1. **Date:** August 24, 2018

2. **Name of Applicant:** Diversey, Inc.

3. **Address:**
All communications on this matter are to be sent in care of Counsel for the Notifier:

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4. Description of the Proposed Action

A. Requested Action

The action identified in this Notification is to provide for the use of the food-contact substance (FCS), identified as an aqueous mixture of peroxyacetic acid, hydrogen peroxide, acetic acid, l-hydroxyethylidine-1,1-diphosphonic acid (HEDP), dipicolinic acid, and optionally sulfuric acid as an antimicrobial agent in:

(1) process water applied as a spray, wash, rinse, dip, chiller water, low-temperature (e.g., less than 40 °F) immersion baths, or scald water for whole or cut poultry and meat carcasses, parts, and trim; and

(2) process water, ice, or brine used for washing, rinsing, or cooling of processed and pre-formed meat and poultry.

The components of the FCS mixture will not exceed:

(1) 2000 parts per million (ppm) peroxyacetic acid (PAA), 1474 ppm hydrogen peroxide (HP), 118 ppm HEDP, and 0.5 ppm dipicolinic acid in spray, wash, rinse, dip, chiller water, low-temperature (e.g., less than 40 °F) immersion baths, or scald water for whole or cut poultry and meat carcasses, parts, and trim; and

(2) 495 ppm PAA, 365 ppm HP, 29 ppm HEDP and 0.1 ppm dipicolinic acid in process water, ice, or brine used for washing, rinsing, or cooling of processed and pre-formed meat and poultry.

B. Need for Action

The antimicrobial effect of peroxyacetic acid reduces or eliminates populations of pathogenic and nonpathogenic microorganisms from the process water and ice used in the production and preparation of meat, including processed and preformed meat. The FCS will not have an ongoing antimicrobial effect on the meat and/or processed and pre-formed meat. The FCS will serve a technical effect only in the process water and ice. In poultry processing, particularly, industry has now added “finishing chillers” in order to treat the pathogen *Campylobacter* more effectively.

C. Locations of Use/Disposal

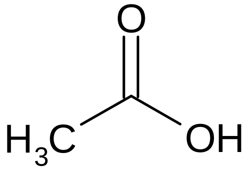
The FCS is intended for use in meat and poultry processing plants throughout the United States. All waste process water containing the FCS at these plants is expected to enter the wastewater treatment unit at the plants. For the purposes of this Environmental Assessment, it is assumed that treated wastewater will be discharged directly to surface waters in accordance with the plants’ National Pollutant Discharge Elimination System (NPDES) permit. This assumption can be considered a “worst-case” scenario since it does not take into account any further treatment that may occur at a Publicly Owned Treatment Works (POTW). It is further assumed that very minor or negligible quantities of the FCS are lost via evaporation.

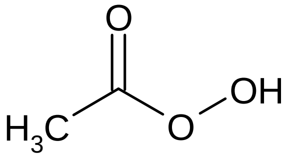
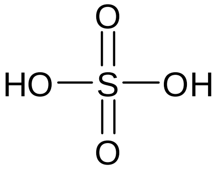
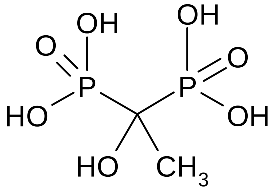
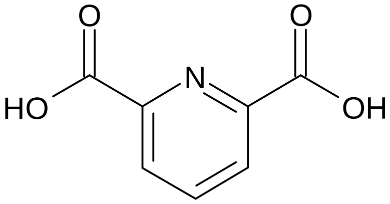
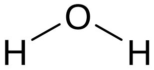
5. Identification of Chemical Substance that is the Subject of the Proposed Action

Chemical Identity

The subject of this notification is a clear liquid solution containing peroxyacetic acid (CAS Reg. No. 79-21-0), hydrogen peroxide (CAS Reg. No. 7722-84-1), acetic acid (CAS Reg. No. 64-19-7), 1-hydroxyethylidene-1,1-diphosphonic acid (HEDP) (CAS Reg. No. 2809-21-4), sulfuric acid (CAS Reg. No. 7664-93-9), dipicolinic acid (DPA) (CAS Reg. No. 499-83-2) and water (CAS Reg. No. 7732-18-5). PAA formation is the result of an equilibrium reaction between acetic acid and hydrogen peroxide.

