Refractory ceramic fibers (RCF) as an alternative to asbestos

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Contents

Fibers

Length > 5 µm

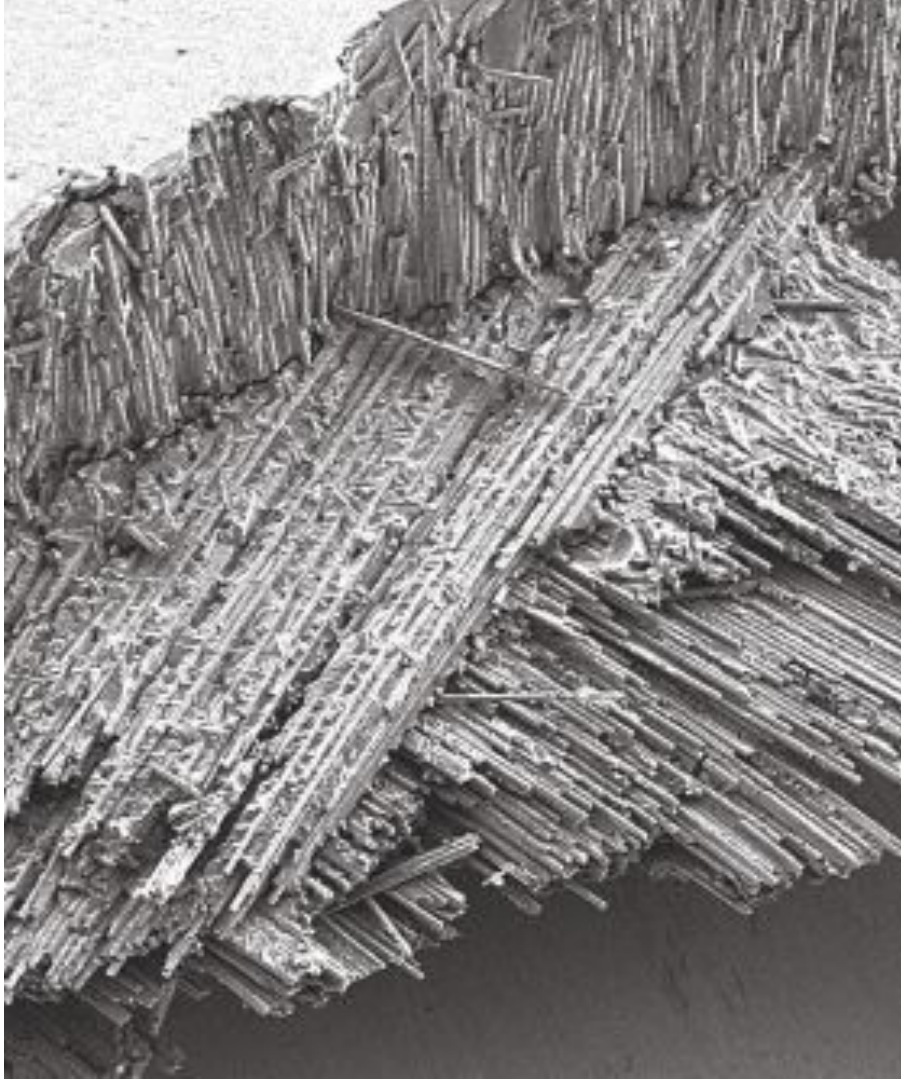
Diameter < 3 µm

Length/Diameter ratio > 3

Elasticity, resistance to heat/chemicals are often key properties

Refractory : resistant

Ceramic : Amorphous material formed by heat



Types of fibers

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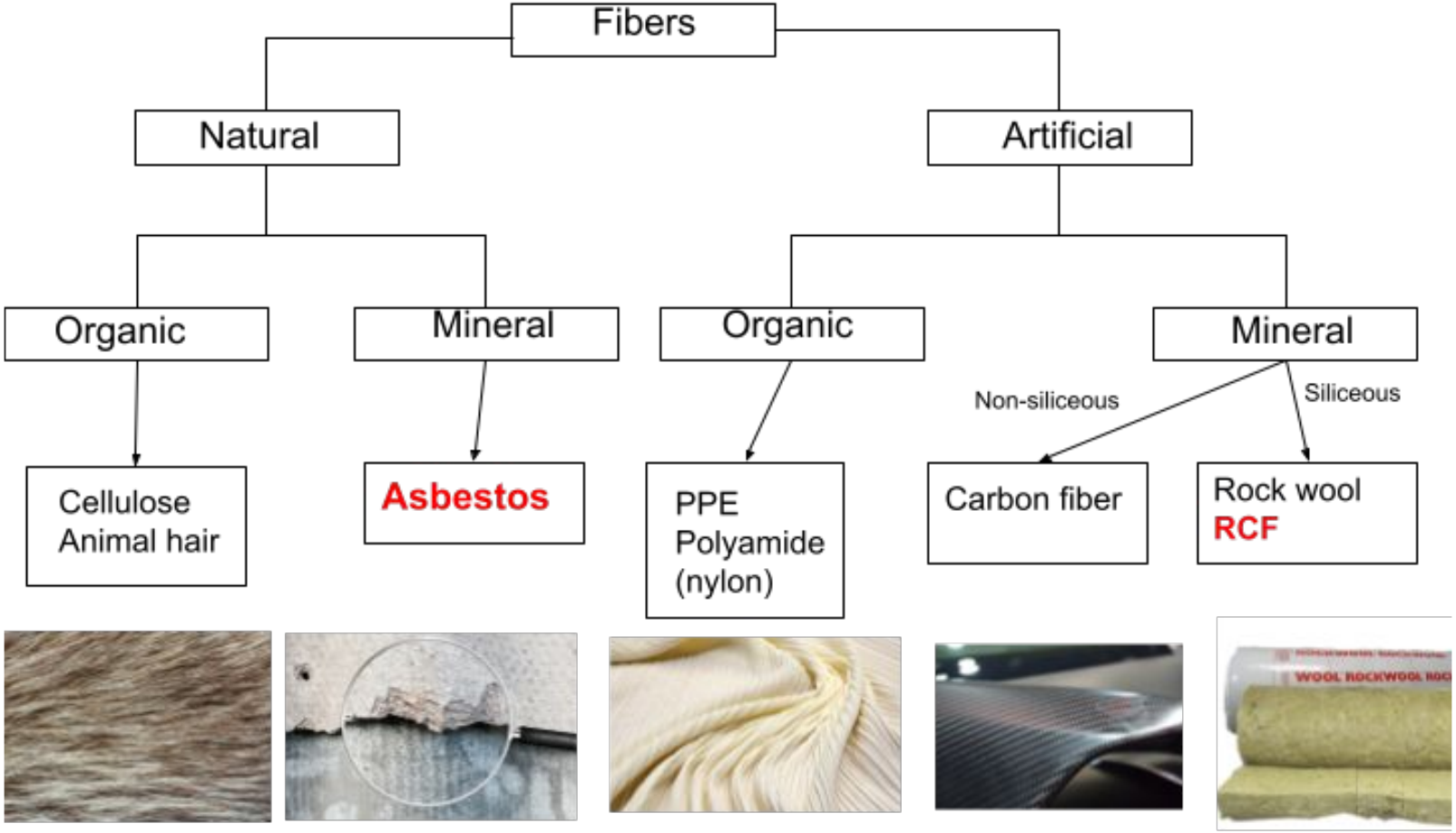
