

Fiberfrax® Blanket and Mat Products

Introduction

The Fiberfrax® blanket and mat product family is a group of lightweight, thermally efficient ceramic fiber insulating materials that combine the advantages of dimensional stability at high temperatures with complete resistance to thermal shock. Featuring a broad range of thermal capabilities and physical characteristics, this product family provides proven and effective solutions to a variety of heat processing applications.

Durablanket® ceramic fiber products are high strength, needled insulating blankets that are made from spun Fiberfrax ceramic fibers. The extra-long spun fibers, cross-locked through a unique forming process, produce a blanket with exceptional handling strength. The Durablanket product family is completely inorganic and available in a variety of temperature grades, densities, and sizes.

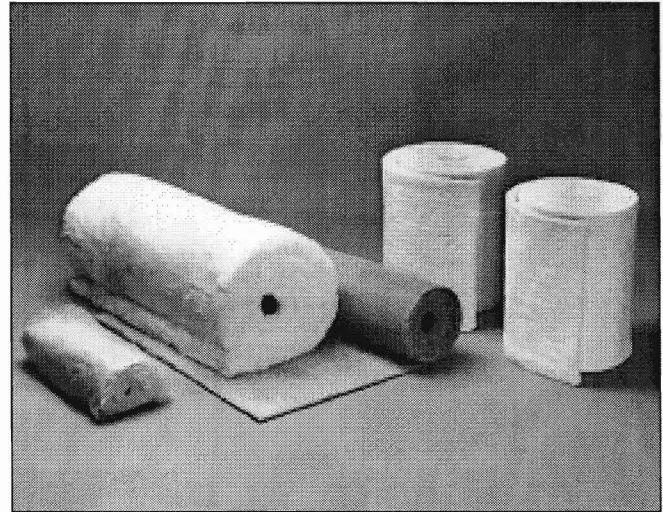
Fibermax® Mat, PH blanket, and Moist Pak-D® insulation provide additional options for specific application requirements ranging from high-temperature filtration to hot gas velocity resistance.

Fibermax® Mat is a high-temperature, flexible mat product entirely composed of Fibermax polycrystalline mullite fibers, making it an extremely lightweight, highly resilient insulator that is virtually free of unfiberized ("shot") particles.

Having excellent chemical stability, Fiberfrax blanket and mat products are unaffected by most chemicals except hydrofluoric and phosphoric acids and concentrated alkalis. If wet by water or steam, thermal and physical properties remain unaffected after drying.

Durablanket® S

Fiberfrax Durablanket S insulation is a strong, lightweight, flexible needled blanket that is made from spun ceramic fibers. Available in a wide variety of thicknesses, widths and densities, Durablanket S insulation provides an array of proven solutions for a broad spectrum of application problems.



Durablanket® HP-S

Fiberfrax Durablanket HP-S insulation is a needled blanket made from spun Fiberfrax ceramic fibers. Durablanket HP-S insulation combines all of the physical characteristics offered by Durablanket S insulation in a product with a high-purity chemistry. The chemistry of Durablanket HP-S provides improved performance and service life in applications where fluxing or chemical attack occurs.

Durablanket® 2600

Fiberfrax Durablanket 2600 insulation extends the high-temperature performance of the Durablanket product line. The product is made from high-purity alumina, zirconia, and silica spun ceramic fibers. This chemical composition, manufactured in a unique fiber-making process, imparts Durablanket 2600 insulation with extremely low shrinkage characteristics at elevated temperatures.

Refer to the product Material Safety Data Sheet (MSDS) for recommended work practices and other product safety information.

Product Family Characteristics

- Excellent handling strength
- Excellent hot strength
- Low thermal conductivity
- Low heat storage
- Light weight
- Resiliency
- Thermal shock resistance
- High heat reflectance
- Excellent corrosion resistance
- Excellent thermal stability
- Excellent sound absorption
- Excellent fire protection

Specific Product Characteristics

- Extremely low shrinkage: Fibermax Mat
- Low shrinkage: Durablanket 2600 insulation
- Exceptional handling strength: Durablanket 2600 insulation, Durablanket S insulation, Durablanket HP-S insulation, Fibermat Blanket
- Exceptional hot strength: Durablanket 2600 insulation
- Exceptional velocity resistance: Moist Pak-D insulation
- Excellent conformance to complex shapes: Moist Pak-D insulation
- Low shot content (95% fiber index): Fibermax Mat
- Exceptional sound absorption: Fibermat Blanket, PH blanket
- High resiliency: Fibermax Mat
- Excellent compression recovery: Fibermat Blanket
- Excellent filtration capabilities: PH blanket

