

# Some CIPP ingredients (initiators) are designed to react and form new chemicals

## Trigonox®

Acetone  
Acetophenone  
**Benzene**  
Benzoic acid  
*tert*-Amyl alcohol  
*tert*-Butanol  
3-*tert*-Butoxyheptane  
2-*tert*-Butyloxy-2,4,4-trimethylpentane  
Carbon dioxide  
3-(1,1-Dimethylpropoxy) heptane  
Ethane  
2-Ethylhexanoic acid  
Heptane  
Methane  
2-Phenylisopropanol  
3,3,5-Trimethylcyclohexanone

## Perkadox®

**Benzene**  
Benzoic acid  
4-*tert*-Butylcyclohexanone  
4-*tert*-Butylcyclohexanol  
Carbon dioxide  
Diphenyl  
Phenylbenzoate  
Tetradecanol

## Butanox®

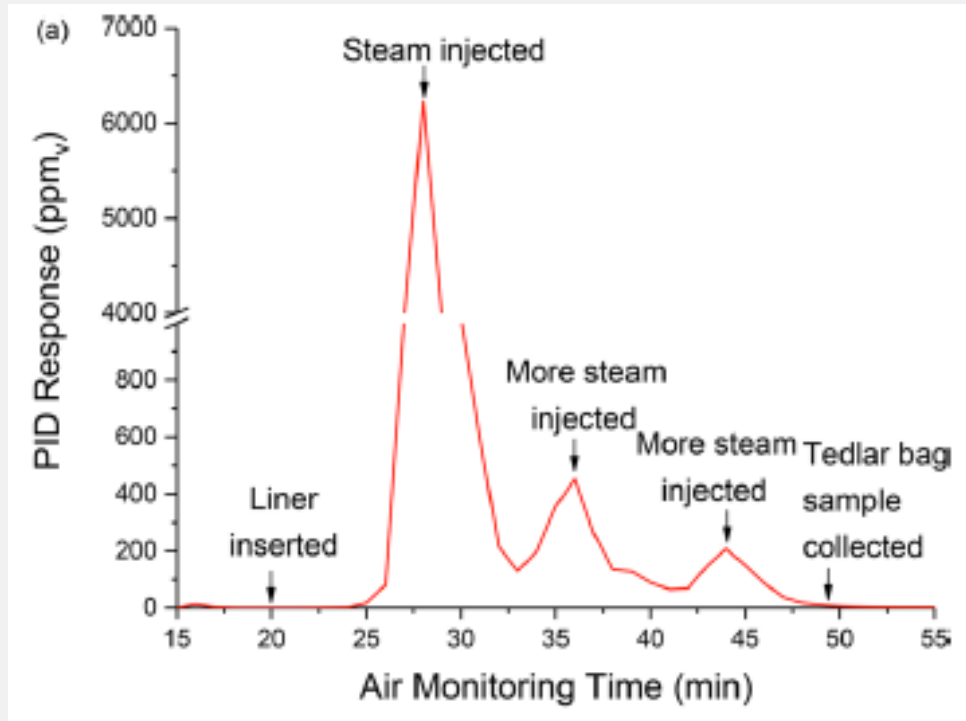
Acetic acid  
Carbon dioxide  
Formic acid  
Propanoic acid  
**Methyl ethyl ketone**

## *N,N*-Dimethylaniline

Aniline  
Carbon oxides  
Nitric oxides

# WHAT chemicals are discharged into air?

PID air monitoring result in IN CIPP worksite



Seyedeh Mahboobeh et al., 2017

\*Investigators speculated that styrene caused the PID response

In addition to Styrene<sup>a,b,c</sup>, other chemical compounds were detected

Acetone	4-(1,1-Dimethyl) cyclohexanol
Acetophenone	4-(1,1-Dimethyl) cyclohexanone
Benzaldehyde	1-Dodecanol
Benzene	Ethylbenzene
Benzoic acid	3-Heptanol
BHT	Isopropylbenzene
tert-Butyl alcohol	<i>p</i> -Isopropyltoluene
tert-Butyl benzene	Methylene chloride
4- <i>tert</i> -Butylcyclohexanone	<i>N</i> -Propylbenzene
4- <i>tert</i> -Butylcyclohexanol	Phenol
Chloroform	1-Tetradecanol
<i>o</i> -Chlorotoluene	Toluene
Diallyl phthalate (DAP)	1,2,4-Trimethylbenzene
Dibutyl phthalate (DBP)	1,3,5-Trimethylbenzene
Diethyl phthalate (DEP)	Xylene (total)
Di(2-ethylhexyl) phthalate (DEHP)	And more...

# WHAT chemicals are created onsite?

In addition to Styrene<sup>a,b,c</sup>, other chemical compounds were detected

Acetone	4-(1,1-Dimethyl)cyclohexanol
Acetophenone	4-(1,1-Dimethyl)cyclohexanone
<b>Benzaldehyde</b>	1-Dodecanol
Benzene	Ethylbenzene
Benzoic acid	3-Heptanol
<b>BHT</b>	Isopropylbenzene
tert-Butyl alcohol	<i>p</i> -Isopropyltoluene
t-Butyl benzene	Methylene chloride
4- <i>tert</i> -Butylcyclohexanone	<i>N</i> -Propylbenzene
4- <i>tert</i> -Butylcyclohexanol	Phenol
Chloroform	1-Tetradecanol
<i>o</i> -Chlorotoluene	Toluene
Diallyl phthalate (DAP)	1,2,4-Trimethylbenzene
Dibutyl phthalate (DBP)	1,3,5-Trimethylbenzene
Diethyl phthalate (DEP)	<b>Xylene (total)</b>
Di(2-ethylhexyl) phthalate (DEHP)	And more...

Only Styrene, benzaldehyde, BHT, and xylene were detected in the uncured resin tubes

Non-styrene compounds were likely created during curing and other manufacturing process

Teimouri et al. 2017. Worksite Chemical Air Emissions and Worker Exposure during Sanitary Sewer and Stormwater Pipe Rehabilitation Using Cured-in-Place-Pipe (CIPP). OPEN ACCESS. *Env. Sci. Technol. Letters*.

<https://doi.org/10.1021/acs.estlett.7b00237>

Ra et al. 2018. Critical Review: Surface Water & Stormwater Quality Impacts of Cured-In-Place-Pipe Repairs. *J. Am. Water Works Assoc.* OPEN ACCESS.

<https://doi.org/10.1002/awwa.1042>

# WHY CIPP associated chemical exposures can be serious?

- 1) Material SDSs do not list all chemicals of concern released including carcinogens, EDCs, and HAPs
- 2) New chemicals are created during CIPP plastic manufacture
- 3) Standard CIPP = Emissions are *-not-* captured. Instead, blown into public spaces, often buildings.
- 4) Most prior air testing only looked for styrene in air

1,820+ ppm exiting CIPP liner delivery truck, St. Louis, MO (2019)

86+ ppm & 1+ ppm methylene chloride exiting pipes, Sacramento, CA (2017)

250-1,070 ppm exiting manhole in downtown Los Angeles, CA (2014)

10s-100s ppm exiting pipes, manholes into air for several studies

- 5) But, *non-styrene* chemicals are released and can pose risks [Inhalation Toxicology, Kobos et al. 2019]