

GreenScreen® Assessment for [Magnesium Hydroxide (CAS#1309-42-8)]

Method Version: GreenScreen® Version 1.2¹

Verified or Non-Verified²: NON-VERIFIED

Introduction^{3,4,5}

This GreenScreen assessment is based on the information reported in the corresponding chemical hazard profile in “An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report”³. Additional information on hazard endpoints beyond what was included in the final report was not sought with the exception of reactivity. Hazard classification information for reactivity was supplemented because it is not included in the DfE report but is needed to apply the GreenScreen Benchmark system.

Hazard classification levels reported in the DfE profiles and in this GreenScreen report may differ due to differences between criteria as defined in the DfE “Alternatives Assessment Criteria for Hazard Evaluation”⁴ and the GreenScreen for Safer Chemicals v1.2 methods⁵. Any differences in interpretation are explained and justified in this GreenScreen report.

<u>Non-Verified GreenScreen® Assessment Prepared By:</u>	<u>Non-Verified GreenScreen® Assessment Quality Control Performed By:</u>
Name: Eric Rosenblum, Ph.D.	Name: Alex Stone, Sc.D.
Title: Senior Toxicologist	Title: Safer Chemical Alternatives Chemist
Organization: Rosenblum Environmental consulting to Clean Production Action	Organization: Washington Department of Ecology
Date: February 9, 2014 (expires after 3 years)	Date: March 19, 2014
Licensed Profiler or Certified Practitioner (specify): N/A	

Confirm application of the *Disclosure and Assessment Rules and Best Practice*⁶: (List any deviations)

¹ Use GreenScreen® Assessment Procedure (Guidance) V1.2

² “NON-VERIFIED” means that Verification Has Not Been Performed on this GreenScreen Assessment

³ An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report Available at: <http://www.epa.gov/dfe/pubs/projects/decaBDE/deca-report-complete.pdf>, p 4-361, accessed 2/9/2014.

⁴ Available at: http://www.epa.gov/dfe/alternatives_assessment_criteria_for_hazard_eval.pdf, accessed 10/2013.

⁵ Details available at: <http://www.cleanproduction.org/Greenscreen.v1-2.php>, accessed 10/2013.

⁶ See GreenScreen Guidance V1.2 Section 8

Disclosure thresholds applied by DfE are unclear in the DfE report.

Chemical Name (CAS #): Magnesium Hydroxide (CAS # 1309-42-8)]

Also Called:

Magnesium hydroxide ($\text{Mg}(\text{OH})_2$) (TSCA Inventory), Magnesium hydroxide gel, Magnesium(II) hydroxide, Magnesia hydrate, Magnesium dihydroxide

Tradenames:

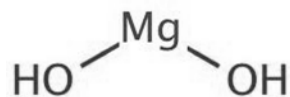
Brucite, Milk of Magnesia; Alcanex NHC 25, Asahi Glass 200-06, Baschem 12, Combustrol 500, Duhor, Duhor N, Ebson RF, FloMag H, FloMag HUS, Hydro-mag MA, Hydrofy G 1.5, Hydrofy G 2.5, Hydrofy N, Kisuma 4AF, Kisuma 5, Kisuma 5A, Kisuma 5B, Kisuma 5B-N, Kisuma 5BG, Kisuma 5E, Kisuma 78, Kisuma S 4, Kyowamag F, Lylcal 96 HSE, Mag Chem MH 10, MagneClear 58, Magnesia magma, Magnesiamaito, Magnifin H 10, Magox, Marinc H, Marinc H 1241, Martinal VPF 8812, Milmag, Mint-O-Mag, Nermalite, Oxaine M, Phillips Magnesia Tablets, Phillips Milk of Magnesia Liquid, Reachim, Star 200, Versamag

Suitable analogs or moieties of chemicals used in this assessment (CAS #'s):

No analogs; Mg^{2+} ions are expected to form when $\text{Mg}(\text{OH})_2$ and other magnesium containing compounds dissociate in aqueous conditions. Studies included in this assessment demonstrate the hazards associated with Mg^{2+} from other sources like MgCl_2 .

