

The logo for Stratus Environmental Solutions, Inc. features the word "STRATUS" in a stylized, blue, hand-drawn font. The letters are interconnected, with the 'S' and 'T' being particularly prominent. The background of the logo is a light blue, cloud-like shape. Below the main text, the words "ENVIRONMENTAL SOLUTIONS, INC." are written in a smaller, black, sans-serif font, underlined.

STRATUS

ENVIRONMENTAL  
SOLUTIONS, INC.

# **Benzene Challenges Ahead**

August 7, 2024

**AHFA**



# Background Things to Know

- “Air Toxic”
- “Ambient Air Limits”
- Toxic Pollutant Emission Rate “TPER”
- How TPER is enforced: “Demonstration”

## Contents

- Recap – The DEQ email
- Benzene health effects
- Recap – when the NC TAP rule applies
- What is an emission factor
- How to increase EF accuracy
- Source test: What to expect
- Possible outcomes

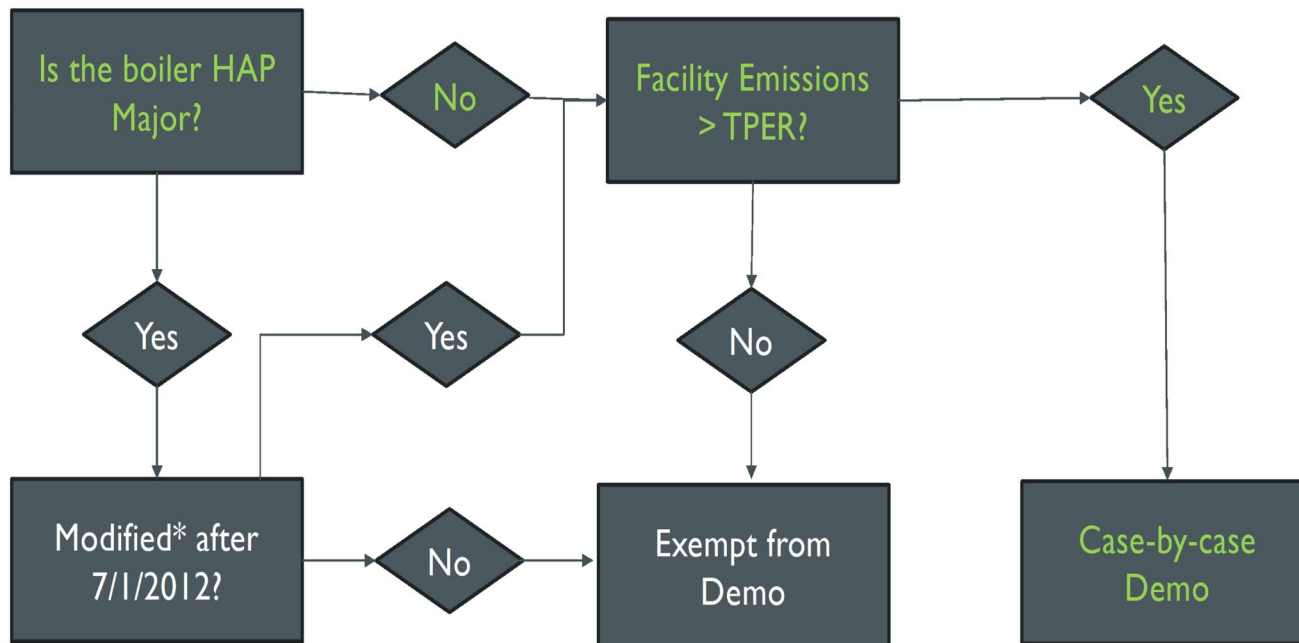


# **Benzene ambient air exposure health effects**

- General population exposure to benzene is mainly from breathing air
- Ambient air levels of benzene:
  - **Can affect reproductive organs**
  - **Affects blood-forming tissues, such as bone marrow**
  - **Can cause anemia**
  - **Long-term exposure can cause cancer, specifically acute myeloid leukemia**

