B20-1.0 DALAPON

B20-1.1 Background Information

IUPAC: 2,2-dichloropropionic acid

CAS: 2,2-dichloropropionic acid

CASRN: 75-99-0

DALAPON USAGE:

Dalapon was used to control Bermuda grass, oxtails, Johnson grass, quackgrass, and other perennial and annual grasses, as well as cattails and rushes. Registration for Dalapon, was voluntarily canceled by the registrants in the United States (Federal Register, 2002). Dalapon is not registered for use in Canada.

Dalapon/M3189 was used in conjunction with picloram, and it was only applied during the 1967 U.S. trials (Demaree and Haws, 1968).

Table B20-1 Dalapon Usage at CFB Gagetown[a]

Year	Area Treated (ha)	Amount of Dalapon Applied (kg)
1967	2.4	44.9
Total	**2.4E+00**	**4.5E+01**

[a] Adapted from Demaree and Haws, 1968.

B20-2.0 CHEMICAL AND PHYSICAL PROPERTIES

Formula: $C_3H_4Cl_2O_2$

Activity: Halogenated aliphatic herbicides

Notes: Dalapon can be used as an acid, ester or a salt. Various forms of dalapon include: Dalapon-calcium [CASRN: 53606-78-3], dalapon-magnesium [CASRN: 29110-22-3], dalapon-sodium [CASRN: 127-20-8].

Structure:

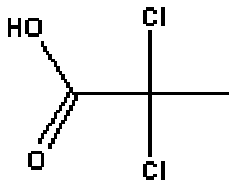

Figure 2-1 Dalapon [CAS No. 75-99-0] Structure

Table B20-2 Chemical and Physical Properties of Dalapon[a]

Chemical/Physical Property	Result	Reference
Colour/Form	White to tan white free-flowing powder	Paynter and Tusing, 1960
Dissociation Constant (pKa)	1.79	JW, 2006
Henry's Law constant	$6.43x10^{-08}$atm-m^3/mole at 25ºC	JW, 2006
Log K_{ow}	0.78	JW, 2006
Melting Point	193-197ºC	Paynter and Tusing, 1960
Molecular Weight	142.97	JW, 2006
Vapour Pressure	0.19 mm Hg at 25ºC	JW, 2006
Water Solubility	5×10^5 mg/L at 25ºC	JW, 2006

[a] Dalapon present as a sodium salt.

B20-3.0 PMRA EVALUATION

No information found.

B20-4.0 TOXICOLOGICAL SUMMARY

B20-4.1 Human Health Effects

Table B20-3 Human Health Effects Resulting from Acute Exposure to Dalapon Containing Herbicides [a,b]

Exposure	Effects	Response
Acute	Cardiovascular	Coronary spasm, hypotension, and sinus tachycardia may occur following exposure.
	Respiratory	Aspiration of insecticide containing petroleum distillate may result in pneumonitis.
	Neurologic	CNS excitation, seizures, tremor, ataxia, agitation, nervousness, and amnesia may occur.
	Gastrointestinal	Nausea, vomiting, and diarrhea may follow ingestion.
	Hepatic	Chronic absorption may cause hepatomegaly and centrilobular hepatic necrosis in humans.
	Genitourinary	Depressed sperm counts may accompany excessive absorption. Ingestion may cause acute renal failure.
	Fluid-electrolyte	Severe metabolic acidosis secondary to seizures has been reported.
	Hematologic	Blood dyscrasias, anemia, and leukemia have been associated with organochlorine exposure. Disseminated intravascular coagulation has been reported.
	Dermalogic	Extensive contact results in dermal irritation.

[a] Rumack and Hall, 2006.
[b] MEDITEXT®, 2006.

B20-4.2 Health Effects by Route of Exposure

B20-4.2.1 Oral Exposure

Table B20-4 Mammalian LD_{50} Values Resulting from Oral Exposure to Dalapon

Test Organism (Species/Sex)	LD_{50} (mg/kg)	Reference
Acute		
Mice (F)	>4,600	Paynter and Tusing, 1960
Rats (M)	9,330	Paynter and Tusing, 1960
Rats (F)	7,570	Paynter and Tusing, 1960
Guinea pig (F)	3,860	Paynter and Tusing, 1960
Chick (Mixed)	5,660	Paynter and Tusing, 1960
Rabbit (F)	3,860	Paynter and Tusing, 1960

(M) denotes male.
(F) denotes female.

