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MATERIAL SAFETY DATA SHEET

Effective Date: 12/10
 Replaces: N.A.

I – PRODUCT AND COMPANY IDENTIFICATION		
CHEMICAL NAME Volcanic Tuff	CHEMICAL FORMULA Mixture	MOLECULAR WEIGHT Not Applicable
TRADE NAME Volcanic Tuff		
SYNONYMS Aggregate, Volcanic Rock		DOT IDENTIFICATION NO. None

II – COMPOSITION/INFORMATION ON INGREDIENTS				
COMPONENT(S) CHEMICAL NAME	CAS REGISTRY NO	% by weight (approx)	MSHA/OSHA PEL	ACGIH TLV-TWA
Silicon Dioxide, SiO ₂ ⁽¹⁾	14808-60-7	50 - 60	(R) 10 mg/m ³ / (% SiO ₂ +2) ⁽²⁾	(R) 0.025 mg/m ³
Aluminum Oxide, Al ₂ O ₃ ⁽³⁾	1344-28-1	15 - 20	(T) 15 mg/m ³ , (R) 5 mg/m ³	(R) 1 mg/m ³
Iron oxide (Fe ₂ O ₃)	1309-37-1	5 - 10	10 mg/m ³ ⁽⁴⁾	(R) 5 mg/m ³
Calcium Oxide, CaO	1305-78-8	5 - 10	5 mg/m ³	2 mg/m ³
Magnesium Oxide, MgO	1309-48-4	1 - 5	15 mg/m ³ ⁽⁵⁾	(I) 10 mg/m ³
Sodium Oxide, Na ₂ O ⁽⁶⁾	1313-59-3	1 - 5	2 mg/m ³	(C) 2 mg/m ³
Potassium Oxide, K ₂ O	12136-45-7	1 - 3	-	(C) 2 mg/m ³ ⁽⁷⁾
Titanium Oxide, TiO ₂	13463-67-7	0 - 2	15 mg/m ³	10 mg/m ³
Manganese (III) Oxide, Mn ₂ O ₃ ⁽⁸⁾	1317-34-6	< 1	(C) 5 mg/m ³	0.2 mg/m ³
Phosphorus Pentoxide, P ₂ O ₅ ⁽⁹⁾	1314-56-3	< 1	0.1 mg/m ³	0.1 mg/m ³
Sulfur Trioxide, SO ₃	7446-11-9	< 1	-	-

(1): Product may contain 18-25% crystalline silica (quartz)

(2): Crystalline Silica is normally measured as Respirable Dust. The OSHA/MSHA standard also presents a formula for calculation of the PEL based on Total Dust: 30 mg/m³ / (% SiO₂ +2).

(3): Based on Aluminum Metal and Insoluble Compounds.

(4): As Iron Oxide Fume.

(5): As Magnesium Oxide Fume.

(6): Based on NaOH.

(7): Based on Potassium Hydroxide.

(8): Based on Manganese Compounds/Fume for PEL and based on Manganese and Inorganic Compounds as Mn for TLV.

(9): Based on Phosphorus (Yellow).

(R): Respirable Fraction.

(T): Total Dust.

(I): Inhalable Fraction.

(C): Ceiling Limit

III – HAZARDS IDENTIFICATION

Volcanic tuff is a type of rock which is formed from compacted volcanic ash and fragments of material associated with volcanic eruptions. It is a low-density, high-porosity rock. Its color varies. Size may range from ash (< 2mm in diameter) to pebbles. It is odorless and not flammable. Respirable dust particles containing silicon dioxide may be generated by handling volcanic tuff. Inhalation of excessive particulate matter may cause respiratory problems. Crystalline silica, a component of this product, has been designated as a Group I carcinogen by IARC.

Health Effects: The information below represents an overview of health effects caused by overexposure to one or more components in volcanic tuff. The individual effects are described in Section XI.

Primary routes(s) of exposure: Inhalation Skin Ingestion

EYE CONTACT: Direct contact with dust may cause irritation by mechanical abrasion. Conjunctivitis may occur.

SKIN CONTACT: Direct contact may cause irritation by mechanical abrasion. Some components of material are also known to cause mild corrosive effects to skin and mucous membranes.