# REGULATORY PATHWAY TO APPLICABILITY

- Regulatory pathway to applicability – IN GENERAL
  - **MACT boilers are exempt**
- For furniture manufacturers, the rule currently applies to:
  - **North Carolina Facilities with non-MACT Boilers**
    - Title V facilities that took HAP minor limitations on boilers
    - Non-Title V facilities with wood boilers
    - Any other facility with a threshold source of benzene emissions: **> 8.5 lb/yr**



CONCEPTUAL APPLICABILITY FLOWCHART

\* Modification might mean ANY increase in air toxics, facility-wide

# Could also be important in the future

- Facilities that have been “passed over” could be evaluated on a case-by-case basis
- Title V facilities with MACT major boilers, if there is a Director’s Call
- Potentially, facilities in other states

# What is an emission factor?

- A quantitative measure of how much pollutant is release by a particular activity
- Usually developed by source testing several different facilities undertaking the same type of activity, e.g.
  - **Petroleum refining**
  - **Pulp and paper production**
  - **Surface coating**
  - **COMBUSTION**
- It is NOT an emission or control standard
- Benzene emission factor is focus of this discussion



**WOODWASTE COMBUSTION EMISSIONS CALCULATOR REVISION L 09/03/2019 - OUTPUT SCREEN**



Instructions: Enter emission source / facility data on the "INPUT" tab/screen. The air emission results and summary of input data are viewed / printed on the "OUTPUT" tab/screen. The different tabs are on the bottom of this screen.

This spreadsheet is for your use only and should be used with caution. DENR does not guarantee the accuracy of the information contained. This spreadsheet is subject to continual revision and updating. It is your responsibility to be aware of the most current information available. DENR is not responsible for errors or omissions that may be contained herein.

**SOURCE / FACILITY / USER INPUT SUMMARY (FROM INPUT SCREEN)**

COMPANY: <b>Facility Name, Inc.</b>		FACILITY ID NO.: 01/12/00999	
EMISSION SOURCE DESCRIPTION: 25 MMBTU/HR DRY WOOD (<= 19 % MOISTURE) FIRED BOILER		PERMIT NUMBER: 9999R02	
EMISSION SOURCE ID NO.: ES-1		FACILITY CITY: ANY TOWN	
PARTICULATE CONTROL DEVICE: MECHANICAL COLLECTOR (NO REINJECTION)		FACILITY COUNTY: ANY COUNTY	
SPREADSHEET PREPARED BY: Your Name		FUEL HEAT VALUE: 8000 BTU/LB	NOX 0
ACTUAL FUEL THROUGHPUT: 3000 TON/YR	TON/YR	HEV Used for GHGs (MMBTU/TON): 15.38	PM CAL CD AS 24%
POTENTIAL FUEL THROUGHPUT: 13688 TON/YR	TON/YR	BOILER TYPE: STOKER	PM10 CAL CD AS 23.9%
REQUESTED MAX. FUEL THRPT: 13688 TON/YR	TON/YR	NO STACK TEST DATA USED	PM2.5 CAL CD AS 45.9%
METHOD USED TO COMPUTE ACTUAL GHG EMISSIONS: TIER 1 - DEFAULT HIGH HEAT VALUE AND DEFAULT EF		CARBON CONTENT USED FOR GHGS (AS A FRACTION): CARBON CONTENT NOT USED FOR CALCULATION TIER CHOSEN	

