

# Characterization of Formaldehyde Emissions from Tire Crumb Rubber in Small Environmental Chambers

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## Background

- A large volume of used automobile and truck tires enters the waste stream in the U.S. each year. Recycled rubber from tires is used in synthetic turf fields, on playgrounds, etc.
- Concerns have been raised about the safety of recycled rubber tire crumbs used in synthetic turf fields and playgrounds in the U.S.
- Previous studies have not provided evidence for the health concerns, and the existing studies do not comprehensively evaluate all aspects of exposure associated with these use scenarios.
- Research is needed to help fill important data gaps that will lead to improved exposure assessment and risk evaluation for children and adults using synthetic turf fields and playgrounds with tire crumb rubber.
- U.S. EPA NERL/NRMRL, CDC/ATSDR, and the U.S. CPSC launched a multi-agency federal action plan to study key environmental human health questions associated with tire crumb rubber on synthetic turf fields and playgrounds in 2016.
- U.S. EPA NRMRL conducted dynamic small chamber tests to measure potential formaldehyde emissions from tire crumb rubber materials collected from tire recycling facilities and synthetic turf fields around the U.S. to support federal efforts to better characterize recycled tire-derived surface materials.

## Methods

### Tire Crumb Rubber Sample Collection

- Collected samples from nine tire recycling facilities and forty synthetic turf fields around the U.S.

#### Number and types of tire recycling facilities and synthetic turf fields

U.S. Census Region	Outdoor Fields	Indoor Fields	Total Fields Sampled
<b>Synthetic Turf Fields</b>			
Northeast	5	4	9
South	11	2	13
Midwest	2	6	8
West	7	3	10
<b>Total Number of Fields</b>	<b>25</b>	<b>15</b>	<b>40</b>
<b>Tire Recycling Facilities</b>			
Ambient Recycling Process		6	
Cryogenic Recycling Process		3	
<b>Total Number of Facilities</b>		<b>9<sup>a</sup></b>	

<sup>a</sup>Samples from three different batches or containers per facility were collected, the total number of samples were 3 x 9=27



### Small Chamber Tests

- Conformed to ASTM D5116
- 53-L dynamic small chambers (51 x 25 x 41 cm<sup>3</sup>) housed in temperature-controlled incubators; Clean air supply; OPTO 22 data acquisition system
- Test conditions:
  - Placed approximately 15 grams of tire crumb rubber materials placed in the center of the chamber on an aluminum weighing pan
  - 25° C, 45% RH, 1 air changes per hour (ACH)
  - 60° C, 7% RH, 1ACH
- Test procedures:
  - Collected chamber background before test
  - Placed tire crumb rubber materials in the chamber for 24 hours before air sampling
  - Collected air samples using 2,4-dinitrophenylhydrazine (DNPH) cartridges sampling at a rate of 200-400 mL/min for 90 minutes
  - Conducted 82 tests under each chamber condition
  - Determined HCHO concentrations by solvent extraction and analysis by HPLC with Diode-Array Detector.
  - Performed six duplicates and two time series tests under each set of chamber conditions.
- Implemented QA/QC

