

§171.1(c)(H) ENVIRONMENTAL ASSESSMENT

Section Contents

- 1.0 DATE: July 23, 1999
- 2.0 PETITIONER: Alcide Corporation
- 3.0 ADDRESS: 8561 154th Avenue, NE
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- 4.0 DESCRIPTION OF THE PROPOSED ACTION
- 5.0 IDENTIFICATION OF CHEMICAL SUBSTANCES THAT ARE
SUBJECT OF THE PROPOSED ACTION
- 6.0 INTRODUCTION OF SUBSTANCES INTO THE ENVIRONMENT
- 7.0 FATE OF EMITTED SUBSTANCES IN THE ENVIRONMENT
- 8.0 ENVIRONMENTAL EFFECTS OF RELEASED SUBSTANCES
- 9.0 USE OF RESOURCES AND ENERGY
- 10.0 MITIGATION MEASURES
- 11.0 ALTERNATIVES TO PROPOSED ACTION
- 12.0 PREPARER
- 13.0 CERTIFICATION
- 14.0 APPENDICES
- 15.0 BIBLIOGRAPHY

99 F-2907

4.0 DESCRIPTION OF THE PROPOSED ACTION

4.1 REQUESTED APPROVAL

Approval is requested for the use of acidified sodium chlorite (ASC) solutions to reduce microbial pathogens on the surfaces of red meat cuts, organ meats and related specialty cuts, for use *per se* or prior to their being ground into chopped meat and/or related comminuted meat products. The identically formulated solutions are currently approved under 21CFR §173.325 for use as an antimicrobial carcass spray agent in the processing of red meat.

There are two components used to create these solutions, the food-grade acid and the sodium chlorite. Sufficient acid is added to a 500 - 1,200 parts per million (ppm) solution to reduce its pH to the 2.5 - 2.9 range. The resulting acidified sodium chlorite solutions are then applied to the meat surfaces as either a spray or a dip. In the former case, the liquid is dispensed from a spray apparatus in which either i) two streams of the chlorite and the acid solutions are mixed at, or immediately before the spray nozzle, or ii) a single stream of acidified chlorite is directed to the spray nozzle from a pre-mixed solution. The latter may be prepared up to 8-hours prior to spraying, preferably in cold water, so long as the chlorite and acid levels have been analytically determined to be within acceptable levels. When the antimicrobial solution is applied as a dip, the meat pieces are immersed in the dip solution for a brief period of time, generally 10 to 30 seconds. Following both spray and dip application, the meat pieces are rinsed with water to remove the applied solution.

4.2 NEED FOR THE ACTION

There is still a strong need for good hygienic practices after the initial post-slaughter decontamination of red meat carcasses, in order to ensure the unbroken microbiological

0169

safety and quality of the subprimal, secondary and retail meat cuts and specialty meats. Of particular importance are the comminuted meat products, in which any pathogenic organisms that were initially present on the surface of the meat pieces become intimately combined with the ground product. Unless proper temperatures are achieved during the cooking of the comminuted meat to destroy the pathogens, they can survive and cause illness or death to the consumer.

Millions of Americans become ill each year from something they eat. This number can only be approximated by government officials, who indicate that less than 5 percent of food illnesses are ever reported to authorities, and must therefore rely heavily on estimates when quantifying the problem. The Centers for Disease Control and Prevention calculates that *E. coli* O157:H7 alone infects up to 20,000 Americans a year through contaminated meat, produce and other sources. Of these up to 500 may die. A 1987 survey of retail meats from grocery stores in Madison, WI found that *E. coli* O157:H7 could be isolated from approximately 2% of beef, poultry, pork and lamb samples. A more recent example occurred in mid-1997, when the US suffered its most widespread food scare and the biggest product recall in history. The Hudson Foods Company was forced to recall 25 million pounds of frozen minced beef after an outbreak of food poisoning in Colorado was traced to meat contamination with *E. coli* O157:H7 from one of its well-inspected, up-to-date plants. Most recently, in 1998, Iowa Beef Packers received some contaminated beef in its Illinois plant, and the resulting ground product caused outbreaks of *E. coli* O157:H7 in Florida and Georgia.

Although this particular pathogenic organism has been the center of attention in recent years, there are many well known organisms which tend to be less lethal, but nonetheless are the main source of most of the sicknesses and occasional deaths that arise from pathogen-bearing comminuted meat products. Pathogens can be recovered from beef and other red meats, as well as meat specialty cuts such as tongue, liver and intestines, in meat-handling facilities where good hygiene is not always sufficient to eliminate them completely. These pathogens, include various *Salmonella* species, *Listeria monocytogenes*,

0170

Staphylococcus aureus and *Campylobacter jejuni*. These pathogens often require additional means to diminish or eliminate their numbers than the customary surface rinsing, or simple wiping which meat pieces sustain. It is the position of the Alcide Corporation that the acidified sodium chlorite solutions which are the subject of this Food Additive Petition, and which have already been approved by the FDA for use in both poultry and red meat carcass processing, can play a major role in upgrading the microbial quality of the primary and secondary meat cuts, organs and related meat parts, particularly those materials which are further processed into the U.S. ground meat supply.

4.3 LOCATIONS WHERE PRODUCTS WILL BE PRODUCED

There are two components to the acidified chlorite solutions being proposed for Secondary Direct Food Additive Status, the sodium chlorite and the acidifier needed to achieve the desired solution pH. The acidifier can be any one of a variety of FDA-approved GRAS acids, including phosphoric, sulfuric, malic, acetic and citric. These are all materials of very high volume usage, and of many current diverse applications. The projected volumes of use as an activator of sodium chlorite are much below a fractional percentage of the other applications. Thus the sites of production of these different acids is not considered relevant to this environmental assessment.

Sodium chlorite is currently being used as a chlorine dioxide (ClO₂) source in water treatment, as well as an industrial bleaching agent in a number of industries (primarily pulp and paper), in cleaning applications for the electronics industry, as a biocide in the food processing industry, and in various applications in the oil industry. On April 23, 1996 the U.S. FDA approved the use of sodium chlorite as a component of acidified sodium chlorite solutions for pathogen reduction in poultry processing. Thereafter, in a similar action on February 27, 1998, the FDA allowed for the use of ASC solutions in red meat carcass sprays. The current size of the North American market for sodium chlorite is about 20 million lb. per year, slowly growing primarily at the expense of chlorine. The major production source has

0171

been the Vulcan chemicals facility in Witchita, which has a production capacity of about 22 million lb per year. About 50% of that sodium chlorite is directed towards drinking water disinfection in the United States. Sterling Chemicals, of Houston, Texas, along with its Tenneco's production facility in Richmond, Virginia, contribute to the total 11 million lb per year sodium chlorite manufacturing capacity ex. Buckingham, Quebec. Other foreign production sites for sodium chlorite, which may be accessed if quality and economics are appropriate, include that of France's Atochem, S.A., the world's largest product and Energia Industrias Aragonesas, Madrid, Spain.