Table B20-5 Mammalian Effects Resulting from Oral Exposure to Dalapon

Test Organism (Species)	Exposure	Dose (Duration)	Response	Reference
Sub-chronic				
Wistar Rats	Diet	0, 0.0115, 0.0346, 0.115, 0.346, 1.15% of dalapon in diet	Growth retardation, increased average weight of liver and kindneys, and slight histopathological changes in the liver and kidneys.	Paynter and Tusing, 1960
Bull suckling calf	Diet	1 g/kg/day for 10 successive days	Kidneys showed slight cloudy swelling of the proximal convoluted tubules and hypertrophy of the glomerular cells with decreased glomerular spaces.	Paynter and Tusing, 1960
Mongrel dogs (1M/1F)	Oral	50 to ,1000 mg/kg/ day for 81 days	Vomiting, no other effects observed.	Paynter and Tusing, 1960
Heifer	Diet	1 g/kg/day for 10 successive days	General lassitude, diarrhea, roughness of coat, loss of appetite, slight loss of weight, slowed pulse rate, mild cyanosis of the mucous membranes, some discharge from the eyes.	Paynter and Tusing, 1960
Chronic				
Mongrel dogs	Diet	0, 15, 50, or 100 mg/kg/day for 52 weeks	No significant differences were observed through histopathological examination.	Paynter and Tusing, 1960
Beagle dogs	Diet	0, 15, 45, or 90 mg/kg over two years.	Increased in liver weight and vacuoles in the spinal cord.	CDFA, 1986
Rats	Diet	0, 0.01 or 0.03% of diet for 2 years.	No adverse effects were observed.	CDFA, 1986

Table B20-5 Mammalian Effects Resulting from Oral Exposure to Dalapon

Test Organism (Species)	Exposure	Dose (Duration)	Response	Reference
Dogs	Diet	0, 15, 50 or 100 mg/kg for 52 weeks	No chronic effects due to treatment were reported.	CDFA, 1986
Albino rats	Diet	5, 15, and 50 mg/kg/day	Increased kidney weight. No other systemic effects observed.	Paynter and Tusing, 1960

Table B20-6 Mammalian Developmental and Reproductive Effects Resulting from Oral Exposure to Dalapon

Test Organism (Species)	Exposure	Dose (mg/kg/day) (Duration)	Response	Reference
Rat	Diet	0, 0.03, 0.1 or 0.3% in the diet for 3 generations	No evidence of a reproductive effect.	CDFA, 1986
Dog	Diet	50, 100 or 200 mg/kg	No evidence of a reproductive effect.	CDFA, 1986
Rat	Gavage	0, 500, 1,000 or 1,500 mg/kg	Skeletal developmental effects, decreased fetal weights, decreased maternal weight gains.	CDFA, 1986
Albino Rats	Diet	0.0, 0.03, 0.1, or 0.3% dalapon in the diet	No reproductive or developmental effects observed.	Paynter and Tusing, 1960

B20-4.2.1.1 No Observed Adverse Effect Levels

Table B20-7 Mammalian NOELs and LELs for Oral Exposure to Dalapon

Test Organism (Species)	Effect	Value	Endpoint	Reference
Chronic				
Beagle Dogs	NOEL	45 mg/kg	Increase in liver weight, Vaculoes in the spinal cord.	CDFA, 1986
Mice	NOEL	60 mg/kg	Liver weight changes.	CDFA, 1986
Rats	NOEL	1,000 mg/kg	Maternal weight gain.	CDFA, 1986
Albino Rats	NOEL	8.45 mg/kg/day	Increased kidney body weight ratio	Paynter and Tusing, 1960
	LEL	28.17 mg/kg/day		

B20-4.2.2 Dermal Exposure

Permanent effects were not observed after dalapon sodium solutions were applied to the skin and eyes of the rabbit. All acute effects healed to completion without any scarring (Paynter and Tusing, 1960).

B20-4.2.3 Inhalation Exposure

No data found.

B20-4.3 Carcinogenicity

This substance/agent has not undergone a complete evaluation and determination under U.S. EPA's IRIS program for evidence of human carcinogenic potential (U.S. EPA, 1989).