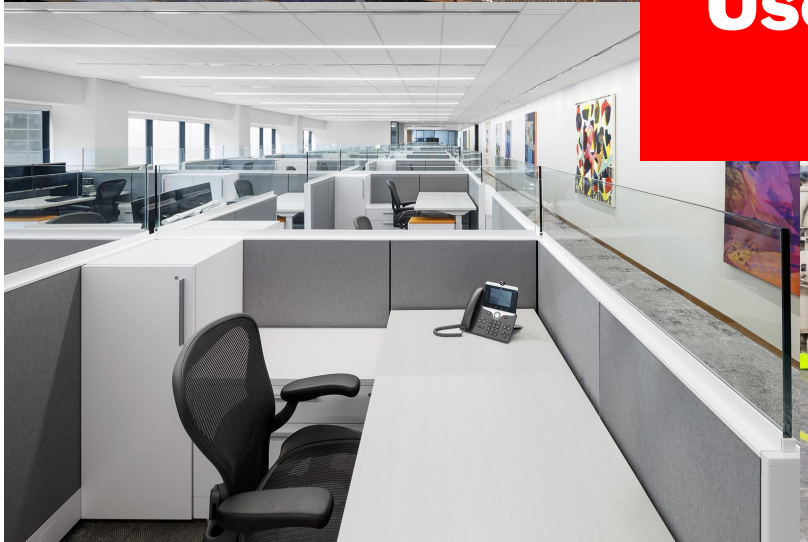


Uses



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Main similarities and differences between asbestos and RCF

	Asbestos	RCF
Chemical formula	$Mg_3Si_2O_5(OH)_4$ (chrysotile)	$x(Al_2O_3)$ $y(SiO_2)$
Thermal resistance	1000°C	1500°C
Uses	Historically widely used	High temperature industries
Source	Natural	Artificial
Effect on health	Respiratory issues	Respiratory issues

