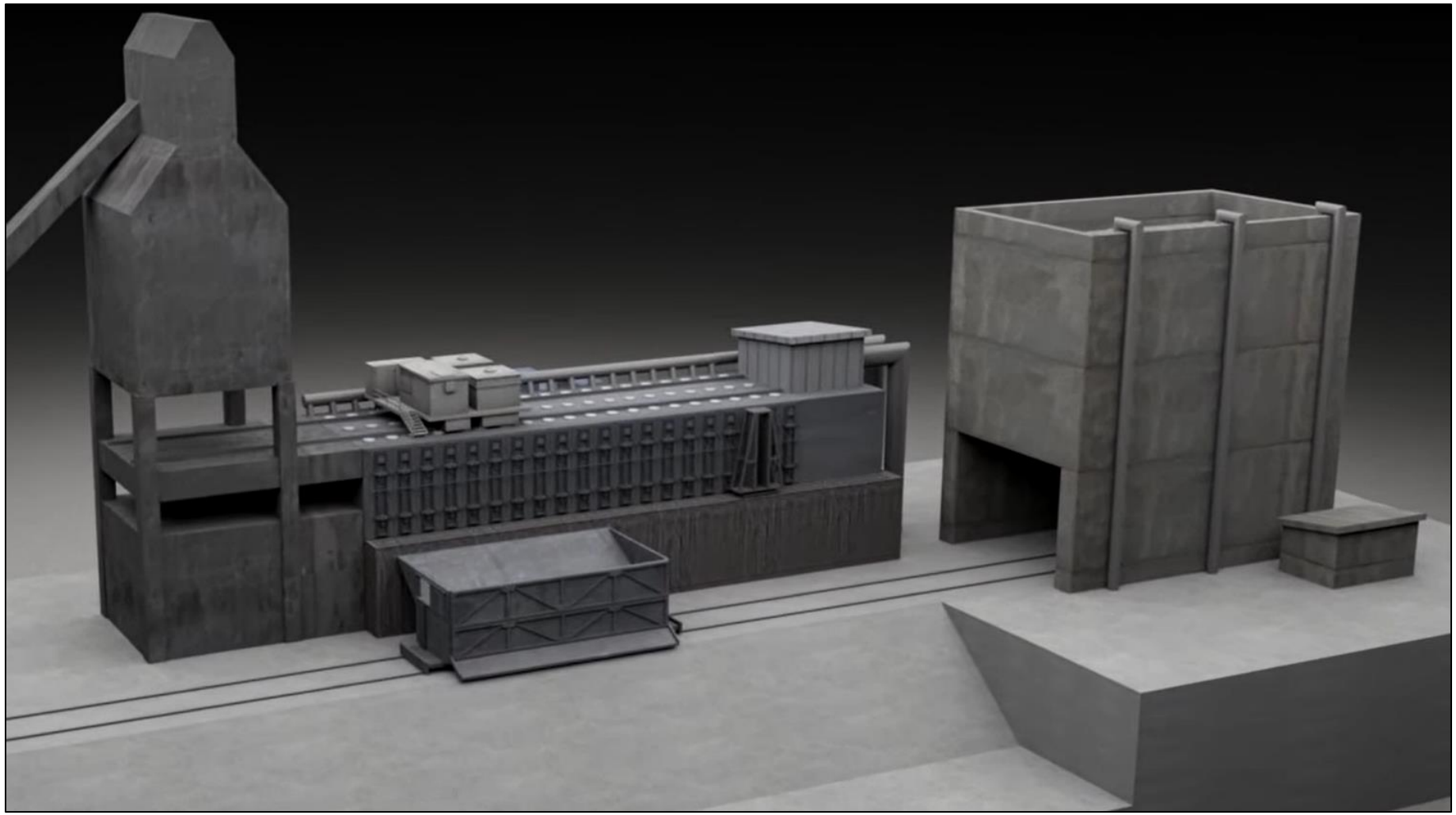
ENVIRONMENTAL INTEGRITY PROJECT

High Benzene Concentrations at Coke Oven Plants

March 20, 2024

What are coke ovens?