The chemical structures are shown here:

Complete Name	CAS #	Molecular Weight	Molecular Formula	Structural Formula
Hydrogen Peroxide	7722-84-1	34.01 g/mol	H_2O_2	HO—OH
Acetic Acid	64-19-7	60.05 g/mol	$C_2H_4O_2$	

Peracetic Acid	79-21-0	76.05 g/mol	$C_2H_4O_3$	
Sulfuric Acid	7664-93-9	98.1 g/mol	H_2SO_4	
Hydroxyethylidene Diphosphonic Acid (HEDP)	2809-21-4	206.03 g/mol	$C_2H_8O_7P_2$	
Dipicolinic Acid (DPA)	499-83-2	167.12 g/mol	$C_7H_5NO_4$	
Water	7732-18-5	18.01 g/mol	H_2O	

6. Introduction of Substances into the Environment

a. 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, indicating any adverse environmental impact as a result of the manufacture of the antimicrobial agent. Consequently, information on the manufacturing site and compliance with relevant emissions requirements is not provided here.

b. As a Result of Use and Disposal

Sulfuric acid dissociates readily in water to sulfate ions (SO_4) and hydrated protons; at environmentally-relevant concentrations, sulfuric acid is practically totally dissociated.[1] As part of the natural sulfur cycle, sulfate is either incorporated into living organisms, reduced via

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[1] *See* Sulfuric Acid. The Organization for Economic Co-operation and Development (OECD) SIDS Voluntary Testing Program for International High Production Volume Chemicals. 2001, *available at* http://www.inchem.org/documents/sids/sids/7664939.pdf.

anaerobic biodegradation to sulfides, deposited as sulfur, or re-oxidized to sulfur dioxide and sulfate.[2] Therefore, any terrestrial or aquatic discharges of sulfate associated with the use described in this FCN are not expected to have any significant environmental impact, as sulfate is a ubiquitous anion that is naturally present in the ecosystem and virtually indistinguishable from industrial sources.[3]

The FCS mixture is provided as a concentrate that is diluted on site. When diluted for use, the resulting maximum concentration of PAA, hydrogen peroxide, HEDP, and DPA will be as follows:

Use	**PAA**	**H_2O_2**	**HEDP**	**DPA**
Whole or cut poultry and meat carcasses, parts, trim, and organs	2000 ppm	1474 ppm	118 ppm	0.5 ppm
Processed and pre-formed meat and poultry	495 ppm	365 ppm	29 ppm	0.1 ppm

Treatment of the process water at an on-site waste water treatment facility and/or at a POTW is expected to result in complete degradation of peroxyacetic acid, hydrogen peroxide, and acetic acid. Specifically, the peroxyacetic acid will breakdown into oxygen and acetic acid, while hydrogen peroxide will breakdown into oxygen and water.[4] Furthermore, acetic acid is rapidly metabolized by ambient aerobic microorganisms to carbon dioxide and water.[5] Therefore, these substances are not expected to be introduced into the environment to any significant extent as a result of the proposed use of the FCS. The remainder of this section will therefore consider only the environmental introduction of HEDP and DPA.

In poultry processing facilities specifically, the defeathered, eviscerated carcasses are generally sprayed before being chilled via submersion in baths.[6] The carcass is carried on a

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[2] *See* HERA - Human & Environmental Risk Assessment on Ingredients of European Household Cleaning Products: Sodium Sulfate. Section 4 (Environment), January 2006, *available at* http://www.heraproject.com/files/39-f-06_sodium_sulfate_human_and_environmental_risk_assessment_v2.pdf.

[3] *Id.*

[4] Environmental Protection Agency, Reregistration Eligibility Decision: Peroxy Compounds (December 1993), p. 18.

[5] U.S. High Production Volume (HPV) Chemical Challenge Program: *Assessment Plan for Acetic Acid and Salts Category*; American Chemistry Council, June 28, 2001.