Hazard identification

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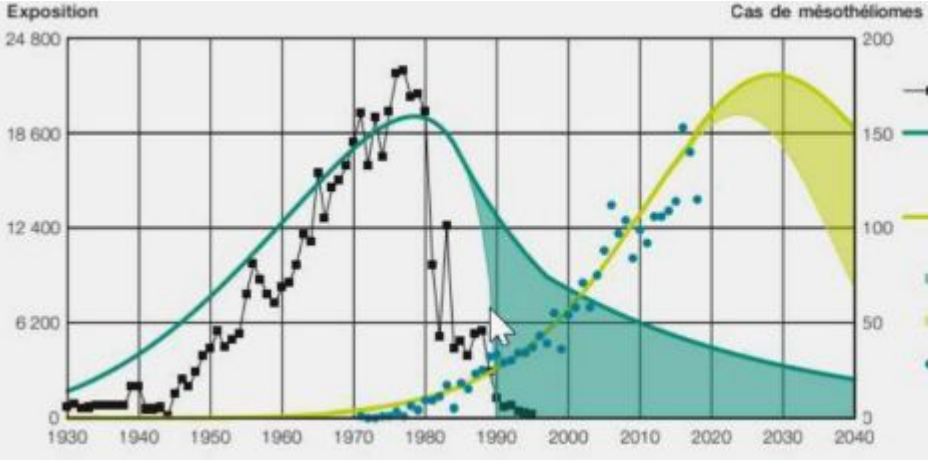
	Asbestos	RCF
Exposure route	Inhalation	Inhalation
Specific issues	Asbestosis, Mesothelioma, Damage to lungs	Skin and eye irritation, cough, dyspnea, pleural plaques
Carcinogenicity classification (IARC)	Group 1 (Carcinogenic to humans)	Group 2B (Possibly carcinogenic to humans)
Weighted halftime in human body	400 to 900 days	100 days

Risk assessment

Risk assessment



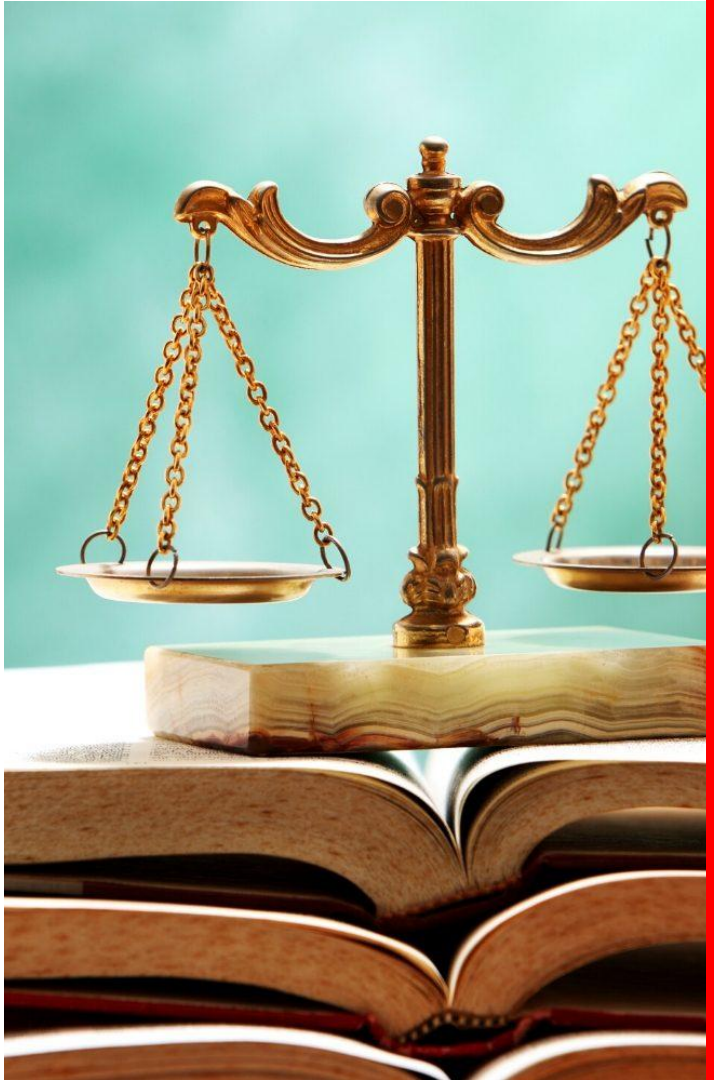
Delay of 30-40 years between exposure and disease
Exposure much lower than for asbestos : 0.6 fb/ml vs 10-100 fb/ml on avg

Workers exposed : 30’000 (US), 25’000 (EU)
20 to 40% of workers > recommended limit
Animal studies showed cancer risks, but no human cancer increase
Clear increase of pleural plaques in exposed workers

Risk assessment

To summarize, the risk is low, because :

- Only mild respiratory symptoms have been associated
- Exposure is much lower than asbestos
- Bio persistence is lower
- RCFs are present only in controlled environments and can be monitored
- “ the maximum likelihood estimate of the incremental risk associated with a working lifetime exposure to RCF at 1 fb/ml was approximately 4.4×10−5” (Moolgavkar et al. (2000))



Relevant regulations

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- Ban of asbestos in Switzerland in 1989
- REACH Regulation (ECHA) : DNEL = 2.17 fb/ml in 2010
- BOEL in EU regulation : 0.3 fb/ml. Developed with ECFIA in 2017
- US : Product stewardship program (PSP) by the RCF industry in collaboration with OSHA and NIOSH. Guideline of 0.5 fb/ml → reduce risks to levels between 0.073/1000 and 1.2/1000
- Category 2 carcinogen in EU → Obligation to reduce and replace under ALARP

Recommendations

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- Closed systems and ventilation
- Wetting and use of manual tools to limit fibers in the air
- PPE : wear goggles and suit if needed
- Use of respirators and monitoring for most affected workers (guided by the PSPs)
- Substitute with AES

References

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