DRAFT

Didecyl Dimethyl Ammonium Chloride (DDAC)

Risk Assessment

(DP Barcode 069149)

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1.0 EXECUTIVE SUMMARY

This document provides a risk assessment for the Group I Quat Cluster. The Group I Quat Cluster is a group of structurally similar quaternary ammonium compounds ("quats") that are characterized by having a positively charged nitrogen covalently bonded to two alkyl group substituents (at least one C_8 or longer) and two methyl substituents. In finished form, these quats are salts with the positively charged nitrogen (cation) balanced by a negatively charged molecule (anion). The anion for the quats in this cluster is chloride or bromide. In this document, the Group I Quat Cluster will be referred to as DDAC (didecyl dimethyl ammonium chloride).

DDAC is the active ingredient in numerous types of products. The products are mainly disinfectants and deodorants that are used in agricultural, food handling, commercial/ institutional/industrial, residential and public access, and medical settings. Examples of registered uses for DDAC in these settings include application to indoor and outdoor hard surfaces (e.g., walls, floors, tables, toilets, and fixtures), eating utensils, laundry, carpets, agricultural tools and vehicles, egg shells, shoes, milking equipment, humidifiers, medical instruments, human remains, ultrasonic tanks, reverse osmosis units, and water storage tanks. There are also DDAC-containing products that are used in residential and commercial swimming pools, in aquatic areas such as decorative ponds and decorative fountains, and in industrial process and water systems such as re-circulating and once through cooling water systems, drilling muds and packer fluids, oil well injection and wastewater systems. Additionally, DDAC-containing products are used for wood preservation through non-pressure and pressure-treatment methods. There are registered uses for fogging in occupational settings. Products containing DDAC are formulated as liquid ready-to-use, soluble concentrate, pressurized liquid, and water soluble packaging. The percentage of DDAC in the various end-use products ranges from 0.08% to 80% DDAC. Residential products such as EPA Reg. No. 10324-69 range up to 50% DDAC for swimming pools and spas.

The durations and routes of exposure evaluated in this assessment include short-term (ST), intermediate-term (IT), and in some instances long-term (LT) inhalation exposures, ST dermal exposures, and ST oral exposures. The ST inhalation endpoint and the ST oral endpoint are based on a NOAEL of 10 mg/kg/day from a prenatal developmental toxicity study in rats. The LOAEL (20 mg/kg/day) was based largely on increased incidence of skeletal variations in females. This developmental study, along with a developmental study in rabbits do not indicate increased susceptibility in rats or rabbits from *in utero* and postnatal exposures to DDAC. The IT/LT inhalation endpoint is also confirmed by a NOAEL of 10 mg/kg/day but from a chronic toxicity study in dogs. No short-term dermal endpoint for systemic effects was selected for DDAC, since no systemic effects were identified. However, a short-term dermal irritation endpoint was identified. The short-term dermal endpoint for DDAC (2 mg/kg/day which is equivalent to 8 $\mu g/cm^2$) was determined from a LOAEL of 6 mg/kg/day based on increased clinical and gross findings (erythema, edema, exfoliation, excoriation, and ulceration). A 21-day dermal toxicity study was also conducted using a 0.13% ai formulation. No short-term dermal endpoint was identified for this formulation because no irritation or systemic effects were identified up to and including the limit dose of 1,000 mg/kg/day. Intermediate- or long-term dermal irritation endpoints were not identified for DDAC. Because the effect to the skin is localized skin irritation, a skin concentration ($\mu g/cm^2$) of exposure, rather then a dose (mg/kg/day) was used to assess the dermal risk

concerns. No body weight is needed for the dermal irritation endpoint, since no systemic dose is calculated. Since the toxicological endpoint for inhalation is female-specific, a body weight of 60 kilograms is used in the assessment. This represents the body weight of an adult female. The Agency's level of concern (LOC) for occupational and residential DDAC inhalation and oral exposures is 100 (i.e., a margin of exposure (MOE) less than 100 exceeds the Agency's level of concern). The level of concern is based on 10x for interspecies extrapolation and 10x for intraspecies extrapolation. The level of concern for the dermal route of exposure is a target MOE of 10 (i.e., 3X intraspecies variation and 3X interspecies extrapolation).

The acute toxicity categories (Tox Cat) for DDAC include: acute oral (Tox Category II), acute dermal (Tox Category III), acute inhalation (Tox Category II) and primary eye and skin irritation (Tox Category I). DDAC is not a dermal sensitizer.

Dietary Risk Summary

DDAC can be used as a disinfectant or sanitizer on counter tops, utensils, appliances, tables, refrigerators, on animal premises and/or farms, and in mushroom premises. The use of DDAC as an antimicrobial product on food or feed contact surfaces, agricultural commodities, and application to food-grade eggs may result in pesticide residues in human food. Residues from treated surfaces, such as utensils, countertops, equipment, and appliances can migrate to food coming into contact with the treated and rinsed surfaces and can be ingested by humans.

The results of the indirect food contact (i.e., countertops and utensils) assessment indicate no risks of concern. The acute and chronic dietary risks are the same because they are based on the same NOAEL. For indirect food contact exposures, the percent of the acute and chronic population adjusted dose occupied (%aPAD or cPAD) is 3.3 percent for adults and 13.3 percent for children. For direct applications to food, the % aPAD and cPAD for all individual uses and populations is less than or equal to 1. For the direct food contact as well as the indirect food contact the risks are not of concern. The drinking water exposures from DDAC uses are negligible and are not quantifiable.

Residential Risk Summary

Dermal

For the residential handler dermal exposure and risk assessment, dermal risks were calculated by comparing residues on the surface of the skin to the short-term dermal irritation endpoints. Additional dermal toxicity studies could provide a better characterization of the relationship between percent DDAC in a formulation and dermal irritation. Residues on the surface of the skin (dermal irritation exposure) were determined using hand unit exposures from CMA and/or PHED adjusted for the surface area of the hand (mg/lb ai/cm^2), application rates, and use amounts. The dermal MOEs were above the target MOE of 10 for all scenarios except for the spray applications to carpets and the heavy duty cleaning rate (0.02 lb ai per gallon) for mopping and wiping.

The residential post-application dermal risks were assessed by comparing the surface residue on the skin (dermal skin irritation exposure) to the short-term dermal endpoint. It was assumed that during the exposure period the skin repeatedly contacts the treated surface until

a steady-state concentration of residues is achieved on the skin. For residential scenarios, the post-application dermal MOEs were above the target MOE of 10 for the laundered clothing (assuming 1% residue transfer) but below the target MOE for the following:

- Wearing clothes treated with a fabric spray: ST dermal MOE = **≤1** using a 100% clothing to skin transfer factor and the MOE = 8 using a 5% clothing to skin transfer factor.
- There are no wipe data available to assess the children's dermal contact to treated decks and/or play sets. Based on hand measurements of workers at the treatment plants, dermal MOEs range from 3 to 13 with considerable uncertainties, and therefore a wipe study is warranted.

Inhalation

For the residential handler inhalation assessment, the inhalation risks were calculated by comparing the daily doses to the short-term inhalation endpoint. The inhalation MOEs were above the target MOE of 100 for all scenarios.

For the residential post-application inhalation exposure and risk assessment, the MOEs were below the target MOE of 100 for the following scenario:

- Humidifier: ST/IT 8-hr Inhalation MOE = **27** for adults and **8** for children; ST/IT 24-hr Inhalation MOE = **11** for adults and **5** for children

Incidental Oral

For the residential post-application incidental oral assessment, the MOEs were above the target MOE of 100 for all scenarios.

Aggregate Risk Summary

The acute and chronic dietary aggregate risk assessment includes direct and indirect food contact uses. There are no drinking water exposures as a result of DDAC applications. The acute and chronic endpoints are based on the same NOAEL value. Based on the results of the acute and chronic aggregate assessment, the % aPAD and cPAD for adults and children are 3.8% and 14%, respectively. Therefore, the acute and chronic dietary aggregate risks are not of concern (i.e., less then 100 % of aPAD and/or cPAD).

The DDAC toxicity endpoints for the chronic dietary and the intermediate-term incidental oral are based on the same toxic effect (and same study), and therefore, these two dietary routes of exposure are aggregated. On the other hand, the dermal and inhalation routes of exposure are based on different toxic effects, and therefore, these two routes of exposure are not aggregated. However, the dermal route of exposure is aggregated among those dermal exposure scenarios that are believed to co-occur. In addition, the inhalation route of exposure is also aggregated among the inhalation exposure scenarios that are believed to co-occur. The aggregate risks are not of concern for adults for the oral and inhalation routes. However, the adult dermal MOE for the heavy duty cleaning products are all of concern by themselves. As an aggregate, the adult dermal MOE is less than the target MOE of 10 for the general cleaning rate (aggregate MOE = 7) and for the heavy duty cleaning rate (aggregate MOE = 1). For children, the oral aggregate (dietary and intermediate-term ingestion for children at day care centers) is 270. The children aggregate MOE for the dermal route is 42, and therefore, not of concern. No children aggregate

inhalation scenarios were determined to co-occur. It is important to note, however, that some of the individual risks for scenarios not included in the aggregate are of concern by themselves (e.g., the humidifier use and the fabric spray for clothing).

Occupational Risk Summary

Dermal

DDAC dermal irritation exposures and risks were not estimated for occupational handler exposures. Instead, dermal irritation exposures and risks will be mitigated using default personal protective equipment requirements based on the toxicity of the end-use product. To minimize dermal exposures, the minimum PPE required for mixers, loaders, and others exposed to end-use products containing concentrations of DDAC that result in classification of category I, II, or III for skin irritation potential will be long-sleeve shirt, long pants, shoes, socks, chemical-resistant gloves, and chemical-resistant apron. Once diluted, if the concentration of DDAC in the diluted solution would result in classification of toxicity category IV for skin irritation potential, then the chemical-resistant gloves and chemical-resistant apron can be eliminated for applicators and others exposed to the dilute. Note that chemical-resistant eyewear will be required if the end-use product is classified as category I or II for eye irritation potential.

Dermal irritation exposures are assumed to be negligible for all post-application occupational scenarios, except those associated with wood preservation. As with occupational handlers, dermal irritation exposures and risks from post-application activities in a wood preservation treatment facility will be mitigated using default personal protective equipment requirements based on the toxicity of the end-use product. For construction workers handling treated wood the MOEs range from 3 to 13 with a target MOE of 10. A wipe study on treated wood will be needed to assess the potential exposure to handling treated wood.

Inhalation

For the occupational handler inhalation exposure and risk assessment, the MOEs were above the target MOE of 100 for all scenarios.

For the occupational inhalation post-application exposure and risk assessment, the MOEs were above the target MOE of 100 for all scenarios except for fogging in a food processing plant. The 8-hr MOE from starting 2 hours after application (i.e., 2 hour re-entry interval) is **8**.

Environmental Fate and Ecological Risk: AD Specific Uses

The results of the dietary avian studies indicate that DDAC is practically non-toxic to both mallard duck and bobwhite quail. In the Acute oral studies, the chemical was found to be moderately toxic to bobwhite quail. The results from freshwater fish acute toxicity studies demonstrated that DDAC was moderately to highly toxic. DDAC is very highly toxic to freshwater aquatic invertebrates. DDAC is very highly toxic to mysid shrimp a marine/estuarine invertebrate. DDAC is toxic to freshwater alga at microgram concentrations.

Data Gaps:
The following data requirements are outstanding for the currently registered uses of DDAC:
850.4225 - Non-target plant phytotoxicity testing (seedling emergence test using rice).
850.1035 - Acute Sheepshead minnow testing
850.1300 - Fish-Early Life Stage
850.1400 - Aquatic Invertebrate Life Cycle
850.4400 – Aquatic Plant Growth
850.1950 – Aquatic Field Monitoring
850.4250 – Vegetative Vigor using Rice
850.3030 – Honey Bee Toxicity Studies

Monitoring/Tier II modeling of once-through cooling tower use to establish EEC's for risk assessment.

Environmental Fate and Eco Risks: Agricultural Premises:

The Environmental Fate and Effects Division (EFED) has evaluated the outdoor use of the quaternary ammonium compounds, didecyl ammonium chlorides (DDAC), being considered for reregistration by the Antimicrobial Division (AD) (DP Barcode D325481). Although primarily used as antimicrobial agents, DDAC is labeled for use in puddles and decorative pools to control algae. This use is intended for waterbodies generally disconnected from the greater watershed and will not likely result in exposure to nontarget aquatic species. It is possible these uses will result in exposure to amphibians utilizing these waterbodies for some portion of their lifecycle (e.g. reproduction) and to birds and mammals utilizing these waterbodies for drinking water. At the maximum label rate, 3 ppm initially followed by weekly 1.5 ppm treatments, there are no LOC exceedances, assuming the toxicity of DDAC is similar to that of ADBAC. However, due to the persistence of DDAC, it is possible that concentrations of DDAC in some waterbodies treated over time could become harmful to animals utilizing these waterbodies.