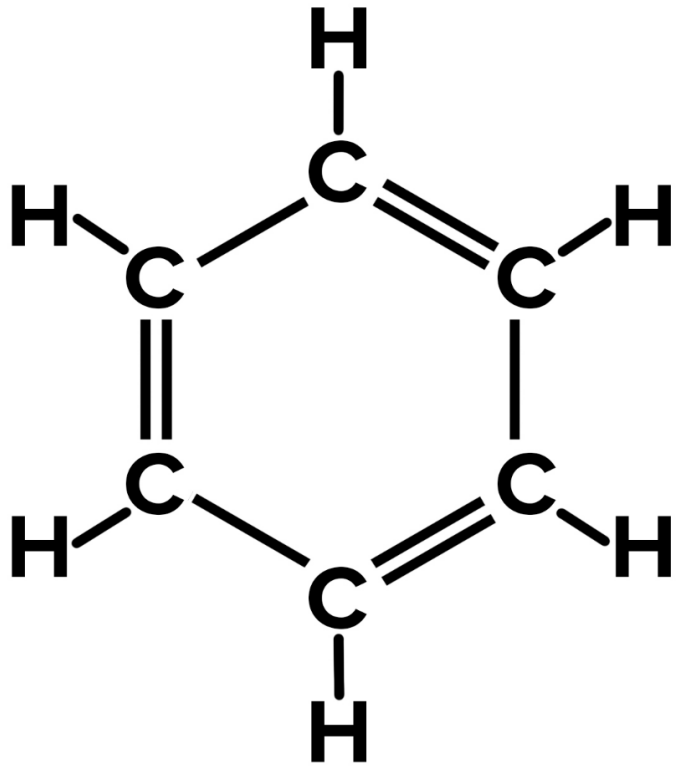
Source: https://www.youtube.com/watch?v=oysum8XCM54

What are coke ovens?

Source: https://www.post-gazette.com/opinion/Op-Ed/2021/06/06/As-others-see-it-Clairton-is-dead-long-live-Clairton-Christopher-Briem/stories/202106020011

Benzene (C_6H_6)

- Colorless or light-yellow liquid at room temperature but evaporates quickly (high vapor pressure)
- Released during coke making process
- Health effects
  - Carcinogenic
  - Can cause blood and immune system disorders



Source: https://www.gas-sensing.com/benzene-c6h6

Occupational standards/reference concentrations for benzene

Standard	Concentration	Legally Enforceable?
OSHA (exempt facilities under 29 CFR 1910.1028(a)(2), including coke oven plants) 8-hour TWA PEL	10 ppm (31,900 µg/m³)[a]	Yes
OSHA (non-exempt facilities) 8-hour TWA PEL	1 ppm (3,190 µg/m³)[b]	Yes
NIOSH 10-hour TWA REL	0.1 ppm (319 µg/m³)[c]	No
ACGIH 8-hour TWA TLV	**0.02 ppm (64 µg/m³)[d]**	**No**

