**Summary of TAP Reviewer's Analyses**[1]

Hydrogen chloride (gas which then turns to acid) is being petitioned for use in the cotton seed delinting process. The liquid anhydrous hydrogen gas is vaporized and then sprayed on cotton seeds after the ginning process. The gas mixes with the moisture in the seeds, resulting in acidic properties under which the seeds are subjected. The lint on the seeds becomes weakened by the acid and is more readily buffed off before planting occurs.

All three reviewers concluded that hydrogen chloride/hydrochloric acid is synthetic. The reviewers agreed that variable other alternatives were available and due to the corrosive nature of HCl, it should not be included on the National List of synthetic substances allowed for use as a crop material.

| ***Synthetic/ Nonsynthetic*** | ***Allow without restrictions?*** | ***Allow only with restrictions? (See Reviewers' comments for restrictions)*** |
|---|---|---|
| **Synthetic (3)**<br>**Non-synthetic (0)** | **Yes (0)**<br>**No (3)** | **Yes (0)**<br>**No (3)** |
| | | |

**Identification**

**Chemical names:**

Hydrogen Chloride CAS NO. **7647-01-0**

**Other Names:**

Anhydrous Hydrochloric Acid, Muriatic Acid

**Characterization**

**Composition:**

Colorless gas with irritating fumes; pungent smell; hygroscopic

**Properties:**

Melting Point: -114.24 deg C
Boiling Point: -85.06 deg C
Density: 0.909 g/mL
Molecular Weight: 36.4609 g
Water Solubility: 62g/100mL

[1] *This Technical Advisory Panel (TAP) review is based on the information available as of the date of this review. This review addresses the requirements of the Organic Foods Production Act to the best of the investigator's ability, and has been reviewed by experts on the TAP. The substance is evaluated against the criteria found in section 2119(M) of the OFPA [7 USC 6517(m)]. The information and advice presented to the NOSB is based on the technical evaluation against that criteria, and does not incorporate commercial availability, socio-economic impact, or other factors that the NOSB and the USDA may want to consider in making decisions.*

**How Made:**

***Hydrochloric acid is a solution of hydrogen chloride gas. In the case of the company who filed the petition, hydrogen chloride gas ($HCl_g$) is sprayed on the seeds and the seed moisture content causes the change from the gas stage into hydrochloric acid ($HC\ l_{aq}$). Therefore, the terms hydrochloric acid and hydrogen chloride are used interchangeably throughout this document. (It is the acid which causes the weakening of the lint, making it brittle and easily blown off of the seeds.)***

Hydrochloric Acid exists in two forms,

**(1) as a solution or (2) as a fuming gas:**

(1) Hydrochloric acid existing as a solution of hydrogen chloride in water has the molecule dissociated in solution into its ions.

**HCl ==> H(+) + Cl(-)**

(2) Hydrochloric acid existing as a colorless fuming gas implies that the polar covalent gas hydrogen chloride is very soluble in water. In aqueous solution, the molecule exists in its ionic form, as the positively charged Hydrogen Ion, H(+), and the negatively charged Chloride Ion, Cl(-).

| | | | | | |
|---|---|---|---|---|---|
| **HCl** | **+** | | **==>** | **H(+)** | **+** | **Cl(-)** |
| **Hydrogen Chloride** | | | | **Hydrogen Ion** | | **Chloride Ion** |

It should be noted that the Hydrogen Ion, H(+), is stabilized by hydration in aqueous solution, as the Hydronium Ion, H3O(+).

| | | | | |
|---|---|---|---|---|
| **H(+)** | **+** | **$H_2O$** | **==>** | **$H_3O(+)$** |
| **Hydrogen Ion** | | | | **Hydronium Ion** |

Hydrochloric acid normally contains approximately 28-35 weight percent hydrogen chloride. Hydrogen chloride is formed by the direct combination of chlorine and hydrogen gases. This reaction occurs rapidly at temperatures in excess of 250 degrees Celsius. Heat and moisture act as catalysts in this reaction. Hydrogen chloride itself is produced on both laboratory and industry sized scales. Hydrogen chloride is also produced through the reaction of sodium chloride (NaCl) and sulfuric acid ($H_2SO_4$). Other hydrogen chloride production processes include the reaction of various chlorides with water and the chlorination of organic substances (ie. methane, benzene).