2.0 PHYSICAL AND CHEMICAL PROPERTIES

The Group I Quat Cluster is a group of structurally similar quaternary ammonium compounds ("quats") that are characterized by having a positively charged nitrogen covalently bonded to two alkyl group substituents (at least one C_8 or longer) and two methyl substituents. In finished form, these quats are salts with the positively charged nitrogen (cation) balanced by a negatively charged molecule (anion). The anion for the quats in this cluster is chloride or bromide. In this document, the Group I Quat Cluster will be referred to as DDAC (didecyl dimethyl ammonium chloride).

Currently, there are 5 active ingredients identified by the Agency that are registered and included in Case Number 3003. Table 2.1 below provides the common chemical name, active ingredient code, CAS number, chemical structure and number of registered product for each compound.

Table 2.1. Active Ingredients in the Group I Quat Cluster Identified by the AIJV

Prod Code	CAS RN	Name	Structure	Chain Lengths

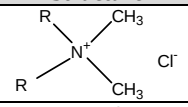
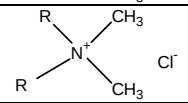
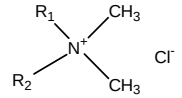
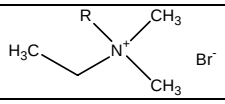
Table 2.1. Active Ingredients in the Group I Quat Cluster Identified by the AIJV				
Prod Code	**CAS RN**	**Name**	**Structure**	**Chain Lengths**
69149	7173-51-5	Didecyl Dimethyl Ammonium Chloride (DDAC)		R = C10
69166	5538-94-3	Dioctyl Dimethyl Ammonium Chloride		R = C8
69165	32426-11-2	Octyl Decyl Dimethyl Ammonium Chloride		R1 = C8 (variable %) R2 = C10 (variable %)
69146	84540-07-8	Alkyl Dimethyl Ethyl Ammonium Bromide		R = C12 (5%) C14 (90%) C16 (5%)
69173	68607-28-3	Oxydiethylenebis (alkyl*) dimethyl ammonium chloride		R=C12 (40%) C14 (50%) C16 (10%)

Table 2.2 provides the physical/chemical characteristics that have been reported for DDAC.

Table2.2. Physical/Chemical Properties of DDAC	
Parameter	DDAC
Molecular Weight	362.08
Density	0.9216 g/cm3 at 25 C
Boiling Point	NA
Water Solubility	Completely soluble
Vapor Pressure	2.33E-11 mmHg

3.0 ENVIRONMENTAL FATE

DDAC is used primarily as a disinfectant, sanitizer, or as a microbiocide/microbiostat. It also serves as an algaecide, bacteriocide/bacteriostat, fungicide/fungistat, insecticide, miticide, virucide, and tuberculocide. Use sites for DDAC include agricultural premises and equipment, food handling, commercial, industrial and institutional settings, residential areas or areas of public access, kennels, medical facilities, swimming pools, aquatic areas, and industrial water systems. DDAC is also used as a wood preservative. Some of the required guideline studies for an environmental fate assessment have been submitted. The Agency is using these environmental fate studies for fate assessment of DDAC to fulfill the reregistration requirements.

DDAC has been shown to be hydrolytically stable under abiotic and buffered conditions over the pH 5-9 range. The calculated half-lives for DDAC were 368 days at pH 5, 194 days at pH 7 (TRIS), 175 days at pH 7 (HEPES), and 506 days at pH 9. DDAC is

stable to photodegradation in pH 7 buffered aqueous solutions; even in the presence of a photosensitizer (acetone), degradation is minimal with a calculated half-life of 227 days. DDAC is photolytically stable in soil with a calculated half-life of 132 days.

Aquatic metabolism studies under aerobic and anaerobic conditions indicate that DDAC is stable to microbial degradation. The calculated aerobic and anaerobic half-lives of ^{14}C-DDAC in flooded river water are 180 days and 261 days, respectively. Similarly, DDAC was found to be stable with very little degradation in aerobic soils during a year-long metabolism study. The calculated half-life for aerobic soil degradation was 1,048 days. However, a report on the biodegradability of DDAC prepared by the Registrant concluded that the degree of DDAC biodegradability is variable and is influenced by the chemical concentration, alkyl chain length, the presence of anionic moieties and the quantity and characteristics of the microbial population. According to this report, DDAC is biodegradable and environmentally acceptable. This report was based on information from the open literature, unpublished sources, and meeting proceedings and has not been reviewed by the Agency.

DDAC is immobile in soil. A soil mobility study reviewed by the Agency shows that DDAC has a strong tendency to bind to sediment/soil with Freundlich K_{ads} values of 1,095, 8,179, 3,279, and 30,851 in sand, sandy loam, silty clay loam, and silt loam soils, respectively. Because of its strong adsorption to soils, DDAC is not expected to contaminate surface and ground waters.

Bioaccumulation of DDAC in freshwater fish is not likely to occur. Mean steady state bioconcentration factors for DDAC were determined to be 38X, 140X, and 81X in the edible, nonedible, and whole body fish tissue, respectively. During depuration, 57%, 67%, and 71% of the residues that accumulated in the edible, whole body, and nonedible tissues, respectively, were eliminated. DDAC is not expected to pose a concern for bioconcentration in aquatic organisms.

Information on the aqueous availability of DDAC from wood indicates that the use of DDAC as a wood preservative may result in minimal releases to the environment.

The Environmental Fate and Effects Division (EFED) has evaluated the outdoor use of the quaternary ammonium compounds, didecyl ammonium chlorides (DDAC), being considered for reregistration by the Antimicrobial Division (AD) (DP Barcode D325481). Although primarily used as antimicrobial agents, DDAC is labeled for use in puddles and decorative pools to control algae. This use is intended for waterbodies generally disconnected from the greater watershed and will not likely result in exposure to nontarget aquatic species. It is possible these uses will result in exposure to amphibians utilizing these waterbodies for some portion of their lifecycle (e.g. reproduction) and to birds and mammals utilizing these waterbodies for drinking water. At the maximum label rate, 3 ppm initially followed by weekly 1.5 ppm treatments, there are no LOC exceedances, assuming the toxicity of DDAC is similar to that of ADBAC. However, due to the persistence of DDAC, it is possible that concentrations of DDAC in some waterbodies treated over time could become harmful to animals utilizing these waterbodies.

4.0 HAZARD CHARACTERIZATION

4.1 Hazard Profile

DDAC was assigned a Toxicity Category II from results of two acute oral toxicity studies in rats, MRIDs 41394404 [65% a.i.; LD_{50} = 262 mg/kg (combined)] and 42296101 [80% a.i.; LD_{50} = 238 mg/kg (combined)]. DDAC was assigned Toxicity Category III from two acute dermal toxicity studies in rabbits, MRIDs 42053801 [65% a.i.; LD_{50} = 2930 mg/kg (combined)] and 00071158 [50% a.i.; LD_{50} = 4350 mg/kg (combined)]. For acute inhalation toxicity (MRID 00145074; TRID 455201010), DDAC (purity not reported) is assigned a Toxicity Category II (LC_{50} = 0.07 mg/L). For primary eye irritation, DDAC was found to be corrosive (Toxicity Category I) in two primary eye irritation studies in rabbits, MRIDs 41394404 [65% a.i.] and 42161602 [80% a.i]. For primary dermal irritation, DDAC (80% a.i.) was found to be corrosive (Toxicity Category I) in a primary dermal irritation study in rabbits (MRID 42161601). For dermal sensitization, DDAC was found to be a non-sensitizer in two dermal sensitization studies in guinea pigs (MRID 42161603 [80% a.i.]) (MRID 46367601 [purity not reported]).

For subchronic toxicity, the database includes a 90-day oral toxicity test in rats (MRID 40966302), a 90-day oral study in dogs (MRID 40262901), and a 90-day dermal toxicity study in rats (MRID 41305901). In the 90-day rat oral feeding study (MRID 40966302), incidence of gross pathological observations and non-neoplastic lesions, including a higher incidence of glycogen depletion in the liver and contracted spleens were observed. In the 90-day dog feeding study (MRID 40269201), no treatment-related clinical chemistry, hematology, urinalysis, or pathological findings were observed. In the 90-day dermal toxicity test in rats (MRID 41305901), systemic toxicity was not observed and clinical and gross findings (erythema, edema, exfoliation, excoriation and ulceration) were limited to the treated skins.

For developmental toxicity, the data from two developmental toxicity studies, one in the rat (MRID 41886701, range-finder MRID 42746901) and another in the rabbit (MRID 41018701), do not indicate increased susceptibility in rats or rabbits from *in utero* and postnatal exposure to DDAC. In the rat developmental toxicity study (MRID 41886701), developmental toxicity (skeleton variations) was observed only at treatment levels which also resulted in maternal toxicity (audible respiration). In the rabbit developmental toxicity study, developmental toxicity (decreased fetal body weight and increased number of dead fetuses) occurred at levels which also resulted in maternal toxicity (hypo activity, audible respiration, and decreased body weight gain).

For reproductive toxicity, the toxicity database for DDAC includes a 2-generational reproductive toxicity study in rats (MRID 41804501). In this study, effects in offspring (decreased pup body weight/weight gain) occurred at the same dose level as maternal effects (decreased maternal body weight/weight gain and food consumption).

In a 1-year dog feeding study (MRID 41970401), beagle dogs were given doses of 0, 3, 10, or 20/30 mg/kg/day in the diet. Treatment-related clinical signs (soft/mucoid feces, emesis) were observed frequently in high-dose animals, and total cholesterol levels were significantly decreased in high-dose females.

DDAC was not carcinogenic when administered in the diet in 2-year chronic/

carcinogenicity studies in rats (MRID 41965101) and mice (MRID 41802301). In the rat study, an increase in incidence of interstitial cell adenomas in the testes were reported, but the incidence was with in the range of historical controls. In the mouse study, no treatment-related effects were noted in the incidence of clinical signs, deaths, and gross and histopathological observations.

For mutagenicity, DDAC was negative in a battery of tests. In the Ames test (MRID 40282201, supplemental information MRID 44005801); DDAC was not mutagenic with or without metabolic activation. In a forward gene mutation test (MRID 93014008, reformat of 40895202), DDAC was negative for induction of gene mutations in CHO cells at the HGPRT locus with and without metabolic activation. In an in vitro chromosome aberration test (MRID 41252601), DDAC did not induce chromosome aberration in the Chinese hamster ovary (CHO) cells with or without metabolic activation. In an unscheduled DNA synthesis (UDS) assay (MRID 93014007, reformat of 40895201), DDAC did not cause UDS in primary rat hepatocytes.

Although there are no neurotoxicity studies available in the database, the available toxicity for DDAC show no evidence for neurotoxic effects.

In a rat pharmacokinetics/ metabolism study (MRID 41617101 and addendum MRID 41385101), single oral doses of ^{14}C- DDAC (5 or 50 mg/kg) or repeated doses (34 ppm of DDAC in the diet for 14 days and then one single dose of 5 mg/kg of ^{14}C- DDAC) were given to both male and female rats. DDAC was mostly excreted in the feces within 3 days principally as parent compound and metabolites. The elimination pattern and metabolic profile was not substantially altered by the dose or exposure duration. Male and female rats showed similar elimination patterns, but females metabolized DDAC more extensively than males. Four major metabolites were identified as oxidation products with oxidation confined to the decyl side chains.

The acute toxicity data for DDAC are summarized below in Table 4.1 (USEPA, 2006).

Table 4.1 Acute Toxicity Profile for DDAC

Guideline Number	Study Type/ Test substance (% a.i.)	MRID Number/ Citation	Results	Toxicity Category
870.1100 (§81-1)	Acute oral, rat (Purity 65%)	MRID 41394404	LD_{50} =262 mg/kg (combined)	II
870.1100 (§81-1)	Acute oral, rat (Purity 80%)	MRID 42296101	LD_{50} =238 mg/kg (combined)	II
870.1200 (§81-2)	Acute dermal, rabbit (Purity 65%)	MRID 42053801	LD_{50} =2930 mg/kg (combined)	III
870.1300 (§81-3)	Acute inhalation, rat (Purity not reported)	MRID 00145074 TRID 455201010	LC_{50} = 0.07 mg/L (combined)	II
870.2400 (§81-4)	Primary eye irritation, rabbit (Purity 80% a.i.)	MRID 42161602	Corrosive.	I
870.2500 (§81-5)	Primary dermal irritation, rabbit (Purity 80%)	MRID 42161601	Corrosive.	I
870.2600 (§81-6)	Dermal sensitization, guinea pigs (Purity 80%)	MRID 46367601	Not a sensitizer.	NA

4.2 FQPA Considerations

Under the Food Quality Protection Act (FQPA), P.L. 104-170, which was promulgated in 1996 as an amendment to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug and Cosmetic Act (FFDCA), the Agency was directed to "ensure that there is a reasonable certainty that no harm will result to infants and children" from aggregate exposure to a pesticide chemical residue. The law further states that in the case of threshold effects, for purposes of providing this reasonable certainty of no harm, "an additional tenfold margin of safety for the pesticide chemical residue and other sources of exposure shall be applied for infants and children to take into account potential pre- and post-natal toxicity and completeness of the data with respect to exposure and toxicity to infants and children. Notwithstanding such requirement for an additional margin of safety, the Administrator may use a different margin of safety for the pesticide residue only if, on the basis of reliable data, such margin will be safe for infants and children."