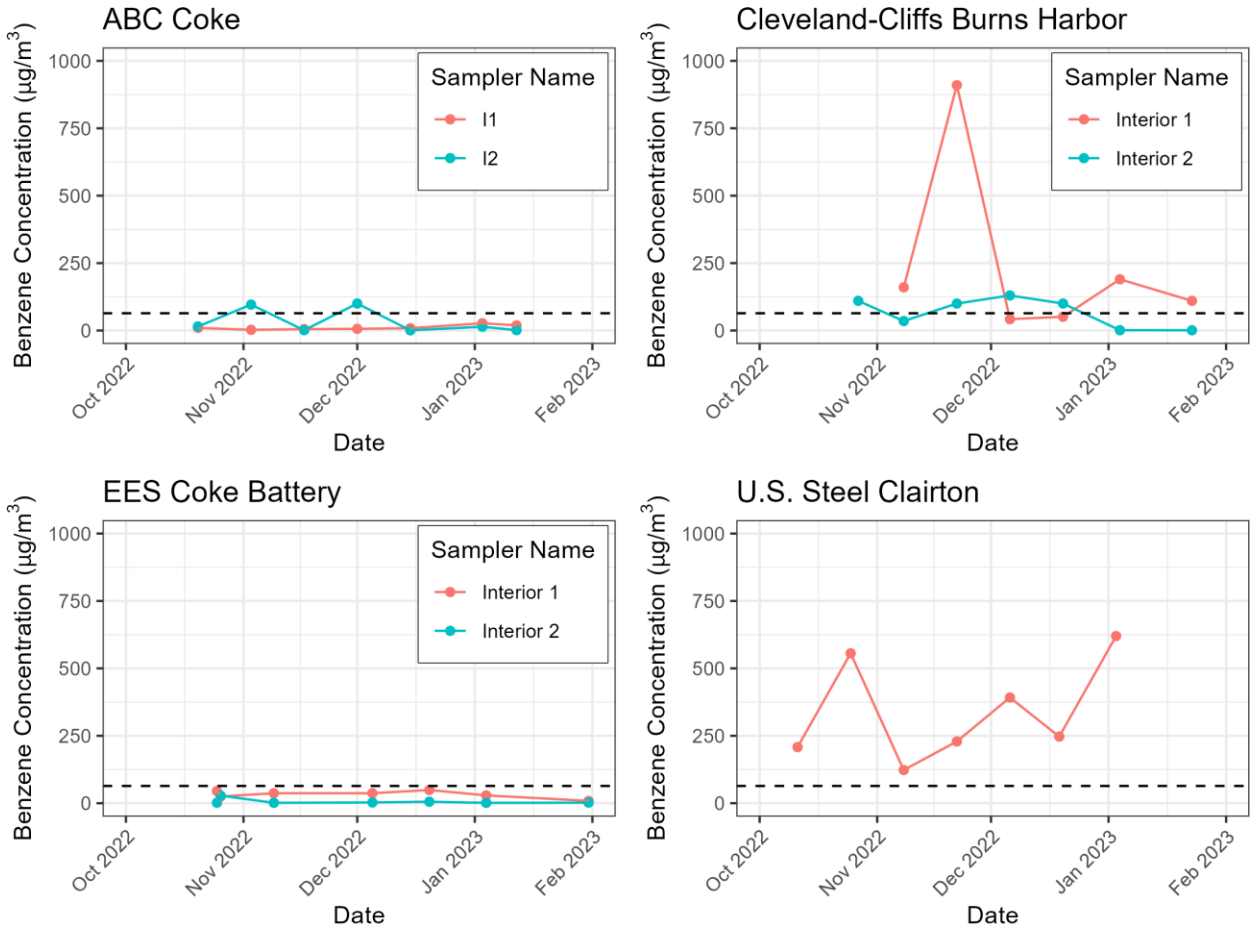
OSHA acknowledges PELs are outdated and recommends the consideration of other reference concentrations. See more here.

[a]Source: Table Z-2 in 29 CFR 1910 Subpart Z
[b]Source: 29 CFR 1910.1028(c)
[c]Source: https://www.cdc.gov/niosh/npg/npgd0049.html
[d]Source: https://www.acgih.org/benzene-2/

Abbreviations:
OSHA = Occupational Safety and Health Administration
NIOSH = National Institute for Occupational Safety and Health
ACGIH = American Conference of Governmental Industrial Hygienists
CA OEHHA = California Office of Environmental Health Hazard Assessment
TWA = Time-Weighted Average
PEL = Permissible Exposure Limit
REL = Recommended Exposure Limit
TLV = Threshold Limit Value

*Note: ppm converted to µg/m³ based on a temperature of 25 °C and a pressure of 1 atm

Benzene concentrations inside the fenceline of four coke oven facilities



Black dashed line represents ACGIH TLV (64 µg/m³).

Benzene concentrations based on 24-hour canister samples collected within the fenceline of the coke oven plants via EPA Compendium Method TO-15A.