a



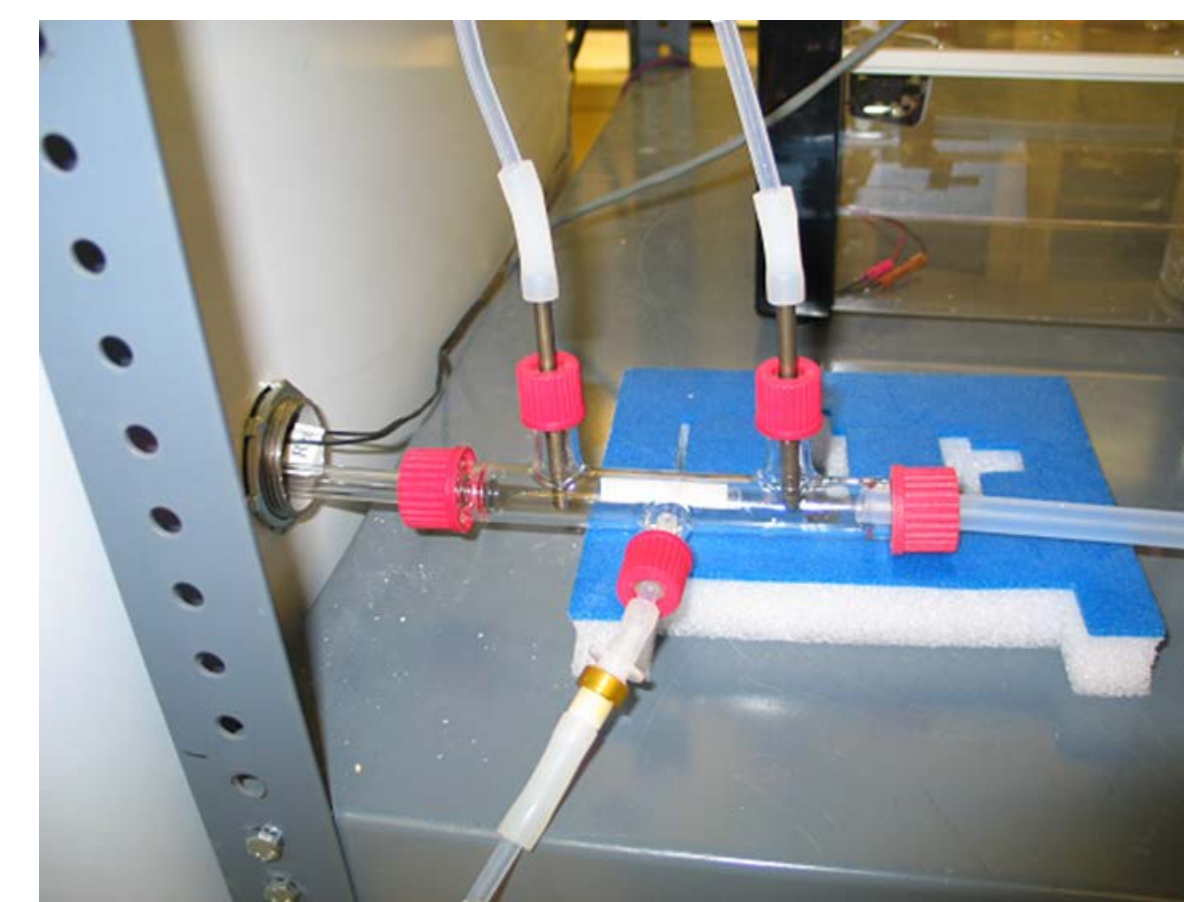
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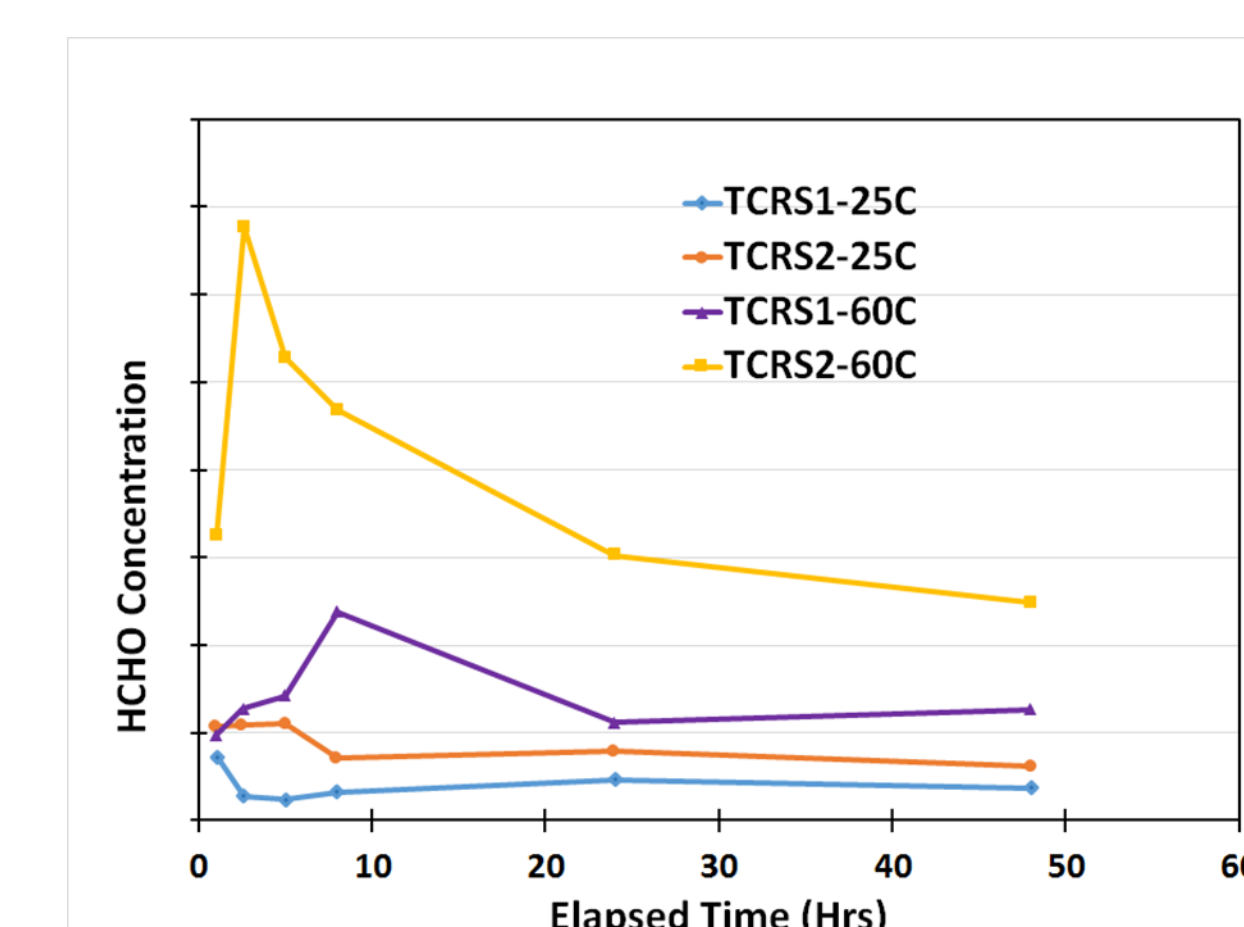
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**Small Chamber Settings for Tire Crumb Emission Tests. a. Chambers in an incubator, b. Tire crumb rubber materials, c. Inside of the small chamber, d. sampling ports**

## Status Update

- Emission factor (EF) calculation
  - EF(ng/g/h) = air concentration (ng/L) x ventilation rate (L/h)/tire crumb mass (g)
  - Assumed steady state emissions, minimum chamber wall sink effect, well mixed chamber air, no chemical reactions
  - Corrected by chamber background and tire crumb moisture
- Data statistically to be analyzed using SAS 9.2



#### Formaldehyde Chamber Air Concentration in Time Series Tests

- Measured formaldehyde concentrations in the chamber at 1 h<sup>-1</sup> ACH, 25 ° C, 46 % RH, were statistically low and close to the chamber background level.
- Measured formaldehyde concentrations in the chamber at 1 h<sup>-1</sup> ACH, 60 ° C, 6.6 % RH, which may represent synthetic field surfaces under hot ambient conditions, were greater than the chamber background for most of the material samples.
- Additional work is needed to better understand the relevance of these results for human exposure at synthetic turf fields.

## Acknowledgement

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## References

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