**CRITERIA AIR POLLUTANT EMISSIONS INFORMATION**

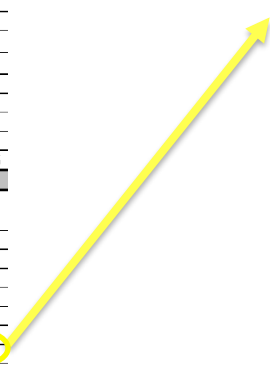
AIR POLLUTANT EMITTED	ACTUAL EMISSIONS		POTENTIAL EMISSIONS				EMISSION FACTOR	
	(AFTER CONTROLS / LIMITS)		(BEFORE CONTROLS / LIMITS)		(AFTER CONTROLS / LIMITS)		lb/ton/100	
	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	uncontrolled	controlled
PARTICULATE MATTER (PM)	7.93	7.61	10.43	45.66	7.93	34.71	0.417	0.317
PARTICULATE MATTER<10 MICRONS (PM <sub>10</sub> )	7.18	6.89	9.43	41.28	7.18	31.43	0.377	0.287
PARTICULATE MATTER<2.5 MICRONS (PM <sub>2.5</sub> )	4.43	4.25	8.18	35.81	4.43	19.38	0.327	0.177
SULFUR DIOXIDE (SO <sub>2</sub> )	0.63	0.60	0.63	2.74	0.63	2.74	0.025	0.025
NITROGEN OXIDES (NO <sub>x</sub> )	12.25	11.76	12.25	53.66	12.25	53.66	0.490	0.490
CARBON MONOXIDE (CO)	15.00	14.40	15.00	65.70	15.00	65.70	0.600	0.600
VOLATILE ORGANIC COMPOUNDS (VOC)	0.43	0.41	0.43	1.86	0.43	1.86	0.017	0.017
LEAD	1.2E-03	1.2E-03	1.2E-03	5.3E-03	1.2E-03	5.3E-03	4.8E-05	4.8E-05

**TOXIC / HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION**

TOXIC / HAZARDOUS AIR POLLUTANT	CAS NUMBER	ACTUAL EMISSIONS		POTENTIAL EMISSIONS				EMISSION FACTOR	
		(AFTER CONTROLS / LIMITS)		(BEFORE CONTROLS / LIMITS)		(AFTER CONTROLS / LIMITS)		lb/ton/100	
		lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	uncontrolled/controlled	uncontrolled/controlled
Acetaldehyde (TH)	75070	2.08E-02	39.840	2.08E-02	181.770	2.08E-02	181.770	8.30E-04	8.30E-04
Acetophenone (H)	98862	8.00E-08	1.54E-04	8.00E-08	7.01E-04	8.00E-08	7.01E-04	3.20E-09	3.20E-09
Acrolein (TH)	107128	1.00E-01	192.000	1.00E-01	876.000	1.00E-01	876.000	4.00E-03	4.00E-03
Alkylaryl Unsulfonated Compounds (component of SEC) (H)	SEC: other	1.98E-04	0.379	1.98E-04	1.730	1.98E-04	1.730	7.90E-06	7.90E-06
Arsenic Unsulfonated Compounds (component of ASC) (TH)	ASC: other	5.50E-04	1.056	5.50E-04	4.818	5.50E-04	4.818	2.20E-05	2.20E-05
Benzene (TH)	71432	1.05E-01	201.600	1.05E-01	919.800	1.05E-01	919.800	4.20E-03	4.20E-03
Benzofulvene (H)	50328	6.50E-05	0.125	6.50E-05	0.569	6.50E-05	0.569	2.60E-06	2.60E-06

NCDEQ Benzene EF =

4.2 x 10<sup>-3</sup> lb/MMBTU



POLLUTANT	ID	FUEL TYPE	FIRING CONFIGURATION	CONTROL DEVICE	NUMBER OF RUNS	RUN AVERAGE
Benzene	B100	Bark/Wet Wood	Dutch Oven	Wet Scrubber	1	9.95E-04
Benzene	B101	Wet Wood	Stoker	ESP	1	1.61E-03
Benzene	B127	Wet Wood	Not Reported	ESP	2	1.90E-03
Benzene	B133	Wet Wood	Stoker	Fabric Filter	1	1.15E-03
Benzene	B134	Wet Wood	Stoker	ESP	2	2.35E-04
Benzene	B135	Wet Wood	Stoker	ESP	1	1.90E-04
Benzene	B14	Wet Wood	Not Reported	Mechanical Collector	1	2.91E-05
Benzene	B19	Dry Wood	Stoker	Mechanical Collector	1	2.90E-03
Benzene	B26	Wet Wood	Stoker	Wet Scrubber	1	2.72E-04
Benzene	B45	Bark	Stoker	Wet Scrubber	1	4.23E-03
Benzene	B50	Wet Wood	FBC	Uncontrolled	1	3.92E-05
Benzene	B74	Bark/Wet Wood	Stoker	Fabric Filter	1	5.65E-05
Benzene	B78	Wet Wood	Stoker	Wet Scrubber	2	6.48E-02
Benzene	B79	Wet Wood	Not Reported	Wet Scrubber	1	3.80E-04
Benzene	B81	Wet Wood	Dutch Oven	Mechanical Collector	1	2.13E-05
Benzene	B86	Bark/Wet Wood	FBC	ESP	1	2.55E-05
Benzene	B91	Bark/Wet Wood	Stoker	ESP	1	6.66E-04
Benzene	B92	Wet Wood	Stoker	ESP	1	5.70E-04
Benzene	B99	Wet Wood	Dutch Oven	Mechanical Collector	1	1.54E-05
					<b>AVG</b>	4.21E-03
					<b>MIN</b>	1.54E-05
					<b>MAX</b>	6.48E-02
					<b>STD DEV</b>	1.47E-02
					<b>COUNT</b>	19

