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Resilient Flooring Alternatives for Health Care: Benefits and Challenges

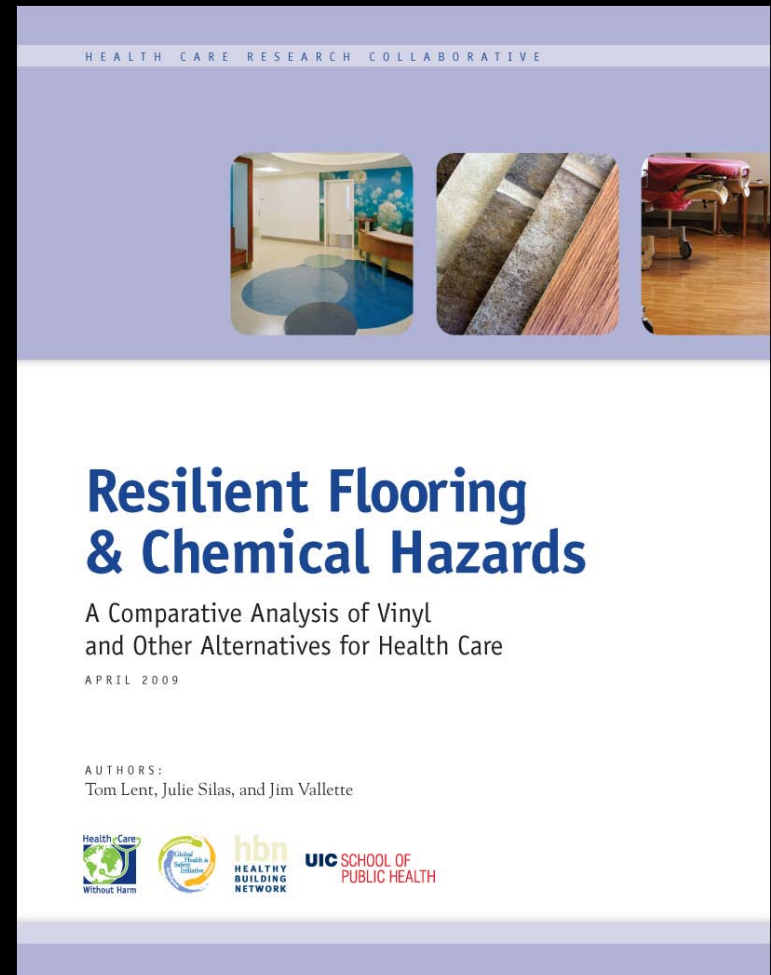
Julie Silas
Director, Health Care Projects
Healthy Building Network
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Resilient Flooring Alternatives for Health Care: Benefits and Challenges

Potential health impacts of 4 resilient flooring materials: vinyl (VCT and sheet flooring), synthetic rubber (SBR), polyolefins (Stratica), and linoleum. A content analysis of stock intermediaries, chemical manufacturers, and other alternatives through health care.

- Synthetic rubber (SBR)
- Polyolefins (Stratica)
- Linoleum



Chemical Hazard-Based Framework

Focus on Analysis looks at: persistent, bioaccumulative toxicants (PBTs), bioaccumulative toxicants (BPTs), carcinogens, mutagens or reproductive toxicants (CMRs)

- Human exposure

Authoritative bodies include IARC, Stockholm POPs, the EPA, NTP, California Prop65, and others