Chemical Structure(s):

*Note: Include chemical structure(s) of all suitable analogs (and /or moieties) used in the assessment.



Notes related to production specific attributes⁷:

For Inorganic Chemicals and relevant particulate organics (if not relevant, list NA)

Define Properties:

According to the DfE report, “This alternative is an inorganic compound. In the absence of experimental data, professional judgment using chemical class and structural considerations were used to complete this hazard profile.”⁸

Information on particle size, structure and mobility were not included in the report.

1. Particle size (e.g. silica of respirable size) - NA
2. Structure (e.g. amorphous vs. crystalline) - NA
3. Mobility (e.g. Water solubility, volatility) - NA

⁷ Note any composition or hazard attributes of the chemical product relevant to how it is manufactured. For example, certain synthetic pathways or processes result in typical contaminants, by-products or transformation products. Explain any differences between the manufactured chemical product and the GreenScreen assessment of the generic chemical by CAS #.

⁸ An Alternatives Assessment for the Flame Retardant Decabromodiphenylether (DecaBDE) Final Report Available at: <http://www.epa.gov/dfe/pubs/projects/decaBDE/deca-report-complete.pdf>, p 4-361, accessed 2/9/2014.

4. Bioavailability: The magnesium ion is poorly absorbed; when taken orally, only 5-15% of the magnesium from a dose of magnesium hydroxide is absorbed and this magnesium is readily excreted in the urine, if kidney function is normal.

Identify Applications/Functional Uses:

(e.g., Cleaning product, TV casing)

1. Flame Retardant

GreenScreen Benchmark Score and Hazard Summary Table:^{9,10,11,12} Magnesium Hydroxide was assigned a **Benchmark Score of 3** based on moderate group II human toxicity scores (eye and skin irritation) and for very high persistence. Magnesium hydroxide was not assigned a Benchmark 2 score based on very high persistence and moderate skin and eye irritation as the persistence is due to it being an inorganic chemical and the irritation hazards are not based on repeated exposures.

Magnesium Hydroxide could be a Benchmark 1 if the data gap for endocrine activity or respiratory sensitization was filled with data indicating a very high hazard score.

Green Screen Hazard Ratings: [Magnesium Hydroxide]																			
Group I Human					Group II and II* Human								Ecotox		Fate		Physical		
C	M	R	D	E	AT	ST		N	SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F	
						single	repeated	single	repeated										
L	L	L	L	DG	L		L		L	L	DG	L	M	L	L	vH	vL	L	L

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M and L) instead of three (i.e., H, M and L), and are based on single exposures instead of repeated exposures.

Environmental Transformation Products and Ratings¹³:

Identify feasible and relevant environmental transformation products (i.e., dissociation products, transformation products, valence states) and/or moieties of concern¹⁴

According to the DfE report, transformation products are “not applicable”.

⁹ See Appendix A for a glossary of hazard endpoint acronyms

¹⁰ See Appendix B for alternative GreenScreen Hazard Summary Table (Classification presented by exposure route)

¹¹ For inorganic chemicals only, see GreenScreen Guidance V1.2 Section 14.4. (Exceptions for Persistence)

¹² For Systemic Toxicity and Neurotoxicity, repeated exposure data are preferred. Lack of single exposure data is not a Data Gap when repeated exposure data are available. In that case, lack of single exposure data may be represented as NA instead of DG. See GreenScreen Guidance V1.2 Section 9.3.

¹³ See GreenScreen Guidance V1.2 Section 13

¹⁴ A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.

Functional Use	Life Cycle Stage	Transformation Pathway	Environmental Transformation Products	CAS #	Feasible and Relevant?	GreenScreen List Translator Score or GreenScreen Benchmark Score
			Not Applicable			

Introduction

Hazard Classification Summary Section:

For all hazard endpoints:

- **Search all GreenScreen specified lists. Report relevant results either in each hazard endpoint section or attach to the end of the report.**
- **Always indicate if suitable analogs or models were used.**
- **Attach modeling results (See Appendix C).**
- **Include all references either in each hazard endpoint section or at the end of the report.**

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M or L): L

Magnesium hydroxide was assigned a score of LOW for Carcinogenicity based on a low score within the EPA's DfE alternatives assessment. The low designation in both GreenScreen and EPA's Alternatives assessment is based on the same measured endpoints. The score was based on experimental studies reported within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Experimental studies indicate that magnesium hydroxide is of low concern for carcinogenicity.