Table B20-9 Animal Carcinogenicity Data

Test Subjects	Exposure	Dose (mg/kg/day)	Response	Reference
Mice	Diet	0, 2, 60 or 200 mg/kg for 2 years	No oncogenic effects were reported	CDFA, 1986

Mutagenicity studies performed on dalapon using *Salmonella* and T4 phage showed no mutagenic effects. Furthermore, point mutations to 8-azaguanine resistance, mitotic crossing-over and mitotic non-disjunction were tested on dalapon using *Asperigillus nidulans*. No activation or mutagenic effects were observed. Dalapon showed negative results in Ames tests using *TA1535-38*, and *TA98* and *TA100* strains (CDFA, 1986).

B20-4.4 Populations at Special Risk

No information found.

B20-4.5 Toxicokinetics

Dalapon and all of its known metabolites are water soluble. Dalapon is not missible in organic solvents, and hence is not expected to accumulate in cells and tissues. From animal studies, it was shown that dalapon will be hydrolyzed to acetaldehyde. A cetaldehyde from dalapon would be further degraded to acetate and carbon dioxide. The half-life of dalapon in human blood was found to be between 1.5 and 3.0 days (Doyle, 1984; USDA, 1984; Hallenbeck and Cummingham-Burns, 1985).

B20-4.6 Exposure Limits

Table B20-10 Existing RfD Values for Dalapon Exposures

Reference Dose	Reference	Endpoint	Study	Reference	NOEL (mg/kg/day)	Uncertainty Factor	Study Classification
Acute/Short-term (1-7 days)							
No information found	--	--	--	--	--	--	--
Intermediate-term (7 days- Several months)							
No information found	--	--	--	--	--	--	--
Long-term (6 months to lifetime)							
0.03	U.S. EPA, 1989	Increased kidney body weight ratio	2 year Rat Study Oral Exposure (diet)	Paynter and Tusing, 1960	8.45 mg/kg/day	300	Questionable, confidence in the RfD is low

For the risk assessment purposes of this report a chronic RfD of 0.03 mg/kg/day (U.S. EPA, 1989) was selected.

B20-5.0 ENVIRONMENTAL FATE AND EXPOSURE

Dalapon has a low Henry's Law Constant of $6.43x10^{-8}$atm-m^3/mole at 25ºC (JW, 2006). This indicates that it would have little tendency to escape from an aqueous solution. Hence, dalapon is not expected to be found in air with the exception as a consequence of direct aerial application of compounds to agricultural and nonagricultural areas. Dalapon will not bind, or adsorb to soil particles, hence it tends to be very mobile in all soil types. Leaching of dalapon will occur unless it gets rapidly and completely broken down by microorganisms. Microbial degradation is the main route of dalapon dissipation from soil. The rate of dalapon degradation depends on soil type, temperature, and moisture. Dalapon on surface soils can be photodegraded as well (Doyle, 1984; Howard, 1989).

Dalapon can persist in the soil 2 to 8 weeks (JW, 2005), but usually less than 1 month (USDA, 1984). Dalapon will have residual activity in soils up to 4 months when applied at high rates (22 kg/hectare) (Hartley and Kidd, 1983).

In aquatic environments, dalapon will dissipate through microbial degradation, hydrolysis and photolysis (Doyle, 1984). Microbial degradation is the chief form of dalapon dissipation in water. The rate of hydrolysis of dalapon tends to be very slow (months), but increases with temperature and/or pH. (Doyle, 1984; USDA, 1984; U.S. EPA, 1988).

Plants absorb dalapon upon contact, either at leaves, or at the roots. It will be translocated throughout the plant, mostly from leaves to the roots due to the foiliar nature of the treatment (Doyle, 1984). Dalapon will concentrate in areas of the greatest plant metabolic activity such as developing seeds and meristems.

Table B20-11 Half-life of Ammonium Sulfamate in the Environment

Conditions	Environmental Media	Half-life	Reference
Mean half-life	Air	3 weeks	Mackay *et al.*, 1997
Range half-life		300-1,000 hours	
Mean half-life	Water	2 months	
Range half-life		1,000-3,000 hours	
Mean half-life	Soil	2 months	
Range half-life		1,000-3,000 hours	

B20-6.0 SUMMARY

Dalapon was classified as a general use herbicide to control Bermuda grass, oxtails, Johnson grass, quackgrass, and other perennial and annual grasses. Registration for dalapon, was canceled by the registrants in the United States (Federal Register, 2002). Similarly, dalapon is no longer registered for use in Canada. In 1967, approximately 45 kg of dalapon was applied over an area of 2.4 ha at CFB Gagetown (Demaree and Haws, 1968).