The Agency (USEPA, 2006) has decided that the FQPA safety factor be removed for DDAC, based upon the existence of a complete developmental and reproductive toxicity database and the lack of evidence for increased susceptibility in these data.

4.3 Dose-Response Assessment

Table 4.2 summarizes the toxicological endpoints for DDAC (USEPA, 2006).

Table 4.2 Summary of Toxicological Endpoints for DDAC

Exposure Scenario	Dose Used in Risk Assessment (mg/kg/day)	Target MOE/UF, Special FQPA SF for Risk Assessment	Study and Toxicological Effects
Acute Dietary (Females 13-50)	**NOAEL**(developmental) = 10 mg/kg/day	**FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation)	Prenatal Developmental Toxicity - Rat MRID 41886701 **LOAEL** = 20 mg/kg/day based on increased incidence of skeletal variations.
	Acute RfD = 0.1 mg/kg/day (for Females age 13-50)		
Acute Dietary (general population)	An acute dietary endpoint was not identified in the data base. This risk assessment is not required		
Chronic Dietary (general population)	**NOAEL** = 10 mg/kg/day	**FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation	Chronic Toxicity Study - Dog MRID 41970401 **LOAEL** = 20 mg/kg/day based on increased incidence of clinical signs in males and females and decreased total cholesterol levels in females.
	Chronic RfD = 0.1 mg/kg/day		

Table 4.2 Summary of Toxicological Endpoints for DDAC			
Exposure Scenario	**Dose Used in Risk Assessment (mg/kg/day)**	**Target MOE/UF, Special FQPA SF for Risk Assessment**	**Study and Toxicological Effects**
Non-Dietary Exposures			
Incidental Oral Short-Term	**NOAEL** (developmental) = 10 mg/kg/day	**Target MOE** = 100 (10x inter-species extrapolation, 10x intra-species variation) **FQPA SF** = 1	Prenatal Developmental Toxicity - Rat MRID 41886701 **LOAEL** = 20 mg/kg/day based on increased incidence of skeletal variations.
Incidental Oral Intermediate-Term	**NOAEL** = 10 mg/kg/day	**Target MOE** = 100 (10x inter-species extrapolation, 10x intra-species variation) **FQPA SF** = 1	Chronic Toxicity Study - Dog MRID 41970401 **LOAEL** = 20 mg/kg/day based on increased incidence of clinical signs in males and females and decreased total cholesterol levels in females.
Dermal, Short-term (formulated product 0.13% a.i.)	No endpoint identified. No dermal or systemic effects identified in the 21-day dermal toxicity study (MRID 45656601) up to and including the limit dose of 1000 mg/kg/day		
Dermal, Short-term	**NOAEL(dermal)** = 2 mg/kg/day ($8\ \mu g/cm^2$)[b]	**Target MOE** = 10 (3x inter-species extrapolation, 3x intra-species variation)	90-day Dermal Toxicity - Rat MRID 41305901 **LOAEL** = 6 mg/kg/day based on increased clinical and gross findings (erythema, edema, exfoliation, excoriation, and ulceration)
Dermal, Intermediate- and Long-term	No appropriate endpoint identified.		
Inhalation, Short-Term	**NOAEL** [b] = 10 mg/kg/day	**Target MOE** = 100 (10x inter-species extrapolation, 10x intra-species variation) **FQPA SF** = 1	Prenatal Developmental Toxicity - Rat MRID 41886701 **LOAEL** = 20 mg/kg/day based on increased incidence of skeletal variations.
Inhalation, Intermediate- and Long-Term	**NOAEL** [c] = 10 mg/kg/day	**Target MOE** = 100 (10x inter-species extrapolation, 10x intra-species variation) **FQPA SF** = 1	Chronic Toxicity Study - Dog MRID 41970401 **LOAEL** = 20 mg/kg/day based on increased incidence of clinical signs males and females and decreased total cholesterol levels in females.

UF = uncertainty factor, FQPA SF = special FQPA safety factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic), RfD = reference dose, MOE = margin of exposure, LOC = Level of concern, NA = Not Applicable.

[a] Short-term dermal endpoint = (2 mg/kg rat x 0.2 kg rat x 1000 ug/mg) / $50cm^2$ area of rat dosed = $8\ \mu g/cm^2$.

[b] An additional UF of 10x is used for route extrapolation from an oral endpoint to determine if a confirmatory study is warranted.

4.4 Endocrine Disruption

EPA is required under the FFDCA, as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." Following recommendations of its Endocrine Disruptor and Testing Advisory Committee (EDSTAC), EPA determined that there was a scientific basis for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP).

5.0 EXPOSURE ASSESSMENT AND CHARACTERIZATION

5.1 Summary of Registered Uses

For dietary uses, DDAC can be used as a disinfectant or sanitizer on counter tops, utensils, appliances, tables, refrigerators, and in mushroom premises. The use of DDAC as an antimicrobial product on food or feed contact surfaces, agricultural commodities, and application to food-grade eggs may result in pesticide residues in human food. Residues from treated surfaces, such as utensils, countertops, equipment, and appliances can migrate to food coming into contact with the treated and rinsed surfaces and can be ingested by humans.

Products containing DDAC can also be used as general cleaners, disinfectants, and deodorizers. These products are primarily for use on indoor surfaces such as hard floors, carpets, walls, bathroom fixtures, trash cans, toilet bowls, and household contents. Additionally, other uses in the home include liquid laundry deodorizers that are added to the final rinse of the wash cycle, algaecide/bactericides that are added to portable humidifiers and swimming pools, and deodorizers that are sprayed on fabric. Residents may also be exposed to items that have been treated with DDAC in occupational settings, such as dimensional lumber for decks and play sets. Appendix A presents a summary of all exposure scenarios that may occur in residential settings based on examination of product labels.

5.2 Dietary Exposure and Risk

In the absence of data on DDAC residues on treated food contact surfaces, the Agency estimated residue levels that may occur in food from the application rates on food contact surfaces. Dietary exposures from application to food grade eggs and mushroom houses are expected to be much lower than the dietary exposures resulting from the surface disinfectant and sanitizing uses; therefore, these uses were not assessed separately.

To estimate the Estimated Daily Intake (EDI) to treated food contact surfaces and food utensils, an FDA (FDA, 2003) screening - level assessment model was used in lieu of

residue data. The maximum application rate for DDAC in food handling establishments from the various labeled ready-to-use products is 0.0043 pounds per gallon of treatment solution. The EDI calculations presented in this assessment assumes that food can contact 2,000 cm^2 or 4,000 cm^2 (50% and 100% of the FDA worst case scenario) of treated surfaces, and that 10% of the pesticide migrate to food. The use of the 10% transfer rate, instead of the use of a 100% transfer rate that is used in the FDA Sanitizer Solution Guidelines, requires the submission of confirmatory data to establish the reliability of the use of the 10% transfer rate. These daily estimates were conservatively used to assess both acute and chronic dietary risks. None of the calculated percent acute population adjusted dose (% aPAD) or chronic (% cPAD) estimates exceeded 100%. The estimated EDI, % aPAD, and % cPAD for food contact surfaces are presented in Table 5.1. Note: The NOAEL for both the acute and chronic dietary endpoints are the same so only one % PAD is reported (i.e., aPAD and cPAD are identical). The results indicate that for the aggregate risks the adult %aPAD and %cPAD is 2.8% for males and 3.3% for females, and for children 13.3%.

For DDAC treatments of food processing plants, the application rates are similar to food handling establishments presented in Table 5.1, and hence the exposure, EDIs, DDDs, and % aPAD and cPADs are also similar.

Table 5.1: Calculated EDIs, aPAD, and cPAD for Utensils and Countertops

Exposure Group	Utensils			Countertops			Aggregate		
	EDI (mg/day)	DDD (mg/kg/d)	% PAD[a]	EDI (mg/day)	DDD (mg/kg/d)	% PAD[a]	EDI (mg/p/d)	DDD (mg/kg/d)	% PAD[a] (mg/kg/d)
Adult males	0.0959	0.00137	1.37	0.103	0.00147	1.47	0.199	0.00284	2.84
Adult females	0.0959	0.00160	1.60	0.103	0.00172	1.72	0.199	0.00332	3.32
Children	0.0959	0.00639	6.39	0.103	0.00687	6.87	0.199	0.0133	13.3

a. % PAD = exposure (DDD) /(aPAD or cPAD) x 100. The acute and chronic population average dose is the same; therefore the % PADs are the same.
EDI is the estimated daily intake (mg/day).
DDD is the dietary daily dose (mg/kg/day).

The maximum application rate for DDAC for bottling/packing of food is 0.0020 lbs a.i per gallons of treatment solution. EDI values were calculated using an approach similar to that used for treated food-contact surfaces and food utensils. Exposure was assumed to occur through the ingestion of three food products that might be packaged with treated material: milk, egg products, and beverages (alcoholic and non-alcoholic). The calculated %aPAD and %cPAD did not exceed 100%. The results of the EDI and % cPAD are presented in Table 5.2.

Table 5.2: Calculated EDIs, aPAD, and cPAD for Representative Dairy and Beverage Consumption

Food Type	Exposure Group	EDI (mg/p/d)	DDD (mg/kg/d)	% PAD (aPAD & cPAD)
Milk	Adult Male	0.00451	6.44×10^{-5}	0.0644
	Adult Female		7.52×10^{-5}	0.0752
	Child[a]	0.00290	1.94×10^{-4}	0.194
Egg product	Adult Male	8.10×10^{-9}	1.16×10^{-10}	1.16×10^{-7}
	Adult Female		1.35×10^{-10}	1.35×10^{-7}
	Child [a]	5.22×10^{-9}	3.48×10^{-10}	3.48×10^{-7}
Beverages, non-alcoholic	Adult Male	0.0230	3.29×10^{-4}	0.329
	Adult Female		3.84×10^{-4}	0.384
	Child[a]	0.0148	9.90×10^{-4}	0.990
Beverages, alcoholic, beer	Adult Male	2.91×10^{-4}	4.16×10^{-6}	0.00416
	Adult Female		4.85×10^{-6}	0.00485

5.3 Drinking Water Exposures and Risks

The only DDAC outdoor uses are as an algaecide in decorative pools and for oil field operations which are considered to be contained. Therefore, the DDAC contributions to drinking water exposure are considered to be negligible and are not quantified.

5.4 Residential Exposure/Risk Pathway

The exposure scenarios assessed in this document for the representative antimicrobial uses selected by the Agency to represent the residential risks include:

- Indoor hard surfaces (e.g., mopping, wiping, trigger pump sprays);
- Carpets;
- Swimming pools;
- Wood preservative;
- Textiles (e.g., diapers treated during washing and clothes treated with fabric spray); and
- Humidifiers.

Exposure Data and Assumptions

The residential handler scenarios were assessed to determine dermal and inhalation exposures. The scenarios were assessed using PHED and CMA data. Specific surrogate data used in determining the dermal and inhalation exposures are reported below:

- For the mopping, wiping, low pressure hand wand, and liquid pour in swimming pool the CMA data were used; and
- For aerosol spray and trigger pump scenarios the PHED data were used.

The quantities handled/treated were estimated based on information from various sources, including the Antimicrobial Division's estimates.

- For ***mopping*** scenarios, it is assumed that 1 gallon of diluted solution is used.
- For ***wiping and trigger pump spray*** scenarios, it is assumed that 0.5 liter (0.13 gal) of diluted solution is used.
- For ***low pressure hand wand,*** it was assumed that 2 gallons are used in all indoor applications.
- For ***liquid pour*** in ***swimming pool*** scenario, it was assumed that a residential pool contains 20,000 gallons of water.
- For ***liquid pour*** in ***humidifier*** scenario, it was assumed that a humidifier with a 11 gallon tank would be treated, based on Holmes Model# HM4600-U-11. This humidifier releases 11 gallons/1,700 ft^2/24 hours (http://www.holmesproducts.com/estore/product.aspx?CatalogId=3&CategoryId=1120&ProductId=582).

Post-application scenarios have been developed that encompass multiple products, but still represent a high end exposure scenario for all products represented. Post-application scenarios assessed include crawling on treated hard surfaces, carpets, and treated lumber such as decks/play sets (dermal and incidental oral exposure to children), wearing treated clothing from wash treatment and from a direct clothing spray treatment (dermal exposure to adults and children and incidental oral exposure to children), using portable humidifiers (adult and child inhalation exposure), and swimming in treated pools (adult and child incidental ingestion).

Since no toxicological endpoint of concern was identified for dermal systemic adverse effects, post-application dermal risks were assessed using the toxicological endpoint of concern for dermal irritation. The residential post-application dermal risks were assessed by comparing the surface residue on the skin (dermal skin irritation exposure) to the short-term dermal irritation endpoint. It was assumed that during the exposure period, the skin repeatedly contacts the treated surface until a steady-state concentration of residues is achieved on the skin.

The duration of exposure for most homeowner exposures is believed to be best represented by the short-term duration (1 to 30 days). The reason that short-term duration was chosen to be assessed is because the different handler and post-application scenarios are assumed to be episodic, not daily. In addition, homeowners are assumed to use different products with varying activities, not exclusively DDAC treated products.