Mutagenicity/Genotoxicity (M) Score (H, M or L): L

Magnesium hydroxide was assigned a score of LOW for Mutagenicity based on a low score within the EPA's DfE alternatives assessment. The low designation in both GreenScreen and EPA's Alternatives assessment is based on the same measured endpoints. The score was based on empirical data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Experimental studies indicate magnesium hydroxide is not mutagenic to bacteria or mammalian cells in vitro and does not cause chromosomal aberrations in human lymphocytes in vitro.

Reproductive Toxicity (R) Score (H, M, or L): L

Magnesium hydroxide was assigned a score of LOW for Reproductive Toxicity based on a low score within the EPA's DfE alternatives assessment. For reproductive toxicity EPA's DfE uses numerical data quantifying the hazard associated with the 3 different hazard levels, whereas GreenScreen does not base the hazard score on a numerical rating system but bases classifications on listing under GHS, the EU, and NTP. Therefore the conversion of DfE's developmental and reproductive toxicity conclusions to comparable GreenScreen hazard scores is done on a case by case basis. DfE's low score was based on experimental data which observed no reproductive effects at the highest levels tested. The score was based on experimental data for magnesium hydroxide within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: There were no reproductive effects observed in rats in a repeated dose toxicity study with the reproduction/developmental toxicity screen at doses of magnesium hydroxide as high as 1,000 mg/kg-day. In addition, magnesium hydroxide is expected to have low hazard for reproductive effects based on a non-standard experimental study indicating magnesium chloride produces no adverse effects on reproductive performance or outcomes at levels up to 96 mg/kg/day of Mg^{2+} ion.

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M or L): L

Magnesium hydroxide was assigned a score of LOW for Developmental Toxicity based on a low score within the EPA's DfE alternatives assessment. For developmental toxicity EPA's DfE uses numerical data quantifying the hazard associated with the 3 different hazard levels, whereas GreenScreen does not base the hazard score on a numerical rating system but bases classifications on listing under GHS, the EU, and NTP. Therefore the conversion of DfE's developmental and reproductive toxicity conclusions to comparable GreenScreen hazard scores is done on a case by case basis. DfE's low score was based on experimental and epidemiologic data for magnesium chloride within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Magnesium hydroxide is expected to be of low concern for developmental effects based on a non-standard experimental study indicating magnesium chloride produces no adverse effects on developmental outcomes at levels up to 96 mg/kg/day of Mg^{2+} ion and an experimental study from a secondary source showing no effect on human newborns. In addition, there were no developmental effects observed in rats in a repeated dose toxicity study with the reproduction/developmental toxicity screen at doses as high as 1,000 mg/kg-day.

Endocrine Activity (E) Score (H, M or L): DG

Magnesium hydroxide was assigned a score of DATA GAP for Endocrine Activity. This conclusion was made based on no data located.

Group II and II* Human Health Effects (Group II and II* Human)

Note: Group II and Group II endpoints are distinguished in the v 1.2 Benchmark system (the asterisk indicates repeated exposure). For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints. When classifying hazard for Systemic Toxicity/Organ Effects and Neurotoxicity endpoints, repeated exposure results are required and preferred. Lacking repeated exposure results in a data gap. Lacking single exposure data does not result in a data gap when repeated exposure data are present (shade out the cell in the hazard table and make a note). If data are available for both single and repeated exposures, then the more conservative value is used.*

Acute Mammalian Toxicity (AT) Group II Score (vH, H, M or L): L

Magnesium hydroxide was assigned a score of LOW for Acute Mammalian Toxicity. The low designation for Acute Mammalian Toxicity in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on empirical data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:

LOW: Acute lethality values suggest that magnesium hydroxide is of low concern for acute toxicity for oral exposure. There were no data located regarding acute dermal and inhalation exposure.