[6] *See* DRAFT FSIS Compliance Guideline for Controlling *Salmonella* and *Campylobacter* in Raw Poultry December 2015 *available at* http://www.fsis.usda.gov/wps/wcm/connect/6732c082-af40-415e-9b57-90533ea4c252/Controlling-Salmonella-Campylobacter-Poultry-2015.pdf?MOD=AJPERES.

conveyor through a spray cabinet and then submerged in the chiller baths. Parts and organs may also be passed through a spray cabinet and then submerged in the chiller baths. Parts and organs may also be chilled by submersion in baths containing the antimicrobial agent. Chiller baths typically include a "main chiller" bath, as well as a "finishing chiller" bath, both containing the FCS. Again, the majority of the solution containing the antimicrobial agent drains from the poultry carcasses and enters the plant's wastewater processing treatment facilities.

The poultry industry added "finishing chillers" in response to the U.S. Department of Agriculture Food Safety and Inspection Service's (FSIS) new performance standards for *Campylobacter* and *Salmonella*.[7] The finishing chiller combines a high-dose treatment with shorter dip times to treat *Campylobacter*, as required by its dose-response characteristics. In contrast, the main chiller targets primarily *Salmonella*, which is a time-responsive bacteria that requires a longer residence time in the chiller bath, but does not require the high antimicrobial concentration. We understand that as permitted by 9 CFR 416.2(g)(3), the finishing chiller water is recycled into the main chiller system. The finishing chiller bath will typically contain the maximum concentration of the FCS, but contains a much lower volume of water. The contents of the finishing chiller feed the main chiller as a water source. Since much greater amounts of water are present in the main chiller (roughly 10 times that of the finishing chiller), the FCS is significantly diluted in the main chiller. With respect to environmental impact, it is the contents of the main chiller that pass into the wastewater treatment system and are ultimately released to the environment.

Assuming, in the very worst-case, that all of the water used in a processing plant is treated with the FCS, the HEDP and DPA environmental introduction concentrations (EICs) would be 118 ppm and 0.5 ppm, respectively.

As indicated by the Human & Environmental Risk Assessment Project (HERA), the treatment of wastewater at an onsite treatment facility or POTW will result in the absorption of approximately 80% of HEDP into sewage treatment sludge.[8] By applying this 80% factor, we are able to estimate the potential environmental introduction of HEDP to water and sewage sludge, respectively. To calculate the expected environmental concentrations (EECs), we have

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[7] *See* USDA-FSIS Press Release, "USDA Proposes New Measures to Reduce Salmonella and Campylobacter in Poultry Products", dated January 21, 2015, *available at*: http://www.usda.gov/wps/portal/usda/usdamediafb?contentid=2015/01/0013.xml&printable=true, as well as Notice and Request for Comments, Docket No. FSIS-2014-0023, *available at*: http://www.fsis.usda.gov/wps/wcm/connect/55a6586e-d2d6-406a-b2b9-e5d83c110511/2014-0023.pdf?MOD=AJPERES.

[8] Human & Environmental Risk Assessment (HERA) on ingredients of European Household Cleaning Products: Phosphonates (2004), Table 13, available at http://www.heraproject.com/files/30-F-04-%20HERA%20Phosphonates%20Full%20web%20wd.pdf.

incorporated a conservative 10-fold dilution factor for discharge to surface waters of the effluent from an onsite treatment facility or POTW,[9] as indicated below.

HEDP EEC_{sludge} = 118 ppm x 0.8 = 94.4 ppm HEDP

HEDP $EEC_{aqueous}$ = 118 ppm x 0.2/10 = 2.36 ppm HEDP

$DPA_{aqueous}$ = 0.5 ppm/10 = 0.05 ppm DPA

For facilities that wash, rinse, or cool processed and pre-formed meats exclusively using these treated water and ice baths, these values are:

HEDP EEC_{sludge} = 29 ppm x 0.8 = 23.2 ppm HEDP

HEDP $EEC_{aqueous}$ = 29 ppm x 0.2/10 = 0.58 ppm HEDP

$DPA_{aqueous}$ = 0.1 ppm/10 = 0.01 ppm DPA

Because large-scale facilities do not typically process more than one type of food, we will use the use levels of 118 ppm and 0.5 ppm for HEDP and DPA, respectively, as the respective worst-case EIC_{total} values for all processing facilities using the FCS in the intended applications. Further, even if a POTW receives and mixes water from two different facilities employing the FCS, the maximum EEC will never be greater than the highest single use concentration, *i.e.*, 2.36 ppm HEDP and 0.05 ppm DPA. Therefore, the discussion of impacts from use of the FCS will focus on comparing the poultry and meat processing EECs to appropriate ecotoxicity endpoints that are provided under Item 8.

