

Environmental Assessment

1. **Date:** July 1, 2020
2. **Name of Applicant/Notifier:** Hydrite Chemical Co.
3. **Address:** 300 N. Patrick Blvd.
Brookfield, WI 53045

All communication regarding this food contact notification (FCN) environmental assessment (EA) should be sent to attention of:

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4. **Description of the Proposed Action:**

- A. **Requested Action**

The action identified in this FCN is to provide for the use of the food-contact substance (FCS), an aqueous mixture of peroxyacetic acid (PAA), hydrogen peroxide (HP), acetic acid (AA), 1-hydroxyethylidene-1,1-diphosphonic acid (HEDP) and, optionally, sulfuric acid, as an antimicrobial agent in process water and ice used for washing or chilling fruits and vegetables.

- B. **Need for Action**

This FCS is intended for use as an antimicrobial agent to inhibit the growth of undesirable or pathogenic microorganisms in food processing water and ice used in the production and preparation of fruits and vegetables. Previous authorizations of these uses have allowed processing plants more flexibility in using and managing microbial interventions across the entire production process. The current FCN is needed only to allow market access for the Notifier identified herein.

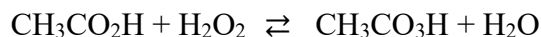
- C. **Locations of Use/Disposal**

The antimicrobial agent is intended for use in fruit and vegetable processing plants throughout the United States. The waste process water containing the FCS generated at facilities is expected to enter the wastewater treatment unit at the plants. It is assumed that very minor quantities of the mixture are lost to evaporation throughout the process. 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 account for any further treatment that may occur at a Publicly Owned Treatment Works (POTW).

5. Identification of Chemical Substances that are the Subject of the Proposed Action:

Chemical Identity

The subject of this notification is an aqueous mixture of 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), and optionally sulfuric acid (CAS Reg. No. 7664-93-9). PAA formation is the result of an equilibrium reaction between acetic acid and hydrogen peroxide.



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 suggests no extraordinary circumstances, in this case, indicating any significant 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

Process water containing the FCS will be treated at an on-site wastewater treatment facility and/or at a POTW. HEDP, the only stable component of the FCS, will partition between the treated process water and the treated sludge, as described more fully below. Only extremely small amounts, if any, of the FCS constituents are expected to enter the environment due to the landfill disposal of sludge containing minute amounts of HEDP in light of the EPA 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, and to have ground-water monitoring systems (40 C.F.R. Part 258). 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 collections systems, they are required to monitor groundwater and to take corrective action as appropriate.

It is assumed, for the purposes of this Environmental Assessment, that treated wastewater will be discharged directly to surface waters in accordance with a National Pollutant Discharge Elimination System (NPDES) permit. This assumption may be considered a worst-case scenario since it takes no account of further treatment that may occur at a Publicly Owned Treatment Works (POTW).

Treatment of the process water at an on-site wastewater treatment facility and/or at a POTW is expected to result in complete degradation of peroxyacetic acid, hydrogen peroxide,

and acetic acid.¹ Specifically the peroxyacetic acid will break down into oxygen and acetic acid, while hydrogen peroxide will break down into oxygen and water. Acetic acid is rapidly metabolized by ambient aerobic microorganisms to carbon dioxide and water.² Therefore, these substances are not expected to be introduced into the environment to any significant extent when the FCS is used as intended.

Sulfuric acid is listed as an optional ingredient in the FCS formulation. Sulfuric acid is used to catalyze the reaction between acetic acid and hydrogen peroxide, more rapidly producing a stable PAA mixture, and to modify the pH of the FCS.

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 pKa 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. So 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.³ As part of the natural sulfur cycle, sulfate is either incorporated into living organisms, reduced via anaerobic biodegradation to sulfide, deposited as sulfur, or re-oxidized to sulfur dioxide and sulfate.⁴ 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.⁵

The remainder of the environmental assessment will therefore consider only the environmental introduction, fate, and potential effects of the stabilizer, HEDP.

The FCS mixture is provided to users as a concentrate that is diluted on site. When diluted for use, the resulting concentration of HEDP will be as follows:

¹ Environmental Protection Agency, Reregistration Eligibility Decision: Peroxy Compounds (December 1993), p. 18.

² U.S. High Production Volume (HPV) Chemical Challenge Program: Assessment Plan for Acetic Acid and Salts Category; American Chemistry Council, June 28, 2001.

³ The Organization for Economic Cooperation and Development (OECD) SIDS Voluntary Testing Programme for International High Production Volume Chemicals (OECD SIDS), Sulfuric Acid, 2001 at <https://hpvchemicals.oecd.org/UI/handler.axd?id=248f397d-64b3-4e14-8be9-473974e8dfdb>.

⁴ HERA – Human and Environmental Risk Assessment on ingredients of Household Cleaning Products, Sodium Sulfate, January 2006, available at https://www.heraproject.com/files/39-f-06_sodium_sulfate_human_and_environmental_risk_assessment_v2.pdf.