Risk Characterization

A summary of the residential handler inhalation risks are presented in Table 5.3. Although the inhalation endpoint represents short-, intermediate-, and long-term durations, the exposure duration of most homeowner applications of cleaning products is believed to be best represented by the short-term duration. The inhalation toxicological endpoint is based on an oral study because a route-specific inhalation study is not available. The calculated inhalation MOEs are above the target MOE of 100. The dermal MOEs are presented in Table 5.4. The dermal MOEs were above the target MOE of 10 for all scenarios evaluated except for the spray applications to carpets and the heavy duty cleaning rate (0.02 lb ai/gallon) for mopping and wiping.

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Table 5.3 Short-Term Residential Handler Inhalation Exposures and MOEs						
Exposure Scenario Application Method	Application Method	Application Rate[a] (lb ai/gallon)	Quantity Handled/ Treated per day[b] (gallons)	Unit Exposure (mg/lb a.i.)	Daily Dose (mg/kg/day) [c]	MOE [d] (Target MOE = 100)
Application to indoor hard surfaces	Mopping	0.020	1	2.38	0.00079	13,000
	Wiping	0.020	0.13	67.3	0.0029	3,400
	Trigger Spray	0.020	0.13	2.4	0.00010	96,000
Application to Carpets	Low Pressure Spray	0.0088	2	0.681	0.012	50,000
Application to Swimming Pools	Liquid Pour	0.0000244	20,000	0.00346	0.00002	510,000
Application to Humidifiers	Liquid Pour	0.0043	11	1.89	0.0015	6,700

a Application rates are the maximum application rates determined from EPA registered labels for DDAC.
b Amount handled per day values are estimates or label instructions.
c Daily dose (mg/kg/day) = [unit exposure (mg/lb a.i.) x application rate (lb ai/gal) x quantity treated (gal/day) x absorption factor (1.0 for inhalation)]/ Body weight (60 kg for inhalation).
d MOE = NOAEL / Absorbed Daily Dose. [Where short-term NOAEL = 10 mg/kg/day for inhalation]. Target MOE = 100.

Table 5.4 DDAC Short-Term Residential Handler Dermal Risks						
Exposure Scenario	Application Method	Application Rate[a] (lb ai/gal)	Quantity Handled/ Treated per day[b] (gallon)	Hand Unit Exposure Adjusted for Surface Area (mg/lb ai/cm^2)[c]	Dermal Skin Irritation Exposure [d] (µg/cm^2)	MOE [e] (Target MOE = 10)
Application to indoor hard surfaces	Mopping	0.0043	1	0.063	0.273	29
		0.02			1.27	6
	Wiping	0.0043	0.13	1.341	0.750	11
		0.02			3.49	2
	Trigger Spray	0.0043	0.13	0.129	0.072	110
		0.02			0.34	24
Application to Carpets	Low Pressure Spray	0.0088	2	0.161	2.832	3
Humidifier	Liquid Pour	0.0043	11	0.000239	0.011	710
Application to swimming pools	Liquid Pour	0.000017	20,000	0.000239	0.08	98

a Application rates are the maximum application rates determined from EPA registered labels for DDAC.
b Amount handled per day values are estimates or label instructions.
c Unit Exposure (mg/lb ai/cm^2) = Hand unit exposure from PHED or CMA (mg/lb ai) / surface area of hand (820 cm^2).
d Dermal Skin Irritation Exposure (µg/lb ai/cm^2) = Unit Exposure (mg/lb ai/cm^2) x Application Rate (lb ai/gal) x Quantity Treated (gal/day) x 1,000 µg/mg
e MOE = NOAEL (µg/cm^2)/ Dermal Skin Irritation Exposure (µg/cm^2). [Where short-term dermal NOAEL = 8 µg/cm^2]. Target MOE = 10.

A summary of the residential post application are presented in Table 5.5. Although the inhalation endpoint represents short-, intermediate-, and long-term durations, the exposure duration of most homeowner applications of cleaning products is believed to be best represented by the short-term duration. The inhalation toxicological endpoint is based on an oral study because a route-specific inhalation study is not available. The calculated

incidental oral MOEs are above the target MOE of 100. The dermal MOEs are above the target MOE for all scenarios except for the laundered clothing. The inhalation MOEs are above the target MOE of 100 for all scenarios, except the humidifier. The 24-hour inhalation MOEs for adults and children are 11 and 5, respectively.

Table 5.5. Short-term Residential Post Application Risks for Adults and Children.

Exposure Scenario	Dermal MOE (Target MOE =10)	Incidental Ingestion MOE (Target MOE = 100)	Inhalation MOE (Target = 100)
Child playing on floor	**33**	760	NA
Child playing on carpet	**45**	520	NA
Clothing (Laundered – 1% transfer)	690 adults and children	2,600	NA
Clothing (Fabric spray – 5% transfer)	8	150	
Child playing on decks/play sets	Range from 3 to 13	360 (high end)	NA
Swimming	NA	Ranges from 330 to 4,000 for adults and children	NA
Humidifiers	NA	NA	**Adult 11 (24-hrs)** **Child 5 (24-hrs)**

NA = not assessed because negligible exposure is assumed by that route for the exposure scenario of concern.

6.0 AGGREGATE RISK ASSESSMENT AND RISK CHARACTERIZATION

In order for a pesticide registration to continue, it must be shown that the use does not result in "unreasonable adverse effects on the environment". Section 2 (bb) of FIFRA defines this term to include "a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with standard under section 408..." of FFDCA. Consequently, even though no pesticide tolerances have been established for DDAC, the standards of FQPA must still be met, including "that there is reasonable certainty that no harm will result from aggregate exposure to pesticide chemical residue, including all anticipated dietary exposures and other exposures for which there are reliable information." Aggregate exposure is the total exposure to a single chemical (or its residues) that may occur from dietary (i.e., food and drinking water), residential, and other non-occupational sources, and from all known or plausible exposure routes (oral, dermal, and inhalation). Aggregate risk assessment were conducted for short-term (1-30 days), intermediate-term (1-6 months) and chronic (several months to lifetime) exposures.

In performing aggregate exposure and risk assessments, the Office of Pesticide Programs has published guidance outlining the necessary steps to perform such assessments (General Principles for Performing Aggregate Exposure and Risk Assessments, November 28, 2001; available at http://www.epa.gov/pesticides/trac/science/aggregate.pdf). Steps for deciding whether to perform aggregate exposure and risk assessments are listed, which include: identification of toxicological endpoints for each exposure route and duration; identification of potential exposures for each pathway (food, water, and/or residential); reconciliation of durations and pathways of exposure with durations and pathways of health effects; determination of which possible residential exposure scenarios are likely to occur together within a given time frame; determination of magnitude and duration of exposure for all exposure combinations; determination of the appropriate technique (deterministic or probabilistic) for exposure assessment; and determination of the appropriate risk metric to estimate aggregate risk.

6.1 Acute and Chronic Aggregate Risks

The acute and chronic aggregate risk assessment includes dietary and drinking water exposures. No drinking water exposures were identified for DDAC. Acute and chronic dietary risk estimates from direct and indirect food uses are presented in Section 5.2. Table 6.1 presents a summary of these exposures, including the aggregate indirect and direct dietary exposure (all direct and indirect food contact exposures). Based on the results of the acute and chronic aggregate assessment, the % aPAD and % cPAD for adults and children are 3.8% and 14%, respectively. Therefore, the acute and chronic dietary risks are not of concern (i.e., less then 100 % of aPAD and cPAD).

Table 6.1 DDAC Acute and Chronic Aggregate Exposures and Risks (aPAD and cPAD)

Exposure Routes	Acute and Chronic Dietary Exposures (mg/kg/day)				
	Indirect Dietary Exposures[a]	Direct Food Contact Dietary Exposures[a]	Drinking Water Exposures	Aggregate Dietary Exposures[b]	% aPAD and cPAD (MOE)
Adults					
Oral Ingestion	0.0033	0.00046	None	0.00376	3.8 (2,700)
Children					
Oral Ingestion	0.013	0.0012	None	0.0142	14 (700)

a Dietary (indirect + direct food contact) exposures are presented in Tables 5.1 and 5.2.
b Aggregate Dietary Exposures = indirect dietary + direct food contact + drinking water exposures.
c %aPAD and cPAD (percent acute or chronic population adjusted dose) = aggregate exposures / (a PAD or cPAD) x 100. Where aPAD and cPAD = NOAEL 10 mg/kg/day / 100x uncertainty factor = 0.1 mg/kg/day. MOE = NOAEL of 10 mg/kg/day / aggregate dietary exposures mg/kg/day.

6.2 Short- and Intermediate-Term Aggregate Exposures and Risks

Short- and intermediate-term aggregate exposures and risks were assessed for adults and children that could be exposed to DDAC residues from the use of products in non-occupational environments. The short- and intermediate-term aggregate risks account for pesticide exposures from the diet, drinking water, and residential uses. The following list summarizes all of the potential sources of DDAC exposures for adults and children.

Adult DDAC exposure sources:

- handling of cleaning products containing DDAC as an active ingredient during wiping, mopping, and spraying activities;
- applying DDAC as an air deodorizer using an aerosol spray;
- applying DDAC to carpets using a low pressure sprayer;
- applying DDAC to swimming pools via open pouring;
- applying DDAC to humidifiers via open pouring;
- contacting pressure treated wood;
- wearing treated clothing;
- use of DDAC in humidifiers; and
- eating food having DDAC residues from indirect or direct food contact.

Child DDAC exposure sources:

- post-application exposures to cleaning product residues containing DDAC that are used on hard surfaces (e.g, floors/carpets);
- breathing air treated with a humidifier;
- swimming in treated pools;
- contacting pressure treated wood;
- wearing treated clothing/diapers;
- eating food having DDAC residues from indirect or direct food contact.

The use patterns of the products and probability of co-occurrence must be considered when selecting scenarios for incorporation in the aggregate assessment. Table 6.2 summarizes the scenarios included in the short- and intermediate-term aggregate assessments.

Table 6.2 Exposure Scenarios Included in the Aggregate Assessments		
	Short-term (ST) Aggregate	Intermediate-Term (IT) Aggregate
Adults	▪ chronic dietary (direct and indirect) ▪ handling cleaning products (wipe + trigger pump spray) ▪ wearing treated clothing ▪ humidifier	Oral: ST and IT endpoints are the same for both durations. Dermal: ST endpoint only. Inhalation: All durations same endpoint.
Children	▪ chronic dietary – (direct and indirect) ▪ post-application to cleaning product on carpets (dermal and oral) ▪ wearing treated clothing ▪ humidifier	Oral: ST and IT endpoints are the same for both durations. Dermal: ST endpoint only. Inhalation: All durations same endpoint.

The chronic dietary exposures were used in both the short- and intermediate-term aggregate assessment because chronic dietary exposures occur nearly every day (as opposed to acute dietary exposures occurring on a one-time basis). Therefore, short- or intermediate-term non-dietary exposures have a much higher probability to co-occur with the chronic dietary intake.

Cleaning activities in a residential setting occur on a short-term basis. However, the DDAC-containing cleaning products are also labeled for use in institutional settings such as day-care facilities where cleaning activities can occur on an intermediate-term basis. Therefore, children could have exposure to cleaning product residues on a more continuous basis in a day care facility, thus, these post-application scenarios were included in the intermediate-term aggregate assessment.

The DDAC toxicity endpoints for the chronic dietary and the intermediate-term incidental oral are based on the same toxic effect (and same study), and therefore, these two dietary routes of exposure are aggregated. On the other hand, the dermal and inhalation routes of exposure are based on different toxic effects, and therefore, these two routes of exposure are not aggregated. However, the dermal route of exposure is aggregated among those dermal exposure scenarios that are believed to co-occur. In addition, the inhalation route of exposure is also aggregated among the inhalation exposure scenarios that are believed to co-occur. Aggregate risks were calculated using the total MOE approach outlined in OPP guidance for aggregate risk assessment (August 1, 1999, Updated "Interim Guidance for Incorporating Drinking Water Exposure into Aggregate Risk Assessments"). Table 6.3 presents a summary of the short-term aggregate risks (i.e., MOEs). Only the short-term aggregate is presented because the endpoints for incidental oral as well as inhalation are identical for the short- and intermediate-term durations. Only a short-term dermal endpoint was identified (i.e., no intermediate- and/or long-term dermal endpoints were identified).

The aggregate risks are not of concern for adults for any of the three routes of exposure except for the dermal exposure. The adult dermal MOE for the heavy duty cleaning product rate indicates that the MOE is 1 which is less than the target MOE of 10. The general cleaning rate has an aggregate MOE of 7 for the combined mopping, wiping and spraying. For children, the oral aggregate (dietary and intermediate-term ingestion for children at day care centers) is 270. The children aggregate MOE for the dermal route is 42, and therefore, not of concern . No children aggregate inhalation scenarios were determined to co-occur. It

is important to note, however, that some of the individual risks for scenarios not included in the aggregate are of concern by themselves (e.g., the humidifier use and the fabric spray for clothing). However, the dermal contribution from the fabric spray would not be combined with the dermal exposure to children playing on treated carpets. These two scenarios are not combined because the dermal endpoint of irritation is from a localized skin exposure and the skin exposed to the treated clothing would not also be exposed to the treated carpet.

