Amorphous Silica (CAS# 7631-86-9) GreenScreen® for Safer Chemicals (GreenScreen®) Assessment

Prepared for:

Washington State Department of Ecology

Prepared by:

ToxServices LLC

1367 Connecticut Ave., N.W., Suite 300
Washington, D.C. 20036

December 1, 2014

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

GreenScreen® Executive Summary for Amorphous Silica (CAS# 7631-86-9)

Amorphous silica is a chemical that functions as a filler in the rubber industry, in tire compounds, as free-flow and anti-caking agents in powder materials, and as a liquid carrier, particularly in the manufacture of animal feed and agrochemicals; other uses are found in toothpaste additives, paints, silicon rubber, insulation material, liquid systems in coatings, adhesives, printing inks, plastisol car undercoats, and cosmetics (HSDB 2014).

Inhalation: Amorphous silica was assigned a GreenScreen® Benchmark Score of 1 ("Avoid-Chemical of High Concern") as it has High Group I Human Toxicity (carcinogenicity-C), Very High persistence-P, and High Group II* Human Toxicity (systemic toxicity repeated dose-STr*). This corresponds to GreenScreen® benchmark classifications 1c and 1e in CPA 2011. Data gaps (DG) exist for endocrine activity-E, acute toxicity-AT, neurotoxicity-Nr*, respiratory sensitization-SnR*, and chronic aquatic toxicity-CA. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), amorphous silica meets requirements for a GreenScreen® Benchmark Score of 1 despite the hazard data gaps. In a worst-case scenario, if amorphous silica were assigned a High score for any of the data gaps it would still be categorized as a Benchmark 1 Chemical.

Oral: Amorphous silica was assigned a GreenScreen® Benchmark Score of 2_{DG} ("Use but Search for Safer Substitutes-Due to Data Gaps") as it has Low Bioaccumulation and Low Toxicity (Ecotoxicity, Group I, II, and II* Human), and Low Physical Hazards. The Very High persistence alone is not deemed problematic for inorganic chemicals. This corresponds to GreenScreen® benchmark classification 4 in CPA 2011. Data gaps (DG) exist for endocrine activity-E, neurotoxicity-Nr*, respiratory sensitization –SnR*, and chronic aquatic toxicity -CA. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), amorphous silica does not meet requirements for a GreenScreen® Benchmark Score of 4 or a Benchmark Score of 3_{DG} due to the hazard data gaps. Therefore a score of 2_{DG} was assigned. In a worst-case scenario, if amorphous silica were assigned a High score for the data gaps E, Nr*, or CA, it would be categorized as a Benchmark 1 Chemical.

Dermal: Amorphous silica was assigned a GreenScreen® Benchmark Score of U ("Benchmark Unspecified Due to Data Gaps"). It has Low Bioaccumulation and Low Toxicity (Ecotoxicity, Group I, II, and II* Human), and Low Physical Hazards. Very High Persistence alone is not deemed problematic for inorganic chemicals. This corresponds to GreenScreen® benchmark classification 4 in CPA 2011. Data gaps (DG) exist for carcinogenicity-C, endocrine activity-E, systemic toxicity-STr*, neurotoxicity-Nr*, respiratory sensitization –SnR*, and chronic aquatic toxicity-CA. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), amorphous silica does not meet requirements for a GreenScreen® Benchmark Score of 2, 3, or 4 due to the hazard data gaps. In a worst-case scenario, if amorphous silica were assigned a High score for the data gaps C, E, STr*, Nr*, SnR*, or CA, it would be categorized as a Benchmark 1 Chemical.

GreenScreen® Benchmark Score for Relevant Route of Exposure:
In order to address route specific hazards, all exposure routes (oral, dermal, and inhalation) were evaluated separately and GreenScreen® Benchmark Scores were generated for each route of exposure.

GreenScreen® Hazard Ratings for Amorphous Silica

Route of Exposure	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*										
Inhalation	H	L	L	L	DG	DG	DG	H	DG	DG	L	DG	L	L	L	DG	*vH*	*vL*	*L*	*L*
Oral	L					L	L	L												
Dermal	DG					L	L	DG												

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. Please see Appendix A for a glossary of hazard acronyms.

GreenScreen® Assessment for Amorphous Silica (CAS# 7631-86-9)

Method Version: GreenScreen® Version 1.2[1]
Assessment Type[2]: Certified

Chemical Name: Amorphous silica

CAS Number: 7631-86-9

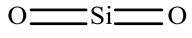
GreenScreen® Assessment Prepared By:
Name: Nikki Maples-Reynolds, M.S.
Title: Toxicologist
Organization: ToxServices LLC
Date: October 2, 2014
Assessor Type: Licensed GreenScreen® Profiler

Quality Control Performed By:
Name: Bingxuan Wang, Ph.D.
Title: Toxicologist
Organization: ToxServices LLC
Date: December 1, 2014

Name: Jennifer Rutkiewicz, Ph.D.
Title: Toxicologist
Organization: ToxServices LLC
Date: October 13, 2014
Assessor Type: Licensed GreenScreen® Profiler

Confirm application of the *de minimus* rule[3]: N/A

Chemical Structure(s):