Typical Applications

Durablanket[®] S and Durablanket[®] HP-S

- Furnace, kiln, reformer and boiler linings
- Investment casting mold wrappings
- Removable insulating blankets for stress relieving welds
- Reusable insulation for steam and gas turbines
- Flexible high-temperature pipe insulation
- Pressure and cryogenic vessel fire protection
- High-temperature kiln and furnace insulation
- Furnace door linings and seals
- Soaking pit seals
- Furnace repairs
- Thermal reactor insulation
- Expansion joint seals
- Primary reformer header insulation
- High-temperature gasketing
- Glass furnace crown insulation
- Incineration equipment and stack linings
- Annealing cover seals
- High-temperature filtration
- Nuclear insulation applications
- Atmosphere furnace lining
- Field steam generator lining



Typical Product Properties

	Duraback	Durablanket S	Durablanket HP-S	Durablanket 2600
Color	White	White	White	White
Temperature Grade*	982°C (1800°F)	1260°C (2300°F)	1260°C (2300°F)	1430°C (2600°F)
Recommended Operating Temperature	1800°F	2150°F	2150°F	2450°F
Melting Point	1648°C (3000°F)	1760°C (3200°F)	1760°C (3200°F)	1760°C (3200°F)
Fiber Diameter	2-4 microns (mean)	2.5-3.5 microns (mean)	2.5-3.5 microns (mean)	3.5 microns (average)
Specific Heat @ 1093°C (2000°F)	1130 J/kg °C (0.27 Btu/lb °F)	1130 J/kg °C (0.27 Btu/lb °F)	1130 J/kg °C (0.27 Btu/lb °F)	1130 J/kg °C (0.27 Btu/lb °F)
Specific Gravity	2.73 g/cm ³	2.73 g/cm ³	2.73 g/cm ³	2.73 g/cm ³
Average Tensile Strength (ASTM 686-76)	—	4 lb/in ² min. @ 4 PCF 6 lb/in ² min. @ 6 PCF 7 lb/in ² min. @ 8 PCF	—	—

	PH Blanket	Moist Pak-D
Color	Tan	White
Temperature Grade*	1260°C (2300°F)	1093°C (2000°F)
Recommended Operating Temperature	2150°F	1850°F
Melting Point	1790°C (3260°F)	1790°C (3260°F)
Fiber Diameter	4-8 microns (mean)	2-3 microns (mean)
Specific Heat Capacity @ 1093°C (2000°F)	—	1130 J/kg °C (0.27 Btu/lb °F)
Tensile Strength – 6.4 mm (¼"): (ASTM 686-76)	—	Wet = 1.2 x 10 ⁵ N/m ² (17 psi) Dry = 3.5 x 10 ⁵ N/m ² (50 psi)
Hot Gas Erosion Resistance:	N/A	Test procedure based on British Gas Council Research Comm. GC173 = over 30.5 m/sec (100 ft/sec)

	Fibermat Blanket	Fibermax Mat
Color	White	White
Temperature Grade*	760°C (1400°F)	1650°C (3000°F)
Recommended Operating Temperature	1250°F	2850°F
Melting Point:	—	1870°C (3400°F)
Fiber Diameter	2.5-3.5 microns (mean)	2-3.5 microns (mean)
Specific Gravity:	2.73 g/cm ³	3 g/cm ³
Tensile Strength (ASTM 686-76):	7-10 psi (typical)	—
Specific Heat Capacity at 1093°C (2000°F):	—	1246 J/kg °C (0.297 Btu/lb °F)
Fiber Surface Area:	—	7.65 m ² /g

*The temperature grade of Fiberfrax insulation is determined by irreversible linear change criteria, not product melting point. Test data shown are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.



Typical Product Parameters

	Duraback	Durablanket S	Durablanket HP-S	Durablanket 2600
Available Density				
kg/m ³	64	64, 96, 128	64, 96, 128	96, 128
(lb/ft ³)	(4)	(4, 6, 8)	(4, 6, 8)	(6, 8)
Chemical Composition				
Al ₂ O ₃	31-35%	43-47%	43-47%	29-31%
SiO ₂	50-54%	53-57%	53-57%	53-55%
ZrO ₂	5%	—	—	15-17%
Fe ₂ O ₃	1.3%	Trace	—	—
TiO ₂	1.7%	Trace	—	—
MgO	*0.5%	—	—	—
CaO	≤7.5%	—	—	—
Na ₂ O ₃	—	<.5%	<.5%	—
Alkali	—	0.05%	—	—
Leachable Chlorides	—	<10 ppm	<10 ppm	<10 ppm
Other Inorganics	—	0.85%	—	—

*MgO and other trace inorganics

	PH Blanket	Moist Pak-D*	Fibermat Blanket	Fibermax Mat
Available Density		(Typical Dry)		
kg/m ³	96	190-290	88	24
(lb/ft ³)	(6)	(12-18)	(5.5)	(1.5)
Binder Content	3-5%	—	—	—
Chemical Composition				
Al ₂ O ₃	43-47%	23-32%	29-47%	72%
SiO ₂	53-55%	68-77%	52-57%	27%
ZrO ₂	—	—	<18%	—
Fe ₂ O ₃	Trace	—	—	0.02%
TiO ₂	Trace	—	—	0.001%
MgO	—	—	—	0.05%
CaO	—	—	—	0.05%
Na ₂ O ₃	<.5%	<.5%	<.5%	0.10%
Alkali	—	—	—	—
Leachable Chlorides	<10 ppm	—	<10 ppm	11 ppm
Other Inorganics	—	—	—	—
Nominal Weight	—	—	½" thickness = 3.7 oz/ft ² 1" thickness = 7.3 oz/ft ² 2" thickness = 14.7 oz/ft ²	—

*Normal shelf life one year in unopened containers.

