

Refractory Ceramic Fiber (RCF) and Regulatory Changes

ASGE, June 2010



Introduction: Regulatory Changes on RCF

- Refractory Ceramic Fiber (RCF) materials are a common insulation type utilized in the thermal process industries for over 50 years.
- Increasing concerns over the health effects relating to RCF have caused players in the ceramic fiber industry to develop alternative fibre products, as well as to work with existing process upgrades to address concerns related to RCF.
- Today we'll review some of the most recent changes to EH&S in relation to RCF as well as potential options to the consumer.

Refractory Ceramic Fiber Coalition (RCFC)

A commitment to a healthy environment

- The RCFC members have been proactive in studying the health aspects of RCF for more than 20 years.
- All members have helped to lead the work in the USA and in the EU through ECFIA in the fields of:
 - Epidemiological (human) studies
 - Toxicological (animal and *in vitro*) studies
- The studies have been carried by independent scientists and organisations and are used as references by regulators.
- Members of the RCFC provide occupational hygiene services to help its customers control and reduce RCF exposure at their premises.

Health and safety reference sources

- TC and members of the RCFC/ECFIA are not expert bodies in the field of toxicology and epidemiology
- We consistently rely upon officially recognised sources of information and advice.
- The most common sources of information are expert or regulatory bodies including:
 - US NTP, NIOSH, Cal OSHA, EU Commission, ECHA, AFSSET,
 - IARC, University of Cincinnati, Institute of Occupational Medicine, Fraunhofer Institute, ACGIH
 - The regulatory agencies of Canada, Australia and Korea.

Why are regulators concerned about RCF?

- History shows that fine asbestos fibres inhaled into the lungs may cause cancer.
- RCF is not asbestos.
- However, RCF has a higher biopersistence than most glass wools and mineral wools.
- Animal testing of RCF in the early 1990s showed signs of carcinogenicity.
- Human epidemiology has shown
 - reduction in lung function among smokers exposed to RCF
 - a correlation between pleural plaque development and cumulative RCF exposure
 - No increase in lung cancer above that found in general population

RCF is classified as a possible or probable carcinogenic substance by many agencies

- IARC (WHO) has classified RCF as a possible human carcinogen (Group 2B).
- In the USA NTP has classified respirable RCF as a substance reasonably anticipated to be carcinogenic.
- CEPA (Canada) has classified RCF as “Probably carcinogenic” (Group 2);
- In Europe RCF are classified as a carcinogenic substance in animals. (1B under new CLP classification system)
- ACGIH has classified RCF in category A2: Suspected human carcinogen

More and more stringent RCF airborne dust limits

- For some years, the RCFC has recommended a maximum workplace exposure of 0.5 f/ml.
- Many local jurisdictions have set up limit values for RCF to the same or even lower values:
 - France, Norway: 0.1 F/ml,
 - Sweden, Korea, California: 0.2 F/ml
 - NL, Australia, Austria: 0.5 F/ml
- Other organisations have recommended OELs, such as ACGIH, 0.2f/ml and NIOSH, 0.5f/ml.
- Most recent standard change is the PEL of 0.2 f/cc adopted by the State of California in February of 2010.

(1) NIOSH stands for National Institute for Occupational Safety and Health

NIOSH reference:

- *Criteria for a Recommended Standard:*
Occupational Exposure to Refractory Ceramic Fibers (2006)
- Full details: www.cdc.gov/niosh/docs/2006-123/
- The following statement is from the NIOSH document summary:

*[...]NIOSH proposes a recommended exposure limit (REL) for RCFs of 0.5 F/cm³ of air as a time weighted average (TWA) concentration
[...] Limiting airborne RCF exposures to this concentration will minimize the risk for lung cancer and irritation of the eyes and upper respiratory system and is achievable based on a review of exposure monitoring data collected from RCF manufacturers and users.*

However, because a residual risk of cancer [...] may still exist at the REL, continued efforts should be made toward reducing exposure to less than 0.2 F/cm³.

RCF Regulatory aspects

Summary of Cal-OSHA OEL

Passed into law: 3rd February 2010

Effective: 3rd August 2010

Cal-OSHA regulation: simple summary

- Applies to RCF dust in the workplace.
- Legally enforceable from 3rd August 2010
- Workplace PEL of 0.2 f/ml TWA
- Inspectors may accept individual measurements up to 0.5 f/ml.....
- If the employer can demonstrate that normal exposure is maintained at below 0.2 f/ml
- Declared intention is that employers using RCF should be able to demonstrate regular workplace dust monitoring.