7. Fate of Emitted Substances in the Environment

As noted and referenced above, treatment of the process water at an on-site waste water treatment facility or at a POTW is expected to result in complete degradation of peroxyacetic acid, hydrogen peroxide, acetic acid, and sulfuric acid. The U.S. High Production Volume (HPV) Chemical Challenge Program determined that 99% of acetic acid degraded in 7 days under anaerobic conditions, and therefore, the FCS is not expected to concentrate in the waste water that is discharged to municipal treatment plants.[10] Upon contact with organic materials, transition metals, and exposure to sunlight, peroxyacetic acid and hydrogen peroxide will rapidly degrade. According to the European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC), the half-life for PAA in buffered solutions was 64 hours (pH = 7) for a 748 ppm

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[9] Rapaport, Robert A., 1988 Prediction of consumer product chemical concentrations as a function of publicly owned treatment works, treatment type, and riverine dilution. *Environmental Toxicology and Chemistry* 7(2), 107-115.

[10] *See* U.S. High Production Volume (HPV) Chemical Challenge Program: Assessment Plan for Acetic Acid and Salts Panel, American Chemistry Council, Appendix I. June 28, 2001.

solution and 48 hours (pH = 7) for a 95 ppm solution while the half-life for hydrogen peroxide varies based on the surface water.[11]

Sulfuric acid degrades into sulfate (SO_4), which is not a toxicological or environmental concern at the proposed use levels.[12] Specifically, as indicated by the Human Environmental Risk Assessment Project (HERA), dispersive uses of sulfate do not significantly impact the environment.[13]

As noted in the organization for Economic Co-operation and Development (OECD) SIDS Voluntary Testing Program for International High Production Volume Chemicals Report on sulfuric acid:

> Sulfuric acid is a strong mineral acid that dissociates readily in water to sulfate ions and hydrated protons, and is totally miscible with water. Its pK_a is 1.92 at 25°C. At pH 3.92, for example, the dissociation is 99%, and sulfate ion concentration is 1.2×10^{-4} moles = 11.5 mg/L. At environmentally relevant concentrations, sulfuric acid is practically totally dissociated, sulfate is at natural concentrations and any possible effects are due to acidification. This total ionization will imply also that sulfuric acid, itself, will not adsorb on particulate matters or surfaces and will not accumulate in living tissues.[14]

See Section 6.b for additional discussion of why sulfuric acid will not significantly impact the environment.

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[11] ECETOC: European Centre for Ecotoxicology and Toxicology of Chemicals. JACC No. 40, “Peracetic Acid and its Equilibrium Solutions”, January 2001 and JACC No. 22, “Hydrogen Peroxide”, January 1993.

[12] Sulfuric Acid. The organization for Economic Co-operation and Development (OECD) SIDS Voluntary Testing Program for International High Production Volume Chemicals. 2001, *available at* http://www.inchem.org/documents/sids/sids/7664939.pdf.

[13] HERA - Human & Environmental Risk Assessment on Ingredients of European Household Cleaning Products: Sodium Sulfate. Section 4 (Environment), January 2006, *available at* http://www.heraproject.com/files/39-f-06_sodium_sulfate_human_and_environmental_risk_assessment_v2.pdf.

[14] *See supra* note 12.

It has been shown that DPA, a polysubstituted pyridine derivative readily biodegrades under both aerobic and anaerobic conditions.[15,16, 17] In presenting a review on the microbial metabolism of pyridines, including DPA, Kaiser, *et al.* describe aerobic metabolism of DPA to carbon dioxide, ammonium, and water, and anaerobic metabolism to dihydroxypyridine which is then rapidly photodegraded to organic acids (*i.e.*, propionic acid, acetic acid), carbon dioxide, and ammonium.

As indicated above, the highest amount of DPA that may be released into the environment during use of the FCS would be a maximum of 0.05 ppm.