For additional information about product performance or to identify the recommended product for your application, please contact the Unifrax Application Engineering Group at 716-278-3888.





MATERIAL SAFETY DATA SHEET

MSDS No. M0114

Effective Date: 02/11/2002

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITREOUS ALUMINOSILICATE FIBER
Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMF)
Trade Names: FIBERFRAX® AZS PRODUCTS , INCLUDES:
MODULES
FIBERWALL® BONDED 2600 MODULES

BLANKETS
FIBERFRAX® DURABLANKET® 2600 INSULATION

FIBERS
FIBERFRAX® AZS FIBERS

Manufacturer/Supplier: Unifrax Corporation
2351 Whirlpool St.
Niagara Falls, NY 14305-2413

Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)

For additional MSDSs, visit our web page, <http://www.unifrax.com>, or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate (with zirconia)	142844-00-6	100

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:

Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:

If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –

Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability:** 0 **Health:** 1 **Reactivity:** 0 **Special:** 0

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products: None

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES

COMPONENTS	OSHA PEL	MANUFACTURER REG
Refractories, Fibers, Aluminosilicate (with zirconia)	None Established*	0.5 f/cc, 8-hr. TWA**

* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc; Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

ENGINEERING CONTROLS

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

**MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS
WHEN HANDLING RCF PRODUCTS**

<u>Respirable Airborne Fiber Concentration</u> (levels are 8-hr. time-weighted averages)	<u>Respirator Recommendation</u> [†]
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
5.0 f/cc to 25 f/cc	Full-facepiece, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode
When individual workers request respiratory protection as a matter of personal comfort or choice where exposures are "reliably" below 0.5 f/cc	A NIOSH certified respirator, such as a disposable particulate respirator, or respirators with filter cartridges rated N95 or better

[†]The P100 recommendation is a conservative default choice; in some case, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
- The manufacturer recommends the use of a full-facepiece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.
- Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home. If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	None.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

- 1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.
- 2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.

3) In early studies, an apparent statistical "trend" was observed, in the exposed population, between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests found that there was no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.

4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurrence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the "maximum tolerated dose" was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Unifrax Corporation Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

This product is manufactured with zirconium compounds which may contain trace quantities (<500ppm) of naturally occurring radioactive material (NORM) consisting of uranium, thorium, and/or radium. The quantity of radioactive materials in the zirconium compounds is below the regulatory level of 0.05% established by the Nuclear Regulatory Commission (NRC). Check your local, regional and state or provincial regulations for specific applicable handling and disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

EPA: **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).

Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory. RCF has been assigned a CAS number; however, it is a simple mixture and therefore not required to be listed on the TSCA inventory. The components of RCF are listed on the inventory.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.

OSHA: Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.

California: Ceramic fibers (airborne particles of respirable size)" is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.

Other States: RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada: **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects
Canadian Environmental Protection Act (CEPA) - All substances in this product

are listed, as required, on the Domestic Substance List (DSL)
European Union: **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it "should be regarded as if it is carcinogenic to man."

16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline silica (cristobalite) formation may begin at temperatures of approximately 1200° C (2192° F). The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied" (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm²).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

PRODUCT STEWARDSHIP PROGRAM

The Unifrax Corporation has established a program to provide customers with up-to-date information regarding the proper use and handling of refractory ceramic fiber. In addition, Unifrax Corporation has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call the Unifrax Corporation Product Stewardship Information Hotline at 1-800-322-2293.

On February 11, 2002, the Refractory Ceramic Fibers Coalition (RCFC) and the U.S. Occupational Safety and Health Administration (OSHA) introduced a voluntary worker protection program entitled PSP 2002, a comprehensive, multi-faceted risk management program designed to control and reduce workplace exposures to refractory ceramic fiber (RCF). Unifrax Corporation, as a member of RCFC, is participating in this highly acclaimed product stewardship program. For more information regarding PSP 2002, please call the Unifrax Corporation's Product Stewardship Information Hotline at 1-800-322-2293 or refer to the RCFC web site: <http://www.rcfc.net>.

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
AZS:	Alumino-zirconia-silicate
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act

DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCFC:	Refractory Ceramic Fibers Coalition
RCRA:	Resource Conservation and Recovery Act
REG:	Recommended Exposure Guideline (RCFC)
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Section 3: IARC update, Section 8: Respiratory Protection table expanded, Section 11: Minor changes, Section 16: Added PSP2002 information.

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DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Unifrax Corporation does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.