4.4 LOCATIONS WHERE THE PRODUCTS WILL BE USED

The annual beef and veal consumption of the United States in 1996 was 11.7 million metric tons, with a pork consumption of 8.3 million metric tons. This equates to an annual per capita consumption of 64.2 pounds of beef, 1.0 pounds of veal, and 46.1 pounds of pork¹. Of this, the American Meat Institute estimates that about 50% of the red meat consumed in this country is as ground product¹. This ground product primarily encompasses the meat used in hamburger, ground beef and sausage. Hamburger meat is ordinarily a blend of beef and less expensive cuts, including fat up to 30%. Some ground beef, which can also contain up to 30% fat, can be produced and packaged at USDA-inspected plants. Both products must be labeled in accordance with the Federal Standards and Labeling Policy, and marked with a USDA label. The Food Safety and Inspection Service carries out the USDA's responsibilities under the Federal Meat Inspection Act.

All meat that is transported and sold in interstate commerce must be federally inspected. For meat that is being transported and sold within a state, state inspection then applies. State inspection programs must enforce requirements at least equal to those of the Federal inspection laws. The larger cuts are usually shipped to local stores, where it is ground. Most ground beef is ground and packaged in local stores rather than in food processing plants under USDA inspection. Yet most of the reported pathogen-induced meat

outbreaks appear to be associated with hamburger produced in central distribution points. For example, in the Jack-In-The-Box incident, the hamburger was produced in a contract patty-making operation using meat from several sources, and the ground product then shipped to local outlets. The Hudson Foods and Iowa Beef Packers incidents are also examples of centralized production, using meat sources from many locations. No matter how well-inspected and modern an operation, the basic problem is that grinding exposes more of the meat, whose interiors are normally sterile, to microbial contamination from the air, the meat surface itself, butchers' hands and cutting equipment. This pathogen contamination is not immediately detectable; and bacteria can multiply in temperature ranges between 40° F and 140° F, with *E. coli* 0157:H7 capable of growth from 44° F upwards.

Once the pending Food Additive Petition is accepted as a regulation, the acidified chlorite antimicrobial will become available to all central processing plants in the United States as well as local supermarkets and butchers. Generally the central processing plants are located in the same geographic areas as the abattoirs. According to the American Meat Institute, the following States contain the highest percentages of such plants among its member companies.

RANK	STATE	PERCENT
1	Kansas	20
2	Nebraska	19
3	Texas	18
4	Colorado	7
5	Iowa	5
6	Wisconsin	4
7	Minnesota	3
8	Pennsylvania	2.9
9	California	2.6
10	Washington	2.5

0173

Other red meat processors are located in Illinois, Indiana, Ohio, Michigan, North Dakota, South Dakota, Missouri, Tennessee, Virginia, North Carolina, South Carolina, Georgia, Florida, Arkansas and Oklahoma. Few plants are found in the North East and West, other than in California and Washington.

It is difficult to obtain an estimate of the hamburger, ground beef and sausage that is produced locally, but it appears from the above information that the predominance of comminuted meat production will focus in the central U.S. states, with local production accounting for somewhat less usage in the eastern and far-western states. The projected usage of the petitioned ASC solutions will generally correspond in volume to the production site locations described above.

0174

5.0 IDENTIFICATION OF CHEMICAL SUBSTANCES THAT ARE SUBJECT OF THE PROPOSED ACTION

5.1 CHEMICAL NAMES AND PHYSICAL PROPERTIES

5.1.1 Sodium Chlorite

CAS Reg. No.: 7758-19-2
Color (37% Solution): Colorless to light green
Specific Gravity: 1.21
Viscosity (@25°C): 1.62 cps
pH: 12.33

5.1.2 Acidifiers (GRAS)

Phosphoric Acid

CAS Reg. No.: 7664-38-2
Conforms with 21CFR §182.1073 as a Multiple Purpose GRAS Food Substance

Citric Acid

CAS Reg. No.: 77-92-9 (anhydrous)
5949-29-1 (monohydrate)
Conforms with 21CFR §182.1033 as a Multiple Purpose GRAS Food Substance

0175

Hydrochloric Acid

CAS Reg. No.: 7647-01-0

Conforms with 21CFR §182.1057 as Multiple Purpose GRAS Food Substance

Malic Acid

CAS Reg. No.: 617-48-1 DL mixture

97-67-6 L isomer

Conforms with 21CFR §184.1069 as a Specific Substance Affirmed as GRAS, with respect to the following ¶'s,

- (a) description
- (b) specifications
- (c) use as pH control agent
- (d) maximum use level

Sulfuric Acid

CAS Reg. No.: 7664-93-9

Conforms with 21CFR §184.1095 as a Specific Substance Affirmed as GRAS, with respect to the following ¶'s,

- (a) description
- (b) specifications
- (c) use as pH control agent
- (d) maximum use level

0176

Acetic Acid

CAS Reg. No.: 64-19-7

Conforms with 21CFR §184.1005 as a Specific Substance Affirmed as GRAS, with respect to the following ¶s,

- (a) description
- (b) specifications
- (c) use as a pH control agent
- (d) maximum use level

The subject of this food additive petition (FAP) is the system comprised of acidified aqueous sodium chlorite solutions for use as an antimicrobial agent to reduce pathogenic microorganisms on organs and red meat cut surfaces, particularly those subject to subsequent comminution or grinding into such items as hamburger patties, ground beef or sausage. The composition and concentration of the system depends on the mode, site of application of the antimicrobial solution (*e.g.*, large processing facility, supermarket) and quantity of meat being processed.

5.2 MODE OF ACTION OF THE GERMICIDAL SYSTEM

The germicidal activity of this antimicrobial system derives from the degradation of chlorous acid (HClO_2 ; CAS No. 13898-47-0) which will form as a predictable fraction of the total chlorite species (ClO_2^-) in the solution. The degree to which chlorous acid forms will depend on the hydrogen ion concentration (*i.e.* pH) of the solution. Chlorous acid, an unstable material, can exist in equilibrium with the chlorite ion in aqueous systems with a stability proportionate to its total concentration; the lower the concentration the slower the rate of degradation.