Table 6.3 Short- and Intermediate-term Aggregate Risk (MOE) Assessment for DDAC

Exposure Routes	Chronic Dietary MOE	Cleaning Product MOEs (Adult Applicators & Children Playing)			Humidifier MOE	Wearing Treated Clothing MOE	Route-Specific Aggregate MOE
Adults							
Oral Ingestion	2,700	NA			NA	NA	2,700
Dermal	NA	29 (mop)	11 (wipe)	110 (spray)	NA	690	7
Dermal (Heavy duty cleaning rate)		6 (mop)	2 (wipe)	24 (spray)			1
Inhalation	NA	13,000 (mop)	3,400 (wipe)	96,000 (spray)	Not included, risk of concern	NA	2,600
Children							
Oral Ingestion	700	520 (IT hand-to-mouth carpets)			NA	2,600 (IT Laundered)	270
Dermal	NA	45 (playing on carpets, 5% residue transfer)			NA	690 (Laundered)	42
Inhalation	NA	NA			Not included, risk of concern	NA	No co-occurrence

Aggregate MOE = $1/((1/MOE_{same\ route}) + (1/_{MOE\ same\ route}) + etc)$

7.0 CUMULATIVE EXPOSURE AND RISK

Another standard of section 408 of the FFDCA which must be considered in making an unreasonable adverse effect determination is that the Agency considers "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity."

Unlike other pesticides for which EPA has followed a cumulative risk approach based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding as to DDAC and any other substances and DDAC does not appear to produce a toxic metabolite produced by other substances. For the purposes of this tolerance action, therefore, EPA has not assumed that DDACs has a common mechanism of toxicity with other substances. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements released by EPA's Office of Pesticide Programs concerning common mechanism determinations and procedures for cumulating effects from substances found to

have a common mechanism on EPA's website at http://www.epa.gov/pesticides/cumulative/.

8.0 OCCUPATIONAL EXPOSURE ASSESSMENT

Potential occupational handler exposure can occur in various use sites, which include: agricultural premises, industrial processes and water systems, food handling premises, commercial/institutional/industrial premises, medical premises, swimming pools, and aquatic areas. Additionally, occupational exposure can occur during the preservation of wood. For the preservation of wood, the procedure for treatment can occur in different ways, such that multiple worker functions were analyzed. Due to the complexity of the wood preservative analysis, the results for handler and post-application exposures are presented separately in Section 8.3.

8.1 Occupational Handler Exposures

DDAC dermal irritation exposures and risks were not estimated for occupational handler exposures. Instead, dermal irritation exposures and risks will be mitigated using default personal protective equipment requirements based on the toxicity of the end-use product. To minimize dermal exposures, the minimum PPE required for mixers, loaders, and others exposed to end-use products containing concentrations of DDAC that result in classification of category I, II, or III for skin irritation potential will be long-sleeve shirt, long pants, shoes, socks, chemical-resistant gloves, and chemical-resistant apron. Once diluted, if the concentration of DDAC in the diluted solution would result in classification of toxicity category IV for skin irritation potential, then the chemical-resistant gloves and chemical-resistant apron can be eliminated for applicators and others exposed to the dilute. Note that chemical-resistant eyewear will be required if the end-use product is classified as category I or II for eye irritation potential.

Inhalation exposures and risks were presented based on the oral toxicity endpoint (i.e., route-specific inhalation study not available). The surrogate unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999b: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998). The specific inhalation unit exposures and quantity of DDAC handled are provided in the Occupational and Residential Exposure chapter for DDAC.

The inhalation MOEs were calculated for the short- and intermediate-term durations for occupational handlers using the oral endpoint.

Risk Characterization

The resulting inhalation exposures and MOEs for the representative occupational handler scenarios are presented in Table 8.1. The calculated MOEs were above the target MOE of 100 for all scenarios, except for once-through cooling water, metering pump: using the average flow rate for high flow streams (153 MGD) the ST inhalation MOE= 91 for initial applications.

Table 8.1 Short- , Intermediate- and Long-Term Inhalation Risks Associated with Occupational Handlers

Exposure Scenario	Method of Application	Inhalation Unit Exposure (mg/lb a.i.)	Application Rate	Quantity Handled/ Treated per day	Inhalation Daily Dose (mg/kg/day)[a]	Inhalation MOE[b, c] (Target MOE = 100)
Agricultural Premises and Equipment (Use Site Category I)						
Application to hard surfaces, equipment, and vehicles	Mop	2.38	0.0094 lb ai/gal	2 gallons	0.0075	13,000
	High pressure/high volume spray	0.12	0.0094 lb ai/gal	40 gallons	0.00075	13,000
	Low pressure handwand	0.681	0.0094 lb ai/gal	40 gallons	0.0043	2,300
	Trigger pump sprayer	1.3	0.0094 lb ai/gal	0.26 gallons	0.000052	190,000
	Wipe	67.3	0.0094 lb ai/gal	0.26 gallons	0.0027	3,600
Fogging (mix/load only)	Liquid pour	1.89	1.88E-05 lb/ft^3	150,000 ft^3	0.089	110
Food Handling/Storage Establishments Premises And Equipment (Use Site Category II)						
Application to indoor hard surfaces	Low pressure handwand	0.681	0.0200 lb ai/gal	2 gallons	0.00045	22,000
	Mop	2.38	0.0200 lb ai/gal	2 gallons	0.0016	6,300
	Wipe	67.3	0.0200 lb ai/gal	0.26 gallons	0.0058	1,700
	Trigger pump sprayer	1.3	0.0200 lb ai/gal	0.26 gallons	0.00011	89,000
	Immersion, Flooding, Circulation	1.89	0.00196 lb ai/gal	2 gallons	0.00012	81,000
Commercial, Institutional and Industrial Premises and Equipment (Use Site Category III)						
Application to indoor hard surfaces	Low pressure handwand	0.681	0.0200 lb ai/gal	2 gallons	0.00045	22,000
	Mop	2.38	0.0200 lb ai/gal	2 gallons	0.0016	6,300
	Wipe	67.3	0.0200 lb ai/gal	0.26 gallons	0.0058	1,700
	Trigger pump sprayer	1.3	0.0200 lb ai/gal	0.26 gallons	0.00011	89,000
	Liquid pour	1.89	0.0043 lb ai/gal	2 gallons	0.00027	37,000
Application to carpets	Liquid pour	0.00346	0.102 lb ai/gal	32 gallons	0.00019	53,000
Medical Premises and Equipment (Use Site Category V)						
Application to hard surfaces	Mop	2.38	0.0200 lb ai/gal	45 gallons	0.036	280
Industrial Processes and Water Systems (Use Site Category VIII)						
Small process water systems: Recirculation cooling tower	Liquid pour	0.45	4.17 lb ai/gal product	2.5 gallons	0.078	130
	Metering pump	0.00432	Initial Dose (ST): 1.50E-03lb ai/gal water	20,000 gallons	0.0022	ST = 4,600
			Maintenance Dose (IT): 1.50E-04lb ai/gal water	20,000 gallons	0.00022	IT =46,000
Oil field operations - drilling mud and packing fluids	Liquid pour	0.00346	1.50 lb ai/gal product	5.6 gallons	0.00048	ST = 21,000
				2.8 gallons	0.00024	IT = 41,000
Once-through Cooling Water System - Power plant	Metering pump	0.000265	Slug Dose (ST): 4.89E-5 lb ai/gal water	5,900,000 gallons	0.0013	ST=2300
			Initial Dose (ST): 4.89 E-5 lb ia/gal water	153,000,000 gallons	0.033	ST=91
Swimming Pools (Use Category X)[d]						

Table 8.1 Short- , Intermediate- and Long-Term Inhalation Risks Associated with Occupational Handlers						
Exposure Scenario	Method of Application	Inhalation Unit Exposure (mg/lb a.i.)	Application Rate	Quantity Handled/ Treated per day	Inhalation Daily Dose (mg/kg/day)[a]	Inhalation MOE[b, c] (Target MOE = 100)
Application to swimming pools	Liquid pour	0.00346	Heavy algae Dose (ST): 0.000017 lb ai/gal	200,000 gallons	0.00020	ST= 15,000
			Maintenance Dose (IT/LT): 0.00000417 lb ai/gal	200,000 gallons	0.000048	IT=210,000

ST = short-term, IT = intermediate-term, LT = long-term, N/A= No data available

a Daily dose (mg/kg/day) = [unit exposure (mg/lb a.i.) x absorption factor (1.0 for inhalation) x application rate x quantity treated / Body weight (60 kg for inhalation).

b MOE = NOAEL (mg/kg/day) / Absorbed Daily Dose [Where NOAEL = 10 mg/kg/day for all inhalation exposure durations]. Target MOE = 100.

c The MOEs refer to short-term and intermediate-term duration unless indicated otherwise.

d. The swimming pool scenario also represents the decorative pond/fountain scenario in the aquatic area use site category because the application rates are very similar.

8.2 Occupational Post-application Exposures

Except for the post-application scenarios assessed for fogging and wood preservatives (Section 8.3), occupational post-application dermal and inhalation exposures are assumed to be negligible.

Fogging (Food Processing Plant and Hatchery)

Post-application inhalation exposures only were assessed for entry into a building (hatchery and food processing plant) after a fogging application, because dermal post application is presumed to be negligible. The inhalation exposure assessment was conducted using the Multi-Chamber Concentration and Exposure Model (MCCEM v1.2). MCCEM estimates average and peak indoor air concentrations of chemicals released from products or materials in houses, apartments, townhouses, or other residences. Although the data libraries contained in MCCEM are limited to residential settings, the model can be used to assess other indoor environments. MCCEM has the capability to estimate inhalation exposures to chemicals, calculated as single day doses, chronic average daily doses, or lifetime average daily doses. (All dose estimates are potential doses; they do not account for actual absorption into the body.)

The product, EPA Reg # 10324-80 (3.3% ai) with a maximum application rate of 0.0065 lb ai/gal, was assessed for fogging use in a food processing plant. The label states to fog one quart of the diluted product per 1,000 cubic feet. All labels which can be used for fogging in food processing areas indicate that all personnel must vacate the room during fogging and for a minimum of 2 hours after fogging. Therefore, exposure was calculated for a person entering the food processing plant 2 hours after all the applied fogger has been deployed.

The MOE for fogging in the food processing plant (2-hr re-entry interval) was below

the target MOE of 100. For fogging in hatcheries, the 8-hr MOE is 120 immediately after fogging and 6,600 after a 2 hour REI. The risks of concern for the food processing plant are attributed to the low air changes per hour assumed (i.e., 0.18 ACH as a default parameter in MCCEM to represent low air flow) in the assessment. This assessment can be refined with additional information on air flows in food processing plants. For the poultry barn, ventilation rate was obtained from Jacobson (2005). The assessment for food processing plants could be refined if a more accurate ventilation rate could be obtained.

8.3 Wood Preservation

DDAC is used in products that are intended to preserve wood through both non-pressure treatment methods and pressure treatment methods. Section 8.3.1 presents the exposure analysis for the handler and post-application scenarios for non-pressure treatment scenarios and Section 8.3.2 presents the exposure analysis for the handler and post-application scenarios for pressure treatment scenarios.

Dermal irritation exposures from post-application activities in the wood preservation treatment facility will be mitigated using default personal protective equipment requirements based on the toxicity of the end-use product. Therefore, only inhalation exposures and risks are presented.

8.3.1 Non-Pressure Treatment Scenarios (Handler and Post-application)

The proprietary study, "*Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used in the Protection of Cut Lumber (Phase III)"* (Bestari et al., 1999, MRID 455243-04) identified various worker functions/positions for individuals that handle DDAC-containing wood preservatives for non-pressure treatment application methods and for individuals that could then come into contact with the preserved wood. The worker functions/positions identified in the DDAC study are presented below.

Handler:

- ***Blender/spray operators*** are workers that add the wood preservative into a blender/sprayer system for composite wood via closed-liquid pumping.
- ***Diptank Operators*** can be in reference to wood being lowered into the treating solution through an automated process (i.e., elevator diptank, forklift diptank). This scenario can also occur in a smaller scale treatment facility in which the worker can manually dip the wood into the treatment solution.
- ***Chemical operators*** for a spray box system consist of chemical operators, chemical assistants, chemical supervisors, and chemical captains. These individuals maintain a chemical supply balance along with flushing and cleaning spray nozzles.

Post-application:

- ***Graders,*** positioned right after the spray box, grade dry lumber by hand (i.e. detect faults). In the DDAC study, graders graded wet lumber; therefore, the exposures to graders using DDAC are worst-case scenarios.
- ***Millwrights*** repair all conveyer chains and general up-keep of the mill.
- ***Clean-up crews*** perform general cleaning duties at the mill.

- ***Trim saw operators*** operate the hula trim saw and consist of operators and strappers. In the DDAC study, hula trim saw operators handled dry lumber.
- ***Construction workers*** install treated plywood, oriented strand board, medium density fiberboard, and others.

The blender/spray operator position was assessed using CMA unit exposure data and the remaining handler and post-application positions were assessed using data from the DDAC study (Bestari et al., 1999).