Also called: Acticel; Aerogel 200; Aerosil; Aerosil 300; Aerosil 380; Aerosil A 300; Aerosil bs-50; Aerosil E 300; Aerosil K 7; Aerosil M-300; Aerosil-degussa; AI3-25549; Amorphous silica ; Amorphous silica dust; Amorphous silica gel; Cab-o-sil M-5; Cabosil N 5; Cabosil st-1; Carplex; Carplex 30; Carplex 80; Caswell No. 734A; CCRIS 3699; Celite superfloss; Chalcedony; CI 7811; Colloidal silicon dioxide; Corasil II; Cristobalite; Diatomaceous earth; Diatomaceous earth, calcined; Dimethyl siloxanes and silicones; Diatomaceous silica; Diatomite; Dri-Die; EINECS 231-545-4; ENT 25,550; EPA Pesticide Chemical Code 072605; Extrusil; Fossil flour; Fused silica; Glass; Hi-Sil; HK 400; Hydrophobic silica 2482; Infusorial earth ; Ludox hs 40; Manosil vn 3; Micro-cel; Min-U-sil; N1030; Nalco 1050; Nalfloc N 1050; Neosil; Neosyl; Opal; Pigment White 27; Porasil; Positive sol 130M; Positive sol 232; Quartz; Quso 51; Quso G 30; Santocel; Sg-67; Silanox 101; Silica (SiO2); Silica particles; Silica, amorphous; Silica, amorphous, fumed ; Silica, amorphous fused; Silica, colloidal; Siliceous earth, purified; Silicic anhydride; Silicon dioxide; Silicon dioxide (amorphous); Silicon dioxide, colloidal; Silicon oxide; Silica; Silica slurry; Silikil; Sillikolloid; Siloxid; Sipernat;

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

[2] GreenScreen® reports are either "UNACCREDITED" (by unaccredited person), "AUTHORIZED" (by Authorized GreenScreen® Practitioner), "CERTIFIED" (by Licensed GreenScreen® Profiler or equivalent) or "CERTIFIED WITH VERIFICATION" (Certified or Authorized assessment that has passed GreenScreen® Verification Program)

[3] Every chemical in a material or formulation should be assessed if it is:
1. intentionally added and/or
2. present at greater than or equal to 100 ppm

Snowtex 30; Snowtex O; Superfloss; Syton 2X; Tokusil TPLM; Tridymite; U 333; Ultrasil VH 3; Ultrasil VN 3; UNII-ETJ7Z6XBU4; Vitasil 220; Vulkasil S; Wessalon; White carbon; Zeofree 80; Zipax; Zorbax sil; CAB-O-SIL N-70TS; Silica 2482, hydrophobic; Silicon dioxide, chemically prepared (ChemIDplus 2014)

Chemical Structure(s) of Chemical Surrogates Used in the GreenScreen®:
No surrogates were used in this assessment.

Identify Applications/Functional Uses:
1. Filler
2. Anti-caking agent
3. Abrasive

GreenScreen® Summary Rating for Amorphous Silica[4]:
Inhalation: Amorphous silica was assigned a GreenScreen® Benchmark Score of 1 ("Avoid-Chemical of High Concern") as it has High Group I Human Toxicity (carcinogenicity-C), Very High persistence-P, and High Group II* Human Toxicity (systemic toxicity repeated dose-STr*). This corresponds to GreenScreen® benchmark classification 1c and 1e in CPA 2011. Data gaps (DG) exist for endocrine activity-E, acute toxicity-AT, neurotoxicity-Nr*, respiratory sensitization-SnR*, and chronic aquatic toxicity-CA. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), amorphous silica meets requirements for a GreenScreen® Benchmark Score of 1 despite the hazard data gaps. In a worst-case scenario, if amorphous silica were assigned a High score for any of the data gaps it would still be categorized as a Benchmark 1 Chemical.

Oral: Amorphous silica was assigned a GreenScreen® Benchmark Score of 2_{DG} ("Use but Search for Safer Substitutes-Due to Data Gaps") as it has Low Bioaccumulation and Low Toxicity (Ecotoxicity, Group I, II, and II* Human), and Low Physical Hazards. The Very High persistence alone is not deemed problematic for inorganic chemicals. This corresponds to GreenScreen® benchmark classification 4 in CPA 2011. Data gaps (DG) exist for endocrine activity-E, neurotoxicity-Nr*, respiratory sensitization –SnR*, and chronic aquatic toxicity -CA. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), amorphous silica does not meet requirements for a GreenScreen® Benchmark Score of 4 or a Benchmark Score of 3_{DG} due to the hazard data gaps. Therefore a score of 2_{DG} was assigned. In a worst-case scenario, if amorphous silica were assigned a High score for the data gaps E, Nr*, or CA, it would be categorized as a Benchmark 1 Chemical.

Dermal: Amorphous silica was assigned a GreenScreen® Benchmark Score of U ("Benchmark Unspecified Due to Data Gaps"). It has Low Bioaccumulation and Low Toxicity (Ecotoxicity, Group I, II, and II* Human), and Low Physical Hazards. Very High persistence alone is not deemed problematic for inorganic chemicals. This corresponds to GreenScreen® benchmark classification 4 in CPA 2011. Data gaps (DG) exist for carcinogenicity-C, endocrine activity-E, systemic toxicity-STr*, neurotoxicity-Nr*, respiratory sensitization –SnR*, and chronic aquatic toxicity-CA. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), amorphous silica does not meet requirements for a GreenScreen® Benchmark Score of 2, 3, or 4 due to the hazard

[4] For inorganic chemicals with low human and ecotoxicity across all hazard endpoints and low bioaccumulation potential, persistence alone will not be deemed problematic. Inorganic chemicals that are only persistent will be evaluated under the criteria for Benchmark 4.

data gaps. In a worst-case scenario, if amorphous silica were assigned a High score for the data gaps C, E, STr*, Nr*, SnR*, or CA, it would be categorized as a Benchmark 1 Chemical.

Figure 1: GreenScreen® Hazard Ratings for Amorphous Silica

Route of Exposure	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*										
Inhalation	H	L	L	L	DG	DG	DG	H	DG	DG	L	DG	L	L	L	DG	*vH*	*vL*	*L*	*L*
Oral	L					L	L	L												
Dermal	DG					L	L	DG												

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. Please see Appendix A for a glossary of hazard acronyms.