0177

Chlorous acid has a pK_a of 1.1×10^{-2} , and from this constant the relative amount of chlorous acid can be calculated for the pH range of intended application of this acidified sodium chlorite system. At the petitioned range of pH's, 2.5 - 2.9, the chlorous acid levels, as percentages of total chlorite ion, are as follows:

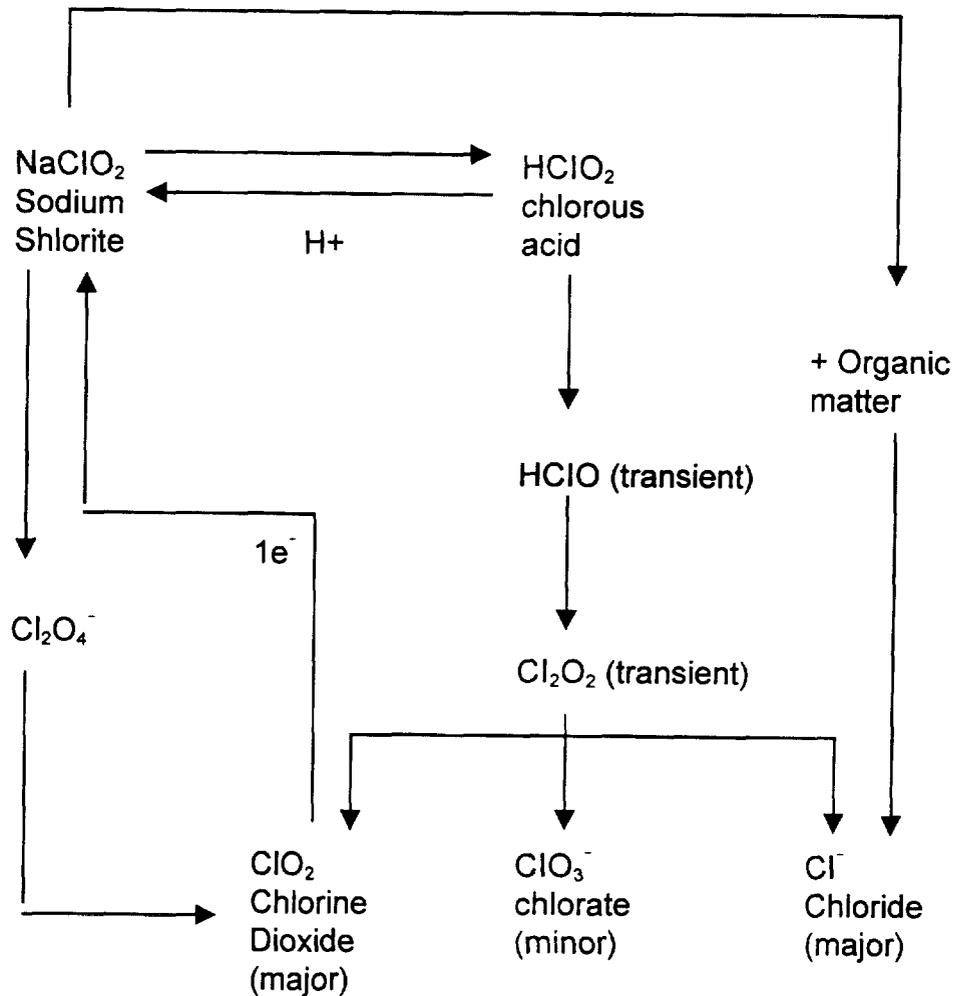
pH	% Chlorite as $HClO_2$
2.5	22.2
2.6	18.1
2.7	15.0
2.8	12.3
2.9	10.0

To achieve these solution pH values, different quantities of the individual GRAS acids are required, depending on their strength and buffering action needed. This can range from *ca.* 0.01% for a mineral acid to ~1.5 - 2.5% level of acetic acid.

0178

The ability to provide sustained antimicrobial activity based on the presence of chlorous acid relies on the presence of reservoirs of chlorite and hydrogen ions in the solution. As the chlorous acid is consumed, through interaction with microorganisms and certain other organic matter in solution, re-equilibration will occur to produce more of the acid chlorous acid. The following schematic covers the relevant aspects of this chemistry:

Schematic of Chlorite/Chlorous Acid System



0179

As chlorous acid degrades it produces a series of transient oxidants, including hypochlorous acid and dichlorine dioxide; and ultimately chlorine dioxide (ClO_2 ; CAS No. 10049-04-4) if the intermediates are not consumed through a redox interaction with such organic materials as microorganisms. The ClO_2 that forms may further combine with free chlorite (ClO_2^-) to form the cidal oxidant Cl_2O_4^- .

The H^+ ion source can be any protic acid which, for this application, must be a GRAS material. Three such acids, covering a range of strengths, are phosphoric acid (CAS No. 7664-38-2), citric acid (CAS No. 77-92-9) and acetic acid (CAS No. 64-19-7), although these materials are representative rather than restrictive of the GRAS acids which may be employed as suitable acidifiers of the chlorite ion.

0180

6.0 INTRODUCTION OF SUBSTANCES INTO THE ENVIRONMENT

6.1 PRODUCTION RELEASES

As noted above in Section 4, the acidified chlorite/chlorous acid solution will be produced on site immediately before application in the processing facility, be it a major operation, a contract operation for a specific chain, or a supermarket facility. The solution mixing will take place either immediately prior to, or directly during the spraying process, the latter by confluence of the separate acid activator and sodium chlorite solutions at the nozzle. In both cases the acid and sodium chlorite solutions will be prepared in cool tap water, so that during the brief time between creation and activation of the ASC solution the levels of free chlorine dioxide that are generated from the solution are not expected to exceed *ca.* 1 ppm (i.e. 1 mg/ liter).

In larger operations, it is anticipated that the spray treatment will be applied to the meat chunks as they pass through a semi-enclosed, baffled spray cabinet. The spray will be applied via pressurized spray nozzles, for up to about 30 seconds before the carcass exits the cabinet. The semi-enclosed spray cabinet area will be negatively pressurized via an aspirating air hose venting into a drain pipe located in the base of the cabinet. This will ensure the removal of excess fluid and gaseous materials. The drain pipe will be routed to an enclosed drain for removal with other wastes.

While chlorine dioxide has a minimum tendency to form when chlorite and acid are initially combined immediately prior to spraying, it has an increasing tendency to form as the solution concentrates during the evaporative process. Thus, in a typical situation, the potential for chlorine dioxide entry into the air of the workplace would be expected to derive from both that initially formed in solution (estimated as < 1.0 ppm), and any formed during

evaporation. Chlorine dioxide also has a significant tendency to react with, and be degraded by soluble organic matter (such as blood proteins) to chlorite and ultimately chloride. It is therefore expected that a major portion of both the initially projected chlorine dioxide maximum of 1 mg/liter of solution and any quantity formed upon subsequent solution evaporation will be reduced to a non-volatile, chlorine-containing ion that would be removed in the water.

It is further expected that the degree of ASC evaporation of, and concentration-induced creation of chlorine dioxide during the treatment's 30-second residence time on the meat pieces will be low. This is particularly true because the high humidity conditions prevailing in the cabinet will tend to suppress evaporation. Thus the projected 1 mg/liter level of chlorine dioxide is expected to correspond to the maximum amount from both initial and evaporative sources.

To put this into perspective, assume that an ASC spray operation uses 5 ml of ASC solution per pound of meat, of which about half that amount is retained on the product. For every 1,000 pounds of meat, the corresponding 5 liters of solution that would be used might release up to 5 mg of chlorine dioxide, at the 1 ppm maximum projected loss. Assuming a static air environment, with no venting or circulation of the air in the vicinity of that quantity of meat, the dispersal of 5 mg into only 17 M³ of air would bring its concentration to the OSHA 8-hour TLV of 0.3 mg/M. It is fully expected that with venting and circulation of the air associated with a throughput of 1,000 pounds of meat, that the maximum projected chlorine dioxide air level would therefore not be a safety concern. A dipping operation, with less air dispersal of the ASC than a spray operation, would provide even less chlorine dioxide to the surrounding air.