8. Environmental Effects of Released Substances

Terrestrial Toxicity

HEDP present in the surface water is not expected to have any adverse environmental impact based on the terrestrial toxicity endpoints available for plants, earthworms, and birds. Specifically, the No Observed Effect Concentration (NOEC) for soil dwelling organisms was >1,000 mg/kg soil dry weight for earthworms in soil, while the 14-day LC_{50} for birds was >284 mg/kg body weight.[18]

Additionally, as noted above, the maximum concentration of HEDP in sludge is 94.4 ppm. Therefore, the maximum concentration in sludge is 3 – 10 fold lower than the terrestrial endpoints noted above and the maximum concentration in soil, when used as a soil amendment, should have an even larger margin of safety with respect to the NOEC level. As such, the FCS is not expected to present any terrestrial environmental toxicity concerns.

Aquatic Toxicity

Aquatic toxicity of HEDP has been summarized, and is shown in the following table:

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[15] J.A. Amador and B.P. Tatlor, "Coupled metabolic and photolytic pathway for degradation of pyridinecarboxylic acids, especially dipicolinic acid" *Applied and Environmental Microbiology* **1990**, *56(5)*, 1352-1356.

[16] B. Seyfried and B. Schnink, "Fermentive degradation of dipicolinic acid (Pyridine-2,6-dicarboxylic acid) by a defined coculture of strictly anaerobic bacteria," *Biodegradation*, **1990**, *1(1)*, 1-7.

[17] J.P. Kaiser, Y. Feng, and J.M. Bollag, "Microbial metabolism of pyridine, quinolone, acridine, and their derivatives under aerobic and anaerobic conditions," *Microbiological Reviews*, **1996**, *60(3*), *483-498.*

[18] Human & Environmental Risk Assessment (HERA) on ingredients of European Household Cleaning Products: Phosphonates (2004), Table 13, available at http://www.heraproject.com/files/30-F-04-%20HERA%20Phosphonates%20Full%20web%20wd.pdf.

Environmental Toxicity Data for HEDP		
Species	**Endpoint**	**mg/L**
Short Term		
Lepomis macrochirus[19]	96 hr LC_{50}	868
Oncorhynchus mykiss[20]	96 hr LC_{50}	360
Cyprinodon variegatus[21]	96 hr LC_{50}	2180
Ictalurus punctatus[22]	96 hr LC_{50}	695
Leuciscus idus melonatus[23]	48 hr LC_{50}	207 – 350
Daphnia magna[24]	24 – 48 hr EC_{50}	165 – 500
Palaemonetes pugio[25]	96 hr EC_{50}	1770
Crassostrea virginica[26]	96 hr EC_{50}	89
Selenastrum capricornutum[27]	96 hr EC_{50}	3
Selenastrum capricornutum[28]	96 hr NOEC	1.3
Algae[29]	96 hr NOEC	0.74
Chlorella vulgaris[30]	48 hr NOEC	≥100
Pseudomonas putida[31]	30 minute NOEC	1000
Long Term		
Oncorhynchus mykiss[32]	14 day NOEC	60 – 180
Daphnia magna[33]	28 day NOEC	10 - <12.5
Algae[34]	14 day NOEC	13

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[19] Jaworska, J.; Van Genderen-Takken, H.; Hanstveit, A.; van de Plassche, E.; Feijtel, T. Environmental risk assessment of phosphonates, used in domestic laundry and cleaning agents in the Netherlands. *Chemosphere* **2002,** *47*, 655-665.

[20] *See id.*

[21] *See id.*

[22] *See id.*

[23] *See id.*

[24] *See id.*

[25] *See id.*

[26] *See id.*

[27] *See supra* note 18.

[28] *See supra* note 19.

[29] *See supra* note 18.

Jaworska et al. 2002 and HERA 2004 showed that acute toxicity endpoints for HEDP ranged from 0.74 – 2,180 mg/L, while chronic NOECs were 60 – 180 mg/L for the 14 day NOEC for *Oncorhynchus mykiss* and the 28 day NOEC for the *Daphnia magna* was 10-<12.5 mg/L. Although a chronic NOEC of 0.1 mg/L for reproductive effects in *Daphnia magna* was reported, it is inconsistent with other toxicity data and Jaworska et al. suggest that it is due to the depletion of micronutrients by HEDP instead of the intrinsic toxicity of HEDP.[35]

Because HEDP is a strong chelating agent, which can result in negative environmental effects such as, the complexing of essential nutrients, both an intrinsic NOEC (NOECi) and a NOEC, which accounts for chelating effects (NOECc) are determined. The wastewater effluent from meat and poultry processing facilities are regulated because of excess nutrients (among other contaminants) in the wastewater, and therefore, HEDP toxicity resulting from complexing of essential nutrients is not anticipated to be relevant in the case of this FCN.[36]