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)

(ST-single) Group II Score (single dose: vH, H, M or L):

DfE evaluates Systemic Toxicity based on repeated exposures. Lack of data for Systemic Toxicity based on a single exposure does not constitute a data gap when data for repeated exposures are available.

(ST-repeat) Group II* Score (repeated dose: H, M, L): L

Magnesium hydroxide was assigned a score of LOW for Systemic Toxicity/Organ Effects based on repeated exposure. The low designation for systemic toxicity/organ effects based on repeated exposure in both GreenScreen and EPA's alternatives assessment are based on the same measured endpoints. The score was based on experimental data which indicated LOAELs all significantly above 100 mg/kg-bw. In addition magnesium hydroxide is expected to have a low immunotoxicity hazard based on expert judgment. The low designation within EPA's alternatives assessment is based on experimental data for magnesium hydroxide ions and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:

LOW: Experimental studies indicate magnesium ions produce no adverse systemic effects in rats or mice at magnesium levels $\geq 1,000$ mg/kg/day of magnesium hydroxide.

In addition:

Magnesium hydroxide is expected to be of low hazard for immunotoxicity based on expert judgment.

Neurotoxicity (N)

(N-single) Group II Score (single dose: vH, H, M or L):

DfE evaluates Neurotoxicity based on repeated exposures. Lack of data for Neurotoxicity based on a single exposure does not constitute a data gap when data for repeated exposures are available.

(N-repeat) Group II* Score (repeated dose: H, M, L): L

Magnesium hydroxide was assigned a score of LOW for Neurotoxicity based on a low score within the EPA's DfE alternatives assessment. This conclusion was made based on expert judgment with no other available information. The low designation in both GreenScreen and EPA's alternatives assessment are based on the same measured endpoints. The score was based on expert judgment within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:

LOW: Magnesium hydroxide is expected to be of low hazard for neurotoxicity based on expert judgment.

Skin Sensitization (SnS) Group II* Score (H, M or L): *L*

Magnesium hydroxide was assigned a score of LOW for Skin Sensitization. This conclusion was made based on expert judgment with no additional information provided. The low designation for skin sensitization in both GreenScreen and EPA's alternatives assessment are based on the same measured endpoints. The score was based on professional judgment within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Magnesium hydroxide is not estimated to cause skin sensitization based on professional judgment.

Respiratory Sensitization (SnR) Group II* Score (H, M or L): DG

Magnesium hydroxide was assigned a score of DATA GAP for Respiratory Sensitization. This conclusion was made based on no data located.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M or L): *L*

Magnesium hydroxide was assigned a score of LOW for Skin Irritation/Corrosivity based on expert judgment and a secondary source indicating it does not causes skin irritation in rabbits. The low designation for skin irritation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on expert judgment and a confidential study within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was as follows:
LOW: An experimental study indicates that magnesium hydroxide is not an irritant to rabbit skin.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M or L): M

Magnesium hydroxide was assigned a score of MODERATE for Eye Irritation based on tests results provided within the EPA's DfE alternatives assessment which indicates magnesium hydroxide is an eye irritant in rabbits. The moderate designation for skin irritation in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on empirical data within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
MODERATE: Based on irritation and damage to the corneal epithelium in rabbits that cleared within 2-3 days.

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M or L): *L*

Magnesium hydroxide was assigned a score of LOW for Acute Aquatic Toxicity. The low designation for acute aquatic toxicity in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on values from experimental data and estimation software within EPA's alternatives assessment and therefore is not reported in italics within the GreenScreen assessment. While one species was reported to have an LC₅₀ below 100

mg/L (*Gammarus lacustris* LC₅₀ = 64.7 mg/L), it was not included in scoring as study details were not reported and it is not a standard aquatic toxicity test species.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Estimated LC₅₀ values for all of the species in the standard toxicity profile are greater than 100 mg/L. LC₅₀ values are much greater than the anticipated water solubility, suggesting no effects at saturation (NES).

Chronic Aquatic Toxicity (CA) Score (vH, H, M or L): *L*

Magnesium hydroxide was assigned a score of LOW for Chronic Aquatic Toxicity. The low designation for chronic aquatic toxicity in both GreenScreen and EPA's alternatives assessment is based on the same measured endpoints. The score was based on professional judgment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Estimated chronic values (ChV) are all >10 mg/L. ChVs are much greater than the anticipated water solubility, suggesting NES.