Hydrochloric acid can be produced by 1 of the 5 following processes [2]:

1. Synthesis from elements:

$$H_2 + Cl_2 \rightarrow 2HCl$$

2. Reaction of metallic chlorides, particularly sodium chloride (NaCl), with sulfuric acid ($H_2SO_4$) or a hydrogen sulfate:

$$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$$
$$NaCl + NaHSO_4 \rightarrow Na_2SO_4 + HCl$$
$$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$$

3. As a byproduct of chlorination in the production of dichloromethane, trichloroethylene, perchloroethylene, or vinyl chloride:

$$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$$
$$C_2H_4 + Cl_2 \rightarrow C_2H_3Cl + HCl$$

4. By thermal decomposition of the hydrated heavy-metal chlorides from spent pickle liquor in metal treatment:

$$2FeCl_3 + 6H_2O \rightarrow Fe_2O_3 + 3H_2O + 6HCl$$

5. From incineration of chlorinated organic waste:

$$C_4H_6Cl_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O + 2HCl$$

**Specific Uses:**

Hydrogen chloride ($HCl_g$) is used to remove lint from cottonseeds. The seeds in turn will be able to be mechanically planted. HCl has other various uses in manufacturing and medicine. Additional uses of HCl include refining ore to produce tin and tantalum, neutralizing basic solutions, and adding HCl solutions and in cleansers to prevent bacteria growth.

**Action:**

Hydrogen chloride is used to remove cellulose (lint) from cottonseeds. The seed enters a revolving tank more commonly known as a delinting machine. Pressurized, liquid, anhydrous hydrogen chloride is released from a tank when the delinting machine is completely loaded. Approximately eight to twelve pounds of hydrogen chloride are needed in the delinting process of one ton of cottonseed. After its release, the hydrogen chloride is then pumped into the seed in the delinting machine. At this point, the hydrogen chloride exists as a gas at atmosphere pressure, 1 atmosphere (atm). Seed exposure time to $HCl_g$ is approximately eight to ten minutes. The seed is then sent through buffers for ten to fifteen minutes where the weakened lint from, what is now $HCL_{aq,}$ is mechanically buffed from the seed. A stream of air at a regulated velocity carries away the lint, leaving behind delinted seed. Remaining acid on the seed must be neutralized to prevent further acid damage to the seeds and to the seed bags. Calcium

[2] Processes referenced from http://www.epa.gov/ttn/chief/ap42/ch08/final/c08s06.pdf.

carbonate is the neutralizing agent most commonly used. The seeds are then sorted by size and bagged.

**Note- Anhydrous liquid Hydrogen Chloride *must* be stored in large, heavy specified containers. These containers are very expensive, thus, usage of this phase of hydrogen chloride is limited.

**Combinations:**

Hydrochloric acid is incompatible with all of the following materials: Acetate, acetic anhydride, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, calcium phosphide, cesium acetylene carbide, cesium carbide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethyleneimine, fluorine, lithium silicide, magnesium boride, mercuric sulfate, oleum, perchloric acid, potassium permanganate, b-propiolactone, propylene oxide, rubidum acetylene carbide, rubidum carbide, silver perchlorate + carbon tetrachloride, sodium, sodium hydroxide, sulfuric acid, uranium phosphide, vinyl acetate. Substance polymerizes on contact with aldehydes or epoxides.

It is the reaction of these chemicals with HCl which will, when heated to decomposition, emit toxic hydrogen chloride fumes. Hydrogen chloride fumes are dangerous because they can react with water/steam to produce heat as well as corrosive fumes. Explosive hydrogen gas can potentially also be created upon the oxidative heated decomposition of hydrochloric acid.