Transformation Products and Ratings:

Identify feasible and relevant fate and transformation products (i.e., dissociation products, transformation products, valence states) **and/or moieties of concern**[5]

Transformation products were not assessed, as amorphous silica is a persistent inorganic chemical that is not subject to biodegradation or transformation in the environment.

Introduction

Amorphous silica is transparent, tasteless crystals found in nature as agate, amethyst, chalcedony, cristobalite, flint, sand, quartz, and tridymite. Amorphous silica functions as a filler in the rubber industry, in tire compounds, as free-flow and anti-caking agents in powder materials, and as a liquid carrier, particularly in the manufacture of animal feed and agrochemicals; other uses are found in toothpaste additives, paints, silicon rubber, insulation material, liquid systems in coatings, adhesives, printing inks, plastisol car undercoats, and cosmetics (HSDB 2014)

ToxServices assessed amorphous silica against GreenScreen® Version 1.2 (CPA 2013) following procedures outlined in ToxServices' SOP 1.69 (GreenScreen® Hazard Assessment) (ToxServices 2013).

GreenScreen® List Translator Screening Results

The GreenScreen® List Translator identifies specific authoritative or screening lists that should be searched to identify GreenScreen® benchmark 1 chemicals (CPA 2012b). Pharos (Pharos 2014) is an online list-searching tool that is used to screen chemicals against the List Translator electronically. It checks all of the lists in the List Translator with the exception of the U.S. Department of Transportation (U.S. DOT) lists (U.S. DOT 2008a,b) and these should be checked separately in conjunction with running the Pharos query. The output indicates benchmark or possible benchmark scores for each human health and environmental endpoint. The output for amorphous silica can be found in Appendix C and a summary of the results can be found below:

[5] 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.

- Carcinogenicity –
  - NIOSH-C – Occupational carcinogen
  - IARC – Group 3: Agent is not classifiable as to its carcinogenicity to humans
- PBT
  - Canada – DSL – substances that are persistent
- Restricted List
  - German FEA – (VwVwS) Exempt - Non-Hazardous to Water (Water Hazard Class 0 NWG)

PhysicoChemical Properties of Amorphous Silica

Amorphous silica is transparent, tasteless crystals found in nature as agate, amethyst, chalcedony, cristobalite, flint, sand, quartz, and tridymite. The compound is insoluble in water or acids except hydrofluoric acid (ChemIDplus 2014). In the REACH Dossier experimental evidence suggests slight solubility in water at 0.1-100 mg/L (ECHA 2014). It has a log P_{ow} estimated to be 0.53, indicating that it has a low calculated potential to bioaccumulate in aquatic biota.

Table 1: Physical and Chemical Properties of Amorphous Silica (CAS# 7631-86-9)

Property	Value	Reference
Molecular formula	SiO_2	ChemIDplus 2014
SMILES Notation	[Si](=O)=O	ChemIDplus 2014
Molecular weight	60.084	ChemIDplus 2014
Physical state	Solid	ChemIDplus 2014
Appearance	transparent, tasteless crystals	ChemIDplus 2014
Melting point	3110°F	ECHA 2014
Vapor pressure	Not applicable	ECHA 2014
Water solubility	0.1-100 mg/L	ECHA 2014
Dissociation constant	pKa = 6.8	ECHA 2014
Density/specific gravity	≥ 1.9 ≤ 2.2 g/cm³at 20ºC	ECHA 2014
Partition coefficient	Log P_{ow} = 0.53[6]	ECHA 2014
Particle size	Aprox. 211 µm geometric mean MMAD Aprox. 1% 10 µm geometric mean Aprox. 1.5% 50 µm geometric mean Aprox. 10% 103 µm geometric mean Aprox. 16% 124 µm geometric mean Aprox. 50% 211 µm geometric mean Aprox. 99% 610 µm geometric mean	ECHA 2014
Structure	Amorphous	ChemIDplus 2014
Bioavailability	Not applicable	ECHA 2014

[6] Calculations performed by using software program KOWWIN v. 1.67 (U.S. EPA)

Hazard Classification Summary Section:

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M, or L): H (inhalation), **L** (oral), DG (dermal)
Amorphous silica was assigned a score of Low for carcinogenicity via the oral route of exposure. GreenScreen® criteria classify chemicals as a Low for carcinogenicity when adequate data are available and are negative for carcinogenicity, and the chemical is not present on authoritative or screening lists. Amorphous silica was assigned a score of Data Gap for carcinogenicity via the dermal route of exposure based on a lack of data via this route. Amorphous silica was assigned a score of High for carcinogenicity via the inhalation route of exposure based on presence on authoritative lists. GreenScreen® criteria classify chemicals as a High hazard for carcinogenicity when the chemical is listed on the CDC's NIOSH occupational carcinogen list (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* NIOSH-C – Occupational carcinogen
  - *Screening:* IARC – Group 3: Agent is not classifiable as to its carcinogenicity to humans
- EC 2000
  - Male and female Fischer 344 rats were given 1.25, 2.5, or 5% fumed silica (equivalent to 143.46, 179.55, or 581.18 g for male rats and 107.25, 205.02, or 435.33 g for female rats, respectively) in their feed daily for 103 weeks. Tumor incidence in testes, mammary glands, prepuce and clitoris were higher in the controls than they were in the treated groups. Fumed silica was not carcinogenic under these test conditions.
  - Male and female B6C3F1 mice were given 1.25, 2.5, or 5% fumed silica (equivalent to 38.45, 79.78, or 160 g for male mice and 37.02, 72.46, or 157.59 g for female mice, respectively) in their feed daily for 93 weeks. While there were tumors found in the hematopoietic organs, the incidence of these lesions was not significant compared to control animals. While there were lung adenomas found, they were found to be neither sex- nor dose-related. Non-neoplastic lesions were seen in the subcutis, lungs, kidneys, and liver in the treated groups; however, these were found to be of no toxicological significance.