SKIN ABSORPTION: Not expected to be a significant route of exposure.

INGESTION: Small amounts (a tablespoonful) swallowed during normal handling operations are not likely to cause injury. Ingestion of large amounts may cause gastrointestinal irritation and blockage.

INHALATION: Dust may irritate nose, throat, mucous membranes and respiratory tract by mechanical abrasion. Coughing, sneezing, chest pain, shortness of breath, inflammation of mucous membrane, and flu-like fever may occur following exposures in excess of appropriate exposure limits. Repeated excessive exposure may cause pneumoconiosis, such as silicosis and other respiratory effects.

Notes on Silicosis:

Use of volcanic tuff for construction purposes is not believed to cause acute toxic effects. Repeated overexposures to respirable crystalline silica (quartz, cristobalite, tridymite) for periods as short as 6 months has caused acute silicosis.

Symptoms of acute silicosis include (but are not limited to): shortness of breath, cough, fever, weight loss and chest pain. Acute silicosis is a rapidly progressive, incurable lung disease and is typically fatal.

Chronic exposure to respirable quartz-containing dust in excess of appropriate exposure limits has caused silicosis, a progressive pneumoconiosis (lung disease). Restrictive and/or obstructive lung function changes may result from chronic exposure. Chronic tobacco smoking may further increase the risk of developing chronic lung problems.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Inhaling respirable dust and/or crystalline silica may aggravate existing respiratory system disease(s) and/or dysfunctions. Exposure to dust may aggravate existing skin and/or eye conditions. Smoking and obstructive/restrictive lung diseases may also exacerbate the effects of excessive exposure to this product.

IV – FIRST AID MEASURES

EYES: Immediately flush eye(s) with plenty of clean water for at least 15 minutes, while holding the eyelid(s) open. Occasionally lift the eyelid(s) to ensure thorough rinsing. Beyond flushing, do not attempt to remove material from the eye(s). Contact a physician if irritation persists or develops later.

SKIN: Wash with soap and water. Contact a physician if irritation persists or develops later.

INGESTION: If person is conscious, give a large quantity of water and induce vomiting; however, never attempt to make an unconscious person drink or vomit. Get medical attention.

INHALATION: Remove to fresh air. Dust in throat and nasal passages should clear spontaneously. Contact a physician if

irritation persists or develops later.

V – FIRE FIGHTING MEASURES

FLASHPOINT
Not flammable

FLAMMABLE LIMITS IN AIR
Not flammable

EXTINGUISHING AGENT
None required

UNUSUAL FIRE AND EXPLOSION HAZARD
Contact with powerful oxidizing agents may cause fire and/or explosions (see Section X of this MSDS).

VI – ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Persons involved in cleaning should first follow the precautions defined in Section VII of the MSDS. Spilled materials, where dust can be generated, may overexpose cleanup personnel to respirable quartz-containing dust. Wetting of spilled material and/or use of respiratory protective equipment may be necessary. Do not dry sweep spilled material.

This product is not subject to the reporting requirements of Title III of SARA, 1986, and 40 CFR 372.

VII – HANDLING AND STORAGE

This product is not intended or designed for and should not be used as an abrasive blasting medium or for foundry applications. Follow protective controls set forth in Section VIII of this MSDS when handling this product. Respirable quartz-containing dust may be generated during processing, handling and storage. Do not breathe dust. Avoid contact with skin and eyes. Do not store near food or beverages or smoking materials. Do not stand on piles of materials; it may be unstable.

VIII – EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS

Ventilation: Use local exhaust, general ventilation or natural ventilation adequate to maintain exposures below appropriate exposure limits. If a person breathes large amounts of this material, move the exposed person to fresh air at once; other measures are usually unnecessary.

Other control measures: Respirable dust and quartz levels should be monitored regularly. Dust and quartz levels in excess of appropriate exposure limits should be reduced by implementing feasible engineering controls, including (but not limited to) dust suppression (wetting), ventilation, process enclosure and enclosed employee work stations.

EYE/FACE PROTECTION

Safety glasses with side shields should be worn as minimum protection. Dust goggles should be worn when excessively (visible) dusty conditions are present or are anticipated. If product contacts the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Avoid using contact lenses when working with this material.