**Status**
**Historic Use by Organic Farmers:**

Hydrochloric acid is a crop processing aid that is still under consideration under British Columbia certified organic management standards. Hydrochloric acid is currently being reviewed as a seed treatment. Generally, inorganic acids, such as HCl are disallowed for use as a processing aid and organic acids (ie. lactic acid and acetic acid) are used instead.

**OFPA, USDA Final Rule:**

**Section 6510** –handling- states:

" **In General**. For a handling operation to be certified under this chapter, each person on such handling operation shall not, with respect to any agricultural product covered by this chapter
(1) add any synthetic ingredient during the processing or any post harvest handling of the product."

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*With respect to this petition, HCl will be used in the processing of cotton. HCl will be added during the delinting phase of cleaning the cotton. HCl is a synthetic substance.*

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Certain exemptions are allowed as depicted in **Section 6517-National List** which states:

"(a) **In General**. The Secretary shall establish a National List of approved and prohibited substances that shall be included in the standards for organic production and handling established under this chapter in order for such products to be sold or labeled as organically produced under this chapter.

(b) **Content of List**. The list established under subsection (a) of this section shall contain an itemization, by specific use or application, of each synthetic substance permitted under subsection (c) (1) of this section or each natural substance prohibited under subsection (c)(2) of this section.

(c) **Guidelines for Prohibitions or Exemptions**.

(1) **Exemption for Prohibited Substances**. The National List may provide for the use of substances in an organic farming or handling operation that are otherwise prohibited under this chapter only if

(A) the Secretary determines, in consultation with the Secretary of Health and Human Services and the Administrator of the Environmental Protection Agency, that the use of such substances

(i) would not be harmful to human health or the environment;

(ii) is necessary to the production or handling of the agricultural product because of unavailability of wholly natural substitute products; and

(iii) is consistent with organic farming and handling;

(B) the substance

(i) is used in production and contains an active synthetic ingredient in the following categories: copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals; livestock paraciticides and medicines and production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers;

(ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern; or

(iii) is used in handling and is non-synthetic but is not organically produced; and

(C) the specific exemption is developed using the procedures described in subsection (d) of this section."

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*Under this section of the law, it needs to be decided if the use of hydrochloric acid as a delinter means HCl is being used as a processing aid or a seed treatment.*

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**Regulatory: EPA/NIEHS/Other Sources**

**FDA:** Hydrochloric acid used as a buffer and neutralizing agent in animal drugs, feeds, and related products is generally recognized as safe (GRAS) when used in accordance with good manufacturing or feeding practice. [CITE: 21CFR582.1057]

**EPA:** EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. Hydrochloric acid is included on this list. Hydrochloric acid is listed as a Title III Hazardous Air Pollutant.

**OSHA:** Permissible Exposure Limit: 5 ppm (7 mg/cu m).

**Status Among U.S. Certifiers**

The Texas Department of Agriculture (TDA) previously allowed the use of hydrochloric acid--or any acid for that matter-- for delinting organic cotton planting seed. The TDA felt the act of applying acid to seed was a *process* rather than a *treatment* because no acidic residue remains on the seed once ready for planting. The acid is neutralized by calcium carbonate. Since the implementation of the NOP, USDA has specified that the acid delinting practice is a treatment rather than a process. Therefore, the TDA has notified the Texas Organic Cotton Marketing Cooperative to cease use of any acid pending further NOSB evaluation and ruling. [3]

The State of Virginia is currently following all NOP requirements in reference to the use of hydrogen chloride/hydrochloric acid. [4]

**International**

**European Union:** Hydrochloric acid is approved for use as a food additive (E507).
**Japan:** Hydrochloric acid is not listed as an approved processing aid.
**Codex:** Hydrochloric acid is not listed as an approved substance to be used in organic production.
**Canada:** Hydrochloric acid is currently a "Material Under Consideration," being reviewed for use as a seed treatment.

## Section 2119 OFPA U.S.C. 6518(m)(1-7) Criteria

[3] Phone Interview. Leslie McKinnon, Texas Department of Agriculture, Program Coordinator. July 2, 2003.
[4] Phone Interview. Don Ayers, Virginia Director of Commodity Services, Program Coordinator. July 16, 2003

1. ***The potential of the substance for detrimental interactions with other materials used in organic farming systems.*** Hydrochloric acid is being considered as a crop material. See crop criterion 1, below.

