Reducing PM2.5 Emissions Through Technology

Results from a Recent Study Evaluating the Effectiveness of an Air Curtain Incinerator

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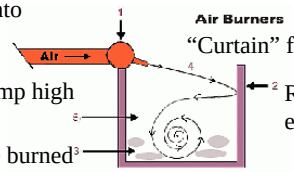
FireLab

An Air Burners LLC 200 Series Incinerator in Operation

In October of 2002, scientists from the Missoula Fire Sciences Laboratory (FiSL) teamed with engineers from the San Dimas Technology and Development Center (SCTDC) to evaluate the performance of an air curtain incinerator. A model 217, with a capacity of 6 tons per hour, was provided by the manufacturer. Other air curtain burners, with through-puts ranging from 1 to 15 tons per hour, are available from Air Burners LLC. For more information contact them at www.airburners.com

How the Incinerator Works

High velocity air is directed into the box



"Curtain" formed from high velocity airflow

Continued airflow keeps fire temp high for more complete combustion

Refractory lined walls (can also be an earthen trench)

Material to be burned

The curtain of air created in this process traps unburned fine particles under the curtain in the high temperature zone where temperatures can reach 1832° F (1000° C). The increased combustion time and turbulence results in a reburn and more complete combustion of the biomass.

How Effective Was It in Reducing Emissions?

Comparing Air Curtain to Pile and Understory Burn Emissions

Type of Burn	EFCO2 (lbs/ton)	EFCO (lbs/ton)	EFCH4 (lbs/ton)	EFNMHC (lbs/ton)	EFPM2.5 (lbs/ton)	CR %
Average Pile	3268	179	13.9	9.9	25.5	89 %
Average Understory	3286	180	6.6	5.4	36.0	90 %
Average Air Curtain	3616	2.6	1.4	1.1	1.1	99 %

Emission Reduction Factors (EF common method/EF air curtain)				
Type of Burn	CO	CH4	NMHC	PM2.5
Pile	7	10	9	23
Understory	7	5	5	33

With similar fuels (P.Pine), the air curtain incinerator tested gave approximately a 23-fold reduction in $PM_{2.5}$ emissions over pile burns and a 33-fold reduction over understory burns.

Hot Stuff

The image to the right was taken with an infrared camera and shows the high ember production from the incinerator.
The incinerator requires a large operations area and the high quantity of embers ejected could pose a hazard at some locations.

The Bottom Line

The air curtain incinerator is very effective in reducing PM2.5 emissions.

Engineers at the SDTDC are currently performing a cost analysis—but the air curtain incinerator will likely be more costly than other common burning methods. SDTDC contact: Sue Zahn at szahn@fl.fed.us

High ember production could be a problem is some cases.

Emission Factors Calculated for an Air Curtain Incinerator, Pile and Understory Burns with P. Pine as the Primary Type of Fuel

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Emission Factors for P.Pine Understory Burns

(AZ 1993=1994)

Emission Factors for P.Pine Understory Burns							
Burn Type / **Fire Code**	**EFCO2** (lbs/ton)	**EFCO** (lbs/ton)	**EFCH4** (lbs/ton)	**EF-NMHC** (lbs/ton)	**EFPM2.5** (lbs/ton)	**CR** Ratio	**Fuel** tons/acre
8 year rotation under-burn							
AZ1_93	3316	167	4.5	4.1	29.3	90%	5
AZ2_93	3334	156	5.1	5.4	26.6	91%	9
AZ4_94	3216	199	7.0	5.8	45.5	88%	35
Broadcast burn							
AZ3_93	3214	201	8.7	6.6	41.7	88%	49
AZ6_93	3288	187	7.6	5.5	50.7	90%	95
First fire in 80+ years							
AZ4_93	3296	173	6.2	5.7	28.9	90%	32
AZ5_93	3246	206	7.5	6.1	48.6	89%	55
AZ2_94	3250	141	5.1	3.9	31.7	91%	43
6 year rotation under-burn							
AZ1_94	3278	185	7.1	5.3	28.8	89%	14
Under-burn, 3 years since last burn							
AZ3_94	3438	114	3.5	3.5	13.3	94%	NA
Average	**3286**	**180**	**6.6**	**5.4**	**36.0**	**90%**	**37**

Emission Factors for Air Curtain Burner

(OR 2002)

Air Curtain Emission Factors						
sample number	**EFCO2** (lbs/ton)	**EFCO** (lbs/ton)	**EFCH4** (lbs/ton)	**EFNMHC** (lbs/ton)	**EFPM2.5** (lbs/ton)	**CE** %
1	3634	1.6	1.1	0.9	0.7	99%
2	3636	1.7	0.9	0.6		99%
3	3589	4.0	2.6	1.7	1.1	98%
4	3613	2.8	1.5	1.2	1.1	98%
5	3646	1.1	0.6	0.5		99%
6	3587	4.1	2.7	1.7	0.9	98%
7	3624	2.3	0.6	0.7	0.9	99%
8	3603	3.4	1.2	1.2	1.7	98%
Average	**3616**	**2.6**	**1.4**	**1.1**	**1.1**	**99%**

Emission Factors for P.Pine Pile Burns

(AZ 1994)

Emission Factors for P.Pine Pile Burns						
Fire Code	**EFCO2** (lbs/ton)	**EFCO** (lbs/ton)	**EFCH4** (lbs/ton)	**EFNMHC** (lbs/ton)	**EFPM2.5** (lbs/ton)	**CE** %
AZP1 Flaming	3462	100	7.4	5.9	11.7	95%
AZP1 Smoldering	3172	210	21.0	10.76	33.9	86%
AZP2 Flaming	3534	58	3.6	2.96	10.3	96%
AZP2 Smoldering	3160	247	20.3	10.5	15.0	86%
AZP3 Flaming	3454	97	5.0	5.7	13.8	94%
AZP3 Smoldering	3076	268	19.5	12.66	52.8	84%
AZP4 Flaming	3076	129	7.7	9.14	18.8	92%
AZP4 Smoldering	3056	277	22.2	12.98	34.7	83%
AZP5 Flaming	3092	115	7.9	10.42	18.6	92%
AZP5 Smoldering	3280	260	21.6	14.02	35.1	84%
AZP6 Flaming	3454	97	5.8	6.94	11.1	94%
AZP6 Smoldering	3008	285	24.5	16.84	49.9	82%
Average Flaming	3444	99	6.2	6.84	14.0	94%
Average Smoldering	3092	258	21.5	12.96	36.9	84%
Average All	**3268**	**179**	**13.9**	**9.9**	**25.5**	**89%**