Blender/Spray Operators

Table 8.2 provides the inhalation doses and MOEs for the workers adding the preservative to the wood slurry. The inhalation MOE is above the target MOE of 100 for short-, intermediate-, and long-term inhalation exposures (MOE = 280).

Table 8.2 Short-, Intermediate-, and Long-Term Inhalation Exposures and MOEs for Blender/Spray Operator

Exposure Scenario	Inhalation Unit Exposure[a] (mg/lb ai)	Application Rate (% ai in solution/ day)	Wood Slurry Treated[b] (lb/day)	Daily Dose[c] (mg/kg/day)	ST/IT/LT MOE[d] (Target MOE = 100)
Occupational Handler					
Blender/spray operator	0.000403	3	178,000	0.036	280

ST = Short-term duration; IT = Intermediate-term duration; and LT = long-term.
a. Inhalation unit exposure: Baseline.
b. Wood slurry treated = (8 batches/day x 7,000 gallons/batch x 0.003785 m^3/gallon x 380 kg/m^3 x 2.2 lb/kg)
c. Daily Dose = unit exposure (mg/lb ai) x App Rate (% ai/day) x Quantity treated (lb/day) x absorption factor (100% for inhalation) / BW (60 kg)
d. MOE = NOAEL (mg/kg/day)/ Daily dose [Where ST/IT/LT NOAEL = 10 mg/kg/day for inhalation. Target MOE = 100.

Chemical Operators, Graders, Millwrights, Clean-up Crews, and Trim Saw Operators

Table 8.3 provides the short-, intermediate-, and long-term inhalation doses and MOEs for chemical operators, graders, millwrights, clean-up crews, and trim saw operators. The inhalation MOEs are above the target MOE of 100 for all worker functions. Any dermal irritation exposures from post-application activities will be mitigated using default personal protective equipment requirements based on the toxicity of the end-use product.

Table 8.3 Short-, Intermediate, and Long-Term Inhalation Exposures and MOEs for Wood Preservative Chemical Operators, Graders, Trim Saw Operators, and Clean-Up Crews (Handler and Post-application Activities)

Exposure Scenario[a] (number of volunteers)	Inhalation UE[b] (mg/day)	Conversion Ratio[c]	Daily Dose[d] (mg/kg/day)	MOE[e] (Target MOE = 100)
Occupational Handlers				
Chemical Operator (n=11)	0.0281	NA	0.000468	21,000
Occupational Post-Application				
Grader (n=13)	0.0295	NA	0.000491	20,000
Trim Saw (n=2)	0.061	NA	0.00101	9,900

Table 8.3 Short-, Intermediate, and Long-Term Inhalation Exposures and MOEs for Wood Preservative Chemical Operators, Graders, Trim Saw Operators, and Clean-Up Crews (Handler and Post-application Activities)				
Exposure Scenario[a] (number of volunteers)	Inhalation UE[b] (mg/day)	Conversion Ratio[c]	Daily Dose[d] (mg/kg/day)	MOE[e] (Target MOE = 100)
Millwright (n=3)	0.057	NA	0.00095	11,000
Clean-Up (n=6)	0.60	NA	0.0101	990

ST = Short-term duration, IT = Intermediate-term duration, LT = Long-term duration

a. The exposure scenario represents a worker wearing short-sleeved shirts, cotton work trousers, and cotton glove dosimeter gloves under chemical resistant gloves. Volunteers were grouped according to tasks they conducted at the mill.

b. Inhalation unit exposures are from Bestari et. al. (1999). Refer to Table E-1 in Appendix E for the calculation of the inhalation exposures. Inhalation exposure (mg/day) was calculated using the following equation: Air concentration (μg/m^3) x Inhalation rate (1.0 m^3/hr) x Sample duration (8 hr/day) x Unit conversion (1 mg/1000 μg). The inhalation rate is from USEPA, 1997.

c. A conversion ratio is not needed because the maximum % active ingredient in the product is the same as the % active ingredient in the DDAC study.

d. Daily dose (mg/kg/day) = exposure (mg/day) x absorption factor (100% for inhalation)/body weight (60 kg).

e. MOE = NOAEL (mg/kg/day)/ Daily dose [Where inhalation NOAEL = 10 mg/kg/day]. Target MOE = 100.

Diptank Operators

Exposures to diptank operators were also assessed using the data from the DDAC study (Bestari et al., 1999). The diptank scenario assessment was conducted differently than for the other job functions because the concentration of DDAC in the diptank solution was provided. The exposure data for diptank operators were converted into "unit exposures" in terms of mg a.i. for each 1% of concentration of the product. Table 8.4 provides the short-, intermediate- and long-term inhalation dose and MOEs for diptank operators. The inhalation MOE is above the target MOE of 100 and, therefore, is not of concern.

Table 8.4 Short-, Intermediate-, and Long-Term Inhalation Exposures and MOEs for Diptank Operator (Handler Activity)				
Exposure Scenario[a] (number of replicates)	Inhalation Unit Exposure[b] (mg DDAC/1% solution)	App Rate (% a.i. in solution/ day)	Daily Dose[c] (mg/kg/day)	MOE[d]
Occupational Handler				
Dipping, with gloves (n=7)	0.046	3	0.0023	4,300

a The exposure scenario represents a worker not wearing a respirator.

b Inhalation unit exposures are from DDAC study (MRID 455243-04). Refer to Table E-2 in Appendix E for inhalation unit exposure calculations. Inhalation exposure (mg) was calculated using the following equation: Air concentration (mg/m^3) x Inhalation rate (1.0 m^3/hr) x Sample Duration (8 hr). The inhalation rate is from USEPA, 1997.

c Daily dose (mg/kg/day) = unit exposure (mg/1% ai solution) x percent active ingredient in solution (3% ai) x absorption factor (100% for inhalation) / body weight (60 kg).

d MOE = NOAEL (mg/kg/day) / Daily dose [Where inhalation NOAEL = 10 mg/kg/day. Target MOE = 100.

Construction workers

Potential risks resulting from construction worker dermal contact with DDAC-treated wood are assessed in the same manner as potential risks resulting from children's dermal contact with DDAC-treated play sets and decks. The risks were calculated using a range of worker residue data for hands available in the DDAC exposure study for contacting dry lumber. Hand residue data from the end stacker, stickman, and tallyman workers were used because of the possibility of the contact with dry treated wood. The range of hand residue values from these data (0.6 up to 3 ug/cm^2) was assumed to be the dermal skin irritation exposure. The dermal MOEs assuming this exposure range from 3 to 13. A wood wipe study is needed to refine the risk estimates.

8.3.2 Pressure Treatment Scenarios (Handler and Post-Application)

DDAC may be used to treat wood and wood products using pressurized application methods such as double vacuum. According to the product labels, the maximum retention rate is 0.6 lb/ft^3. An application rate was not provided on the product labels; therefore, an application rate of 3% ai solution was used in this assessment, based on the master label. DDAC-specific exposure data are not available for assessment of pressure treatment exposure. Therefore, the assessment relies on surrogate chromated copper arsenate (CCA) data (ACC, 2002b) and was based on the approach used in a previous exposure assessment (USEPA, 2003b).

The estimated inhalation exposures and risks for DDAC are presented in Table 8.5. The calculated inhalation MOEs are above the target MOE of 100 for all scenarios.

Table 8.5 Short-, Intermediate-, and Long-Term Inhalation Exposures and MOEs for Pressure Treatment Handler and Post-application Scenarios

Exposure Scenario	Inhalation Unit Exposure[a] (µg As/ppm)	Application Rate (% ai solution)	Absorbed Daily Doses[b] (mg/kg/day)	Inhalation MOEs[c] (Target MOE = 100)
Occupational Handler				
Treatment Operator (TO)	0.00257	3	0.0013	7,800
Treatment Assistant (TA)	0.000802	3	0.00040	25,000
Occupational Post-application				
All (Tram setter, stacker operator, loader operator, supervisor, test borer, and tallyman)	0.00160	3	0.00080	13,000

a. Unit exposure values taken from CCA study and are shown in Table 6.11.
b. Absorbed Daily Dose (mg/kg/day) = Unit Exposure (µg As/ppm) x [% DDAC in solution (3) x 10,000 (parts per million conversion)] x (0.001 mg/µg) x absorption factor (100% for inhalation) / Body weight (60 kg).
c. MOE = NOAEL (mg/kg/day) / Daily dose [Where inhalation NOAEL = 10 mg/kg/day for all durations. Target MOE = 100.

8.4 Data Limitations/Uncertainties

There are several data limitations and uncertainties associated with the occupational handler and post-application exposure assessments. These include:

- Surrogate dermal and inhalation unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999b: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998). Since the CMA data are of poor quality, the Agency requests that confirmatory data be submitted to support the occupational scenarios assessed in this document.
- Unit exposures are not available for some of the specific scenarios that are prescribed for DDAC including open loading into oil-well/field environments
    - The CMA data used for oil-well uses are based on open pouring of a material preservative. Although these data are only represented by 2 replicates each, the exposure values are similar to open loading of pesticides in PHED. Furthermore, there are no representative unit exposure data for chemical metering into secondary recovery oil operations. Since the volume of water being treated in secondary recovery operations is so large, the available CMA data can not be reliably extrapolated because they are based on activities that handle much lower volumes and possibly different techniques. Therefore, it was assumed that if the open pour handling activities for the other oil well operations resulted in MOEs that are not of concern, then the MOEs for the closed system chemical metering into secondary recovery operations would also be not of concern. The Agency requests that confirmatory data be conducted to show that this is accurate.
- For the wood preservative pressure treatment scenarios, CCA exposure data were used for lack of DDAC-specific exposure data. Limitations and uncertainties associated with the use of these data include:
    - The assumption was made that exposure patterns for workers at treatment facilities using CCA and DDAC would be similar to exposure patterns for workers at treatment facilities using DDAC, and therefore the exposures could be used as surrogate data for workers that treat wood with DDAC.
    - For environmental modeling, it was assumed that the leaching process from the DDAC treated wood would be similar to that of CCA and DDAC. However, due to the lack of real data for DDAC -treated wood, it is not possible to verify this assumption.
- The quantities handled/treated were estimated based on information from various sources, including HED's Standard Operating Procedures (SOPs) for Residential Exposure Assessments (USEPA, 2000 and 2001), and personal communication with experts. In particular, the use information for oil-well uses and cooling water tower uses are based on personal communication with biocide manufacturers for these types of uses. The individuals contacted have experience in these operations and their estimates are believed to be the best available without undertaking a statistical survey of the uses. In certain cases, no standard values were available for some scenarios. Assumptions for these scenarios were based on AD estimates and could be further refined from input from registrants.
- The percent active ingredient in solution for the pressure treatment of lumber needs to be refined by the registrant. The labels only provided a retention rate. For this

assessment, the application rate on the master label was used, which is the same as the application rate for non-pressure treatment of lumber.

9.0 INCIDENT REPORTS

To review the evidence of health effects in humans resulting from exposure to QAC as stated in the PR Notice 88-1 (February 26, 1988), the Agency has clustered Quats into four categories:

Group I. Alkyl or hydroxyalkyl (straight chain) substituted quats;
Group II Non-halogenated benzyl substituted quats;
Group III. Di- and tri-chlorobenzyl substituted quats; and
Group IV. Quats with unusual substituents

However for the available incident information, it is difficult to differentiate the specific members of the Quats involved in each incident. Therefore, all the Quats are discussed together.

The Agency consulted the following databases for poisoning incident data for DDAC:

(1) **OPP Incident Data System (IDS)** - The Incident Data System of The Office of Pesticide Programs (OPP) of the Environmental Protection Agency (EPA) contains reports of incidents from various sources, including registrants, other federal and state health and environmental agencies and individual consumers, submitted to OPP since 1992. Reports submitted to the Incident Data System represent anecdotal reports or allegations only, unless otherwise stated. Typically no conclusions can be drawn implicating the pesticide as a cause of any of the reported health effects. Nevertheless, sometimes with enough cases and/or enough documentation risk mitigation measures may be suggested.
(2) **California Department of Pesticide Regulation (1982-2004)** - California has collected uniform data on suspected pesticide poisonings since 1982. Physicians are required, by statute, to report to their local health officer all occurrences of illness suspected of being related to exposure to pesticides. The majority of the incidents involve workers. Information on exposure (worker activity), type of illness (systemic, eye, skin, eye/skin and respiratory), likelihood of a causal relationship, and number of days off work and in the hospital are provided.
(3) **National Pesticide Telecommunications Network (NPTN)** - NPTN is a toll-free information service supported by OPP. A ranking of the top 200 active ingredients for which telephone calls were received during calendar years 1984-1991, inclusive, has been prepared. The total number of calls was tabulated for the categories human incidents, animal incidents, calls for information, and others
(4) **Published Incident Reports** - Some incident reports associated with Quats related human health hazard are published in the scientific literature.

There are many incident reported associated with exposure to end-use products containing Quats. Dermal, ocular and inhalation are the primary routes of exposure. Most of the incidences are related to irritation. Allergic type reactions have also been reported in some incidents. Although risk associated with eye exposure is not assessed in the risk assessment process, symptoms associated with eye are most commonly reported associated

with Quats exposure. The most common symptoms reported for cases of ocular exposure were eye irritation/burning, eye pain, conjunctivitis, swelling eye and swelling of eyelid.