⁵ *Id.*

Application	Use	HEDP Concentration (ppm)
Fruits and Vegetables	Water and ice used for washing or chilling fruits and vegetables in a food processing facility	31

When the FCS is used at the maximum level under the proposed action, HEDP would be present in water at a maximum level of 31 parts per million (ppm). Assuming, in the very worst-case, that all the water used in a fruit and vegetable washing plant is treated with the FCS, the level of HEDP in water entering the plant's wastewater treatment facility, the environmental introduction concentration (EIC), would not exceed 31 ppm.

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.⁶ By applying this 80% factor, we differentiate the potential environmental introduction of HEDP to water and sewage sludge, respectively. Also, we have incorporated a conservative 10-fold dilution factor for discharge to surface waters of the effluent from an onsite treatment facility or POTW,⁷ as indicated below, to estimate the expected environmental concentrations (EECs).

The estimated environmental concentrations, calculated as described above, are provided in the table below.

Component	Use Level	EIC	EEC _{sludge}	EEC _{water}
HEDP	31 ppm	31 ppm	24.8 ppm	0.62 ppm

7. Fate of Emitted Substances in the Environment:

HEDP Fate in Terrestrial Environment

HEDP is expected to partition between water and sludge during wastewater treatment. Sludge resulting from wastewater treatment may end up landfilled or land applied. If land-applied, HEDP shows degradation in soil; as such, disposal on land should ensure mineralization and removal from the environment.⁸ HEDP's half-life in soil is estimated to be 373 days, extrapolated from observed degradation of 20% after 120 days.⁹ Phosphonates are also sensitive

⁶ HERA – Human & Environment Risk Assessment (HERA) on Ingredients of European Household Cleaning Products: Phosphonates (June 9, 2004), available at www.heraproject.com – Phosphonates.

⁷ 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.

⁸ See Footnote 6, HERA Report at p. 18.

⁹ *Id.*

to radical-mediated degradation, which may operate in the soil environment and serve as a method for the removal of phosphonate pollution.¹⁰

If HEDP-containing sludge is disposed of in a landfill, HEDP would be expected to be controlled by the relevant EPA regulations and state or local guidelines, as described in Item 6.b.

HEDP Fate in Aquatic Environment

Wastewaters from food processing facilities that contain the diluted FCS mixture is expected to be disposed of through the processing plant wastewater treatment facility or through a local POTW. Once HEDP enters the aquatic environment, it is quite stable, though hydrolysis and degradation are enhanced in the presence of metal ions, aerobic conditions, and sunlight.¹¹ Photolysis can serve as an important route for the removal of phosphonates like HEDP from the environment, with photodegradation half-lives varying from hours to days depending on the presence of cofactors such as oxygen, peroxides, and complexing metals like iron, copper, or manganese. For example, in the presence of iron, 40-90% degradation occurs within 17 days.¹²

In sediment/river water systems, the ultimate biodegradation of HEDP is estimated as 10% in 60 days, with a corresponding half-life of 395 days.¹³ In such systems, phosphonates like HEDP can become tightly adsorbed onto the sediment, indicating that the major part of biodegradation may occur in the sediment, where a half-life of 471 days was observed for HEDP.¹⁴ While hydrolysis half-lives are comparatively long (50-200 days) when compared with photodegradation, hydrolysis may serve as a significant route of removal in soil and sediment environments.¹⁵

8. Environmental Effects of Released Substances:

Terrestrial Toxicity

HEDP present in the surface water or on land applied sludge 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

¹⁰ 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.

¹¹ See Footnote 6, HERA Report at p.16.

¹² See Footnote 6, HERA Report at p.19.

¹³ See Footnote 6, HERA Report at p.16.

¹⁴ See Footnote 6, HERA Report at p.18.

¹⁵ See Footnote 10, Jaworska *et al.* (2002).

LC₅₀ for birds was >284 mg/kg body weight.¹⁶ These values are all well above the EECs estimated in Item 6, above.

Additionally, as noted above, the maximum estimated concentration of HEDP in sludge is 24.8 ppm. HEDP shows no toxicity to terrestrial organisms at levels of up to 1,000 mg/kg in soil.¹⁷ Thus, the very conservatively estimated *maximum* concentration in sludge is only 2.48% of the NOEC. The maximum concentration in soil will be lower due to dilution by the soil when the sludge is used as a soil amendment resulting in an even larger margin of safety with respect to this 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 in the public literature, and is shown in the following table:¹⁸