RCF Regulatory aspects Europe (relevant to exporters as well)

Summary of European REACH
RCF Is "Substance of Very High Concern"
RCF added to "Annex XV" on January 13th
2010

Registration, Evaluation and Authorisation of Chemicals (REACH)

- RCF was classified by EU in 1997 as carcinogen 2 following a full review of available test data on animals (97/69/EC).
- This new EU regulation came into force on the 1st of June 2007. Under REACH carcinogen 2 becomes "1B"
- A registration dossier has to be submitted for each substance, providing a body of HSE information. These include:
 - AES (Alkaline Earth Silicates) deadline: 1st December 2010
 - RCF(Refractory Ceramic Fibres) deadline: 1st December 2010
 - PCW (polycrystalline fibres); deadline: 1st of December 2013.
- The new REACH regulation states that Carcinogen 1A and 1B are considered as Substances of Very High Concern (SVHC), this includes RCF.

RCF is a Substance of Very High Concern (SVHC)

- Member States may propose substances to be added to Annex XV (The candidate list for authorisation).
- This candidate list is the portal for potential further regulation including restrictions and authorisation.
- In September, Germany submitted 2 dossiers to ECHA, requesting the inclusion of RCF and ZrRCF in the candidate list for authorisation.
- RCF's were added to the candidate list in January 2010.

Consequences of adding RCF to the candidate list

- Suppliers of RCF articles containing more than 0.1% RCF are required to provide sufficient information to the users to allow safe use of the article. (i.e. MSDS...)
- A further step is required under REACH to get to the authorisation process.
- If RCF is “elected” the process might take another 2-3 years before it happens.
- Authorisation would mean that RCF could only be used in precisely defined application areas and be banned elsewhere.

Example: What does it mean to reduce dust levels?

RCF lines at St Marcellin (0.1 f/ml from 1st July 09)



- RCF workshop is divided from Superwool section by a wall.
- Operators wear respirators to achieve 0.1 f/ml
- Open environment is typically 0.2 f/ml