The most common symptoms reported for cases of inhalation exposure were respiratory irritation/burning, irritation to mouth/throat/nose, coughing/choking, chest pain, disorientation, dizziness, shortness of breath.

The most common symptoms reported for cases of dermal exposure were skin irritation/burning, rash, itching, and blistering. Allergic type reactions including hives and allergic contact dermatitis, have also been reported.

Although oral exposure is considered a minor route of exposure for Quats use, irritation to mouth/throat/nose, vomiting/nausea/abdominal pain, dizziness, and headache have been reported in the cases of ingestion.

10.0 ENVIRONMENTAL RISKS

The results of the dietary avian studies indicate that DDAC is practically non-toxic to both mallard duck and bobwhite quail. In the Acute oral studies, the chemical was found to be moderately toxic to bobwhite quail. The results from freshwater fish acute toxicity studies demonstrated that DDAC was moderately to highly toxic. DDAC is very highly toxic to freshwater aquatic invertebrates. DDAC is very highly toxic to mysid shrimp a marine/estuarine invertebrate. DDAC is toxic to freshwater alga at microgram concentrations.

Data Gaps:

The following data requirements are outstanding for the currently registered uses of DDAC:
850.4225 - Non-target plant phytotoxicity testing (seedling emergence test using rice).
850.1035 - Acute Sheepshead minnow testing
850.1300 - Fish-Early Life Stage
850.1400 - Aquatic Invertebrate Life Cycle
850.4400 – Aquatic Plant Growth
850.1950 – Aquatic Field Monitoring
850.4250 – Vegetative Vigor using Rice
850.3030 – Honey Bee Toxicity Studies

Monitoring/Tier II modeling of once-through cooling tower use to establish EEC's for risk assessment.

Tier I once-through cooling tower modeling indicates that DDAC use will result in acute and chronic risk to all non-endangered and endangered/threatened aquatic organisms at all dosages modeled: 32 ppm and 63 ppm for continuous dosing and 1000 ppm and 1800 ppm for intermittent dosing.

The high vs medium vs low water flow rate is based on size of the facility. Generally, higher flow (e.g., > 1000 MGD) would use more chemical than smaller facilities, but the pattern does not hold true across the board, probably because model input values are based on different receiving water ("reach") data for individual facilities. This model uses 7Q10 rainfall conditions, which is essentially the worst-case drought of a 10 year period. Variables such as stream flow rate and DDAC dissipation, degradation, and 1/2 life were not

considered in this Tier I model but should be considered in higher tier modeling. Field monitoring is suggested in the absence of higher Tier modeling. Risk mitigation recommendations should be based on dosing method (e.g. intermittent vs continuous) and application rate instead of facility size, however, risk mitigation is not recommended at this time.

Wood Treatment Use:

The maximum amount of leachate from treated wood per the Krahn and Strub, 1990 model totaled 18.97 ppb. The lowest predicted amount of leachate was 4.7 ppb and the highest amount was 113.8 ppb. Non-endangered/threatened aquatic species (fish and invertebrates) are not expected to be adversely affected - acute or chronic toxicity - based on LOCs above. Endangered/threatened fish (freshwater warm water species) are not expected to be adversely affected by the wood treatment use. However, green alga non-endangered/threatened species, and freshwater fish coldwater species, freshwater and marine aquatic invertebrates, and green algae endangered/threatened species are at risk from the wood treatment use.

Due to the extreme sensitivity of freshwater and marine aquatic invertebrates to DDAC, methods such as indoor or covered wood storage and/or containment of runoff water via berms or plastic barriers in outdoor storage areas are suggested. DDAC is tightly adsorbed to clay and organic matter which greatly reduces potential for DDAC to leach downward through soil to groundwater, and will serve to reduce surface runoff as well.

Endangered Species Concerns:

DDAC uses that have potential for direct release into the environment or runoff to surface waters include once-through cooling tower and wood treatment uses respectively. These uses are considered to be representative of having worst-case potential for impacting the environment. Therefore, these sites were modeled.

The “best case” once-through cooling tower scenario using 1/2 the maximum recommended label dosage intermittently applied in a low water flow resulted in LOC exceedances for all aquatic organisms used in the model, including freshwater fish, green alga, freshwater invertebrates, and marine invertebrates. The agency is not aware of any endangered or threatened green algae. Because DDAC is rapidly adsorbed to organic materials and clay, impacts to aquatic organisms may be less than modeled. Aerobic aquatic metabolism study on DDAC (MRID# 422538-03) provides a sediment half-life of 60 years. There is a potential for sediment concentrations to reach toxic levels over time (aerobic soil metabolism half-life of 2.8 years, MRID# 422538-01). The once-through cooling tower model does not account for degradation and therefore, further assessment is required prior to making an agency endangered species determination.

Endangered/threatened coldwater fish species, marine and freshwater invertebrates, and green algae species are expected to be adversely affected by the wood treatment use. Impacts from the wood treatment use are not expected to occur as long as precautions are taken to prevent leaching when wood is stored outdoors.

The Environmental Fate and Effects Division (EFED) has evaluated the outdoor use of the quaternary ammonium compounds, didecyl ammonium chlorides (DDAC), being considered for reregistration by the Antimicrobial Division (AD) (DP Barcode D325481). Although primarily used as antimicrobial agents, DDAC is labeled for use in puddles and decorative pools to control algae. This use is intended for waterbodies generally disconnected from the greater watershed and will not likely result in exposure to nontarget aquatic species. It is possible these uses will result in exposure to amphibians utilizing these waterbodies for some portion of their lifecycle (e.g. reproduction) and to birds and mammals utilizing these waterbodies for drinking water. At the maximum label rate, 3 ppm initially followed by weekly 1.5 ppm treatments, there are no LOC exceedances, assuming the toxicity of DDAC is similar to that of ADBAC. However, due to the persistence of DDAC, it is possible that concentrations of DDAC in some waterbodies treated over time could become harmful to animals utilizing these waterbodies.

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APPENDIX A: Master DDAC Label