0182

6.2 USE RELEASES

The Environmental Assessment Section (H) of Alcide Corp.'s FAP 7A4532, which successfully sought the safe use of antimicrobial ASC solutions in the processing of red meat carcasses, contained a good deal of relevant information on the subsequent use of ASC solutions on subprimal and secondary meat cuts, and related specialty meat products. Of particular importance is the fact that about 50% of the US red meat consumption is in the form of ground product, such as hamburger, ground beef and sausage. Thus the information provided to substantiate the environmental safety associated with ASC solution use in the post-slaughter processing of meat carcasses is directly applicable to the subsequent use of these same solutions on 50% of the quantities of meat that were initial candidates for such use.

The key areas of potential concern are as follows:

6.2.1 WATER AND AIR RELEASES

The components of the ASC solutions are the GRAS acid, of high purity, and the sodium chlorite (of a technical grade) which has sodium chloride and sodium chlorate as impurities. Upon acidification the chlorite, through chlorous acid, will slightly transform to chlorine dioxide and chlorate. At the level of use of these components, and the minimum standing time for the mixed ASC solution, the amount of chlorine dioxide will not exceed *ca.* 1 ppm. And, being a highly reactive compound, will be quickly reduced by reaction with organic matter and microorganisms on the meat pieces. The reduction will be to even smaller quantities of chlorite and chloride ions, with an even lower amount of chlorate being formed by a disproportionation of the chlorine dioxide.

0183

The air releases of chlorine dioxide, as shown in the previous Section 6.1. and as more fully considered in the previous FAP 7A4532, are considered to be negligible. Of greater possible concern are the relatively higher levels of sodium chlorite, i.e. 1200 ppm as a maximum, of which the chlorite ion represents 895 ppm. For larger processing facilities, the information that was provided in the earlier FAP for the post-slaughter spraying of meat carcasses is directly applicable to the larger facilities where spray application of the ASC to subprimal and secondary cuts will be carried out. Since <50% of US ground meat will be prepared in large facilities, the environmental safety that was shown to be associated with the treatment of red meat carcasses will be similar to such use in down-the-line facilities. The area of potential concern not covered by the initial FAP is that relating to smaller volume use of ASC solutions such as in supermarkets, small sausage-making operations and local butcher shops.

6.2.1.a Water releases - Smaller facilities

It is anticipated that most of the ground meat in the US, perhaps ~30%, will be produced in the larger facilities (*e.g.*, Iowa Beef Packers and contract patty makers) which provide hamburger patties for such major consumer outlets as McDonalds, Burger King and Wendy's. The remaining ASC usage will be distributed over a wide range of local facilities, thereby reducing the per site ASC volume. The actual volume of ASC solution that will be used in the smaller grinding operations, irrespective of whether it is applied by dip or spray, will reasonably represent a smaller fraction of the total water used by that facility than would apply in the large-scale, high-volume spray operations covered in FAP 7A4532.

0184

Because of the diversity of such small-use operations the prediction of specific ASC quantities with respect to other waters in the effluent of a particular type of facility does not seem feasible. However it can be readily concluded that the much smaller chlorite quantities in the facility's effluent would be at least as likely to react with and be degraded by the organic matter in its effluent water as for the larger facilities'. For the latter, reference to Section 6.2.1. of FAP 7A4532 will show that the maximum level of oxychlorines (mostly chlorite) that might be expected in the plant effluent of a carcass operation is ~0.005 ppm.

With respect to the acids used to acidify the sodium chlorite to the petitioned pH range of 2.5 - 2.9, the following are representative levels of GRAS acids required to achieve that range (buffering included):

Sulfuric acid-	≤0.005% (≤50 ppm)
Phosphoric acid-	0.01 - 0.02% (100 - 200 ppm)
Malic acid-	0.02 - 0.04% (200 - 400 ppm)
Acetic acid-	1.5 - 2.5%

These levels are quite low, and will be significantly diluted further by other water sources contributing to the facilities' effluents. They are therefore of little environmental concern. Even the specified range of acetic acid, which has been approved by FSIS at that level for carcass disinfection, is projected to yield diluted effluents above at least 5.5 pH.

0185

6.2.1.b Air releases - Smaller facilities

As seen earlier, the spray application of the ASC solution to the meat pieces would create negligible air levels of chlorine dioxide, in an environment of normal air turnover, even without the use of a spray cabinet to confine its dispersal. In a small ASC dip operation, where meat pieces will generally have some liquid exudate on their surfaces (in which soluble proteins will be contained) this organic matter has been seen to destroy any small levels of chlorine dioxide that may have formed in the solution upon its activation. In experiments in which pieces of meat have been immersed in ASC dips solutions, there has been no noticeable odor of chlorine dioxide above these solutions. The odor threshold for chlorine dioxide detectability is $\sim 0.1 \text{ ppm}^2$. The OSHA TLV for chlorine dioxide is also 0.1 ppm, for continuous 8-hour exposure³. Thus it does not appear that the dipped application of ASC solutions to meat cuts will bring about unsafe air levels of chlorine dioxide in the environment of the dip operation.

6.2.2. RELATION OF PLANT WATER RELEASES TO TOTAL PUBLICLY OWNED TREATMENT WORKS QUANTITIES

The industrial discharges, such as from plants which process subprimal and secondary meats, to local Publicly Owned Treatment Works (POTWs) are further diluted by discharges from other industrial as well as from non-industrial sources. Alcide's Environmental Assessment Document (Section H of FAP 7A4532) that was part of its petition for use of ASC solutions in carcass processing, discussed the relationship of such plant discharges to total POTW intakes. Reference was made to an EPA-sponsored study⁴ which provided guidance in minimizing the discharge effects on these POTWs. In that report it was shown that the average influent waste water from industrial sources was 26.3% of the total intake. That information was used to estimate the projected impact of the meat-processing facilities using ASC treatments.

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Since ~50% of the red meat used in this country is consumed as a ground product, it can be presumed that none of the various facilities which will be using the petitioned ASC solutions will approach the volume usage characteristic of the various primary carcass processors. Thus the subsequent dilution of effluents from down-the-line meat processors can be expected to result in lower oxychlorine discharges to the POTWs than from those from the carcass processors. If, as calculated in FAP 74532, the contribution from a carcass processor to its handling POTW is a maximum 12 parts per billion (ppb), the contribution from a down-the-line processor should be less than that. A similar analogy holds for the food-grade acids used for ASC activation, where the acid contribution to POTW facilities would be *de minimus*.