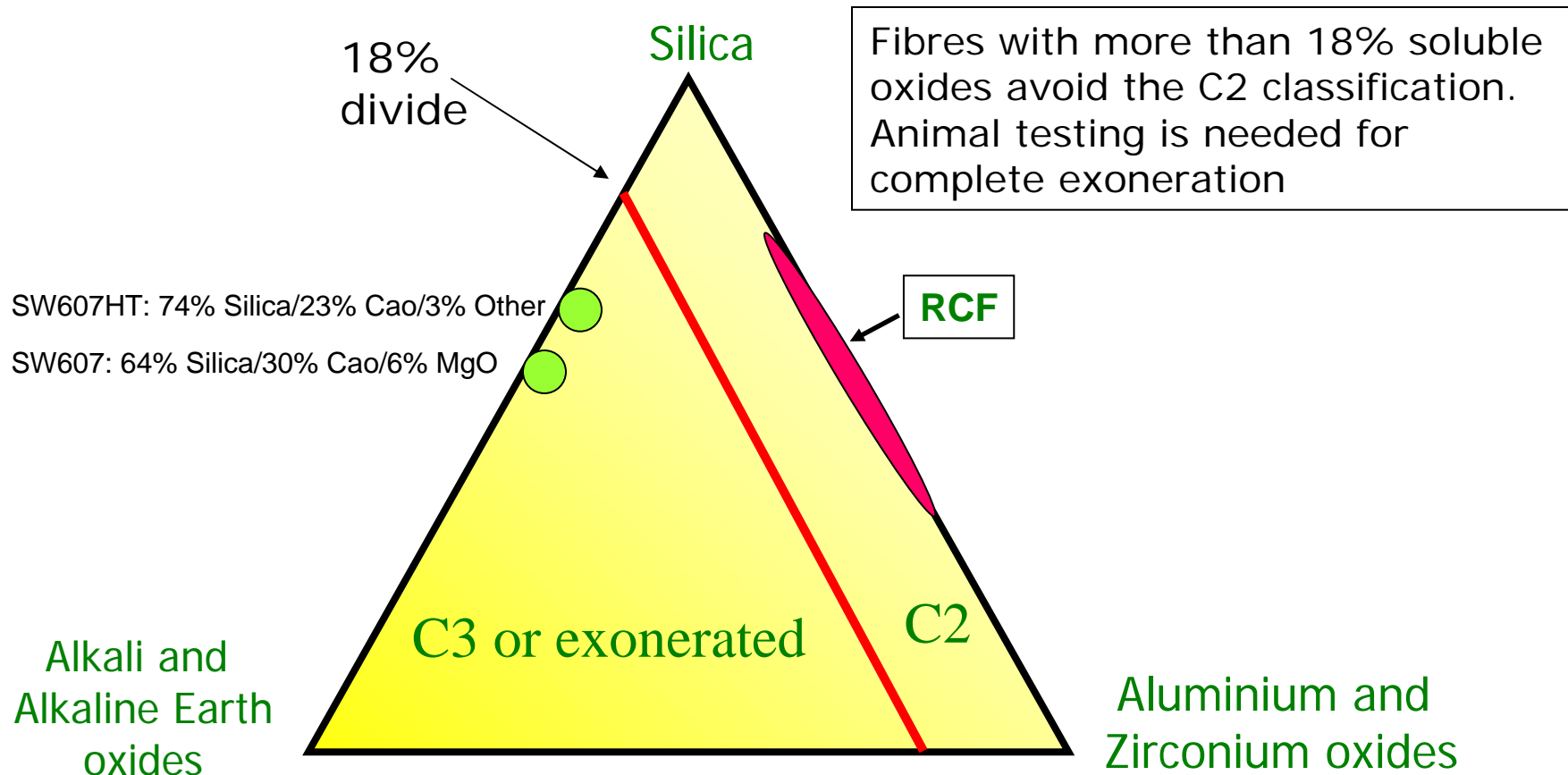
RCF alternatives

The industry (TC included) has developed a series of alternatives to RCF in many applications

Development of RCF Substitutes

- One unanimous recommendation given by all regulators is to look for alternatives to RCF.
- For many years, the refractory material industry have been providing a series of non-fibrous products that can be used as a alternative to RCF in a number of applications (IFB's, Monolithics, Micro-porous products).
- Furthermore, listening to its customers, TC has worked since early 90's on the development of fibrous alternatives.
- Over time this constant effort has provided fibrous alternatives with improved properties in terms of temperature, chemical stability and physical properties.