Mutagenicity/Genotoxicity (M) Score (H, M, or L): L
Amorphous silica was assigned a score of Low for Mutagenicity based on negative results in *in vitro* and *in vivo* mutagenicity and clastogenicity assays. GreenScreen® criteria classify chemicals as a Low hazard for mutagenicity when the adequate data are available and are negative for both mutagenicity and clastogenicity, and the chemical is not present on any authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- CCRIS 2008
  - *In vivo*: A mutagenicity study was performed using rat alveolar cells from male F344 rats. The silica was administered via inhalation at a dose of 50 mg/m^3 for 6 hours per day, 5 days per week for 13 weeks and determined to be negative.
- EC 2000
  - *In vitro:* Not mutagenic in a number of Ames mutation studies. The tests were conducted with *Salmonella typhimurium* tester strains TA98, TA100, TA1535, TA1537, and TA1538; *Escherichia coli* strain WP2; and *Saccharomyces cerevisiae* strain D-3. Strains were tested at concentrations ranging from 33-10,000 µg/plate in the presence and absence of metabolic activation.

- *In vitro*: A HGPRT assay conducted using Chinese hamster ovary (CHO) cells tested at concentrations ranging from 100-500 µg/mL in the presence of metabolic activation and 10-250 µg/mL in the absence of metabolic activation was found to be negative.
- *In vitro*: An unscheduled DNA synthesis (UDS) assay conducted using primary rat hepatocytes tested at concentrations ranging from 0.3-1,000 µg/mL in the absence of metabolic activation was found to be negative.
- *In vitro:* A cytogenetic assay conducted using human embryonic lung cells (Wi-38) exposed to FDA-Compound 71-48 (silica aerogel) at 1-1,000 µg/mL produced negative results for chromosome aberrations.
- *In vitro*: A cytogenetic assay was performed with CHO cells exposed to Cab-O-Sil EH-5 (fumed silica) at 19-300 µl/mL (equivalent to 41.8-660 mg/mL based on a density of 2.2 g/cm^3) without metabolic activation and 250-1,000 µl/mL (equivalent to 550-2,200 mg/mL based on a density of 2.2 g/cm^3) with metabolic activation. Negative results for chromosomal aberrations in the presence and absence of metabolic activation.
- *In vivo:* Cytogenetic assays conducted using Sprague-Dawley rats given oral doses of 1.4, 14, or 140 mg/kg via gavage were found to be negative for both chromosomal aberrations and dominant-lethal effects.

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

Amorphous silica was assigned a score of Low for reproductive toxicity based on negative results in an oral 1-generation reproductive toxicity study in rats. GreenScreen® criteria classify chemicals as a Low hazard for reproductive toxicity when the adequate data are available and are negative for reproductive effects, and the chemical is not present on any authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - A one generation reproductive toxicity study was conducted using male and female Wistar rats. Males received 497 mg/kg and females received 509 mg/kg Aerosil (fumed silica) daily via their feed for 4.5 months prior to mating. There were no clinical symptoms, behavioral or developmental changes, or changes in any other examined parameters in pups. The NOAEL in both the F_0 and F_1 generations was at least 497 mg/kg/day.

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

Amorphous silica was assigned a score of Low for developmental toxicity based on negative results in several developmental toxicity studies in rats, mice, rabbits, and hamsters. GreenScreen® criteria classify chemicals as a Low hazard for developmental toxicity when the adequate data are available and are negative for developmental effects, and the chemical is not present on any authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - Female Wistar rats were given oral doses of FDA-Compound 71-48 (Syloid, silica aerogel) at 0, 13.5, 62.7, 292, or 1,350 mg/kg/day via gavage from days 6-15 of gestation. There were no clearly discernible effects on nidation or maternal or fetal survival. The number of abnormalities seen in soft and skeletal tissues in the test groups did not differ from the

control groups. The maternal NOAEL value was at least 1,340 mg/kg/day and the teratogenic value was 1,350 mg/kg/day.
- Female CD-1 mice were given oral doses of FDA-Compound 71-48 (Syloid, silica aerogel) at 0, 13.4, 62.3, 289, or 1,340 mg/kg/day via gavage from days 6-15 of gestation. There were no clearly discernible effects on nidation or maternal or fetal survival. The number of abnormalities seen in soft and skeletal tissues in the test groups did not differ from the control groups. The maternal NOAEL value was at least 1,340 mg/kg/day and the teratogenic value was 1,350 mg/kg/day.
- Dutch rabbits were given oral doses of FDA-Compound 71-48 (Syloid, silica aerogel) at 0, 16, 74.3, 345, or 1,600 mg/kg/day via gavage from days 6-18 of gestation. There were no clearly discernible effects on nidation or maternal or fetal survival. The number of abnormalities seen in soft and skeletal tissues in the test groups did not differ from the control groups. The maternal and teratogenic NOAEL values were at least 1,600 mg/kg/day.
- Outbred Syrian hamsters were given oral doses of FDA-Compound 71-48 (Syloid, silica aerogel) at 0, 16, 74.3, 345, or 1,600 mg/kg/day via gavage from days 6-10 of gestation. There were no clearly discernible effects on nidation or maternal or fetal survival. The number of abnormalities seen in soft and skeletal tissues in the test groups did not differ from the control groups. The maternal and teratogenic NOAEL values were at least 1,600 mg/kg/day.