Table 4: Resilient Flooring Chemical Listings on Hazard Databases

Chemicals	CAS No	CA Prop 65	EC CMR	EC ESIS	EC Risk	EPA IRIS	EPA NWMF	EPA PPT	EPA TRI	IARC	Lancell	NTP ROC	OSF	UNPOF	UNPOPRC	WA PBT
1,3-butadiene	106-99-0	X	X		X	X				X		X				
1,1,1-trichloroethane	71-55-6				X						X					
Acetaldehyde	75-07-0	X			X					X		X				
Acrylic acid	79-10-7				X											
Acrylonitrile	107-13-1	X	X		X	X						X				
Antimony trioxide	1309-64-4	X			X					X						
Asbestos	1332-21-4	X				X				X		X				
Benzene	71-43-2	X	X			X				X						
Benzo(a,h)perylene	191-24-2						X		X							X
Benzo(a)pyrene	1689-84-5	X														
Butyl benzyl phthalate (BBP or BzBP)	85-68-7	X	X		X	X							X			
Cadmium	7440-43-9	X			X	X	X			X						X
Carbon black (pigment)	1333-86-4	X								X						
Chlorinated paraffins	85535-84-8	X		X	X							X			X	X
Chlorine	7782-50-5				X											
decaBDE	1163-19-5			X								X	X			X
Di(2-ethylhexyl) phthalate (DEHP)	117-81-7	X	X		X	X						X	X			
Dimethylformamide	68-12-2			X	X											
D-n-hexyl phthalate (DnHP)	84-75-3	X														
Dioxins	1746-01-6	X					X	X	X	X		X	X	X	X	X
Dithiocarbamates	Multiple											X				
Epichlorohydrin	106-89-8	X	X			X				X		X				
Ethylbenzene	100-41-4	X								X						
Ethylene	74-85-1										X					
Ethylene dichloride (EDC)	107-06-2	X				X						X				
Ethylene oxide	75-21-8	X	X		X					X	X	X				
Formaldehyde	50-00-0	X				X				X		X				
Hexachlorobenzene (HCB)	118-74-1	X	X	X	X		X	X	X	X	X	X		X		X
Lead	1-12-8	X				X	X	X	X	X	X	X	X			X
Mercury	7439-97-6	X			X		X	X	X	X	X	X				
PFOS	29457-72-5															X
Polychlorinated biphenyls (PCBs)	1336-36-3	X	X	X	X		X	X	X		X	X	X	X		X
Polycyclic aromatic compounds	65996-93-2			X			X				X	X				X
Styrene	100-42-5									X	X		X			
Titanium dioxide	13463-67-7									X						
Toluene	108-88-3	X									X	X				
Tributyltin	688-73-3												X			
Trichloro-	52-68-6										X					
Toluene	1582-09-8					X	X	X		X			X			
Vinyl acetate	108-05-4									X						
Vinyl chloride	75-01-4	X	X			X				X	X	X				
Zinc	7440-66				X											



Vinyl

Most pervasive presence of unavoidable PBTs in its life cycle

Primary chemicals in the manufacture of vinyl are carcinogens

User and manufacturing exposure issues

Additives

Synthetic Rubber

Primary compound (SBR) dependent on 2 carcinogenic feedstock chemicals

Content includes a substantial amount of PBTs

TRI releases

Concern with recycled content made from rubber tires

Carl J. & Ruth Shapiro Cardiovascular Center
Nora Rubber Flooring

Photo courtesy of Brigham & Women's Hospital



Queen of the Valley Medical Center - Surgery Center
Mondo Rubber Flooring

Photo by: Solar Eye Communications



Polyolefins

Reviewed 1 specific product - *Stratica* - used in health care

Manufactured overseas, no access to manufacturing emissions data

Few, if any, known PBT or VOC problems

Feedstock chemical may convert to carcinogen



Kaiser Permanente Medical Center - Santa Teresa-San Jose

Stratica Photos courtesy of Kaiser Permanente

Linoleum

**Only material containing
biobased content**

**Manufactured overseas, no
access to manufacturing
emissions**

**PBTs used in the growing of
flax feedstock (pesticides)
and eutrophication**

**User exposures with VOCs
and odors**

Maimonides Medical Center
Forbo Linoleum
Photos courtesy of Perkins + Will



Photo by Paul Rivera



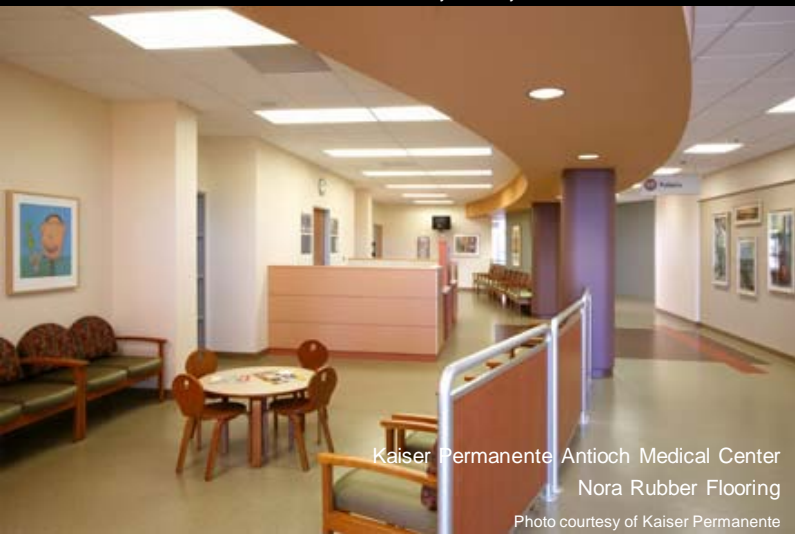
Photo by Frank Oudeman

VOCs and Resilient Flooring

Most certified to meet IAQ standards
Still present exposure concerns



St. Joseph Hospital Patient Care Center - Operating Room
Nora Rubber Flooring
Photo by: Solar Eye Communications