- All these products have been certified according to the latest available standards

RCF and AES materials on a chart showing the EU 18% oxides rule for vitreous silica fibres



Examples of some AES materials:

	Classification Temperature	Continuous Use Temp.	Comments
Superwool 607	1100°C	1000°C	Original Superwool, over 15 years market experience
Superwool 607HT	1300°C	1150°C	Highest melting point, launched in 2006
Superwool Plus	1200°C	1000°C	New manufacturing process gives improved insulation

Classification temperature: <4% shrinkage after 24 hours

Continuous Use Temp: Long term exposure in oxidising atmosphere

Short term exposure is permitted at temperatures up to Classification.

RCF Regulatory aspects Workplace Controls

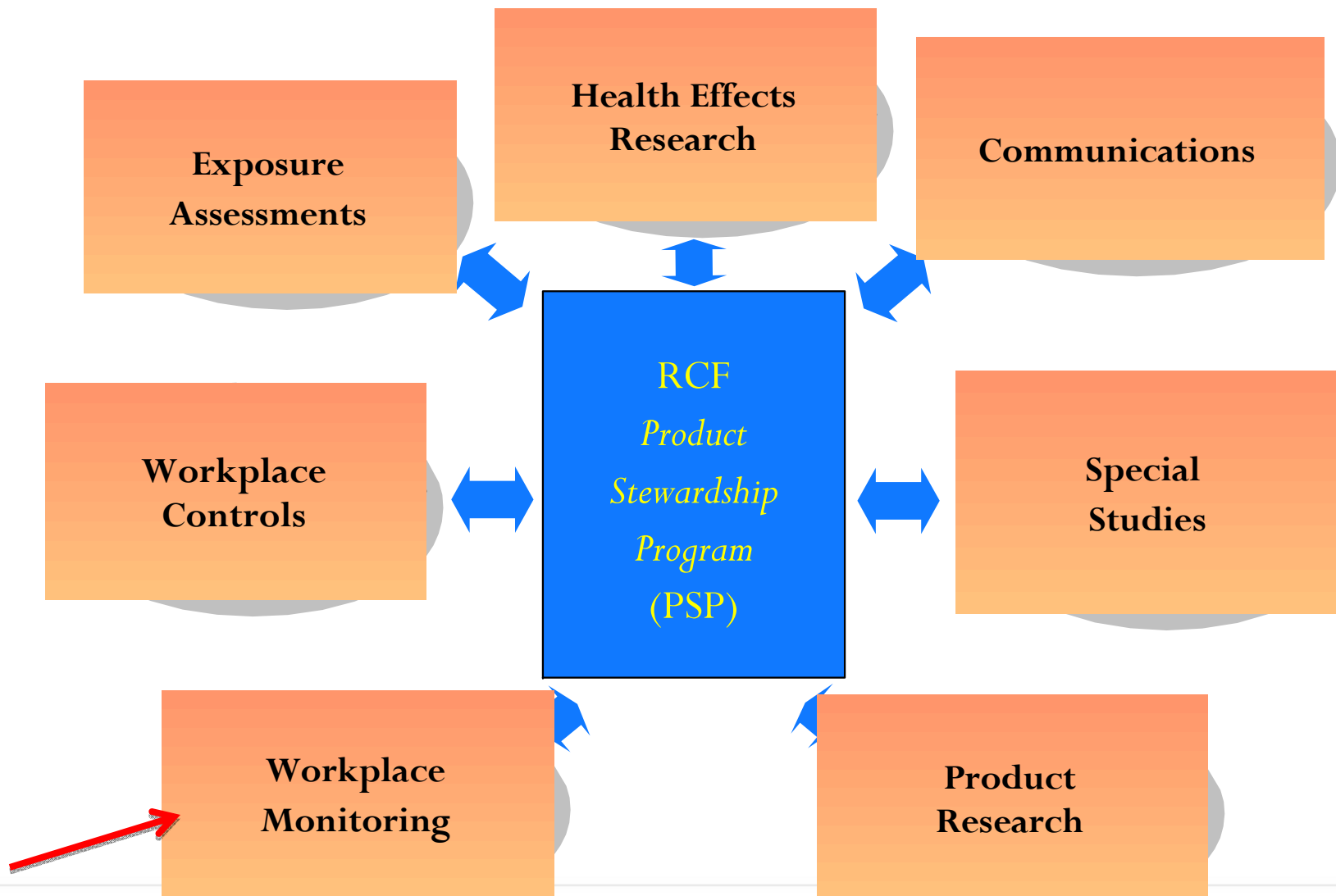
CA OSHA: New PEL for RCF in the Workplace

