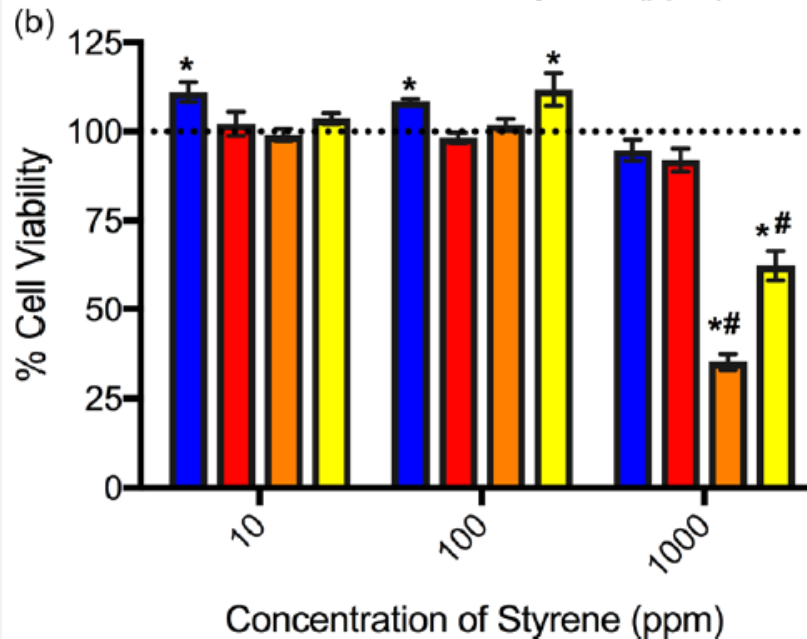
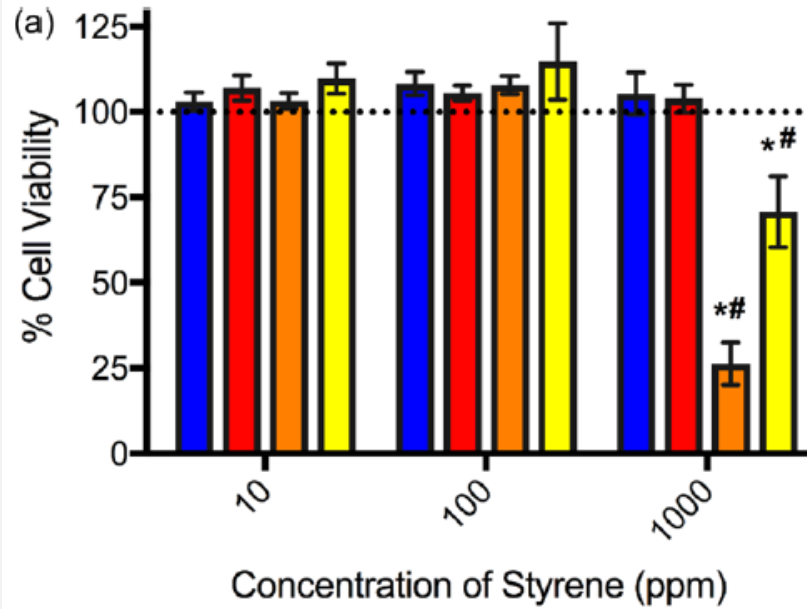


# HOW toxic is styrene from CIPP?



## Toxicity study (MTT assay) for styrene

- (a) Mouse alveolar type II epithelial cells
- (b) macrophages

CIPP condensate-exposed cells for 24 h at a styrene concentration of 10, 100, or 1,000 ppm

Styrene conc. in CIPP condensate is about **1800 ~ 4300 ppm**

Kobos et al., 2019



# WHAT are possible emission and exposure standards for styrene?

Max concentration of styrene in most of CIPP worksite *exceeded the current safety limits*

Units: ppm

Limits for residential and building occupants		Limits for workers			
EPA Acute	Odor threshold	OSHA PEL (TWA)	OSHA Peak	ACGIH TLV	NIOSH IDLH
4.9	0.016	100	600	20	700

Max. conc. reported in studies			
Purdue [Field]	NASSCO LATECH [Field]	LAX [Field]	NIOSH [lab-scale]
4,300	1,820	1,070	5,160

[ Terms ]

PEL: Permissible Exposure Limit

TLV: Threshold Limit Values

IDLH: Immediately Dangerous To Life or Health

Peak: Allowable level for a single time period up to 5 mins for any 3 hrs

# WHAT are other air-contamination risks?

More than 9 chemical compounds are included in *EPA 189 Hazardous Air Pollutants*

Units: ppm

	Odor threshold *	OSHA PEL (TWA)	NIOSH IDLH
Acetophenone	0.00024	[ACGIH TLV] 10	-
Benzene	0.47	1	500
Chloroform	0.102	[ceiling] 50	500
Dibutyl phthalate (DBP)	0.023	0.43	345
Ethylbenzene	< 0.002	100	800
Methylene chloride	1.2	25	2300
Phenol	0.0045	5	250
Toluene	0.021	200	500
Xylene (total)	0.012	100	900

Odor threshold reference \*

American Industrial Hygiene Association (AIHA), 2013