2. ***The toxicity and mode of action of the substance and of its break down products or any contaminants, and their persistence and areas of concentration in the environment.*** See crop criterion 2, below.

3. ***The probability of environmental contamination during manufacture, use, misuse, or disposal of the substance.*** This is considered under crop criterion 3, below.

4. ***The effects of the substance on human health.*** This is considered in the context of crop criterion 4, below, as well as in consideration of the GRAS status of hydrochloric acid.

5. ***The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*** In delinting practices, as performed by organic cotton industries, hydrochloric acid will be completely neutralized by calcium carbonate before seed planting occurs. See crop criterion 5, below.

6. ***The alternatives to using the substance in terms of practices or other available materials.*** See discussion of alternatives under crop criterion 6, below.

7. ***Its compatibility with a system of sustainable agriculture.*** This is considered more specifically in the context of organic handling in crop criterion 7, below.

Crop materials - Criteria From the February 10, 1999 NOSB Meeting

A CROP OR LIVESTOCK PRODUCTION SUBSTANCE may be used if:

**1. There is no potential of the substance to have detrimental interactions with other materials used in organic farming:**

Hydrochloric acid fumes are yielded when water or moisture of any kind is added to hydrogen chloride (HCl is yielded upon hydrolysis). Hydrogen chloride reacts with organic materials, thus, liberating heat. Hydrogen chloride also reacts with the following chemicals: fluorine, calcium carbide, rubidium carbide, and lithium silicide. Hazardous polymerization with hydrogen chloride does not occur. Hydrochloric acid will react with most metals, forming flammable hydrogen gas.

Hydrochloric acid is incompatible with all of the following materials: Acetate, acetic anhydride, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, calcium phosphide, cesium acetylene carbide, cesium

carbide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethyleneimine, fluorine, lithium silicide, magnesium boride, mercuric sulfate, oleum, perchloric acid, potassium permanganate, b-propiolactone, propylene oxide, rubidum acetylene carbide, rubidum carbide, silver perchlorate + carbon tetrachloride, sodium, *sodium hydroxide*, sulfuric acid, uranium phosphide, vinyl acetate. Substance polymerizes on contact with aldehydes or epoxides.

Acetate, acetic anhydride, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, calcium phosphide, cesium acetylene carbide, cesium carbide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethyleneimine, fluorine, lithium silicide, magnesium boride, mercuric sulfate, oleum, perchloric acid, potassium permanganate, b-propiolactone, propylene oxide, rubidum acetylene carbide, rubidum carbide, silver perchlorate + carbon tetrachloride, sodium, *sodium hydroxide*, sulfuric acid, uranium phosphide, vinyl acetate are not approved on the national list in the final rule for use in organic practices. Hydrochloric acid may have a detrimental interaction with sodium hydroxide which is approved for use under section:

**205.601 Synthetic substances allowed for use in organic crop production.**
(1) Aquatic plant extracts (other than hydrolyzed) - Extraction process is limited to the use of potassium hydroxide or sodium hydroxide; solvent amount used is limited to that amount necessary for extraction.

Therefore, the only *potential* interactions with those substances *approved* for use in organic production would be with sodium hydroxide.

**2. The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration are not harmful to the environment.**

Short term HCl exposure can result from process sampling, maintenance, and breakdowns during hydrocarbon chlorination and dehydrochlorination. HCl is produced by the combustion of fuels, particularly, organic chlorides and gasoline. Hydrochloric acid is non-flammable. Hazardous by-products formed by the decomposition of hydrochloric acid include hydrogen chloride, chlorine, carbon monoxide, carbon dioxide, and hydrogen gas. Carbon dioxide gas is heavier than air. Thus, the gas could potentially flow into in low-lying areas and collect in the soil. The concentration of carbon dioxide gas in these low-lying areas is potentially lethal to animals, vegetation and people. Concentrations of chlorine, carbon monoxide, and hydrogen gas are also extremely hazardous to the environment.