- The State of California Passed a Permissible Exposure Limit of 0.2 f/cc for Refractory Ceramic Fiber (RCF) on February 3, 2010
- Effective August 3, 2010
- Enforcement of California's occupational health standards is the responsibility of the Division of Occupational Safety and Health (DOSH).

Permissible Exposure Limit of 0.2 f/cc

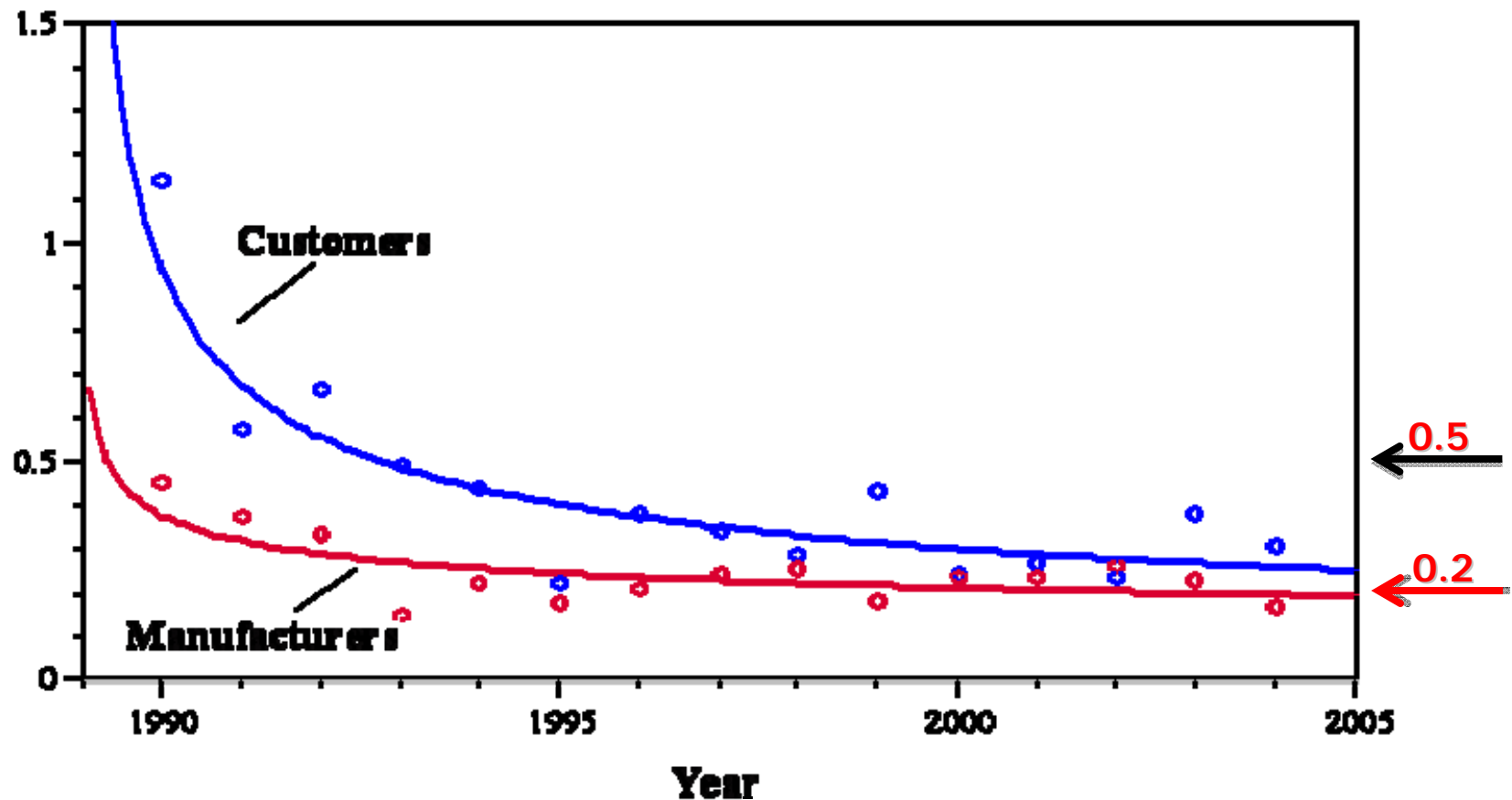
- What does it mean to my company?
- Are we in compliance?
- What is current industry exposure status?
- How can I establish my own RCF exposure profile?
- What can I do if my exposure exceeds the PEL?
- What are the control options for exposure reduction?
- How much will it cost to be in compliance?