SKIN PROTECTION

No personal protection recommended.

RESPIRATORY PROTECTION**Respirator Recommendations:**

For respirable quartz levels that exceed or are likely to exceed appropriate exposure limits, a NIOSH-approved 100 series particulate filter respirator must be worn. If respirable quartz levels exceed or are likely to exceed an 8 hour-TWA of 0.5 mg/m³, a NIOSH-approved air purifying, full-face respirator with a 100 series particulate filter must be worn. Respirator use must comply with applicable MSHA or OSHA standards, which include provisions for a user training program, respirator repair and cleaning, respirator fit testing, and other requirements. For additional information contact NIOSH at 1-800-356-4674 or visit website: <http://www.cdc.gov/niosh/npg> (search for crystalline silica).

Emergency or planned entry into unknown concentrations or IDLH conditions (50 mg/m³ for crystalline silica-quartz): A self-contained breathing apparatus (SCBA) that has a full-face piece and is operated in a pressure-demand or other positive-pressure mode or any supplied-air respirator that has a full-face piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

Escape from unknown or IDLH conditions: An air-purifying, full-face piece respirator with a high-efficiency particulate filter or any appropriate escape-type, self-contained breathing apparatus.

GENERAL HYGIENE CONSIDERATIONS

There are no known hazards associated with this material when used as recommended. Following the guidelines in this MSDS are recognized as good industrial hygiene practices. Avoid breathing dust. Avoid skin and eye contact. Wash dust-exposed skin with soap and water before eating, drinking, smoking and using toilet facilities. Wash work clothes after each use.

IX— PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR Stratified, porous particles, varied color; odorless	SPECIFIC GRAVITY. 2.7-2.9
BOILING POINT Not applicable	VAPOR DENSITY IN AIR (AIR = 1) Not applicable
VAPOR PRESSURE Not applicable	% VOLATILE, BY VOLUME 0%
EVAPORATION RATE Not applicable	SOLUBILITY IN WATER 0%

X – STABILITY AND REACTIVITY

STABILITY Stable	CONDITIONS TO AVOID Contact with incompatible materials (see below).
INCOMPATIBILITY (Materials to avoid) Contact with powerful oxidizing agents such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, and oxygen difluoride may cause fire and/or explosions. Silica dissolves in hydrofluoric acid producing a corrosive gas - silicon tetrafluoride.	
HAZARDOUS DECOMPOSITION PRODUCTS Silica-containing respirable dust particles may be generated during handling.	

XI – TOXICOLOGICAL INFORMATION

This product is a mixture of components. The composition percentages are listed in Section II. Toxicological information for each component is listed below:

Silicon Dioxide: It is comprised of amorphous and crystalline forms of silica. In some batches, crystalline silica may represent up to 50% of silicon dioxide.

Exposure route: Eyes, respiratory system.

Target organs: Eyes, skin, respiratory system.

Respirable crystalline silica (quartz):

ACGIH TLV= 0.025 mg/m³

MSHA and OSHA PEL:

Crystalline quartz (respirable): PEL-TWA = 10 mg/m³ / (%SiO₂ + 2).

Crystobalite: Use ½ the value calculated from the count or mass formula for quartz.

Tridymite: Use ½ the value calculated from the formula for quartz.

Other Particulates:

TLV = 10 mg/m³ (inhalable/total particulate, not otherwise classified),

TLV = 3 mg/m³ (respirable particulate, not otherwise classified),

OSHA PEL = 15 mg/m³ (total particulate, not otherwise regulated),

OSHA PEL = 5 mg/m³ (respirable particulate, not otherwise regulated)

ACGIH, MSHA, and OSHA have determined that adverse effects are not likely to occur in the workplace provided exposure levels do not exceed the appropriate exposure limits. Lower exposure limits may be appropriate for some individuals including persons with pre-existing medical conditions such as those described below.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Inhaling respirable dust and/or crystalline silica may aggravate existing respiratory system disease(s) and/or dysfunctions.

Exposure to dust may aggravate existing skin and/or eye conditions.