Dalapon has low acute toxicity *via* the oral route of exposure in rodents. However, systemic effects in the kidneys were observed in chronic dalapon feeding studies. Furthermore, dalapon did not induce any reproductive/developmental effects at any dose level tested.

B20-7.0 REFERENCES

CDFA. 1986. Summary of Toxicological Data: Dalapon. California Department of Food and Agriculture. August 8, 1986.

Demaree, K.D., and Haws, A.R. 1968. Chemical defoliation of northern tree species. Technical Memorandum 145. Plant Sciences Laboratory, Plant Physiology Division, Department of the Army, Fort Detrick, Frederick, MD.

Doyle, R. 1984. Dalapon information sheet. Food and Drug Administration. Bureau of Foods, HFF- 420. Cited In: EXTOXNET, 1996.

EXTOXNET. 1 996. Dalapon. Extension Toxicology Network, Pesticide Information Profiles. Available at: http://pmep.cce.cornell.edu/profiles/extoxnet/carbaryl-dicrotophos/dalapon-ext.html [Sept 8, 2006].

Federal Register. 2002. Announcement of the Results of EPA's Review of Existing Drinking Water Standards and Request for Public Comment. Page 19030, 40CFR Part 14. Docket ID: fr17ap02-28. Available at: http://wais.access.gpo.gov [Sept 8, 2006]

Hallenbeck, W.H. and Cummingham-Burns, K.M. 1985. Pesticides and human health. Springer-Verlag. Cited In: EXTOXNET, 1996.

Hartley, D. and Kidd, H. eds. 1983. The Agrochemicals handbook. Nottingham, England: Royal Society of Chemistry. Cited In: EXTOXNET, 1996.

Howard, P.H. eds. 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III: Pesticides. Lewis Publishers, Chelsea, MI. Cited In: EXTOXNET, 1996.

HSDB. 2005. Dalapon. U.S. National Library of Medicine's Toxicology Data Network (TOXNET). Hazardous Substances Data Bank. Available at: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB [Sept 8, 2006].

JW. 2005. Final Report. Environmental Site Assessment of CFB Gagetown, N.B: Task 2B-Stage 1 Development of a Strategic Approach. Report to: Public Works and Government Services Canada (PWGSC) on behalf of the Department of National Defence (DND). Project No. 1002588. Jacques Whitford, December 14, 2005

JW. 2006. Final Report. Task 2A: The History and Science of Herbicide Use at CFB Gagetown From 1952 to Present. Report to: Department of National Defence. Jacques Whitford, May 19, 2006.

Mackay, D., Shiu, W.Y., and Ma, D.C. 1997. Illustrated handbook of physical-chemical properties and environmental fate for organic chemicals: Pesticide chemicals. Volume 5. Lewis Publishers, Boca Raton. New York.

MEDITEXT®. 2006. TOMES® Information System Micromedex, Inc., Englewood, Co; CCIS Volume 130, expires Nov, 2006. Cited In: HSDB, 2005.

Paynter, O.E. and Tusing, T.W. 1960. Toxicology of dalapon sodium (2,2-dichloropropionic acid, sodium salt). Herbicide Toxicology. 8 (1): 47-51. Cited In: U.S. EPA, 1989.

Rumack, B.H., and Hall, A.H. Eds. 2006. POISINDEX® Information system Micromedex, Inc., Englewood, CO. CCIS Volume 130, expires Nov 2006. Cited In: HSDB, 2005.

U.S. EPA. 1988. Dalapon: Health Advisory. Office of Drinking Water, US EPA, Washington, DC. Cited In: EXTOXNET, 1996.

U.S. EPA. 1 989. Dalapon. Integrated Risk Information System, U.S. Environmental Protection Agency. Available at: http://www.epa.gov/IRIS/subst/0146.htm [Sept 8, 2006]

USDA. 1984. Herbicides. Agricultural handbook no. 633: Pesticide background statements. Vol. 1. Prepared by Mitre Corporation, McLean, VA. U.S. Department of Agriculture, Forest Service. Cited In: EXTOXNET, 1996.