On the basis of these discussions, and the background in Section H of the previous petition, FAP 7A4532, the Alcide corporation does not believe that the above-indicated concentrations of oxychlorine species or food acids will have a negative impact on the operation of POTW, for the following reasons:

- a) The levels of oxychlorines, *i.e.*, chlorite, chlorate, and chlorine dioxide, that would reach the POTW's, is at the ppb level, at most. Neither chlorite, chlorate nor chlorine dioxide is listed as an Interfering Substance in POTWs, as provided in a document listing Interferences at POTWs⁵. These interfering substances, as contained in certain industrial discharges, can cause "a POTW's noncompliance with its permit or inability to lawfully use or dispose of its sludge." Acidity is also listed as a potential interference in POTW operation, but the levels contributed by this application would not have a measurable impact on pH.
- b) None of the species present at the levels indicated can interfere with the microbiological treatment systems. Chlorine dioxide, a recognized

0187

antimicrobial, will have no effect at the calculated ppb level; neither will the chlorite, a much weaker source of activity, at the minuscule levels possibly present.

6.2.3 COMPLIANCE WITH EMISSION REQUIREMENTS

Alcide is not aware of any federal, state or local water or air emission regulations applicable to chlorite, chlorate or chlorine dioxide. Alcide fully anticipates that any red meat grinding operation that intends to use the acidified sodium chlorite solutions, if deemed appropriate, will obtain the necessary permits and approvals for discharging process waters containing chlorite, chlorate and chlorine dioxide to POTWs. It should be noted that sodium chlorite, used in preparation of these ASC solutions, is an EPA-registered product. It is Alcide's current intention to use one of three EPA registered sodium chlorite products for the proposed application (or the equivalent): Vulcan Chemicals' 79% Technical Sodium Chlorite, Technical Sodium Chlorite Solution 31.25, and 31% Active Sodium Chlorite Solution. Copies of the Technical Data Sheets and Material Safety Data Sheets for these products are provided in Appendix I of this section. Alcide intends to request that Vulcan Chemicals include label copy which mandates that users of the sodium chlorite must discharge the solutions in accordance with the requirements of the facility's National Pollution Discharge Elimination System permit. Any warning statements on the labels concerning the hazard of the products to organisms that may be exposed to it in the environment will also be on the labels of the FDA-regulated use.

6.2.4. COMPLIANCE STATUS

Sodium chlorite has a number of commercial uses, primarily as a source of chlorine dioxide, *e.g.*, pulp and paper bleaching, drinking water treatment, as a slimicide in cooling towers, as a food disinfectant, and as a cleaning agent in the electronics industry. The current U.S. production of sodium chlorite is close to 25 million pounds. The 1994

slaughter data for animals in federally-inspected plants, according to the American Meat Institute, was:

Cattle-	32,593,000
Veal/Calves-	1,159,000
Hogs-	90,000,000
Sheep & Lambs-	5,001,000

If 50% of the meat from all of these animals were to be treated, most of which being converted to ground meat, and using the maximum petitioned 1200 ppm ASC solution, the amount of sodium chlorite employed would certainly not exceed the amount which had been calculated, in the original FAP 7A4532, for the treatment of all of these animals post-slaughter. That amount, approximated as 50,765 pounds annually, was shown to be ~0.2% of the total sodium chlorite consumed annually in this country. So total ASC treatment of all animals post-slaughter combined with its complete usage on all meat cuts intended for grinding would still represent a small percentage of total sodium chlorite use for meat processing.

To take that calculation one step further, one may consider that ASC solutions are also federally approved for use in poultry processing waters. In the corresponding Environmental Assessment (Section H of FAP 4A4433) it was computed that complete use of the ASC's on all the 7.0 billion chickens processed per year would correspond to a sodium chlorite usage that would be 2% of current annual consumption. This use-volume, of course, is an over-exaggeration. So application of the ASC antimicrobial solutions, in realistic terms, would probably not exceed ~1% of current sodium chlorite usage when the treatment is applied in poultry processing as well as both initial and secondary stages of red-meat processing.

0189

7.0 FATE OF EMITTED SUBSTANCES IN THE ENVIRONMENT

Sodium chlorite, sodium chlorate and chlorine dioxide released into the environment will likely undergo reduction in contact with organic matter, and/or microbial degradation wherein microorganisms can use the oxychlorines as an oxygen source when present at sublethal levels. Ultimately the oxychlorines will be reduced to the chloride ion, Cl⁻.

0130

8.0 ENVIRONMENTAL EFFECTS OF RELEASED SUBSTANCES

8.1 EFFECTS ON AQUATIC ORGANISMS

Summaries of relevant portions of this section, as presented in FAP 7A4532 for the oxychlorines that might enter the environment as a result of meat carcass treatment are provided in the next paragraphs. Following the discussion of each specific oxychlorine is a projection of effects from each of these materials as a result of pre-treatment of meat cuts prior to grinding.

Sodium Chlorite: The LC_{50} aquatic toxicity to fish and oyster species ranged from 41 to 149 ppm, and from 151 to 650 ppb for *Daphnia magna* and Mysid shrimp, resp. The EPA has determined that sodium chlorite is toxic to fish, on the basis of the *Daphnia magna* figure. It was shown in Section 6.2.1.a. that a maximum level of about 5 ppm of sodium chlorite would reach the typical POTW, which amount is much below a level of concern. For effluents that might not be directed to POTWs, but are directed to catch ponds and leaching beds, the high levels of organic matter in the earth environment would rapidly reduce the chlorite to safe levels before the entraining water reached habitable waters for aquatic species.

Sodium Chlorate: The LC_{50} for freshwater and marine fish is consistently >1000 ppm. Sodium chlorate, being a small fraction of the impurities in technical grade sodium chlorite, and forming to only a minor extent during the degradation of ASC solutions, is therefore of no concern from their use in carcass treatments. This conclusion is also directly applicable to the lower volume use of ASC's for prior treatment of meat cuts intended for grinding.

0131

Chlorine Dioxide: The rapidity of degradation of chlorine dioxide in organic environments, coupled with its minimum production in ASC solutions eliminates any aquatic toxicity concerns from carcass treatments. This conclusion is also appropriate for effluents resulting from ASC use on meat cuts prior to their comminution.

8.2. EFFECTS ON TERRESTRIAL ORGANISMS

A summary of the corresponding section in the prior FAP, 7A4532, for red meat carcass processing, is provided in the following paragraphs. Included in that summary are comments with respect to anticipated toxicity's resulting from use on pre-ground meat cuts.

A broad variety of toxicological studies have been carried out on the oxychlorine species chlorite, chlorate and chlorine dioxide, in connection with the worldwide use of chlorine dioxide in the disinfection of potable water. The ClO_2 has been found to produce virtually no chlorinated hydrocarbons as potential mutagens, as does chlorine. On a concentrated basis, the oxychlorines have been found to cause oxidative changes to erythrocytes, both in loss of structural integrity and formation of methemoglobin. However at the ppb levels where these materials may be found in red meat processing plant effluents, be they primary or subprimal and secondary meat grinding operations, the data obtained in connection with drinking water levels of the oxychlorines are more relevant.