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
Industrial processes and water systems					
1839-129	Industrial Recirc Water Systems	Cooling Towers (including evaporative condensers, dairy sweetwater systems, cooling canals, pasteurizers, tunnel coolers and warmers)	Pour/metered	1839-129 (50% ai)	Weekly
10707-46	*cooling water, disposal water, oil field operations*		*slug treatment*		
1839-151	Oil Field water flood or salt water disposal	oil field water disposal systems	pour/metered	1839-151	As needed
1839-179	Oil Field	injection and wastewater	continuous injection	Blend with ADBAC	As needed
1839-179	Oil Field	injection and wastewater	batch treatment	Blend with ADBAC	As needed
1839-179	Oil Field	packer fluids		Blend with ADBAC	As needed
1839-179	Oil Field	drilling muds		Blend with ADBAC	As needed
Swimming Pools					
10324-69	Swimming Pool		pour		Once weekly
1839-133	Outside Spas/Whirlpools/Hot Tub Bath		pour		Weekly
Aquatic Areas					
499-482	*greenhouse/nurseries, golf courses, recreational parks, amusement parks, universities, cemeteries*	decorative fountains, decorative pools, ponds, water displays, standing waters	dribble, spray ring	Blend with ADBAC	As needed
499-482	*greenhouse/nurseries*	*irrigation system, watering lines, drip*	*immersing or running thru*	*Blend with ADBAC*	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		lines, emitters, watering nozzles, and hoses	*system*		
Wood Treatment					
6836-212	Pressure Treatment			3% ai soln	As needed
6836-212	Double vacuum			3% ai soln	As needed
6836-212	Dip/Spray surface treatment			3% ai soln	As needed
Agricultural Premises and Equipment					
10324-80	hatcheries, swine/poultry/turkey farms, egg receiving area, egg holding area, setter room, tray dumping area, chick holding room, poultry buildings, dressing plants, farrowing barns and areas, blocks, creep areas, chick holding area, hatchery room, chick processing area, and chick loading area	toilets, urinals, portable toilets, floors, walls, ceilings, feed racks, mangers, troughs, automatic feeders/fountains/waterers, other feeding and watering appliances, halters, ropes and other types of equipment used in handling and restraining animals, as well as forks, shovels, and scrapers used for removing litter and manure, blocks, chutes, incubators, hatchers, glazed porcelain, glazed ceramic tile, glass	mop, wipe, spray, immersion		As needed
10324-81	hatchery rooms		fogging	Blend with ADBAC	As needed
10324-81	incubators and hatchers		fogging	Blend with ADBAC	Every 12 hrs
10324-108	Mushroom Farm	breezeways and track alleys before spawning, inside and outside walls of mushroom houses, lofts, floors, storage sheds and casing rings	mop, wipe	Blend with ADBAC	As needed
1839-167	Mushroom Farm	breezeways and track alleys before spawning, inside and outside walls of mushroom houses, lofts, floors, storage sheds and casing rings	cloth, mop, sponge, spray, immersion	Blend with ADBAC	As needed
1839-167	Mushroom Farm	waterproof footwear	immersion (shoe bath)	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
1839-167	Citrus Farm	trucks, vehicles, equipment, trailers, field harvesting equipment, cargo area, wheels, tires, under carriage, hood, roof, fenders	spray, dip, brush	Citrus canker, Blend with ADBAC	As needed
10324-117	Animal housing facilities	boots and shoes	immersion	Blend with ADBAC	As needed
1839-167	Florists/flower shops, greenhouses, shippers, packing areas	flower buckets, coolers, floors and walls of coolers, design and packing benches, garbage pails	Mop/wipe, cloth, brush, sponge, sprayer	Blend with ADBAC	As needed
241-74	***Greenhouses***	***ornamental plants - plant regulator***	***spray, drench***		
499-482	*greenhouse/ nursuries*	*work tables, benches, pots, flats,knives, pruning tools, floors, plant containers, carts, transplant trays, hanging baskets, tray/ pot holders, water collectors, walkways, windows*	*immersion, spray, brush*	*Blend with ADBAC*	As needed
48815-1	*Farms*	*fish aquariums, tanks, fish handling equipment, nets, seines, traps, filter boxes, pumps, air diffusers, shipping boxes, feeding equipment, floors, countertops, raceways, garbage pails, other hard nonporous surfaces, holding tanks, lavatories.*	*immersion, brush, mop or cloth*		As needed
Residential and Public Access Premises					
10324-134	Homes	floors, walls, windows, toilets, bathtubs, shower stalls, shower door/curtain, sinks, mirrors, restroom fixtures, cabinets, tables, chairs, desks, bed frames, doorknobs, garbage cans/pails, outdoor furniture, telephones, glazed porcelain, glazed ceramic tile, glass, Countertops (kitchen/food prep); Internal (external) surfaces of appliances (refrigerator, microwave, freezer); stovetop;	mop, wipe, (cloth), spray	Disinfect Heavy Duty Cleaning	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		table surfaces; sinks, shelves, racks			
1839-175	Home	floors, walls, metal surfaces, stainless steel, glazed porcelain, glazed ceramic tile, shower stalls, bathtubs, cabinets, plastic surfaces	RTU wipe/spray	Blend with ADBAC	As needed
10324-108	Homes	Carpets	Rotary Floor Machine	Blend with ADBAC	300-500 sq ft/gal
3573-69	Home	Furniture upholstery, window treatments, clothing, plush toys, shoes/sneakers, children mattresses, pet bed, sports bag/equipment, carpet	Spray (fabric sanitizer)		As Needed
3573-69	*homes, mobile home, car, campgrounds, trailer, camper, boat*	*floors, walls, toilets, urinals, bathrooms, bathtubs, sinks, countertops, shower doors/curtains, toilet seats, shower stalls, tables, chairs, shelves, telephones, cabinets, desks, bed springs, door knobs, linen carts, hampers, exercise equipment,cat litter boxes, bidets, diaper changing tables, toys, high chairs, fountains, synthetic marbel, vinyl, linoleum , sealed granite, glazed porcelain, microwave oven exteriors, marlite, plastic, outdoor furniture, laundry hampers,*	*spray (disinfect)*	*potable rinse for chidren toys and food contact*	
10324-117	Homes	cooking utensils; coolers/ice chest; cups; cutlery; dishes; eating	Immersion	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		utensils; glassware			
1836-167	campgrounds, playgrounds, Public facilites, mobile homes, cars, campers, trailers, trucks	floors, walls, toilets, urinals, bathrooms, bathtubs, sinks, countertops, shower doors/curtains, toilet seats, shower stalls, tables, chairs, shelves, telephones, cabinets, desks, bed springs, door knobs, linen carts, hampers, exercise equipment, automobile/truck interiors, garbage cans/pails, fixtures, metal, stainless steel. glazed porcelain, glazed ceramic tile, plastic, granite, marble, chrome, vinyl, glass, enameled surfaces, painted wood work, Formica, vinyl and plastic upholstery, chrome plated fixtures	cloth, mop, sponge, spray	Blend with ADBAC	As needed
10324-117	Homes	water softners and reverse osmosis units	pour		As needed
6718-24	*Homes*	*bedframes, tables, sinks, walls, countertops, chairs, other hard nonporous surfaces*	*cloth, mop, spray*		As needed
1839-178	Homes	counters, stovetops, sinks, outside microwaves, refrigerator exteriors, walls, appliances, finished wood, cabinets, floors, exterior toilet bowl surfaces, trash cans, tubs, shower walls, bathrooms, door knobs, closets, phones, car interiors, computers, hand rails, switch plates, door frames, urinals, desks, cribs, changing tables, patio furniture, dining room surfaces	RTU wipe/spray	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
48815-1	*Homes*	*fish aquariums, tanks, fish handling equipment, nets, seines, traps, filter boxes, pumps, air diffusers, shipping boxes, feeding equipment, floors, countertops, raceways, garbage pails, other hard nonporous surfaces, holding tanks, lavatories.*	*immersion, brush, mop or cloth*		As needed
10324-80	*Homes*	*air ducts*	*spray, brush,mop, wipe, ULV or mist generating, automated spray*	*odor causing bacteria, fungi*	6 months
Medical Premises and Equipment					
1839-167	Hospitals, Health Care facilities, Medical/Dental offices, Nursing homes, operating rooms, patient care facilities, clinics, isolation wards, medical research facilities, autopsy rooms, ICU areas, recovery anesthesia, emergency rooms, X-ray cat labs, newborn nurseries, orthopedics, respiratory therapy, acute care institutions, alternate care institutions, healthcare institutions, Funeral Homes, mortuaries	floors, walls, toilets, urinals, lavatories, bathrooms, bathing areas, bathtubs, sinks, sink tops, shower stalls, shower doors/curtains, mirrors, ultrasonic bath, whirlpools, foot baths, countertops, cabinets, tables, chairs, desks, hospital beds, bed springs, bed frames, traction devices, MRI, CAT, examining tables, scales, paddles, wheelchairs, lifts, door knobs, wheel chairs, telephones, garbage pails/cans, fixtures, metal, stainless steel. glazed porcelain, glazed ceramic tile, plastic, granite, marble, chrome, vinyl, glass, enameled surfaces, painted wood work,	Wipe, mop, (cloth), swab, brush, spray	Blend with ADBAC	As needed
10324-81	Nurseries	Floors, walls, countertops (non-kitchen), sinks (bathroom), toilets, external surfaces of appliances	mop, wipe (cloth)	Blend with ADBAC	As needed
1839-175	Medical Institutions, Hospitals, and Nursing Homes	floors, walls, metal surfaces, stainless steel, glazed porcelain, glazed ceramic tile, shower stalls, bathtubs, cabinets, plastic	RTU wipe/spray	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		surfaces			
10324-134	hospitals, medical/dental offices, nursing homes	floors, walls, windows, toilets, bathtubs, shower stalls, shower door/curtain, sinks, mirrors, restroom fixtures, cabinets, tables, chairs, desks, bed frames, doorknobs, garbage cans/pails, telephones, glass, glazed porcelain, glazed ceramic tile, table surfaces; sinks, shelves, racks	mop, wipe, (cloth), spray	Disinfect Heavy Duty Cleaning	As needed
1839-167	nursing homes and hospitals	floors, walls, windows, toilets, bathtubs, shower stalls, shower door/curtain, sinks, mirrors, restroom fixtures, cabinets, tables, chairs, desks, bed frames, doorknobs, garbage cans/pails, telephones, glass, glazed porcelain, glazed ceramic tile, enameled surfaces, countertops (kitchen/food prep); Internal external surfaces of appliances (refrigerator, microwave, freezer); stovetop, shelves, racks	portable extraction units, truck mounted extraction machines, rotary floor machines, metered, spray	Blend with ADBAC	As needed
6718-24	*hospitals, nursing homes*	*bedframes, tables, sinks, walls, countertops, chairs, other hard nonporous surfaces*	*cloth, mop, spray*		As needed
1839-178	hospitals, day-care facilities, sick rooms	counters, stovetops, sinks, outside microwaves, refrigerator exteriors, walls, appliances, finished wood, cabinets, floors, exterior toilet bowl surfaces, trash cans, tubs, shower walls, bathrooms, door knobs, closets, phones, car interiors, computers, hand rails, switch plates,	RTU wipe	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		door frames, urinals, desks, cribs, changing tables			
1839-173	Morgues and Funeral homes	human remains	sponge, wash cloth, soft brush	Blend with ADBAC	As needed
10324-80	*hospitals, nursing homes*	*air ducts*	*spray, brush,mop, wipe, ULV or mist generating, automated spray*	*odor causing bacteria, fungi*	6 months
Commercial, Institutional, and Industrial premises and equipment					
10324-134	Athletic/recreational facilities, exercise facilities, schools, colleges, dressing rooms, transportation terminals, institutions	floors, walls, windows, toilets, bathtubs, shower stalls, shower door/curtain, sinks, mirrors, restroom fixtures, cabinets, tables, chairs, desks, bed frames, doorknobs, garbage cans/pails, outdoor furniture, telephones, glass, glazed porcelain, glazed ceramic tile, chrome plated intakes, enameled surfaces, countertops (kitchen/food prep); Internal (external) surfaces of appliances (refrigerator, microwave, freezer); stovetop; table surfaces; sinks, shelves, racks	mop, wipe, (cloth), spray	Disinfect Heavy Duty Cleaning	As needed
1839-167	Athletic/recreational facilities, exercise facilites, locker rooms, dressing rooms, schools, colleges, transportation terminals,	floors, walls, toilets, urinals, bathrooms, bathtubs, sinks, countertops, shower doors/curtains, toilet seats, shower stalls, tables, chairs, shelves, telephones, cabinets, desks, bed springs, door knobs, garbage cans/pails, fixtures, metal, stainless steel. glazed porcelain, glazed ceramic tile, plastic, granite, marble,	cloth, mop, sponge, spray	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		chrome, vinyl, glass, enameled surfaces, painted wood work,			
1839-167	Motels, hotels, schools	carpets	portable extraction units, truck mounted extraction machines, rotary floor machines, metered, spray	Cleaning Claim Blend with ADBAC	As needed
1839-175	Hotels and schools	floors, walls, metal surfaces, stainless steel, glazed porcelain, glazed ceramic tile, shower stalls, bathtubs, cabinets, plastic surfaces	RTU wipe/spray	Blend with ADBAC	As needed
6836-78	Barber and Beauty Salons	Barber/ Beauty Instruments and Tools	immersion	Blend with ADBAC	As needed
1839-178	Barber and Beauty Salons, Health clubs, hotels, motels, emergency vehicles, transportation terminals, correctional facilities, factories,	counters, sinks, walls, finished wood, cabinets, floors, exterior toilet bowl surfaces, trash cans, tubs, shower walls, bathrooms, door knobs, closets, phones, car interiors, computers, hand rails, switch plates, door frames, urinals, desks,	RTU wipe	Blend with ADBAC	As needed
1839-167	commercial florists	flower buckets, coolers, floors and walls of coolers, design and packing benches, garbage pails	cloth, mop, sponge, spray	Blend with ADBAC	As needed
3573-69	*Hotels, dorms, convenience stores, recreational centers, offices, motels,*	*floors, walls, toilets, urinals, bathrooms, bathtubs, sinks, countertops, shower doors/curtains, toilet seats, shower stalls, tables, chairs, shelves, telephones, cabinets, desks, bed springs, door knobs, linen carts,*	*spray (disinfect)*	*potable rinse for chidren's toys and food contact surfaces*	

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		hampers, exercise equipment, bidets, fountains, synthetic marble, vinyl, linoleum , sealed granite, glazed porcelain, microwave oven exteriors, marlite, plastic, outdoor furniture, laundry hampers,			
1677-109	*Commercial and institutional laundry mats*	*clothing*	*pour at final rinse or sour to washweel*	*per 100lbs fabric dry wt*	2wk protect 3wk protect 30dy protect
6718-24	*industry and schools*	*bedframes, tables, sinks, walls, countertops, chairs, other hard nonporous surfaces*	*cloth, mop, spray*		As needed
48815-1	*Schools, Institutional, and Industrial*	*fish aquariums, tanks, fish handling equipment, nets, seines, traps, filter boxes, pumps, air diffusers, shipping boxes, feeding equipment, floors, countertops, raceways, garbage pails, other hard nonporous surfaces, holding tanks, lavatories.*	*immersion, brush, mop or cloth*		As needed
10324-80	*Institutional, Industrial premise, school, restaurant*	*air ducts*	*spray, brush,mop, wipe, ULV or mist generating, automated spray*	*odor causing bacteria, fungi*	6 months
Food Handling/Storage Establishments premises and equipment					
1839-152	Restaurants, food service establishments, food processing plants/facilities, beverage processing plants, Bars, Cafeterias, Convenience stores, supermarkets, Dairies, Egg Processing plants, Federally inspected meat and poultry plants , Food Handling areas, Food preparation areas, Food storage areas, Institutional kitchens, USDA inspected food processing facilities, breweries, fast food operations	floors, walls, countertops, appliances (microwaves, refrigerators, stove tops, freezers, coolers), chairs, tables, shelves, picnic tables, outdoor furniture, racks, carts, telephones, door knobs, storage areas, potato storage areas, food storage areas, garbage storage areas, cutting boards, tanks, exhaust fans, refrigerator bins, refrigerated storage/display equipment, coils	cloth, mop, spray, flood, immersion,		As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
		and drain pans of air conditioning/refrigeration equipment, heat pumps, storage tanks, coolers, ice chests, garbage cans/pails			
1839-175	Restaurants	floors, walls, tables, shelves, garbage disposal areas, metal surfaces, stainless steel, glazed porcelain, glazed ceramic tile, shower stalls, bathtubs, cabinets, plastic surfaces	RTU spray/wipe	Blend with ADBAC	As needed
10324-81	Dairies and Food Processing Facilities	floors, walls, metal surfaces, stainless steel, glazed porcelain, glazed ceramic tile, shower stalls, bathtubs, cabinets, plastic surfaces	fogging	Blend with ADBAC	As needed
10324-134	bottling and beverage plants, breweries, tobacco, egg processing plants, meat/poultry processing plants, rendering plants, fishery/milk/citrus/wine/ice cream/ potato processing plants, restaurants	floors, walls, tables, shelves, garbage cans, garbage disposal areas, glazed porcelain, glazed ceramic tile, glass	mop, wipe, (cloth), spray		As needed
1839-178	Restaurants	counters, stovetops, sinks, outside microwaves, refrigerators exteriors, walls, appliances, finished wood, cabinets, floors, exterior toilet bowl surfaces, trash cans, tubs, shower walls, bathrooms, door knobs, closets, phones, computers, hand rails, switch plates, door frames, urinals, desks, dining room surfaces	RTU wipe	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
10324-117	bottling and beverage plants, breweries, tobacco, egg processing plants, meat/poultry processing plants, rendering plants, fishery/milk/citrus/wine/ice cream/ potato processing plants, restaurants	ice machines, water coolers, counters, tables, food processing equipment, food utensils, dairy equipment, dishes, silverware, eating utensils, glasses, sinks, counters, refrigerated/storage display equipment	spray, wipe, sponge, immersion		As needed
10324-117	bottling and beverage plants, breweries, tobacco, egg processing plants, meat/poultry processing plants, rendering plants, fishery/milk/citrus/wine/ice cream/ potato processing plants,	water softners and reverse osmosis units	pour		As needed
10324-117	bottling and beverage plants, breweries, tobacco, egg processing plants, meat/poultry processing plants, rendering plants, fishery/milk/citrus/wine/ice cream/ potato processing plants,	boots and shoes	immersion	Blend with ADBAC	As needed
1839-173	dairies, beverage, and food processing plants	floors, walls, countertops, appliances (microwaves, refrigerators, stove tops, freezers, coolers), chairs, tables, shelves, racks, carts, telephones, door knobs, storage areas, potato storage areas, food storage areas, garbage storage areas, cutting boards, tanks, exhaust fans, refrigerator bins, refrigerated storage/display equipment, storage tanks, coolers, ice chests, garbage cans/pails	fogging	Blend with ADBAC	As needed
10324-80	*food processing plants, food service areas, institutional kitchens, industrial/hospital caferias, school lunchrooms, dairies, and packing plants*	*air ducts*	*spray, brush,mop, wipe, ULV or mist generating, automated spray*	*odor causing bacteria, fungi*	6 months
Clean/Deodorization					
1839-167	Water/Smoke restoration (institutional, industrial, hospital)	carpets, carpet cushion, sub floors, drywall, trim, farm lumber, tackless strip and paneling	Pour, brush, spray	Blend with ADBAC	As needed
1839-167	Sewer backup/river flood cleanup, (clean water source)	carpets, carpet cushion, sub floors, drywall, trim, farm lumber, tackless strip and paneling	spray	Blend with ADBAC	As needed

EPA Reg Number used for Max. Appl. Rate	Use Site	Treatment Site/Surfaces	Method of Application	Notes	Freq of Application
1839-167	garbage storage areas, pet areas, garbage bins & cans			Blend with ADBAC	As needed
71814-1	*hospitals*	*Medical waste*	*pour*	blend w/ ADBAC	Poured into machine