Occupational exposure to free silica is known to produce silicosis, a chronic, disabling lung disease characterized by the formation of silica-containing nodules of scar tissue in the lungs. Simple silicosis, in which the nodules are less than 1 cm in diameter is generally asymptomatic but can be slowly progressive, even in the absence of continued exposure.

Silicosis leads to conditions such as lung fibrosis and reduced pulmonary function. The form and severity in which silicosis manifests itself, depends in part on the type and extent of exposure to silica dusts: chronic, accelerated and acute forms are recognized. In later stages the critical condition may become disabling and potentially fatal. Restrictive and/or obstructive changes in lung function may occur due to exposure. A risk associated with silicosis is development of pulmonary tuberculosis (silico-tuberculosis). Respiratory insufficiencies due to massive fibrosis and reduced pulmonary function, possibly with accompanying heart failure, are other potential causes of death due to silicosis.

Symptoms of Silicosis: Not all individuals with silicosis will exhibit symptoms (signs) of the disease. However, silicosis can be progressive, and symptoms may potentially appear years after exposures have ceased. Symptoms of silicosis may include (but are not limited to): Shortness of breath; difficulty breathing with or without exertion; coughing; diminished work capacity; diminished chest expansion; reduction of lung volume; heart enlargement and/or failure.

Respirable dust containing newly broken particles has been shown to be more hazardous to animals in laboratory tests than respirable dust containing older silica particles of similar size. Respirable silica particles which had aged for sixty days or more showed less lung injury in animals than equal exposures of respirable dust containing newly broken pieces of silica.

There are reports in the literature indicating that crystalline silica exposure may be associated with adverse health effects involving the kidney, scleroderma (thickening of the skin caused by swelling and thickening of fibrous tissue) and other autoimmune and immunity-related disorders. Several studies of persons with silicosis or silica exposure also indicate or suggest increased risk of developing lung cancer, a risk that may increase with the duration of exposure. Many of these studies of silicosis do not account

for lung cancer confounders, especially smoking. In October 1996, an IARC Working group re-assessing crystalline silica, a component of this product, designated crystalline silica as a human carcinogen (Group 1 carcinogen). The NTP indicates that crystalline silica is reasonably anticipated to be a human carcinogen (Group 2). These classifications are based on sufficient evidence of carcinogenicity in certain experimental animals and epidemiological studies of workers exposed to crystalline silica. Crystalline silica in October 1996 was listed on the Safe Drinking Water and Toxic Enforcement ACT of 1986 (California Proposition 65) as a chemical known to the state to cause cancer or reproductive toxicity.

Aluminum Oxide:

Exposure route: Eyes, skin, respiratory system.

Target organs: Eyes, skin, respiratory system.

Acute effect: Animal studies with α -alumina were reported in 1941. This study found that alumina particles well below 40 μm in diameter produced a "nuisance particulate" reaction in animals. Very fine Al_2O_3 powder was not fibrogenic in rats, guinea pigs, or hamsters when inhaled for 6 to 12 months and sacrificed at periods up to 12 months following the last exposure.

Chronic effect/carcinogenicity: Aluminum oxide is not classifiable as a human carcinogen. Epidemiologic surveys have indicated an excess of nonmalignant respiratory disease in workers exposed to aluminum oxide during abrasives production.

Ferric Oxide:

Exposure route: Inhalation.

Target organs: Respiratory system.

Acute effect: Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis. Experimental work in animals exposed by intratracheal injection or by inhalation to iron oxide mixed with less than 5% silica has shown no evidence of fibrosis produced in lung tissue.

Chronic effect/carcinogenicity: It is not generally accepted that inhalation or dermal exposure to iron oxide dust or fume poses a carcinogenic risk to human beings. Not classifiable as human carcinogen.

Calcium Oxide:

Exposure route: Inhalation, ingestion, skin/eye contact.

Target organs: Eyes, skin, respiratory system.

Acute effect: Direct contact of CaO with tissues, can result in burns and severe irritation because of its high reactivity and alkalinity. Major complaints of workers exposed to lime consist of irritation of the skin and eyes, although inflammation of the respiratory passages, ulceration and perforation of the nasal septum, and even pneumonia has been attributed to inhalation of the dust.

Chronic effect/carcinogenicity: Not classifiable as human carcinogen.