Product Stewardship Program



Exposure Time Trends

Weighted Arithmetic Mean (f/ml)

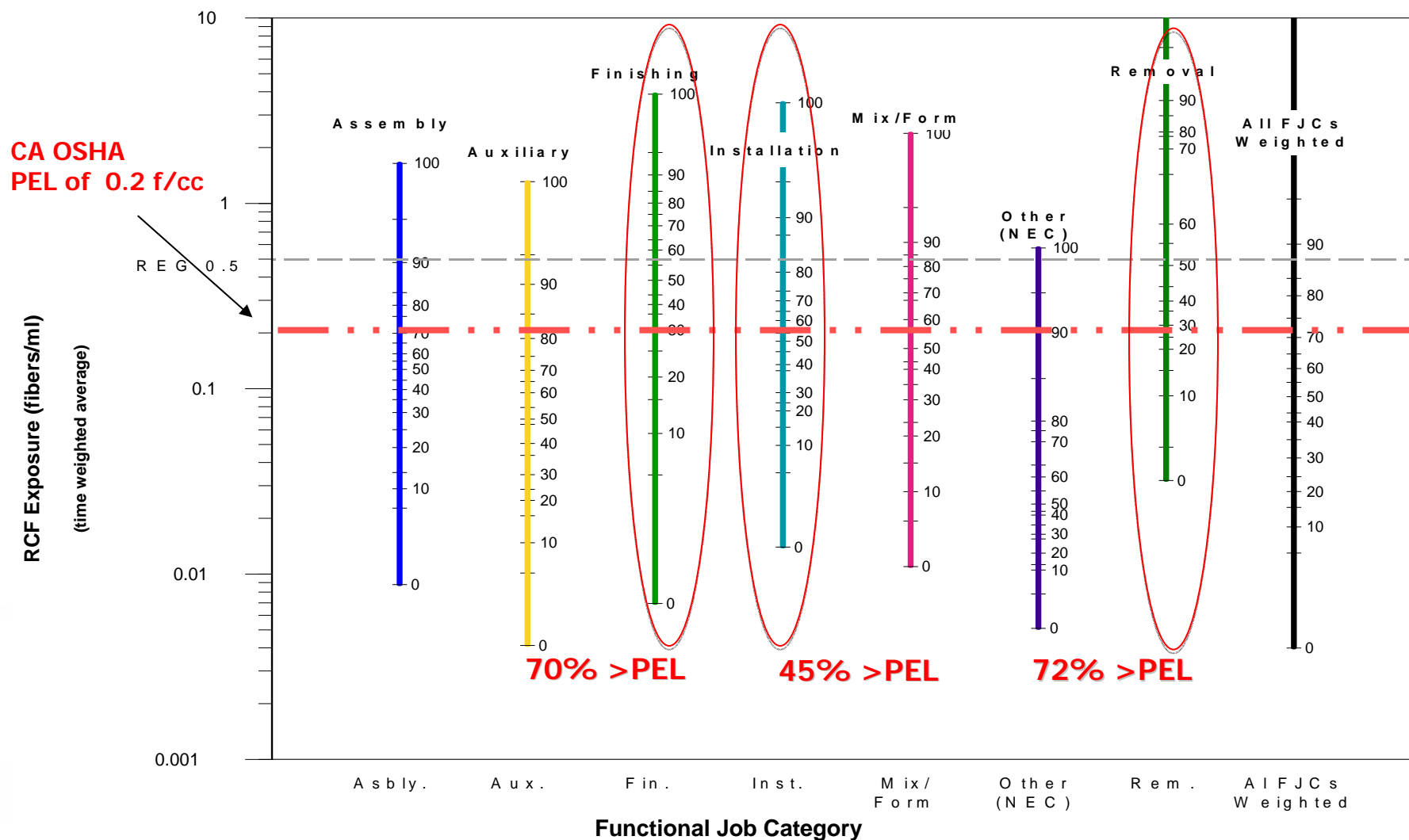


** Data weighted by population at risk in each different job functional category*

Job Functional Categories of PSP Monitoring Data

- **Finishing** - sanding or grinding, cutting, sawing, die cutting, milling or routing of RCF products
- **Installation** - fitting/packing/wrapping, cutting, pounding/tamping, and hardware installation
- **Removal** - furnace repair, disassembly of furnace/heater/oven, clean up/disposal, mode knock out
- **Assembly** - encapsulation/lamination, stapling, module fabrication, heater/oven assembly
- **Mixing/forming** - batching, casting, forming
- **Auxiliary** - maintenance, shipping, laboratory, Quality Control, supervision
- **Other** - paper making, textile, automotive
- **Fiber Production**

Exposure Data Ladder Diagram



Data set: Personal samples collected at customer plants from 2004 through 2008 (1,366 observations)

Exposure Monitoring – What you need to know

- Take representative sample air monitoring – NIOSH method 7400 (using B counting rule for respirable fiber)
- Determine compliance by compare 8-hour time weighted average exposure (8-hr TWA) to OSHA PEL
- $8\text{-hr TWA} = (T_1 \times C_1 + T_2 \times C_2 + T_3 \times C_3 + \dots) / T_{\text{total}} (480 \text{ min})$
- If 8-hr TWA < 0.2 f/cc, no action required, continue monitoring is recommended
- If 8-hr TWA > 0.2 f/cc, corrective actions need to be implemented to reduce exposure

What is Representative Sampling?

Prefer sampling approach -

- Take 8-hr TWA samples for different jobs/positions
- Using “robust and proactive sampling” base on “statistically driven, multiple-samples approaches” to establish your representative 8-hour TWA exposure

Alternative approach -

- Sample at worst condition or
- Sample at average condition

Work with your local professional IH specialist to determine your own unique sampling strategy

Locate an Industrial Hygienist via the *American Industrial Hygiene Association* web site, www.aiha.org

TWA found >0.2 f/cc – What do you do?

- Substitute with less hazardous material
- Engineering Controls - exposures shall be prevented by engineering controls whenever feasible
- Administrative Controls - whenever engineering controls are not feasible or do not achieve full compliance, administrative controls shall be implemented if practicable (e.g. job rotation; work practices)
- Control by Respiratory Protective Equipment –
 - Respiratory protective equipment can be used to prevent excessive exposures as follows:
 - During the time period necessary to install or implement feasible engineering controls;
 - Where feasible engineering controls and administrative controls fail to achieve full compliance
 - In case of emergencies

Engineering Control Example

Exhaust hood for mixing



Local exhaust for planer sander



Enclosure with exhaust ventilation



Local exhaust for disc sander



Engineering Control Example

Environmental Control Booth

for large RCF part manipulation of duct source can not easily be isolated



Engineering Control Example

Down Draft Bench

for RCF product sanding, blanket cutting or small assembly



DB-3000



Engineering Control Resources

- Consult engineer firms or manufacturers who specialize in industrial ventilation control such as:
 - Torit, www.donaldson.com
 - Camfil Farr APC, www.farrapc.com
 - United Air Specialists, www.uasinc.com
 - Air Flow Systems, www.airflowsystems.com
 - Microair, www.microaironline.com
 - Nilfisk, www.nilfiskcfm.com

Engineering Controls may be upset by...

- Cross wind from cooling fan use or any other surrounding activities
- Use of pressurized air for clean up
- Blockage of airflow
- Position of operator
- House keeping / clean up activities

Work Practice Guidelines

RCFC

■ Refractory
Ceramic
Fibers
Coalition

PSP 2000

Work Practice Guidelines

RCF Blanket Cutting

Cutting refractory ceramic fiber blanket is a common operation during its installation. Some workers performing this operation have been observed to have RCF exposures that exceed the industry recommended exposure guideline (REG) of 0.5 fibers/cc of air (8-hour TWA).

Effective engineering controls and proper work practices may reduce exposure to RCF. Engineering controls alone are not always sufficient, however, to reduce exposures below the REG. Therefore, proper work practices and personal protective equipment should always be used. Whenever possible, ensure blanket cutting is undertaken in a well-ventilated area.