On an acute basis, the toxicity of sodium chlorite is in the range of 300 - 350 mg/kg, based on the LD_{50} values for mice, rats, and guinea pigs. For sodium chlorate, the LD_{50} 's cover the range of ~600 to 8000 for mice, rats, dogs, cats and rabbits. With respect to the acute toxicity of chlorine dioxide, an LD_{10} of 500 ppm was found for 15 minutes air exposure by rats. In man, a 5 ppm level in the air was found to be an irritant to the respiratory and G.I. tracts. Such levels would not be found in meat processing plants, either carcass or grinding operations, where any sub-ppm levels of ClO_2 formed during production of the ASC solutions would be rapidly destroyed by organic matter on the carcass or the meat pieces.

0192

A variety of sub-acute studies have been conducted on animals and human volunteers, who ingested waters containing up to 40 ppm of chlorine dioxide in a single episode, or 5 ppm solutions of chlorine dioxide or sodium chlorite for a 12 week period. In the latter case there were some effects on blood chemistry, but little other effects. In the former case there was headache, nausea and abdominal discomfort which passed in 5 minutes.

A recently completed rodent 90-day study, considered to be the "most definitive and comprehensive study of chlorite undertaken" andconsidered....the most relevant basis for risk assessment"⁶ was used, in conjunction with the earlier studies to calculate a NOEL (no observed effect level) of 5/mg/kg/day for chlorite in drinking water. This corresponds to 350 mg/kg/day intake for a 70 kg individual. Applying a 100-fold safety factor, this reduces to a recommended maximum intake of 3.5 mg/day for that individual. In the same publication a NOEL for chlorate is recommended of 78 mg/kg/day, which translates to a maximum intake of 54.6 mg of chlorate per day for a 70 kg person, including the 100 fold safety factor. For chlorine dioxide, the NOEL of 3.5 mg/kg/day is recommended, translating to an intake of 2.45 mg/kg/day for the 70 kg individual.

On the basis of the oxidative tendency of these oxychlorine species to be chemically reduced by organic matter in both the meat treatment, post-washing and plant sanitation waters, and subsequent municipal water treatment facilities, the levels of the three oxychlorine species are anticipated to be significantly lower than the levels calculated to be of minimal risk to individuals.

8.3 ENVIRONMENTAL BENEFITS

The use of acidified sodium chlorite acid systems for treatment of meat- and specialty- meat cuts offers the possibility of several environmental benefits:

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8.3.1 NON-FORMATION OF MUTAGENS AND CARCINOGENS

In those instances where ASC solutions might be used, or are used in place of chlorinated water for disinfecting meat surfaces (not a common practice), the potential for the formation of chlorinated organic materials in the environment would be significantly reduced.

8.3.2. REDUCTION IN AQUATIC TOXICITY

Similar considerations would apply to the reduction of hypochlorite in aquatic environments, which has the following toxicity⁷

- Cold water fish: 0.132 - 135 ppm (LC₅₀-96 hr)
- Warm water fish: 0.28 - 2.1 ppm (LC₅₀-96 hr)
- *Daphnia magna*: 0.037 - 2.1 ppm (LC₅₀-48 hr)

These data indicate that chlorine/hypochlorite is much more toxic to both cold and warm freshwater fish than is chlorite or chlorate, and generally slightly more toxic to the *Daphnia magna* invertebrate.

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9.0 USE OF RESOURCES AND ENERGY

As shown earlier in format section 6, **if all of the secondary meat cuts, organs, and related products in the United States were to be first treated with ASC solutions,** and such solutions were similarly used on all red meat carcasses and all the chickens processed annually in the US, the amount of additional sodium chlorite consumed would only be ~2.3% of the total present consumption of sodium chlorite. Inasmuch as the eventual use of ASC solutions in these multiple applications will obviously be significantly less than that maximum, the impact on national resources and energy by such incremental use will be insignificant. Also no minerals will be used in the preparation or production of the subject additive. Environmental releases of chlorite, chlorate, chlorine dioxide and any of the GRAS acid activators are not expected to adversely affect threatened or endangered species nor impact historic structures.

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10.0 MITIGATION MEASURES

No adverse environmental effects are anticipated from residual "worst-case" levels of chlorine dioxide in workplace, if this petition is approved. Therefore, no mitigation measures are required.

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11.0 ALTERNATIVES TO PROPOSED ACTION

Inasmuch as no potential adverse environmental effects are expected to occur, no mitigation alternative actions are necessary.

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12.0 PREPARER

This Environmental Assessment was prepared by Robert D. Kross, Ph.D. of Kross-Link Laboratories. Dr. Kross has an educational background in physical chemistry, analytical chemistry and physics, and has consulted in the fields of oxychlorine chemistry, food & nutrition, biochemistry, microbiology, toxicology and environmental analysis. He was an intervenor in the siting of the Shoreham Nuclear Power Plant of the Long Island Lighting Corporation.

0198

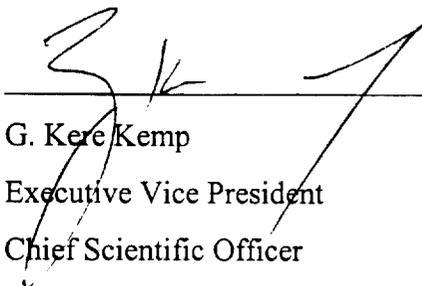
13.0 CERTIFICATION

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

Date:

July 23, 1999

Signature:



Name:

G. Kere Kemp

Title:

Executive Vice President
Chief Scientific Officer

0199

14.0 APPENDICES

Appendix 1. Sodium Chlorite Technical Data Sheets and Materials Safety Data Sheets.

0200



MATERIAL SAFETY DATA SHEET

24 Hour Emergency Phone 316/524-5751

A Division of Vulcan Materials Company
P O Box 530390
Birmingham, AL 35253-0390

SECTION 1 PRODUCT IDENTIFICATION

CHEMICAL NAME Sodium Chlorite Solution	CHEMICAL FORMULA NaClO ₂	MOLECULAR WEIGHT 90.45
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PRODUCT NAME
Technical Sodium Chlorite Solution 31.25, 31% Active Sodium Chlorite, Textone® L, Textone® XL

NOTE: This Material Safety Data Sheet is also valid for technical sodium chlorite solutions weaker than 31.25% (25% Active). Physical data, such as specific gravity will be different from the values listed.

SYNONYMS 25% Min Active Sodium Chlorite and 38.75% Technical Sodium Chlorite	DOT IDENTIFICATION NO. UN 1908
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SECTION 2 COMPONENT DATA

<u>CHEMICAL NAME</u>	<u>CAS NUMBER</u>	<u>% RANGE</u>	<u>EXPOSURE STANDARDS</u>
Sodium chlorite	7758-19-2	25-34%	None Established
Sodium chloride	4647-14-5	1-6%	None Established
Sodium sulfate	7757-82-6	0-2%	None Established
Sodium chlorate	7775-09-9	0-3%	None Established
Water	7732-18-5	59-74%	None Established

SECTION 3 PHYSICAL DATA

APPEARANCE AND ODOR
Clear, water white to slightly yellow liquid, slight chlorine odor

SPECIFIC GRAVITY
1.23-1.30 at 25/25°C

DECOMPOSITION TEMPERATURE
175°C (347°F) (Dry material)

BULK DENSITY
10.4-10.7 lbs./gal. at 25°C

pH @ 25°C
> 12

VAPOR PRESSURE @ 25°C
No Data

SOLUBILITY IN WATER
100%

VOLATILES, PERCENT BY VOLUME
59-74%

SECTION 4 REACTIVITY INFORMATION

SUMMARY OF REACTIVITY
Oxidizer

CONDITIONS TO AVOID:

Temperatures above 175°C (347°F) (dry material)
Evaporation to dryness; dried material can ignite upon contact with combustibles.
Exposure to sunlight or ultraviolet light can reduce product strength.