Magnesium Oxide:

Exposure route: Inhalation, eye/skin contact.

Target organs: Eyes, respiratory system.

Acute effect: Magnesium oxide dust caused slight irritation of the eyes and nose, conjunctivitis, inflammation of the mucous membrane, and coughing up discolored sputum after industrial exposures amongst workers exposed to an unspecified concentration of MgO . Acute toxicity causes nausea, malaise, general depression and paralysis of respiratory, cardiovascular and central nervous system.

Experiments with cats exposed to freshly formed MgO (magnesium ranging from 21 to 156 mg) fumes plus 10% carbon dioxide showed uniform but slight hypothermia. These animals rapidly returned to normal and showed no subsequent ill effect upon cessation of MgO inhalation.

Chronic effect/carcinogenicity: NIOSH indicated that there may be a carcinogenic risk from exposure to MgO dust.

Sodium Oxide:

Exposure route: Inhalation, ingestion, skin/eye contact.

Target organs: Eyes, skin, respiratory system.

Acute effect: Corrosive – causes burns, irritation of skin, eyes, respiratory tract, extremely destructive of mucous membranes.

Chronic effect/carcinogenicity: Not classifiable as human carcinogen.

Potassium Oxide:

Exposure route: Inhalation, ingestion, skin/eye contact.

Target organs: Eyes, skin, respiratory system.

Acute effect: If inhaled, causes sore throat, cough, burning sensation and shortness of breath. Contact with skin produces pain and blisters. Severe deep burns, redness and pain occur with eye contact. Ingestion of K_2O results in burning sensations, abdominal pain, shock or collapse.

Chronic effect/carcinogenicity: Not classifiable as human carcinogen.

Titanium Oxide:

Exposure route: inhalation.

Target organs: respiratory system.

Acute effect: Toxicological studies have concluded that titanium oxide is inert, not absorbed by the body, and exerts no toxic effect.

Chronic effect/carcinogenicity: Currently not classifiable as to human carcinogen potential (In consideration by IARC to be classified as Group 2B-possibly carcinogenic to humans).

XII – ECOLOGICAL INFORMATION

No data available.

XIII – DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

Collect and reuse clean materials. Dispose of waste materials only in accordance with applicable federal, state, and local laws and regulations.

XIV – TRANSPORT INFORMATION

DOT HAZARD CLASSIFICATION

None

PLACARD REQUIRED

None

LABEL REQUIRED

Label as required by the OSHA Hazard Communication standard {29 CFR 1910.1200(f)}, and applicable state and local regulations.

XV – REGULATORY INFORMATION

Crystalline silica, a component of this product, is on the NTP and IARC carcinogen lists, but not on the OSHA carcinogen list. In October 1996, an IARC Working group re-assessing crystalline silica, a component of this product, designated crystalline silica as a human carcinogen (Group 1 Carcinogen).

Crystalline silica in October 1996 was listed on the Safe Drinking Water and Toxic Enforcement ACT of 1986 (California Proposition 65) as a chemical known to the state to cause cancer or reproductive toxicity.

XVI – OTHER INFORMATION

ACGIH: American Conference of Governmental Industrial Hygienists

CFR: US Code of Federal Regulations

DOT: US Department of Transportation

IARC: International Agency for Research on Cancer

IDLH: Immediately Dangerous to Life and Health

NIOSH: National Institute for Occupational Safety and Health, US Department of Health and Human Services

NTP: National Toxicology Program

OSHA: Occupational Safety and Health Administration, US Department of Labor

PEL: Permissible Exposure Limit

SARA Title III: Title III of the Superfund Amendments and Reauthorization Act, 1986

TLV: Threshold Limit Value

TWA: Time-weighted Average

FOR FURTHER INFORMATION

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DATE OF PREPARATION 12/10

NOTICE: Martin Marietta Materials believes that the information contained on this Material Safety Data Sheet is accurate. The suggested precautions and recommendations are based on recognized good work practices and experience as of the date of publication. They are not necessarily all-inclusive or fully adequate in every circumstance as not all use circumstances can be anticipated. Also, the suggestions should not be confused with nor followed in violation of applicable laws, regulation, rules or insurance requirement. However, product must not be used in a manner which could result in harm.

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

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