Original data available at https://www.regulations.gov/document/EPA-HQ-OAR-2002-0085-0880. Data from SunCoke Haverhill excluded because of different coke oven design (non-recovery instead of by-product recovery).

Benzene concentrations inside the fenceline exceeding the ACGIH TLV (64 µg/m³)

Facility	Sampling Period Date	Measured Benzene Concentration (µg/m³)	Percent Above ACGIH Threshold Limit Value
ABC Coke	11/3/2022	96	60%
ABC Coke	**12/1/2022**	**100**	**67%**
Cleveland-Cliffs Burns Harbor	10/27/2022	110	83%
Cleveland-Cliffs Burns Harbor	11/8/2022	160	167%
Cleveland-Cliffs Burns Harbor	**11/22/2022**	**910**	**1,417%**
Cleveland-Cliffs Burns Harbor	11/22/2022	100	67%
Cleveland-Cliffs Burns Harbor	12/6/2022	130	117%
Cleveland-Cliffs Burns Harbor	12/20/2022	100	67%
Cleveland-Cliffs Burns Harbor	1/4/2023	190	217%
Cleveland-Cliffs Burns Harbor	1/23/2023	110	83%
U.S. Steel Clairton Coke Works	10/11/2022	208	247%
U.S. Steel Clairton Coke Works	10/25/2022	556	827%
U.S. Steel Clairton Coke Works	11/8/2022	123	105%
U.S. Steel Clairton Coke Works	11/22/2022	229	282%
U.S. Steel Clairton Coke Works	12/6/2022	392	553%
U.S. Steel Clairton Coke Works	12/19/2022	247	312%
U.S. Steel Clairton Coke Works	**1/3/2023**	**620**	**933%**

See slide 6 for data source.

Cancer risk from benzene exposure at coke oven plants

Facility	Average Benzene Concentration (µg/m³)	Increase in Lifetime Cancer Risk (Lower Estimate)	Increase in Lifetime Cancer Risk (Upper Estimate)
ABC Coke	21.9	0.5 in 10,000	1.7 in 10,000
Cleveland-Cliffs Burns Harbor	149.2	3.3 in 10,000	11.6 in 10,000
DTE/EES Coke Battery	19.5	0.4 in 10,000	1.5 in 10,000
U.S. Steel Clairton Coke Works	339.3	7.5 in 10,000	26.5 in 10,000

See slide 6 for data source.

Average concentration calculated based on all TO-15A samples taken within the fenceline of coke oven plant.

Lower estimate based on inhalation unit risk of 2.2×10^{-6} per µg/m³; upper estimate based on inhalation unit risk of 7.8×10^{-6} per µg/m³. Inhalation unit risk from EPA IRIS database benzene page.

Average highest benzene concentrations measured at fenceline of coke oven plants

Facility	Six-Month Average of Highest Fenceline Benzene Concentrations Measured During Each Two-Week Monitoring Period (µg/m³)
ABC Coke	16.7
Cleveland-Cliffs Burns Harbor	4.2
DTE/EES Coke Battery	3.8
U.S. Steel Clairton Coke Works	35.7

Reference Concentrations for Context

Agency for Toxic Substances and Disease Registry (ATSDR) chronic Minimal Risk Level (MRL)[a]: 9 µg/m³
California Office of Environmental Health Hazard Assessment (OEHHA) chronic Reference Exposure Level (REL)[b]: 3 µg/m³

Benzene concentrations based on two-week sorbent tube samples collected at the fenceline of coke oven plants via EPA Method 325A/B (method description in Appendix A to Part 63, Title 40).

Original data available at https://www.regulations.gov/document/EPA-HQ-OAR-2002-0085-0880. Data from SunCoke Haverhill excluded because of different coke oven design (non-recovery instead of by-product recovery).

[a]Source: Found on page 44 of ATSDR Toxicological Profile for Benzene
[b]Source: https://oehha.ca.gov/air/chemicals/benzene

Questions?

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