The information and guidelines contained in the accompanying table are designed to assist customers in reducing workplace airborne RCF exposures. They are not intended to substitute for a comprehensive exposure assessment or engineering controls evaluation of the RCF manufacturing facility and its processes.

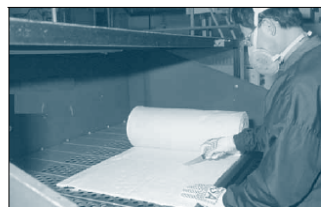
Want more information?

Contact the RCFC or a member company for more information:

Thermal Ceramics
800-722-5681

Unifrax Corporation
800-322-2293

Vesuvius USA Corporation
800-355-1100



March 2001

RCF Blanket Cutting

ENGINEERING CONTROLS

1. Local exhaust ventilation (LEV) should be used at the point of generation of the RCF and particulate material. Capture and transport velocities of the LEV system must be sufficient to capture and remove the airborne material and to prevent the material from reaching the breathing zone of the operator. In general, for manual cutting, a capture velocity of 150 to 250 feet per minute (fpm) and a transport velocity of 3,000 to 4,000 fpm are recommended. Please refer to ACGIH's Industrial Ventilation - A Manual of Recommended Practice¹ or consult an engineer specializing in industrial ventilation for proper LEV system design specifications.

2. If a band saw is used for finishing, refer to RCFC "Unit Operational Code of Practice & Engineering Control Guidebook"². Band Saws for reference. In addition, cross-drafts created by fan use, traffic, or makeup air in the area may affect the efficiency of the LEV.

WORK PRACTICES

1. Ensure LEV system is operating properly.

2. Avoid performing blanket cutting operations in any manner that would create unnecessary generation of airborne dust. Hand tools, rather than mechanical tools, should be used whenever possible.

3. Do not throw, drop, or handle RCF materials excessively. Gently place RCF materials in staging area or packaging material.

4. Keep work area clean. Do not permit RCF waste material to accumulate in the work area. (Waste or scrap material should be placed into a covered container.) Waste or scrap RCF materials should be removed from the work area often to avoid unnecessary generation of airborne dust.

5. Use a HEPA-filtered vacuum or wet sweeping methods for clean-up when vacuuming is not possible.

6. Clean personal clothing with HEPA-filtered vacuum before leaving the work area.

7. Launder work clothes separately.

8. DO NOT USE COMPRESSED AIR FOR CLEAN-UP ACTIVITIES!

PERSONAL PROTECTIVE EQUIPMENT

1. Because blanket cutting activities can result in exposures in excess of the REG, the use of a half-face respirator with P-100 filters is recommended.