Endocrine Activity (E) Score (H, M, or L): DG
Amorphous silica was assigned a score of Data Gap for endocrine activity based on a lack of adequate data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- Not listed as a potential endocrine disruptor on the EU Priority List of Suspected Endocrine Disruptors.
- Not listed as a potential endocrine disruptor on the OSPAR List of Chemicals of Possible Concern.
- High Throughput Screening (HTS) Data –
  - HTS data were identified for amorphous silica using PubChem (http://pubchem.ncbi.nlm.nih.gov/).
  - The data included the following results:
    - Amorphous silica was active in 0/3 androgen receptor agonist assays and 0/6 androgen receptor antagonist assays.
    - Amorphous silica was active in 0/3 estrogen receptor-alpha agonist assays and 0/6 estrogen receptor-alpha antagonist assays.
    - Amorphous silica was active in 0/1 thyroid receptor agonist assay and 0/3 thyroid receptor antagonist assays.
    - The activity of amorphous silica towards the thyroid stimulating hormone receptor was not evaluated.
- These data are insufficient to assign a score for endocrine activity.

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. For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints and test data for single or repeated exposures may be used. If data exist for single OR repeated exposures, then the endpoint is not considered a data gap. 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): DG (inhalation), **L** (oral), **L** (dermal)

Amorphous silica was assigned a score of Data Gap via the inhalation route of exposure based on a lack of adequate data for this endpoint. Amorphous silica was assigned a score of Low for acute toxicity via the dermal route of exposure based in an LD_{50} greater than 2,000 mg/kg in rabbits. GreenScreen® criteria classify chemicals as a Low hazard for acute toxicity when dermal LD_{50} values are greater than 2,000 mg/kg. Amorphous silica was assigned a score of Low for acute toxicity via the oral route of exposure based on an LD_{50} greater than 2,000 mg/kg in rats. GreenScreen® criteria classify chemicals as a Low hazard for acute toxicity when oral LD_{50} values are greater than 2,000 mg/kg (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- EC 2000
    - *Oral*: LD_{50} values in rats range from greater than 5,000 mg/kg to greater than 20,000 mg/kg (as chemically prepared silicon dioxide).
    - *Dermal*: LD_{50} values in rabbits range from greater than 2,000 mg/kg to greater than 5,000 mg/kg (as chemically prepared silicon dioxide).
    - *Inhalation*: A 1-hour LC_{50} value of greater than 2.2 mg/L was determined in the rat (as chemically prepared silicon dioxide).

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)

***Group II Score (single dose)* (vH, H, M, or L):** DG (inhalation), **L** (oral), **L** (dermal)

Amorphous silica was assigned a score of Data Gap via the inhalation route of exposure based on a lack of adequate data for this endpoint. Amorphous silica was assigned a score of Low for systemic toxicity (single dose) via the oral route of exposure based on a lack of systemic toxicity observed in acute oral studies that identified LD_{50} values of greater than 2,000 mg/kg. GreenScreen® criteria classify chemicals as a Low hazard for systemic toxicity (single dose) when no effects are seen below the guidance value of 2,000 mg/kg for an oral study. Amorphous silica was assigned a score of Low for systemic toxicity (single dose) via the dermal route of exposure based on a lack of systemic toxicity observed in acute dermal studies that identified LD_{50} values of greater than 2,000 mg/kg. GreenScreen® criteria classify chemicals as a Low hazard for systemic toxicity (single dose) when no effects are seen below the guidance value of 2,000 mg/kg for a dermal study (CPA 2012).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- EC 2000
    - *Oral*: In most oral toxicity tests no clinical signs of toxicity were observed. Occasional instances of gasping following gavage and colored stools, which was reversible during the observation period, were observed.
    - *Dermal:* Slight erythema and edema were observed following application of silica in acute toxicity studies.

- *Inhalation:* No clinical signs of toxicity were observed in the acute inhalation studies.

Group II* Score (repeated dose) **(H, M, or L): H** (inhalation), **L** (oral), DG (dermal)
Amorphous silica was assigned a score of High for systemic toxicity (repeated dose) via the inhalation route of exposure based on inhalation LOAECs as low as 0.001 mg/L for silica, amorphous, in the dust form. GreenScreen® criteria classify chemicals as a High hazard for systemic toxicity (repeated dose) when inhalation LOAECs for dusts are no greater than 0.02 mg/L (CPA 2012a). Amorphous silica was assigned a score of Low for systemic toxicity (repeated dose) via the oral route of exposure based on NOAELs of 497 to at least 24,200 mg/kg. GreenScreen® criteria classify chemicals as a Low hazard for systemic toxicity (repeated dose) when oral NOAELs/LOAELs are greater than 100 mg/kg. Amorphous silica was assigned a score of Data Gap for systemic toxicity (repeated dose) via the dermal route of exposure based on the lack of data identified for this endpoint (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - *Oral:* Various strains of rats received fumed silica in their feed over periods of time ranging from two weeks to six months. There were no changes seen in any measured parameters. NOAEL values ranged from greater than 497 mg/kg to at least 24,200 mg/kg.
  - *Inhalation, dust*: Numerous studies have been conducted using rats, rabbits, guinea pigs, and monkeys. Studies ranged in length from two weeks to one year. In all cases, respiratory effects were seen at the lowest doses tested, and no NOAELs could be established from these studies. LOAEL values for these studies would range from less than 0.001 mg/L to less than 0.10 mg/L.
  - *Inhalation, vapor:* Several studies have been conducted using rats, guinea pigs, and rabbits. Studies ranged in length from 12-27 months. In all cases, respiratory effects were seen at the lowest doses tested, and no NOAELs could be established from these studies. It is believed that the NOAELs for repeated dose studies tested via the inhalation route would be below the tested doses.