002156

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1 of 6

INCOMPATIBLE MATERIALS

Acids, reducing agents, combustible materials, oxidizers (such as hypochlorites), sulfur-containing rubber, dirt, soap, solvents, paints.

OTHER CONDITIONS TO AVOID

Contamination with acids, chlorine or organic materials. Avoid contact with heat or flame source.

HAZARDOUS DECOMPOSITION PRODUCTS

Explosive and toxic chlorine dioxide gas will be generated on contact with acids or chlorine

HAZARDOUS POLYMERIZATION

Will not occur

SECTION 5 FIRE AND EXPLOSION HAZARD INFORMATION**FLASH POINT**

Not Applicable

AUTOIGNITION TEMPERATURE

Not Applicable

FLAMMABLE LIMITS IN AIR (PERCENT BY VOLUME)

Not Applicable

NFPA RATINGS

Not Established for solution

EXTINGUISHING MEDIA

Not Applicable-Choose extinguishing media suitable for surrounding materials.

FIRE FIGHTING TECHNIQUES AND COMMENTS

Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Use flooding quantities of water as fog or spray. This product becomes a fire or explosion hazard if allowed to dry, so use water spray to keep fire-exposed containers cool. Extinguish fire using agent suitable for surrounding fire. See Section 7 for protective equipment for fire fighting.

SECTION 6 TOXICOLOGY AND HEALTH INFORMATION**EXPOSURE STANDARDS**

None Established

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

There is no level established for this chemical.

ODOR THRESHOLD

There is no data available on the odor threshold of sodium chlorite.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Deficiency in G6PD enzyme and other red blood cell diseases

INTERACTIONS WITH OTHER CHEMICALS WHICH ENHANCE TOXICITY

None known or reported

ACUTE TOXICITY**ROUTES OF EXPOSURE**

Oral, dermal, inhalation and eye contact

INHALATION

Inhalation may cause irritation of the mucous membranes and respiratory tract. Symptoms may include coughing, bloody nose, and sneezing. Severe overexposures may cause lung damage.

SKIN

Direct contact may cause severe irritation and/or burns with symptoms of redness, itching, swelling and possible destruction of tissue.

EYE

Mist or direct contact may cause severe irritation and possibly burns. Symptoms may include tearing, redness and in severe cases, eye damage due to burns.

002157

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INGESTION

Gastroenteritis with any or all of the following symptoms: nausea, vomiting, lethargy, diarrhea, bleeding or ulceration. Acute ingestion of large quantities may also cause anemia due to the oxidizing effects of the chemical.

ANIMAL TOXICOLOGY

Inhalation LC₅₀: No available data
Dermal LD₅₀: > 2 g/kg (rabbit)
Oral LD₅₀: Approximately 350 mg/kg (rat)
Irritation: Severe irritant with corrosive action to skin (of rabbit)
Severe irritant to eyes (of rabbit)

FIRST AID

EYES

Immediately flush eyes with large amounts of water for at least 15 minutes while frequently lifting the upper and lower eyelids. Consult a physician immediately.

SKIN

Remove contaminated clothing. Immediately flush exposed skin areas with large amounts of water for at least 15 minutes. Consult a physician if burning or irritation of the skin persists. Contaminated clothing must be laundered before re-use.

INGESTION

DO NOT induce vomiting. Drink large quantities of water. Consult a physician immediately. DO NOT give anything by mouth if the person is unconscious or having seizures.

INHALATION

Move patient to fresh air and monitor for respiratory distress. If cough or difficulty in breathing develops, administer oxygen, and consult a physician immediately. In the event that breathing stops, administer artificial respiration and obtain emergency medical assistance immediately.

NOTES TO PHYSICIAN

Chlorine dioxide vapors are emitted when this product contacts acids or chlorine. If these vapors are inhaled, monitor patient closely for delayed development of pulmonary edema which may occur up to 48-72 hours post-inhalation.

Following ingestion, neutralization and use of activated charcoal is not indicated.

CHRONIC TOXICITY

INHALATION

There is no data available on the chronic effects of inhaling sodium chlorite.

SKIN

There are no studies or reports on the repeated effects of dermal exposure to sodium chlorite. Because of the acute effects, repeated direct contact may be unlikely.

INGESTION

The chronic ingestion of low concentrations of this product has been studied in laboratory animals. Concentrations in the drinking water of 100 ppm and higher have been shown to cause mild anemia and a minor suppression of thyroid functions in laboratory animals. All effects were reversible after cessation of treatment.

Clinical studies of communities using sodium chlorite as a disinfectant found no adverse effects in the human population studied. However, other studies have suggested that those individuals deficient in an enzyme (G6PD) utilized in hemoglobin synthesis might be susceptible to the development of anemia if exposed repeatedly.

002158

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CHRONIC TARGET ORGAN TOXICITY

Repeated exposures to solutions of chlorine dioxide at concentrations of 10-100 ppm have produced slight effects upon the thyroid in younger animals and the hematologic system. Exposures to these concentration can reduce the cellular and blood levels of glutathione, an agent which is protective against the oxidizing effect of this chemical. Exposure of laboratory animals above 100 ppm in the drinking water have shown a decrease in blood cell glutathione, red blood cell count and hemoglobin. In some studies these levels also caused a slight decrease in thyroid hormones, especially in younger animals.

CARCINOGENICITY

Sodium chlorite is not listed by NTP, IARC, OSHA, EPA, or any other authority as a carcinogen. Carcinogenicity studies conducted in mice and rats did not show an increase in tumors in animals exposed to sodium chlorite in their drinking water.

MUTAGENICITY

Sodium chlorite has been evaluated for possible mutagenic effects in several laboratory tests. Sodium chlorite tested positive in the Ames Salmonella reverse mutation assay without metabolic activators and caused chromosomal aberrations in an in vitro Chinese hamster fibroblast cell line without metabolic activators. Sodium chlorite also tested positive in the mouse micronucleus assay when administered intraperitoneally (directly into the body cavity), but was not mutagenic when administered orally. The significance of these test results for human health is unclear because the oxidizing effects of the chlorite or salting effects of sodium may significantly affect the ability of the tests to accurately detect mutagens.