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): *vH*

Magnesium hydroxide was assigned a score of VERY HIGH for Persistence. While the EPA's alternatives assessment gives magnesium hydroxide a high rating, information provided within the DfE report indicates the chemical fulfills the very high hazard score. The very high designation for persistence in both GreenScreen and EPA's alternatives assessment are based on the same measured endpoints. Therefore a very high hazard score was determined for the GreenScreen profile. The score was based on expert judgment within EPA's alternatives assessment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
HIGH: As an inorganic compound, magnesium hydroxide is not expected to biodegrade, oxidize in air, or undergo hydrolysis under environmental conditions. Magnesium hydroxide does not absorb light at environmentally relevant wavelengths and is not expected to photolyze. Magnesium hydroxide is recalcitrant and it is expected to be found in the environment >180 days after release. As a naturally occurring compound, it may participate in natural cycles and form complexes in environmental waters.

Bioaccumulation (B) Score (vH, H, M, L, or vL): *vL*

Magnesium hydroxide was assigned a score of VERY LOW for Bioaccumulation. The low designation for bioaccumulation in EPA's alternatives assessment is equivalent to a very low score in GreenScreen. The score was based on professional judgment and therefore is reported in italics within the GreenScreen assessment.

The summary provided within the EPA's alternatives assessment was summarized as follows:
LOW: Magnesium hydroxide is not expected to bioaccumulate based on professional judgment.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M or L): *L*

Magnesium hydroxide was assigned a score of LOW for Reactivity based on professional judgment and supporting information from industry. Because of the lack of concrete data for this endpoint, the score of LOW was italicized.

Magnesium hydroxide was identified by the European Commission in a IUCLID Dataset as '*not explosive*' and shows '*no oxidizing properties.*' This was supported by Material Safety Data Sheets (MSDS) from Nile Chemicals and Aluchem Inc. Nile Chemicals stated that magnesium hydroxide is '*...not considered to be an explosion hazard.*' Aluchem Inc. indicated that it '*...does not present fire or explosion hazards as supplied.*'

Based upon professional judgment and the information above, magnesium hydroxide is unlikely to be reactive.

References:

European Commission, European Chemicals Bureau, IUCLID Data Set for Magnesium hydroxide, 2/18/200, 24 p., available at: http://esis.jrc.ec.europa.eu/doc/IUCLID/data_sheets/1309428.pdf, accessed 12/2013.

Nile Chemicals, MSDS for Magnesium hydroxide, available at: <http://www.nilechemicals.com/MagnesiumHydroxide%20msds.htm>, accessed 12/2013.

Aluchem Inc., Material Safety Data Sheet for magnesium hydroxide, 09/10/2010, 7 p., available at: http://www.aluchem.com/products/pdf/MSDS-MAGNESIUM_HYDROXIDE-ENGLISH.pdf, accessed 12/2013.

Flammability (F) Score (vH, H, M or L): L

Magnesium hydroxide was assigned a score of LOW for flammability based on a not flammable description within the DfE report. This conclusion was based on adequate data and is not reported in italics

**APPENDIX A: Hazard Benchmark Acronyms
(alphabetical order)**

- (AA) Acute Aquatic Toxicity**
- (AT) Acute Mammalian Toxicity**
- (B) Bioaccumulation**
- (C) Carcinogenicity**
- (CA) Chronic Aquatic Toxicity**
- (Cr) Corrosion/ Irritation (Skin/ Eye)**
- (D) Developmental Toxicity**
- (E) Endocrine Activity**
- (F) Flammability**
- (IrE) Eye Irritation/Corrosivity**
- (IrS) Skin Irritation/Corrosivity**
- (M) Mutagenicity and Genotoxicity**
- (N) Neurotoxicity**
- (P) Persistence**
- (R) Reproductive Toxicity**
- (Rx) Reactivity**
- (SnS) Sensitization- Skin**
- (SnR) Sensitization- Respiratory**
- (ST) Systemic/Organ Toxicity**