**3. There is no probability of environmental contamination during manufacture, use, misuse, or disposal of the substance.**

If exposed to the environment, hydrochloric acid will neutralize carbonate-based soil components. Soil and sand will absorb hydrochloric acid--these are actually recommended practices for cleaning up HCl spills. Large hydrochloric acid spills can be neutralized with lime or diluted alkaline solutions of soda ash. The EPA 1985

emission inventory indicates that less than one percent of HCl emissions come from production practices. Nearly 89 percent of all HCl emissions come from the combustion of coal.

**4. There are no adverse effects on human health.**

Hydrochloric acid is not considered a carcinogenic substance to humans. A major HCl effect is local irritation. After digestion or skin contact with HCl occurs, the mucous membranes of the nose, throat, and esophagus become corroded. HCl present in the lungs may cause pulmonary edema. HCl will only exist in the air if transported through an aerosol or as a soot particle deposit. HCl ingestion causes glottis edema. HCl inhalation causes coughing, inflammation, pain, and edema of the upper respiratory tract. HCl exposure normally will not affect those vital organs furthest from the point of contact on the body. Eye contact with HCl may induce vision reduction or blindness. HCl concentrations, 35 ppm or greater, can cause throat irritation after short term exposure. Hydrochloric acid is very corrosive, and, if contacted with the skin, irritation and burns may occur.

**5. There are no adverse effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.**

Anhydrous hydrogen chloride readily evaporates when exposed to soil. But hydrogen chloride will infiltrate through soil if exposed. Moisture present in the soil influences the rate at which the HCl moves through the soil. While moving, the HCl will dissolve carbonate based particles found in the soil. HCl will neutralize to an extent while transporting through the soil but significant amounts of HCl still remain. HCl dissociates almost completely in water. The water molecules capture the hydrogen ion forming the hydronium ion.

**6. There are no alternatives to using the substance in terms of practices or other available materials.**

Two alternative organic acids that might be used in the delinting process are lactic acid and acetic acid.

Lactic acid may cause eye irritation if contact occurs. The estimated fatal dose of lactic acid is one gram. Highly concentrated lactic acid solutions may cause severe burns to the skin and eyes. Under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and FDA regulations, lactic acid is an exemption of tolerance requirements when uses in plant growth regulations or on all raw agricultural products. Lactic acid is generally recognized as safe (GRAS) by FDA when used in accordance with good manufacturing practice.

*Pure* acetic acid is toxic if ingested or inhaled. Long term acetic acid exposure can potentially cause skin darkening, tooth enamel erosion, and respiratory tract inflammation. Acetic acid is a strong irritant but less corrosive than mineral acids. Acetic acid can burn the skin and ingestion may cause corrosion of the mouth in

conjunction with vomiting and diarrhea. Eye irritation may occur at concentrations below ten ppm. The acetic acid irritating concentration is 25 mg/cu m. If released to the atmosphere, acetic acid will exist solely in the vapor phase. In soil, acetic acid will have high mobility. Acetic acid rapidly biodegrades in both soil and water. Acetic acid's ubiquitous existence in the environments means acetic acid is constantly around the general public. Primary exposure routes are through oral food consumption and air inhalation. Acetic acid occurs as a normal metabolite in animals and plants. Studies indicate that acetic acid displays no potential biological accumulation or food chain contamination. FDA has deemed acetic acid GRAS when used in accordance with good manufacturing practices. Acetic acid residues are exempted from FIFRA tolerances when used in accordance with good manufacturing practices as applied to raw agricultural commodities after harvest.

**7. If the substance is compatible with a system of sustainable agriculture.**

**"**Sustainable agriculture integrates three main goals--environmental health, economic profitability, and social and economic equity." [5] When exposed to the environment, hydrochloric acid will neutralize carbonate-based components in the soil but will acidify the soil. Organic cotton production is more than a $100 million dollar-a-year business. These factors, probable risk of environmental contamination and economic growth, imply ambiguity in the use of hydrochloric acid to delint cotton seeds. Economic stability may be compatible with a system of sustainable agriculture, but the probable environmental health risks are not.