Neurotoxicity (N)
Group II Score (single dose) **(vH, H, M, or L):** DG
Amorphous silica was assigned a score of Data Gap for neurotoxicity (single dose) based on a lack of data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- No data were identified

Group II* Score (repeated dose) **(H, M, or L):** DG
Amorphous silica was assigned a score of Data Gap for neurotoxicity (repeated dose) based on a lack of data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- No data were identified

Skin Sensitization (SnS) Group II* Score (H, M, or L): L
Amorphous silica was assigned a score of Low for skin sensitization based on negative results for skin sensitization in a guinea pig maximization test. GreenScreen® criteria classify chemicals as a Low hazard for skin sensitization when negative results, no structural alerts, and no GHS classification are available (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - In a guinea pig maximization test conducted according to Directive 84/449/EEC, B.6 "Acute toxicity (skin sensitization)," chemically prepared silica (CAS 7631-86-9) was found to be non-sensitizing (no further details available).

Respiratory Sensitization (SnR) Group II* Score (H, M, or L): DG
Amorphous silica (modified) was assigned a score of Data Gap for respiratory sensitization based on the lack of data identified for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- No data were identified for this endpoint.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M, or L): L
Amorphous silica was assigned a score of Low for eye irritation/corrosivity based on it not being irritating to the eyes of rabbits. GreenScreen® criteria classify chemicals as a Low hazard for eye irritation/corrosivity when negative data, no structural alerts, and no GHS classification are available (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - Silica was not irritating to the skin in a series of dermal irritation tests performed with rabbits. No additional details were provided.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M, or L): L
Amorphous silica was assigned a score of Low for eye irritation/corrosivity based on it not being irritating to the eyes of rabbits. GreenScreen® criteria classify chemicals as a Low hazard for eye irritation/corrosivity when negative data, no structural alerts, and no GHS classification are available (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - Silica was not irritating to the eyes in a series of ocular irritation tests performed with rabbits.

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M, or L): L
Amorphous silica was assigned a score of Low for acute aquatic toxicity based on the acute aquatic toxicity values of 5,000 mg/L in fish, 7,600 mg/L in daphnia, and 440 mg/L in algae. GreenScreen® criteria classify chemicals as a Low hazard for acute aquatic toxicity when acute aquatic toxicity values are greater than 100 mg/L (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- EC 2000
  - 96-hour LC_{50} (*Brachydanio rerio*, zebrafish) = 5,000 mg/L (as chemically prepared silica (CAS #7631-86-9))
  - 48-hour EC_{50} (*Ceriodaphnia dubia*, water flea) = 7,600 mg/L (as chemically prepared silica (CAS #7631-86-9))
  - 72-hour EC_{50} (*Selenastrum capricornutum*) = 440 mg/L ((as chemically prepared silica (CAS #7631-86-9); ISO 8691 "Water quality – fresh water algal growth inhibition test with *Scenedesmus subspicatus* and *Selenastrum capricornutum*")

Chronic Aquatic Toxicity (CA) Score (vH, H, M, or L): DG
Amorphous silica was assigned a score of Data Gap for chronic aquatic toxicity based on a lack of data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- No data were identified for this endpoint.

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): *vH*
Amorphous silica was assigned a score of Very High for persistence based on presence on screening lists and expert judgment, as it is an inorganic chemical that is not subject to biodegradation. GreenScreen® criteria classify chemicals as a Very High hazard for persistence when they are listed on Environment Canada's Domestic Substance List (DSL) as persistent and are determined by expert judgment to be a recalcitrant inorganic chemical (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Environmental Canada – DSL substances that are persistent
- EC 2000
  - Biodegradation is not expected as silica is an inorganic chemical.

Bioaccumulation (B) Score (vH, H, M, L, or vL): *vL*
Amorphous silica was assigned a score of Very Low for bioaccumulation based on a predicted log K_{ow} of 0.53. GreenScreen® criteria classify chemicals as a Very Low hazard for bioaccumulation when log K_{ow} values are no greater than 4 (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

- ECHA 2014
    - Amorphous silica has a predicted log K_{ow} of 0.53.
- EC 2000
    - Bioaccumulation is not expected as silica is an inorganic chemical.
    - Silica is not expected to be soluble in octanol.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M, or L): *L*
Amorphous silica (modified) was assigned a score of Low for reactivity based on having no explosive or oxidizing properties. GreenScreen® criteria classify chemicals as a Low hazard for reactivity when the chemical is not explosive or oxidizing, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- EC 2000
    - Silica is not explosive
    - Silica has no oxidizing properties.

Flammability (F) Score (vH, H, M, or L): *L*
Amorphous silica (modified) was assigned a score of Low for flammability based on a statement that it is not flammable. GreenScreen® criteria classify chemicals as a Low hazard for flammability when available data indicate that the chemical does not warrant GHS classification as a flammable solid, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- EC 2000
    - Silica is non-flammable.

References

Chemical Carcinogenesis Research Information System (CCRIS). 2008. Entry for silicon dioxide (CAS #7631-86-9). United States National Library of Medicine. Available: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?CCRIS.

ChemIDplus. 2014. Entry for amorphous silica (CAS# 7631-86-9). United States National Library of Medicine. Available: http://chem.sis.nlm.nih.gov/chemidplus/chemidheavy.jsp.

Clean Production Action (CPA). 2011. The GreenScreen® for Safer Chemicals Version 1.2 Benchmarks. Dated October 2011. Available: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2012a. The GreenScreen® for Safer Chemicals Version 1.2 Criteria. Dated: November 2012. Available: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2012b. List Translator. Dated February 2012. Available: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2013. The GreenScreen® for Safer Chemicals Chemical Hazard Assessment Procedure. Version 1.2 Guidance. Dated August 31, 2013. Available: http://www.greenscreenchemicals.org/.

European Chemicals Agency (ECHA). 2014. REACH Dossier for silicon dioxide (CAS# 7631-86-9). Available: http://apps.echa.europa.eu/registered/data/dossiers/DISS-76fd35e0-69c4-29a3-e044-00144f26965e/DISS-76fd35e0-69c4-29a3-e044-00144f26965e_DISS-76fd35e0-69c4-29a3-e044-00144f26965e.html.