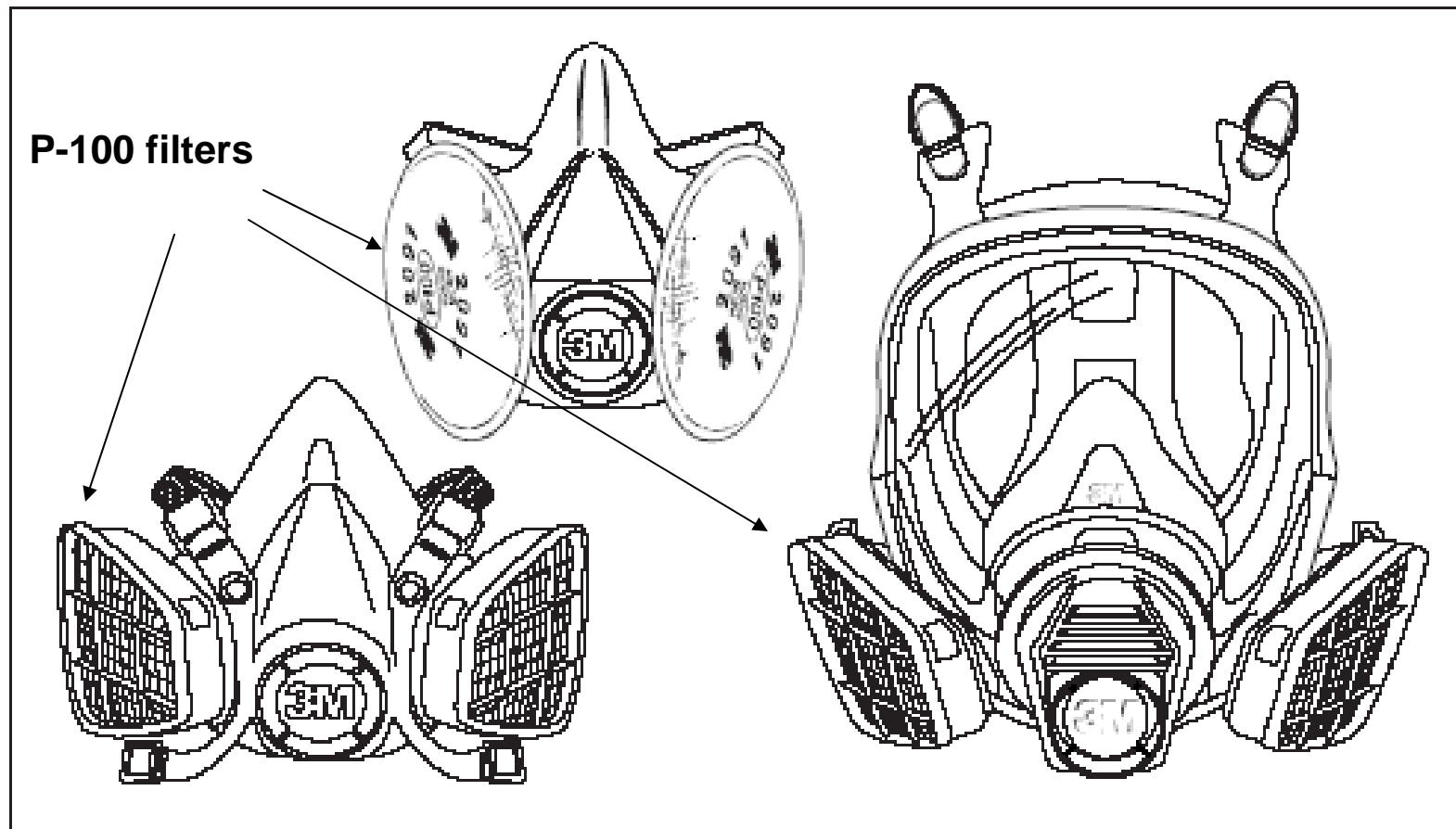
NOTE: If occupational RCF exposure levels are known, a lower level of respiratory protection may be used as recommended in the Material Safety Data Sheet guide lines.

2. Long-sleeved clothing or disposable coveralls.

3. Gloves.

4. Safety glasses or goggles.

Respiratory Protection



**The 3M™ Half and Full Facepiece Respirators 6000 Series,
Reusable with replaceable cartridges/filters**

Respirator Selection

Table I: Assigned Protection Factors~

Type of Respirator	Quarter mask	Half mask	Full facepiece	Helmet/Hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	10	50	—	—
2. Powered Air-Purifying Respirator (PAPR)	—	50	1,000	25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	—	10	50	—	—
• Continuous flow mode	—	50	1,000	25/1,000	25
• Pressure-demand or other positive-pressure mode	—	50	1,000	—	—
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	—	10	50	50	—
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	—	—	10,000	10,000	—



Written Respiratory Protection Program

Mandatory elements of a Respiratory Protection Program:

- Respirator selection
- Medical Evaluations
- Fit-testing
- Respirator storage, cleaning, maintenance and repair
- Respirator Use
- Maintenance and care of respirators
- Breathing air quality and use (when supply-air respirators are used)
- Training and information
- Program Evaluation

Cost Estimates for Compliance – Cal. OSHA (annual costs per worker)

	<u>VACUUM FORMERS</u>	<u>FABRICATION</u>	<u>FURNACE RELATED</u>
HEPA vacuums	\$ 500	0	\$ 502
Engineering controls	\$1,363	0	0
Monitoring program	\$ 500	\$ 500	\$ 500
Disposable PPE	\$ 0	\$ 0	\$ 0
Respirator costs	\$ 600	\$ 600	\$ 394
Training, Compliance Program			
Fit testing, & Records	\$ 156	\$ 149	\$ 339
California OSHA	\$2,963	\$1,249	\$1,735
RCFC	\$11,381	\$7,019	\$4,504

Summary

- New PEL poses a challenge to the use of RCF in California
- If possible, substitution could be considered?
- Many applications will need engineering control (EC) to reduce fiber exposure
- Routine air monitoring becomes a must
- However, well designed EC still needs to cope with stringent work practices, OP&M procedure to achieve lower exposure
- There is no guarantee of low exposure even with EC on many of the applications
- When respirator is used, a mandatory “respiratory protection program” must be implemented
- (REACH)- In the case of export article containing RCF, care should be taken to review the most recent REACH policy details

Questions?

- RCFC website, www.RCFC.net
- ECFIA website, www.EFICA.eu
- Your local Thermal Ceramics Representative
- Thermal Ceramics PSP Hotline for Health & Safety
1-800-722-5681
- Steve.Chen@thermalceramics.com



Thermal Ceramics

Insulating Our World