The HERA report on phosphonates included a discussion of aquatic toxicity resulting from chelation of nutrients, rather than direct toxicity to aquatic organisms. Chelation is not toxicologically relevant in the current evaluation because eutrophication, not nutrient depletion, has been demonstrated to be the controlling toxicological mode when evaluating wastewater discharges from food processing facilities.[37] Jaworska *et al*. reports the lowest relevant endpoint for this use pattern to be 10 mg/L.[38] The worst-case EEC_{aq} for HEDP is below this value and is, thus, not expected to result in any adverse environmental effects.

There is little available ecotoxicology data for DPA. The Material Safety Data Sheet (MSDS) from one supplier states that the freshwater fish 96 hour LC_{50} is 322 mg/L for fathead

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[30] *See supra* note 19.

[31] *See id.*

[32] *See id.*

[33] *See id.*

[34] *See supra* note 18.

[35] *See supra* note 19.

[36] *See* US EPA Meat and Poultry Products Effluent Guidelines, https://www.epa.gov/eg/meat-and-poultry-products-effluent-guidelines.

[37] *See supra* note 18.

[38] *See* Jaworska, J.; Van Genderen-Takken, H.; Hanstveit, A.; van de Plassche, E.; Feijtel, T. Environmental risk assessment of phosphonates, used in domestic laundry and cleaning agents in the Netherlands. *Chemosphere* **2002,** *47*, 655-665.

minnow.[39] Ecological Structure Activity Relationships (ECOSAR) Program Results for DPA further predict the following acute and chronic toxicity endpoints tabulated below:[40]

ECOSAR Class	Organism	Endpoint	mg/L
Pyridine-alpha-acid	Fish	96 hr LC_{50}	323.61
	Fish	ChV	32.37[41]
	Green Algae	96 hr EC_{50}	13.97
	Green Algae	ChV	7.69

These values are all much higher than the "worst-case" scenario of an EEC_{aq} of 0.05 ppm, which is over 100 times lower than the lowest chronic toxicity endpoint for the most sensitive species. Thus, the use of DPA at such a minimal level is not expected to result in a significant environmental impact.

9. Use of Resources and Energy

The notified use of the FCS mixture will not require additional energy resources for the treatment and disposal of wastes as the FCS is expected to compete with, and to some degree replace similar HEDP/DPA stabilized peroxy antimicrobial agents already on the market. The manufacture of the antimicrobial agent will consume comparable amounts of energy and resources as similar products, and the raw materials used in the production of the mixture are commercially manufactured materials that are produced for use in a variety of chemical reactions and processes.

10. Mitigation Measures

As discussed above, no significant adverse environmental impacts are expected to result from the use and disposal of the dilute FCS mixture. Therefore, mitigation measures are not necessary for this FCN.

11. Alternatives to the Proposed Action

No potential adverse effects are identified herein, which would necessitate alternative actions to that proposed in this Notification. If the proposed action is not approved, the result would be the continued use of the currently marketed antimicrobial agents that the subject FCS would replace. Such action would have no environmental impact. The addition of the

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[39] *See* representative MSDS for DPA *available at* http://www.apolloscientific.co.uk/downloads/msds/OR5062_msds.pdf.

[40] *See* ECOSAR Application 2.0 results for CAS 499-83-2, provided as Annex 1 to the Environmental Assessment.

[41] Chronic toxicity was estimated through application of acute-to-chronic ratios per methods outlined in the ECOSAR Methodology Document provided in the ECOSAR Help Menu.

antimicrobial agent to the options available to food processors is not expected to increase the use of peroxyacetic acid antimicrobial products.

12. List of Preparers

Devon Wm. Hill, Counsel for Notifier, Keller and Heckman LLP, 1001 G Street, NW, Suite 500W, Washington, DC 20001. J.D. and Masters in Chemistry with 20 years of experience with Food-Contact Notification submissions and environmental assessments.

Peter N. Coneski, Ph.D., Scientist, Keller and Heckman LLP, 1001 G Street, NW, Suite 500W, Washington, DC 20001. Ph.D. in Chemistry with 4 years of experience with Food-Contact Notification submissions and environmental assessments.

