a half-life of 1.7 days.[6] Formaldehyde may also be removed from air by means of direct photolysis, with a half-life of 4.1 hours.[7]

Finally, the incineration of paper or paperboard products that may contain trace levels of FCS hydrolysis products is not expected to have any adverse environmental impact. The products of complete combustion of FCS hydrolysis products would be carbon dioxide and water, and such combustion would not have any material impact on the amounts of these substances released to the environment or significantly alter the emissions from properly operating municipal solid waste combustors. Thus, incineration of paper and paperboard made with the use of biocides treated with the FCS will not cause municipal solid waste combustors to threaten a violation of applicable emissions laws and regulations (40 C.F.R. Part 60 or relevant state and local laws).

b. Water

The maximum anticipated concentrations of formaldehyde and ethylene glycol that may be released from the paper mill's wastewater treatment plant are 370 ppb and 434 ppb, respectively, assuming conservatively that no formaldehyde or ethylene glycol is lost during processing. The actual concentration of these substances present in the receiving water will necessarily be less, based on dilution. If we assume that the effluent concentrations are diluted by as little as 10-fold, the maximum concentrations of formaldehyde and ethylene glycol in the receiving water will be 37 ppb and 43 ppb, respectively.

Formaldehyde is readily biodegradable (90% after 28 days) according to testing under OECD 301D (closed bottle) test conditions. Hydrolysis is not expected under typical conditions.

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indirect photoreaction: Evaluation of the Atmospheric Oxidation computer program of Syracuse Research Corporation for estimating the second-order rate constant for the reaction of an organic chemical with hydroxyl radicals. Washington, DC: U.S. Environmental Protection Agency. EPA744R93001.

5 This is further evidenced by the low Henry's Law constant for formaldehyde of 3.4×10^{-7} atm-m^3/mol. *See* United States National Library of Medicine (NLM), ChemIDplus Advanced, *available at:* http://chem.sis.nlm.nih.gov/chemidplus/ (search term: CASRN 50-00-0).

6 *See* U.S. Environmental Protection Agency (EPA), Organization for Economic Cooperation and Development (OECD), Screening Information Data Set (SIDS) Voluntary Testing Program for International High Production Volume Chemicals, SIDS Initial Assessment Report for Formaldehyde, Paris, France (March 2002), citing Atkinson, R., Journal of Physical and Chemical Reference Data Monograph No. 2, p. 118, 1992; *available at:* http://www.who.int/ipcs/publications/cicad/en/cicad22.pdf.

7 *See* SIDS Initial Assessment Report for Formaldehyde, *id.*, citing Gardner, E.P. et al., J. Phys. Chem. 88, 5069-5076, 1984.

However, formaldehyde is typically hydrated in aqueous solutions to form methylene glycol. The log P_{OW} is 0.35 at 20°C, indicating that bioaccumulation is unlikely.[8]

Hydrolysis of ethylene glycol in the environment is unlikely. However, ethylene glycol has been shown to readily biodegrade in aqueous media including river water. Primary degradation is generally complete within 3 days, with remaining degradation occurring from 14-21 days.[9] The log P_{OW} has been shown to range from -1.36 to -1.96, indicating that bioaccumulation is unlikely.

c. Land

No significant effects on exposure to any FCS-derived substance in terrestrial ecosystems are anticipated as a result of the proposed use of the FCS. No significant quantities of any substance will be added to these environments upon incineration or disposal in landfills.

8. Environmental Effects of Released Substances

The maximum estimated concentration for formaldehyde and ethylene glycol in receiving waters was determined to be 37 ppb and 43 ppb, respectively. Based on the convervative assumptions employed in these calculations, we would expect the actual concentrations to be considerably less.

Based on the SIDS summary for formaldehyde, the lowest LC_{50} with regard to formaldehyde toxicity to aquatic organisms is 6.7 mg/l (96 hr LC_{50}) for *Morone saxatilis*.[10] The estimated concentration of formaldehyde based on the use of the FCS is 37 ppb, more than 100 times lower than the lowest LC_{50}. The Notifier submits that the potential introduction of formaldehyde to receiving waters at this low level does not pose an environmental concern. To better put the estimated level into perspective, we note that, for example, formaldehyde levels in ozonated drinking water have been reported as high as 30 µg/l (*i.e.*, 30 ppb).[11]

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8 *See* SIDS Initial Assessment Report for Formaldehyde, *supra* note 6, citing (1) Gerike P., Gode P., Chemosphere, 21: 799-812, 1990 (biodegradability); (2) Betterton, E.A., Henry's Law Constants of soluble and moderately soluble organic gases: effects on aqueous phase chemistry, in Gaseous Pollutants: Characterisation and Cycling, Edited by J.O. Nriagu, 1992 (hydration); and (3) Sangster J., Octanol-Water Partition Coefficients of Simple Organic Compounds, J. Phys. Chem. Ref. Data, Vol. 18, No. 3, 1989 (log P_{OW}).