[5] University of California, Sustainable Agriculture Research and Education Program. What is Sustainable Agriculture?: Concept Themes. Davis, CA: December 1997.

***Reviewer 1*** *[Ph.D, Associate Professor of Chemistry, middle US]*

**1. Comments on Database**

The database is rather inadequate. There is frequent confusion between hydrogen chloride (the gas) and hydrochloric acid (the aqueous solution of the gas). The list of substances with which hydrochloric acid is incompatible is both incomplete and misleading.

***2. OFPA Criterion Evaluation***

*1. There is no potential of the substance to have detrimental interactions with other materials used in organic farming:*

Hydrochloric acid is, being a strong acid, relatively reactive. As an aqueous acid, it can also serve to act as a catalyst for multiple reactions. While the list of substances with which it is incompatible includes very few (only one) substance current approved, (a) the list is terribly inadequate and (b) there is a difference between "incompatible" and "can react with" or "can catalyze the reaction between." Hydrochloric acid will undoubtedly have detrimental interactions with other materials used in organic farming.

*2. The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration are not harmful to the environment.*

All of the hazardous by-products are harmful to the environment. The "concentration of carbon dioxide" in low-lying areas is the least worrisome! Concentration of chlorine, carbon monoxide or hydrogen chloride (which would dissolve in moist soil or water) would be far more hazardous.

*3. There is no probability of environmental contamination during manufacture, use, misuse, or disposal of the substance.*

Misusing hydrochloric acid could have drastic effects on the environment, including, but not limited to, change in pH on the environment. Soil will absorb HCl(aq), as was pointed out, but with the effect of acidifying the soil. HCl(aq) can be neutralized by lime or soda ash, but thereby introducing large amounts of metal cations into the environment.

*4. There are no adverse effects on human health.*

It's not carcinogenic because it's so corrosive! Exposure to either HCl(aq) or HCl(g) is extremely hazardous!

*5. There are no adverse effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*

As stated above, exposure of the agroecosystem to either HCl(aq) or (g) will affect the pH of the soil. Everything in the review is correct but understated. The "hydronium ion" is acid!

*6. There are no alternatives to using the substance in terms of practices or other available materials.*

Either lactic or acetic acid are vastly preferable. Plus – they're actually organic as opposed to HCl which is definitively inorganic.

*7. If the substance is compatible with a system of sustainable agriculture.*

"Low-risk of environmental contamination" is a false statement. Thus, it is incompatible.

**3. Conclusion – Summarize why this material should be allowed or prohibited for use in organic systems.**

Not at all. Not organic, hazardous to everything!, has alternatives.

**4. Recommendation Advised to the NOSB:**

Neither HCl(aq) nor HCl(l) nor HCl(g) should be added to the list.

***Reveiwer 2*** *[MS, Biochemistry, Forensic Drug Testing, Adjunct Instructor, Eastern US]*

**1. Comments on Database**

The Identification and Characterization sections are reasonably well summarized.

In aqueous solutions the polar covalent HCl dissociates but does not exist as the charged hydrogen ion ($H^+$). According to the Bronsted-Lowery theory this proton is transferred to a water molecule. Its high positive charge density and small size would predict that it would form a bond and it does producing the hydronium ion ($H_3O^+$) . The $H_3O^+$ is stabilized by hydrogen bonding to three water molecules. Sidgwick (1950) suggested a free proton concentration in solution of $10^{-130}$ M . Since $HCl_{(aq)}$ is a strong acid the dissociation is assumed to be 100 %.

Under specific uses it should be noted that HCl is also produced biochemically in the stomach to denature proteins and activate enzymes that will hydrolyze proteins.

***2. OFPA Criterion Evaluation***

*1. There is no potential of the substance to have detrimental interactions with other materials used in organic farming:*

I agree with the criterion evaluation except the statement "hydrochloric acid may have a detrimental interaction with sodium hydroxide" is unclear. This interaction would be a neutralization reaction producing sodium chloride and water. I'm not sure what is detrimental about this reaction unless it means simply that the sodium hydroxide is removed.