13. Certification

The undersigned certifies that the information presented is true, accurate, and complete to the best of his knowledge.

[redacted]

Devon Wm. Hill
Counsel for Notifier

Date: August 24, 2018

14. References

1. *See* Sulfuric Acid. The Organization for Economic Co-operation and Development (OECD) SIDS Voluntary Testing Program for International High Production Volume Chemicals. 2001, *available at* http://www.inchem.org/documents/sids/sids/7664939.pdf.
2. *See* HERA - Human & Environmental Risk Assessment on Ingredients of European Household Cleaning Products: Sodium Sulfate. Section 4 (Environment), January 2006, *available at* http://www.heraproject.com/files/39-f-06_sodium_sulfate_human_and_environmental_risk_assessment_v2.pdf.
3. Environmental Protection Agency, Reregistration Eligibility Decision: Peroxy Compounds (December 1993), p. 18.

4. U.S. High Production Volume (HPV) Chemical Challenge Program: *Assessment Plan for Acetic Acid and Salts Category*; American Chemistry Council, June 28, 2001.

5. DRAFT FSIS Compliance Guideline for Controlling *Salmonella* and *Campylobacter* in Raw Poultry December 2015 *available at* http://www.fsis.usda.gov/wps/wcm/connect/6732c082-af40-415e-9b57-90533ea4c252/Controlling-Salmonella-Campylobacter-Poultry-2015.pdf?MOD=AJPERES.

6. USDA-FSIS Press Release, "USDA Proposes New Measures to Reduce Salmonella and Campylobacter in Poultry Products", dated January 21, 2015, *available at*: http://www.usda.gov/wps/portal/usda/usdamediafb?contentid=2015/01/0013.xml&printable=true, as well as Notice and Request for Comments, Docket No. FSIS-2014-0023, *available at*: http://www.fsis.usda.gov/wps/wcm/connect/55a6586e-d2d6-406a-b2b9-e5d83c110511/2014-0023.pdf?MOD=AJPERES.

7. Human & Environmental Risk Assessment (HERA) on ingredients of European Household Cleaning Products: Phosphonates (2004), Table 13, available at http://www.heraproject.com/files/30-F-04-%20HERA%20Phosphonates%20Full%20web%20wd.pdf.

8. Rapaport, Robert A., 1988 Prediction of consumer product chemical concentrations as a function of publicly owned treatment works, treatment type, and riverine dilution. *Environmental Toxicology and Chemistry* 7(2), 107-115.

9. ECETOC: European Centre for Ecotoxicology and Toxicology of Chemicals. JACC No. 40, "Peracetic Acid and its Equilibrium Solutions", January 2001 and

10. ECETOC: European Centre for Ecotoxicology and Toxicology of Chemicals. JACC No. 22, "Hydrogen Peroxide", January 1993.

11. J.A. Amador and B.P. Tatlor, "Coupled metabolic and photolytic pathway for degradation of pyridinecarboxylic acids, especially dipicolinic acid" *Applied and Environmental Microbiology* **1990**, *56(5)*, 1352-1356.

12. B. Seyfried and B. Schnink, "Fermentive degradation of dipicolinic acid (Pyridine-2,6-dicarboxylic acid) by a defined coculture of strictly anaerobic bacteria," *Biodegradation*, **1990**, *1(1)*, 1-7.

13. J.P. Kaiser, Y. Feng, and J.M. Bollag, "Microbial metabolism of pyridine, quinolone, acridine, and their derivatives under aerobic and anaerobic conditions," *Microbiological Reviews*, **1996**, *60(3*), *483-498.*

14. Jaworska, J.; Van Genderen-Takken, H.; Hanstveit, A.; van de Plassche, E.; Feijtel, T. Environmental risk assessment of phosphonates, used in domestic laundry and cleaning agents in the Netherlands. *Chemosphere* **2002,** *47*, 655-665.

15. *See* US EPA Meat and Poultry Products Effluent Guidelines, https://www.epa.gov/eg/meat-and-poultry-products-effluent-guidelines.

16. Representative MSDS for DPA *available at* http://www.apolloscientific.co.uk/downloads/msds/OR5062_msds.pdf.

17. ECOSAR Application 2.0 results for CAS 499-83-2, provided as Annex 1 to the Environmental Assessment.