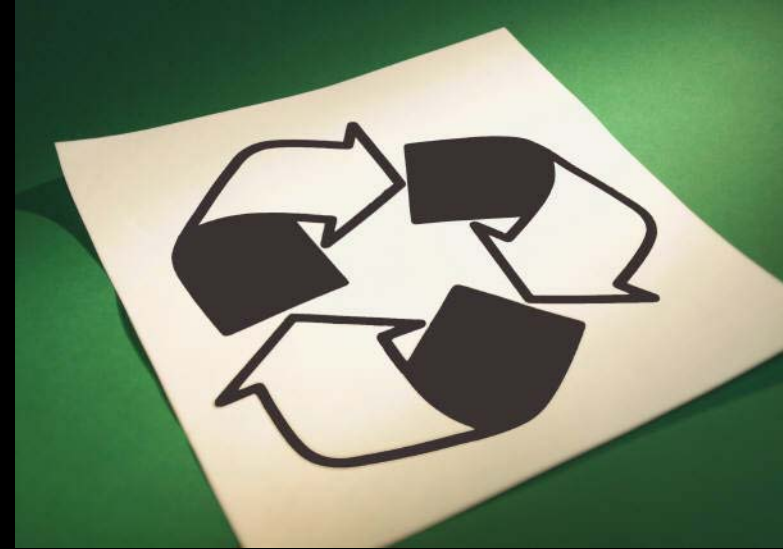


Kaiser Permanente Antioch Medical Center
Nora Rubber Flooring
Photo courtesy of Kaiser Permanente

- Standards don't cover all compounds of concern - e.g., PFCs, heavy metals, phthalates
- Individually may be below thresholds of testing, but may still be problematic in combination

Recycled Content

All materials demonstrate potential to be recycled



None currently use significant amounts of post-consumer recycled content, exception recycled tire rubber

Products with most post-consumer still have toxic issues associated with the processes.

Most are employing downcycling, none are closing the loop



Summary

Table 3. Life Cycle Comparison of Flooring Material Types

	Issues	PVC/Vinyl Reference		Synthetic Rubber (SBR)		Polyolefin (Stratica)		Linoleum
Raw material	Biobased content	None	=	None	=	None	+	High, but ag practices need improvement
	Post consumer recycled content	Virtually none	?	Some have but may be toxic	=	None	=	No PC, highest PI (post industrial)
	POPs, other PBTs, CMRs	Many in petroleum extraction & refining	=	Many - petroleum extraction & refining	=	Many - petroleum extraction & refining	+	Few - pesticides can be eliminated
Manufacturing	POPs	Many, major dioxin source	+	None identified	+	None identified	+	None
	Other PBTs	Many but may be able to be designed out	=	Many but may be able to be designed out	+	None identified	++	
	CMRs	Many integral	=	Many integral	+	Few - all optional, ex ethylene	++	Many but may be able to eliminate all
Use	Heavy metals & flame retardants	Many but may be able to be designed out	=	Many but may be able to be designed out	++	None	++	None
	Phthalates	Many but may be able to be designed out	+	None	+	None	+	None
	VOC	Many. May reduce but not eliminate	=	Many. May reduce but not eliminate	=	Many. May reduce but not eliminate	=	Many. May reduce but not eliminate
End of Life	Recycling or composting	Small experimental recycling	-	None	-	None	=	Small experimental composting
	POPs	Major dioxin source	+	None identified	+	None identified	+	None identified

Material types vary in amount, extent & exposure. As currently produced, no resilient options for health care are hazard free

Key: Comparison to vinyl ? Unclear - Worse = Similar + Better ++ Best

Linoleum

The most preferable product re: chemical hazards

Strong prospects for minimizing chemical hazards - reducing remaining PBTs and CMRs

Biobased content - compostable

Caveat - agricultural practices

Polyolefins (Stratica)

Most preferable of petroleum-based products

Appears PBT-free, problematic re: CMRs

Petroleum-based

Caveat - only reviewed Stratica

Synthetic Rubber

(SBR)

Less preferable re:
chemical hazards

High concern chemicals in
feedstock can't be
eliminated - CMRs

Petroleum-based -
some with high
recycled content

Caveat - Recycled
content of tire rubber =
health issues

Vinyl/VCT

Least preferable re:
chemical hazards

High concern chemicals in
feedstock can't be
eliminated - CMRs **AND**
PBT byproducts

Petroleum-based

Caveat - small
experimental
recycled content

What's Next?

Installation and maintenance issues associated with resilient flooring

More research needed to explore

- **Adhesives;**
- **Coatings;**
- **Cost;**
- **Durability;**
- **Performance; and**
- **Acoustics issues**



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Resources

Healthy Building Network
www.healthybuilding.net

Health Care Without Harm
www.noharm.org

Global Health and Safety Initiative
www.globalhealthsafety.org