Environmental Toxicity Data for HEDP		
Species	Endpoint	mg/L
<i>Short Term</i>		
<i>Lepomis macrochirus</i>	96 hr LC ₅₀	868
<i>Oncorhynchus mykiss</i>	96 hr LC ₅₀	360
<i>Cyprinodon variegatus</i>	96 hr LC ₅₀	2180
<i>Ictalurus punctatus</i>	96 hr LC ₅₀	695
<i>Leuciscus idus melonatus</i>	48 hr LC ₅₀	207 – 350
<i>Daphnia magna</i>	24 – 48 hr EC ₅₀	165 – 500
<i>Palaemonetes pugio</i>	96 hr EC ₅₀	1770
<i>Crassostrea virginica</i>	96 hr EC ₅₀	89
<i>Selenastrum capricornutum</i> ^a	96 hr EC ₅₀	3
<i>Selenastrum capricornutum</i>	96 hr NOEC	1.3
Algae ^a	96 hr NOEC	0.74
<i>Chlorella vulgaris</i>	48 hr NOEC	≥100
<i>Pseudomonas putida</i>	30 minute NOEC	1000
<i>Long Term</i>		

¹⁶ See Footnote 6, HERA Report at Table 13.

¹⁷ See Footnote 6, HERA Report at Table 13.

¹⁸ See Footnote 10, Jaworska *et al.* (2002).

Environmental Toxicity Data for HEDP		
Species	Endpoint	mg/L
<i>Oncorhynchus mykiss</i>	14 day NOEC	60 – 180
<i>Daphnia magna</i>	28 day NOEC	10 - <12.5
Algae ^a	14 day NOEC	13

^a The source for this endpoint is the HERA Phosphonates, 2004, Footnote 6, at Table 13.

Jaworska *et al.* 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* ranged from 10 mg/l to <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.¹⁹

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 (NOEC_i) and a NOEC that accounts for chelating effects (NOEC_c) are determined. As noted, it is probable that there will be excess nutrients present in industrial wastewater because eutrophication occurs widely in industrial wastewater coming from food processing facilities.²⁰

We note that the 96 hour NOEC, 24-48 hour EC₅₀, and 96 hour EC₅₀ values reported by Jarworska *et al.* for *Selenastrum capricornutum*, *Daphnia magna*, and *Crassostrea virginica*, respectively, were all likely due to chelation effects rather than intrinsic toxicity.²¹ As such, these levels are not relevant in situations such as food processing plants, where excess nutrients are present. The HERA report on phosphonates includes a discussion of aquatic toxicity resulting from chelation of nutrients, rather than direct toxicity to aquatic organisms.²² 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. Jaworska *et al.* reports the lowest relevant endpoint for aquatic toxicity to be the 28 day NOEC for *Daphnia magna* (10 mg/L),²³ which is well above the highest conservatively estimated EEC_{water} of 0.62 ppm for HEDP. It is important to again emphasize, however, that these estimated EEC values are entirely substitutional for the EEC values resulting from previously effective FCNs for the same use.

¹⁹ *Id.*

²⁰ See US EPA Office of Water, Fact Sheet EPA-822-F-01-010; Ecoregional Nutrient Criteria, Dec 2001, available at <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1009KCN.PDF?Dockkey=P1009KCN.PDF>.

²¹ See Footnote 10, Jaworska *et al.* (2002).

²² See Footnote 6, HERA Report at p.25.

²³ See Footnote 10, Jaworska *et al.* (2002).

Consequently, there will be no new environmental introductions when this FCN becomes effective.

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 stabilized peroxyacetic acid 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 significant 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 significant environmental impact. The addition of the 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:

Maika Moua, Regulatory Affairs Manager – Food, MS in Organic Chemistry, BS in Biochemistry, Univ. of Wisconsin – Milwaukee, with 3 years of experience in dietary assessments as well as research and review of chemical residue and toxicity data.

13. Certification:

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

Date: July 1, 2020



Maika Moua
Regulatory Affairs Manager – Food

14. **List of References:**

1. Environmental Protection Agency, Reregistration Eligibility Decision: Peroxy Compounds (December 1993).
2. U.S. High Production Volume (HPV) Chemical Challenge Program: Assessment Plan for Acetic Acid and Salts Category; American Chemistry Council, June 28, 2001.
3. The Organization for Economic Cooperation and Development (OECD) SIDS Voluntary Testing Programme for International High Production Volume Chemicals (OECD SIDS), Sulfuric Acid, 2001 at <https://hvpchemicals.oecd.org/UI/handler.axd?id=248f397d-64b3-4e14-8be9-473974e8dfdb>.
4. HERA – Human and Environmental Risk Assessment on ingredients of Household Cleaning Products, Sodium Sulfate, January 2006, *available at* https://www.heraproject.com/files/39-f-06_sodium_sulfate_human_and_environmental_risk_assessment_v2.pdf.
5. HERA – Human & Environment Risk Assessment on Ingredients of European Household Cleaning Products: Phosphonates (June 9, 2004), *available at* www.heraproject.com – Phosphonates.
6. 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.
7. 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.
8. EPA Office of Water, Fact Sheet EPA-822-F-01-010; Ecoregional Nutrient Criteria, (December 2001), *available at* <https://nepis.epa.gov/Exe/ZyPDF.cgi/P1009KCN.PDF?Dockkey=P1009KCN.PDF>.