European Commission (EC). 2000. IUCLID Dataset for Silicon dioxide, chemically prepared (CAS #7631-86-9). European Commission Joint Research Centre. Available: http://esis.jrc.ec.europa.eu/doc/IUCLID/datasheet/7631869.pdf.

Hazardous Substance Database (HSDB). 2014. Entry for amorphous silica (CAS# 7631-86-9). United States National Library of Medicine. Available: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

Pharos. 2014. Pharos Chemical and Material Library Entry for Amorphous silica (CAS# 7631-86-9). Available: http://www.pharosproject.net/material/.

ToxServices. 2013. SOP 1.69: GreenScreen® Hazard Assessments. Dated: August 17, 2013.

United States Department of Transportation (U.S. DOT). 2008a. Chemicals Listed with Classification. 49 CFR § 172.101. Available: http://www.gpo.gov/fdsys/pkg/CFR-2008-title49-vol2/pdf/CFR-2008-title49-vol2-sec172-101.pdf.

United States Department of Transportation (U.S. DOT). 2008b. Classification Criteria. 49 CFR § 173. Available: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title49/49cfr173_main_02.tpl.

APPENDIX A: Hazard Benchmark Acronyms
(in alphabetical order)

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(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

APPENDIX B: Results of Automated GreenScreen® Score Calculation for Amorphous Silica (CAS# 7631-86-9)

TOXSERVICES TOXICOLOGY RISK ASSESSMENT CONSULTING

GREEN SCREEN FOR SAFER CHEMICALS

GreenScreen® Score Inspector for Inhalation Exposure

Table 1: Hazard Table

	Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
	Carcinogenicity	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
Table 2: Chemical Details							S	R *	S	R *	*	*								
Inorganic Chemical?	Chemical Name	CAS#	C	M	R	D	E	AT	STs	STr	Ns	Nr	SNS*	SNR*	IrS	IrE	AA	CA	P	B	Rx	F
Yes	Amorphous silica	7631-86-9	H	L	L	L	DG	DG	DG	H	DG	DG	L	DG	L	L	L	DG	*vH*	*vL*	*L*	*L*

Table 3: Hazard Summary Table

Benchmark	a	b	c	d	e	f	g
1	No	No	Yes	No	Yes		
2	STOP						
3	STOP						
4	STOP						

Table 4

Chemical Name	Preliminary GreenScreen® Benchmark Score
Amorphous silica	1

Note: Chemical has not undergone a data gap assessment. Not a Final GreenScreen™ Score

Table 6

Chemical Name	Final GreenScreen® Benchmark Score
Amorphous silica	1

After Data gap Assessment
Note: No Data gap Assessment Done if Preliminary GS Benchmark Score is 1.

Table 5: Data Gap Assessment Table

Datagap Criteria	a	b	c	d	e	f	g	h	i	j	bm4	End Result
1												1
2												
3												
4												

TOXSERVICES
TOXICOLOGY RISK ASSESSMENT CONSULTING

GREEN SCREEN FOR SAFER CHEMICALS

GreenScreen® Score Inspector for Oral Exposure

Table 1: Hazard Table

			Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
			Carcinogenicity	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
Table 2: Chemical Details									S	R *	S	R *	*	*								
Inorganic Chemical?	**Chemical Name**	**CAS#**	**C**	**M**	**R**	**D**	**E**	**AT**	**STs**	**STr**	**Ns**	**Nr**	**SNS***	**SNR***	**IrS**	**IrE**	**AA**	**CA**	**P**	**B**	**Rx**	**F**
Yes	**Amorphous silica**	**7631-86-9**	**L**	**L**	**L**	**L**	DG	**L**	**L**	**L**	DG	DG	**L**	DG	**L**	**L**	**L**	DG	*vH*	*vL*	*L*	*L*

Table 3: Hazard Summary Table

Benchmark	a	b	c	d	e	f	g
1	No	No	No	No	No		
2	No	No	No	No	No	No	No
3	No	No	No	No			
4	STOP						

Table 4

Chemical Name	Preliminary GreenScreen® Benchmark Score
Amorphous silica	4

Note: Chemical has not undergone a data gap assessment. Not a Final GreenScreen™ Score

Table 6

Chemical Name	Final GreenScreen® Benchmark Score
Amorphous silica	2DG

After Data gap Assessment
Note: No Data gap Assessment Done if Preliminary GS Benchmark Score is 1.

Table 5: Data Gap Assessment Table

Datagap Criteria	a	b	c	d	e	f	g	h	i	j	bm4	End Result
1												
2												
3												
4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	2DG

TOXSERVICES
TOXICOLOGY RISK ASSESSMENT CONSULTING

GREEN SCREEN FOR SAFER CHEMICALS

GreenScreen® Score Inspector for Dermal Exposure

Table 1: Hazard Table

			Group I Human					Group II and II* Human								Ecotox		Fate		Physical	
			Carcinogenicity	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
Table 2: Chemical Details									S	R *	S	R *	*	*								
Inorganic Chemical?	**Chemical Name**	**CAS#**	**C**	**M**	**R**	**D**	**E**	**AT**	**STs**	**STr**	**Ns**	**Nr**	**SNS***	**SNR***	**IrS**	**IrE**	**AA**	**CA**	**P**	**B**	**Rx**	**F**
Yes	**Amorphous silica**	**7631-86-9**	DG	**L**	**L**	**L**	DG	**L**	**L**	DG	DG	DG	**L**	DG	**L**	**L**	**L**	DG	*vH*	*vL*	*L*	*L*

Table 3: Hazard Summary Table

Benchmark	a	b	c	d	e	f	g
1	No	No	No	No	No		
2	No	No	No	No	No	No	No
3	No	No	No	No			
4	STOP						