*2. The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration are not harmful to the environment.*

I agree with the criterion evaluation. The phrases "carbon dioxide is heavier than air" and "collect in the soil" is unclear. I assume what is meant is that large amounts of $CO_2$ can collect near the surface, displace air and be potentially lethal to humans and animals.

*3. There is no probability of environmental contamination during manufacture, use, misuse, or disposal of the substance.*

I agree with the criterion evaluation. As an acid, HCl will neutralize any alkaline substance.

*4. There are no adverse effects on human health.*

I agree with the criterion evaluation recognizing that HCl is a corrosive strong acid and great care must be exercised in its handling and use. Depending on the concentration exposure to any tissue may result in varying degrees of damage to that tissue.

*5. There are no adverse effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*

I agree with the criterion evaluation in part. Hydrochloric acid will neutralize any alkaline substance encountered in the soil. The amount of HCl remaining will depend on the amount of soil and the amount of moisture in the soil. A neutralization reaction produces salt and water so the neutralization of large amounts of HCl would yield large amounts of the corresponding chloride salt.

*6. There are no alternatives to using the substance in terms of practices or other available materials.*

I agree with the criterion evaluation as far as it goes. Both lactic acid and acetic acid are organic acids that occur naturally in organisms. As acids they can be toxic at high levels of exposure. The question of suitability as a delinting agent was not addressed in this criterion so it is difficult to say that there are no alternatives to using hydrochloric acid. My review indicates that some delinting applications use sulfuric acid but the same initial objections should also exist for this mineral acid. Both the organic acids are weak acids and may have limited ability to weaken the cellulose structure of the lint and allow its easy removal from the seed.

*7. If the substance is compatible with a system of sustainable agriculture.*

The criterion evaluation is vague. The listed goals of sustainable agriculture are reasonable but the factors of low environmental risk and economic contributions might be used to justify the use of almost any synthetic substance if it were technically feasible. Under Historic Use by Organic Farmers it mentions that organic acids are used as processing aids but it is not clear if this refers to planting seed delinting.

**3. Conclusion – Summarize why this material should be allowed or prohibited for use in organic systems.**

a. In my opinion hydrochloric acid is a synthetic compound as defined by the OFPA, 6502 Definitions, (21).

b. It should not be permitted for use as a crop material. The application provides a very detailed analysis of the chemistry and synthesis of this compound. While not a carcinogenic agent HCl is a very hazardous substance that will cause injury if ingested, inhaled or exposed to skin or other tissue. The requirements of the National List in the Final Rule however are very specific. The use of synthetic compounds is generally not permitted. The report suggests alternate acids may be available. These alternative organic acids may be adequate to achieve the same objectives that the use of hydrochloric acid provides. If they are not satisfactory then more extensive documentation of the inadequacies of these alternate methods needs to be submitted. Research on mechanical delinting that may eliminate the need to use any acid is ongoing. In my opinion the use of hydrochloric acid would violate the letter and spirit of the OFPA.

**4. Recommendation Advised to the NOSB:**

a. Hydrochloric acid [7647-01-0] is a synthetic compound.

b. Hydrochloric acid should not be added to the National List of synthetic substances allowed for use as a crop material.

***Reviewer 3*** *[USDA Accredited Certifier, Mid-West, US]*

**1. Comments on Database**

Hydrochloric Acid/ Hydrogen Chloride was petitioned for use in the cottonseed delinting process. The acid is created when liquid anhydrous hydrogen gas is vaporized and then sprayed onto the seeds after they are ginned. The gas mixes with the moisture in the seeds resulting in the acid, which weakens the lint on the seeds.

Specific Use:
Hydrogen chloride ($HCl_g$) is used to remove lint from cottonseeds. This enables the seeds to be mechanically planted.

***2. OFPA Criterion Evaluation***

*1. There is no potential of the substance to have detrimental interactions with other materials used in organic farming:*
More compatible alternatives exist. Hydrochloric Acid has the potential to damage soil and to harm humans and the environment.