Benzene Ef  
Basis:

19 tests

ONE dry wood



# WHY THE CURRENT FACTOR IS A PROBLEM

- The benzene emission factor may have resulted in overestimating benzene emissions from our boilers that burn kiln-dried biomass
- A quick look at annual emission reports shows many such boilers with annual emissions > TPER



# POSSIBLE PATHWAYS FORWARD

- It is clear that DEQ has not yet developed a policy to address benzene emissions > TPER
- AHFA will be supporting affected members by:
  - **Monitoring DEQ's future actions related to benzene emissions from member facilities**
  - **Providing technical support to facilities that must complete demonstrations**
- AHFA will evaluate the benefit to membership of developing a new benzene emission factor
  - **A new emission factor specific to dry wood boilers**



# Pathway to develop a more accurate emission factor

- Select facilities with a range of representative dry wood boilers
- Undertake a series of “engineering” tests at selected facilities to evaluate whether emissions are likely to vary from the current published emission factor



# Pathway to develop a more accurate emission factor (cont'd)

- Undertake full EPA Method source testing at all volunteer facilities
- Develop new emission factor based on full test results and a standard protocol for factor calculation
- Provide full report to NCDEQ for consideration and adoption of the new factor



# How does emissions source testing work?

- Facilities operate boiler at a reasonable maximum load, with full combustion
- Air emission testing specialists have specialized equipment to extract and collect stack emissions for benzene
- Stack being tested must have test ports meeting EPA specifications



# How does emissions source testing work?

- Probes are inserted into the ports for sample collection
- A typical test consists of three one-hour test runs, with time between tests for equipment changeover
- Boiler operator must maintain logs during test for parameters such as:
  - **Amount of fuel combusted**
  - **Steam production**
  - **Temperature**



# Air QUALITY dispersion modeling

- If source testing does not result in emissions  $<$  TPER, Air Quality Dispersion Modeling may be required
- “Dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source” (EPA)

# Air QUALITY dispersion modeling

- Using local meteorology and topography, an emission rate input is used to predict a maximum offsite air concentration
- An emission rate lower than the current benzene factor may be helpful
- Maximum offsite result must be  $< 1.2 \times 10^{-4} \text{ mg/m}^3$  (annual basis)  
(the Ambient Air Limit, or AAL)

# WRAP UP

# Possible outcomes – Limited or No DEQ Demonstration requests

- Continue to report benzene emissions using the current emission factor, OR
- Use the only published dry wood boiler rate ( $2.9 \times 10E-03$  lbs/MMBTU), OR
- Undertake voluntary testing in an effort to reduce reportable emission rate

# POSSIBLE OUTCOMES – DEQ TAKES BROAD ACTION TO ENFORCE THE RULE

- Implement the AHFA benzene emission factor development program, AND/OR,
- Undertake boiler-specific testing
- Neither option is a guarantee
  - Emission rates may not change much, or may even be higher (unlikely)
  - Dispersion modeling may still be required
  - But model benzene input would likely be lower, increasing probability of success

# BE SURE YOUR BOILERS ARE IN COMPLIANCE WITH ALL RULES

- Monitoring (e.g. Visible Emissions)
- Recordkeeping (e.g., fuel consumption)
- Reporting (e.g., MACT semiannual reports and/or annual emission reports)
- Work Practice requirements (e.g., periodic boiler tune-ups)



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