9 *See* World Health Organization (WHO), Concise International Chemical Assessment Document 22, "ETHYLENE GLYCOL: Environmental aspects" (2000), *available at:* http://www.who.int/ipcs/publications/cicad/en/cicad22.pdf.

10 *See* SIDS Initial Assessment Report for Formaldehyde, *supra* note 6.

11 *See* WHO, "Formaldehyde in Drinking-water: Background document for development of WHO *Guidelines for Drinking-water Quality*" (2005), *available at:* http://www.who.int/water_sanitation_health/dwq/chemicals/formaldehyde130605.pdf.

Ethylene glycol is considered to be of low toxicity to aquatic organisms, with toxic thresholds above 1000 mg/l. LC_{50}'s for aquatic invertebrates, fish and amphibians are greater than 10,000 mg/l.[12] Use of an LC_{50} of 10,000 mg/l results in a margin of safety greater than 230,000 relative to the estimated concentration in receiving waters.

Accordingly, no adverse effect on aquatic organisms in the environment is expected as a result of the potential release of FCS hydrolysis products to receiving waters. Furthermore, no adverse effects on the environment in total are anticipated based on use of the FCS as intended.

9. Use of Resources and Energy

As with other food packaging materials, the production, use, and disposal of the FCS involves the use of natural resources such as petroleum products and coal. The FCS is already being used in non-food contact applications, and no increase in resources based on production of the FCS is expected. Further, use of the FCS is likely to increase the efficacy of commercial biocides, which will necessarily reduce the amount of those biocides required for the intended uses described herein. Further, the biocides formulated with the Notifier's FCS are expected to compete with, and to a large degree replace, similar biocide products already on the market for use in food-contact applications. No net increase in the use of energy and resources is expected.

Paper or paperboard containing the FCS hydrolysis products will not affect existing paper recycling streams. Formaldehyde is already used widely in paper and coatings and is cleared for use as a preservative for paper coatings per 21 C.F.R. Section 176.170. Further, formaldehyde is an endogenous, 1-carbon substance that is an expected breakdown product of organic substances. With regard to ethylene glycol, many ethylene glycol derivatives are already cleared for use in paper and paperboard per FDA's regulations (*e.g.*, Section 176.170, 176.180, 176.200, 176.210, *etc.*). Further, during the pulping process, the majority of ethylene glycol present in the paper or paperboard will dissolve in the process water, based on its appreciable water solubility. Overall, the potential presence of these substances will pose no issues with regard to paper recycling.

10. Mitigation Measures

The intended use of the FCS is not reasonably expected to create new environmental impacts that would require mitigation measures of any kind. As discussed above, the potential release of FCS hydrolysis products based on the disposal of finished food-contact articles that contain the FCS is insignificant to the environment. In addition, although the potential exists for hydrolysis products of the FCS to enter receiving rivers, we have demonstrated that the maximum levels at which these products could enter the environment is safe to a reasonable certainty. Thus, the use of the FCS as proposed is not expected to result in new environmental releases requiring mitigation measures of any kind.

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[12] *See* ETHYLENE GLYCOL: Environmental aspects, *supra* note 9.

11. Alternatives to the Proposed Action

No potential adverse effects are identified herein that would necessitate alternative actions to that proposed in this request. If the proposed action is not approved, the result would be the continued use of materials that the subject FCS is intended to replace. Such action would have no environmental impact. Considering the desirable properties of the FCS for use in food-contact applications, the fact this its hydrolysis products are not expected to enter the environment at more than minute quantities upon use and disposal of finished food-contact articles, and the absence of any significant environmental impact which would result from its use, the establishment of an effective FCN to permit the use of the subject FCS as described herein is environmentally safe to a reasonable certainty. Therefore, we respectfully submit that alternatives to the proposed action need not be considered.

12. List of Preparers

Catherine R. Nielsen, Partner, Keller and Heckman LLP
Jason P. Schmidt, Scientist, Keller and Heckman LLP
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13. Certification

The undersigned official certifies that the information provided herein is true, accurate, and complete to the best of her knowledge.

Date: January 15, 2014

Catherine R. Nielsen

Keller and Heckman LLP