*2. The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration are not harmful to the environment.*
Anhydrous hydrogen chloride readily evaporates when exposed to soil. But hydrogen chloride will infiltrate through soil if exposed. Moisture present in the soil influences the rate at which the HCl moves through the soil. While moving, the HCl will dissolve carbonate-based particles found in the soil. HCl will neutralize to an extent while transporting through the soil but significant amounts of HCl still remain. HCl dissociates almost completely in water. The water molecules capture the hydrogen ion forming the hydronium ion.

*3. There is no probability of environmental contamination during manufacture, use, misuse, or disposal of the substance.*
Short term HCl exposure can result from process sampling, maintenance, and breakdowns during hydrocarbon chlorination and dehydrochlorination. HCl is produced by the combustion of fuels, particularly, organic chlorides and gasoline. Hydrochloric acid is non-flammable. Hazardous by-products formed by the decomposition of hydrochloric acid include hydrogen chloride, chlorine, carbon monoxide, carbon dioxide, and hydrogen gas. Because carbon dioxide gas is heavier than air, the gas may flow into in low-lying areas and collect in the soil. The concentration of carbon dioxide gas in these areas is potentially lethal to people, animals, and vegetation.

*4. There are no adverse effects on human health.*
Hydrochloric acid is not considered a carcinogenic substance to humans. A major HCl effect is local irritation. After digestion or skin contact with HCl occurs, the mucous membranes of the nose, throat, and esophagus become corroded. HCl present in the

lungs may cause pulmonary edema. HCl will only exist in the air if transported through an aerosol or as a soot particle deposit. HCl ingestion causes glottis edema. HCl inhalation causes coughing, inflammation, pain, and edema of the upper respiratory tract. HCl exposure normally will not affect those vital organs furthest from the point of contact on the body. Eye contact with HCl may induce vision reduction or blindness. HCl concentrations, 35 ppm or greater, can cause throat irritation after short-term exposure. Hydrochloric acid is corrosive, and, if contacted with the skin, irritation and burns may occur.

5. *There are no adverse effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*

Hazardous by-products formed by the decomposition of hydrochloric acid include hydrogen chloride, chlorine, carbon monoxide, carbon dioxide, and hydrogen gas.

Because carbon dioxide gas is heavier than air, the gas may flow into in low-lying areas and collect in the soil. The concentration of carbon dioxide gas in these areas is potentially lethal to people, animals, and vegetation.

6. *There are no alternatives to using the substance in terms of practices or other available materials.*

Lactic acid and acetic acid could be used in cottonseed delinting. Studies indicate that acetic acid displays no potential biological accumulation or food chain contamination. FDA has deemed lactic and acetic acid GRAS when used in accordance with good manufacturing practices. Acetic acid residues are exempted from FIFRA tolerances when used in accordance with good manufacturing practices as applied to raw agricultural commodities after harvest.

7. *If the substance is compatible with a system of sustainable agriculture.*

More compatible alternatives exist. Hydrochloric Acid has the potential to damage soil and to harm humans and the environment.

**3. Conclusion – Summarize why this material should be allowed or prohibited for use in organic systems.**

Hydrochloric acid can be produced by five methods, none of which are non-synthetic:

1. Synthesis from elements
2. Reaction of metallic chlorides, particularly sodium chloride (NaCl), with sulfuric acid (H2SO4) or a hydrogen sulfate
3. As a byproduct of chlorination in the production of dichloromethane, trichloroethylene, perchloroethylene, or vinyl chloride
4. By thermal decomposition of the hydrated heavy-metal chlorides from spent pickle liquor in metal treatment
5. From incineration of chlorinated organic waste

Commentor's note: Although we were not asked to determine whether or not this use of Hydrochloric Acid is a process or a seed treatment, it is my opinion that it is a seed treatment in this instance.

**4. Recommendation Advised to the NOSB:**

a. Hydrochloric acid is a synthetic compound.

b. Hydrochloric acid should not be added to the National List of synthetic substances allowed for use as a crop material.

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