REPRODUCTIVE TOXICITY

Sodium chlorite has not been found to be teratogenic in studies in which animals have been exposed up to 100 ppm in the drinking water. Male rats repeatedly exposed to concentrations of 100 ppm or greater in the drinking water have shown slight effects on sperm motility. No effects were observed at 10 ppm and no effects were observed on fertility rate, histology of the male reproductive system or conception rate of animals exposed at 10 ppm or higher.

AQUATIC TOXICITY

Sodium chlorite is slightly toxic to fish and other aquatic organisms.

For bluegill (*Lepomis macrochirus*), aquatic toxicity studies have shown a TL_{50} of 208 mg/l and LC_{50} values of 265-310 mg/l. Rainbow trout (*Salmo gairdneri*) have been tested and shown acute toxicity values of 50.6 mg/l (TL_{50}) and 290 mg/l (LC_{50}). Of the aquatic species tested, *Daphnia* have been the most sensitive species tested with an LC_{50} of 0.29 mg/l.

Sodium chlorite is acutely toxic to birds when administered by gavage. The acute oral LD_{50} in mallard ducks is 0.49-1.00 g/kg. In bobwhite quail the LD_{50} is 0.66 g/kg.

Sodium chlorite in the diet of birds was not acutely toxic. Eight day dietary LC_{50} 's in mallard ducks and bobwhite quail were both greater than 10,000 ppm in the diet.

SECTION 7 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

PERSONAL PROTECTION FOR ROUTINE USE OF PRODUCT

RESPIRATORY PROTECTION

Wear a NIOSH/MSHA approved acid gas respirator plus dust/mist pre-filters if any exposure to dust or mist is possible.

VENTILATION

Local exhaust ventilation is recommended if vapors, mists or aerosols are generated. Otherwise, use general exhaust ventilation.

SKIN AND EYE PROTECTIVE EQUIPMENT

Wear Neoprene gloves, boots, apron, chemical goggles and a face shield.

002159

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OTHER

Emergency eye wash and safety showers must be provided in the immediate work area. Thoroughly wash all contaminated clothing.

PERSONAL PROTECTION FOR EMERGENCY SPILL AND FIRE-FIGHTING SITUATIONS

Wear full protective clothing (chemically impermeable, full encapsulated suit) and positive pressure self-contained breathing apparatus. This product becomes a fire or explosive hazard if allowed to dry; see Section 5.

SECTION 8 PRECAUTIONS FOR SAFE HANDLING AND STORAGE

WARNING STATEMENTS AND WARNING PROPERTIES

HARMFUL IF SWALLOWED. MAY CAUSE IRRITATION OR BURNS TO SKIN AND EYES.
HARMFUL TO BREATHE.

DO NOT TAKE SWALLOW OR BREATHE. AVOID CONTACT WITH SKIN, EYES AND CLOTHING.
UPON CONTACT WITH SKIN OR EYES, WASH OFF WITH WATER.

STORAGE CONDITIONS

Do not store at temperatures above 100°C (212°F)
Do not expose to direct sunlight or ultraviolet light.

SHELF LIFE LIMITATIONS

2 years

INCOMPATIBLE MATERIALS FOR PACKAGING

Combustible or readily oxidizable materials; sulfur-containing rubber

INCOMPATIBLE MATERIALS FOR STORAGE OR TRANSPORT

Acids, reducing agents, combustible material, oxidizers (such as hypochlorites), paints, sulfur, solvents.

SECTION 9 SPILL AND LEAKAGE PROCEDURES

FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC AT 800-424-9300.

ALL SPILLS OR LEAKS OF THIS MATERIAL MUST BE HANDLED AND DISPOSED OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS

REPORTABLE QUANTITY

None listed for Sodium Chlorite Solution in 49 CFR 172.101, Appendix.

SPILL MITIGATION PROCEDURES

Evacuation procedures must be placed into effect. Evacuate all non-essential personnel. Hazardous concentrations in air may be found in local spill area and immediately downwind. Utilize emergency response personal protective equipment prior to the start of any response. This product may represent an explosion hazard, in the form of explosive chlorine dioxide gas if it contacts acids or chlorine. Remove all sources of ignition, such as flames, hot glowing surfaces or electric arcs. Stop source of spill as soon as possible and notify appropriate personnel.

AIR RELEASE

Vapors may be suppressed by the use of water fog or spray. Contain all liquids for treatment and/or disposal as a (potential) hazardous waste.

WATER RELEASE

Notify all downstream water users of possible contamination. Continue to handle as described in LAND SPILL, below.

002160

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LAND SPILL

Create a dike or trench to contain all liquid material. Spill materials may be absorbed using clay, soil or non-flammable commercial absorbents. Continue to keep damp. If allowed to dry, dried material can ignite in contact with combustible materials. Do not place spill materials back in their original container. Containerize and label all spill materials properly. Decontaminate all clothing and, if permitted, the spill area using strong detergent and flush with large amounts of water.

SPILL RESIDUES

If this product becomes a waste, it meets the criteria of a hazardous waste as defined under 40 CFR 261 and would have the following EPA hazardous waste designation: D002. Also, it will be subject to the Land Disposal Restrictions under 40 CFR 268 and must be managed accordingly.

As a hazardous liquid waste, it must be disposed of in accordance with local, state and federal regulations in a permitted hazardous waste treatment, storage and disposal facility.

SECTION 10 TRANSPORTATION INFORMATION

This material is regulated as a DOT hazardous material.

DOT SHIPPING DESCRIPTION (49 CFR 172.101)
CHLORITE SOLUTION, 8, UN 1908, II

PLACARD REQUIRED
Corrosive, 1908, Class 8

The applicable packaging sections in 49 CFR are 173.202 and 173.242.

SECTION 11 ADDITIONAL REGULATORY STATUS INFORMATION

TOXIC SUBSTANCES CONTROL ACT

The components of this product are listed on the Toxic Substance Control Act inventory.

SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) TITLE III HAZARD CATEGORIES (40 CFR 370.2)

HEALTH: Immediate (Acute), Delayed (Chronic)

PHYSICAL: Fire

EMERGENCY PLANNING AND COMMUNITY RIGHT TO KNOW (40 CFR 355. APP.A)

E H S-THRESHOLD PLANNING QUANTITY
None Established

SUPPLIER NOTIFICATION REQUIREMENTS, PER 40 CFR 372.45:
None Established

Medical Emergencies:

Call collect 24 hours a day
for emergency toxicological
information 415/821-3182

Other Emergency information:

Call 316/524-5751 (24 Hours)

For any other information contact:

Vulcan Chemicals
Technical and Environmental Services
P O Box 530390
Birmingham, AL 35253-0390
800/873-4898
8 AM - 5 PM, Central Time
Monday through Friday

NOTICE: Vulcan Chemicals believes that the information contained on this material safety data sheet is accurate. The suggested procedures are based on experience as of the date of publication. They are not necessarily all-inclusive nor fully adequate in every circumstance. Also, the suggestions should not be confused with nor followed in violation of applicable laws, regulation, rules or insurance requirements.

NO WARRANTY IS MADE, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE.

Date of Preparation: June 1, 1995

FORM 3239-640

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