Table 4

Chemical Name	Preliminary GreenScreen® Benchmark Score
Amorphous silica	4

Note: Chemical has not undergone a data gap assessment. Not a Final GreenScreen™ Score

Table 6

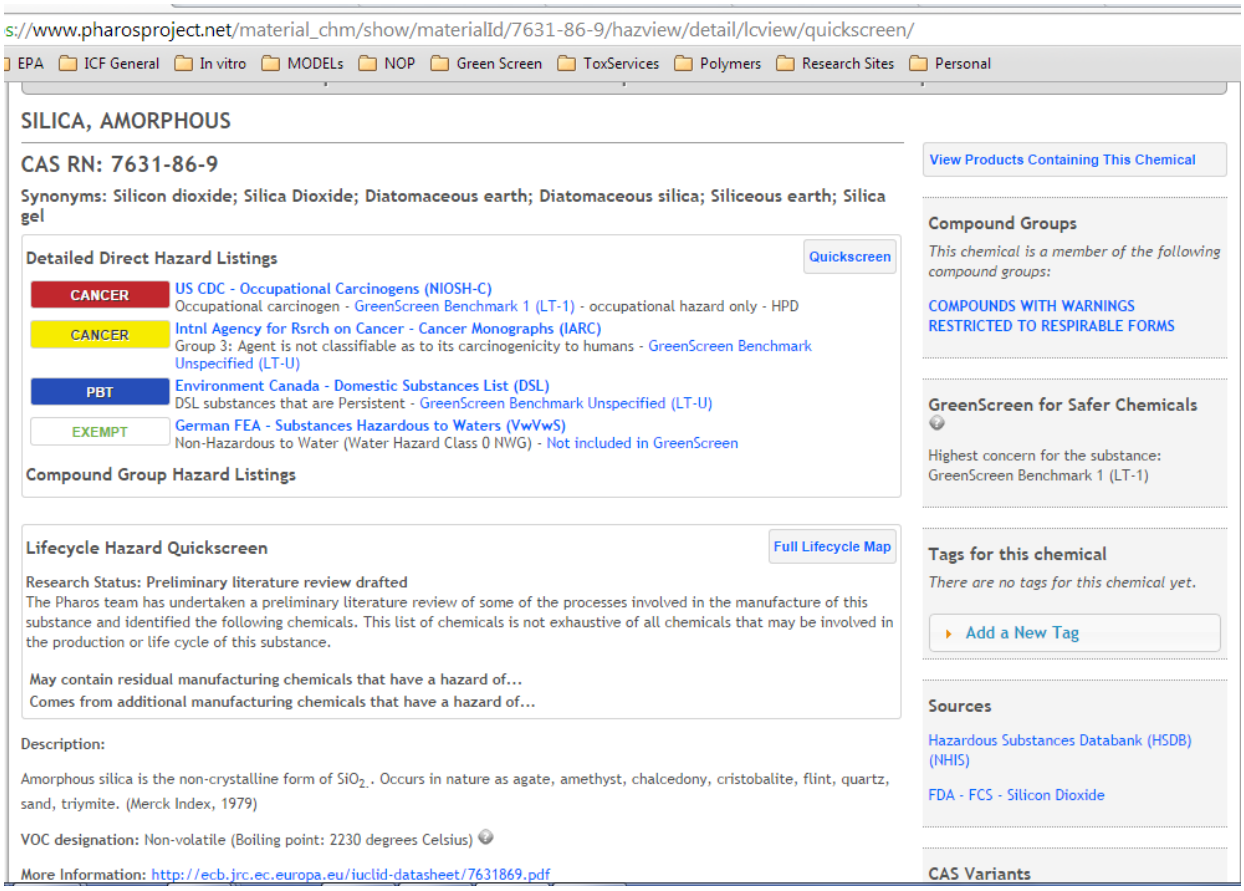
Chemical Name	Final GreenScreen® Benchmark Score
Amorphous silica	U

After Data gap Assessment
Note: No Data gap Assessment Done if Preliminary GS Benchmark Score is 1.

Table 5: Data Gap Assessment Table

Datagap Criteria	a	b	c	d	e	f	g	h	i	j	bm4	End Result
1												
2												
3												
4	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No	U

APPENDIX C: Pharos Output for Amorphous Silica (CAS# 7631-86-9)



Sources to Check for GreenScreen® Hazard Assessment

Note: For a GreenScreen® Hazard Assessment, data queries should be initially limited to the following references. If data gaps exist after these references have been checked, additional references may be utilized.

U.S. EPA High Production Volume Information System (HPVIS):
http://www.epa.gov/hpvis/index.html

UNEP OECD Screening Information Datasets (SIDS):
http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html

OECD Existing Chemicals Database: http://webnet.oecd.org/hpv/ui/SponsoredChemicals.aspx

European Chemical Substances Information System IUCLID Chemical Data Sheets:
http://esis.jrc.ec.europa.eu/index.php?PGM=dat

National Toxicology Program: http://ntp.niehs.nih.gov/

International Agency for the Research on Cancer:
http://monographs.iarc.fr/ENG/Classification/index.php

Human and Environmental Risk Assessment (HERA) on ingredients of household cleaning products:
http://www.heraproject.com/RiskAssessment.cfm

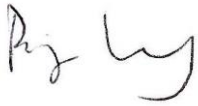
European Chemicals Agency (ECHA) REACH Dossiers: http://echa.europa.eu/

Licensed GreenScreen® Profilers

Amorphous Silica GreenScreen® Evaluation Prepared by:

Nikki Maples-Reynolds, MS.
Toxicologist
ToxServices LLC

Amorphous Silica GreenScreen® Evaluation QC'd by:



Bingxuan Wang, Ph.D.
Toxicologist
ToxServices LLC