Brick Kiln Measurements during the SLCF Campaign 2013
Mexico
Ed Fortner
SHORT-LIVED CLIMATE FORCERS (SLCF) MEXICO - 2013

SLCF Pollutants

Methane – CH$_4$
Black Carbon Particles – BC
Ozone (O$_3$) Precursors:
  - Nitrogen Oxides – NO + NO$_2$ (NO$_x$)
  - Volatile Organic Compounds – VOCs
  - Carbon Monoxide - CO

Other Pollutants

Carbon Dioxide – CO$_2$
Nitrous Oxide – N$_2$O
Sulfur Dioxide – SO$_2$

SLCF Emission Sectors

Landfills
Wastewater Treatment
Livestock
Oil and Gas Production
Biomass Burning
Mobile Vehicles
Cook Stoves
Brick Kilns
SLCF MEXICO - 2013

Participating Organizations

Molina Center for Energy and Environment (MCE²)
Aerodyne Research Inc. (ARI)
Universidad Nacional Autónoma de Mexico (UNAM)
  Mexico City
  Morelia
  Queretaro
  Centro de Ensēnanza, Investigación y Extensión en Ganaderia Tropical (CEIEGT)
Universidad Autónoma de Nuero Leon (UANL)
Instituto Mexicano del Petroleo (IMP)
Universidad Autónoma del Estado de Mexico (UAEM)
Interdisciplinary Group For Appropriate Rural Technology (GIRA)
Secretaria del Medio Ambiente del Distrio Federal (SMA-DF)
Gamatek, S.A. de C.V. (GT)
Short-Lived Climate Forcers 2013 Mexico Campaign

L → Landfills
W → Wastewater
LS → Livestock
OG → Oil and gas
V → Vehicles
CS → Cook stoves
BK → Brick kilns
SLCF MEXICO - 2013

Emission Sector: Brick Kilns

SLCF Pollutants: BC, NO\textsubscript{x}, VOC\textsubscript{s}, CO

Other Pollutants: CO\textsubscript{2}

Measurement Sites: Guanajuato (El Refugio), Guanajuato (Abasolo)

Measurement Participants: MCE\textsuperscript{2}, ARI, GT, UNAM
What we Measured

• **Particle Phase**
  - Black Carbon quantification with 3 instruments SPAMS, MAAP, CAPS
  - Total number concentration with CPC
  - m/z chemical signature of particles with SPAMS
  - Particle size information with SP-AMS

• **Gas Phase**
  - QCL measurements of Methane, Ethane, Acetylene, SO2, CO and N20
  - PTRMS measurements of a large suite of VOCs including acetonitrile, benzene, toluene
  - NO and NOx measurements
  - CO2 measurements on both particle and gas phase inlet for comparison
How We Measured

• Most measurements done at 1 second resolution for the majority of campaign
• Location of the measurements conducted at various points downwind of source
• At night truck was parked and measuring in immediate vicinity of kiln
• SP-AMS operated with both vaporizers
Brick Kiln Sampling SLCF Campaign Mexico 2013
Plume 1 Abasolo 10:46 AM

- 4.44 (ug/m3) BC/ppm CO2
- 8.29 g BC/ kg CO2
- .00698 ppb Benzene/ ppm CO2
- .000333 ppb Acetonitrile/ ppm CO2
- .00476 ppb Acetaldehyde/ ppm CO2
Plume 2 Abasolo 12:54 PM

- 15.9 (ug/m3) BC/ppm CO2
- 29.6 g BC/ kg CO2
- 0035 ppb Benzene/ ppm CO2
- .0021 ppb Acetonitrile/ ppm CO2
- .00737 ppb Acetaldehyde/ ppm CO2
Plume 3 Abasolo 6:04 PM

- 0 (ug/m3) BC/ppm CO2
- 0 g BC/ kg CO2
- 0.000998 ppb Benzene/ ppm CO2
- 0.00333 ppb Acetonitrile/ ppm CO2
- 0.0168 ppb Acetaldehyde/ ppm CO2
ER’s at Abasolo over time

- **Graph 1:** Black Carbon (g(C)) vs. CO2 from 12:00 PM to 6:00 PM on 3/16/2013.
- **Graph 2:** Benzene (ppb) vs. CO2 from 12:00 PM to 6:00 PM on 3/16/2013.
- **Graph 3:** Acetonitrile (ppb) vs. CO2 from 12:00 PM to 6:00 PM on 3/16/2013.
- **Graph 4:** Acetaldehyde (ppb) vs. CO2 from 12:00 PM to 6:00 PM on 3/16/2013.
El Refugio Campaign Traditional Plume 1 8:13 AM Day 1

- .757 ug/m3BC/ppmCO2
- 1.41 g(C) BC/kg(C) CO2
El Refugio Campaign Traditional Plume 2 5:44 PM Day 1

- 1.68 ug/m³ BC)/CO2ppm
- 3.14 (C) BC/ kg(C) CO2

![Graph showing m/z ratio versus nitrate equivalent mass in µg m⁻³. The graph includes various compounds such as Org, NO₂, SO₄, NH₄, Chl, C₁-C₅, C₆-C₃₂, and C₃₂+ (fullerene) each with their corresponding m/z values and masses.]
El Refugio Campaign Traditional Plume 3 12:03
PM Day 2

- 4.01 ugm3 BC/ppmCO2
- 7.47 g(C) BC/ g(C) CO2
MK2 Brick Kiln
El Refugio MK2 Plume 1 2:20 PM Day 1

1.51 ug/m³ (ppmCO₂)

2.82 g(C) Black Carbon/kg(C) CO₂
El Refugio MK2 Plume 2 1:30 AM Day 2

.211 ug/m3)/ppmCO2

.394 g(C)BC/kg(C) CO2
El Refugio MK2 Plume 3 4:30 PM Day 2

- 0.562 ug/m3)/CO2ppm
- 1.05 g(C) BC/ kg(C) CO2

![Diagram showing nitrate equivalent mass (µg m⁻³)]
NH4Cl in brick kilns
Some Conclusions in Progress

• The MK2 is supposed to be the new cleaner technology. Limited number of plumes show it cleaner but not by the amount projected. Need more analysed plumes for better time coverage.

• Clear difference between flaming and smoldering is evident for the Fixed Traditional Kiln but not for the other 2.
Work to do

• Continue to process/refine the dataset
• Look at particle sizing
• What measurements at the site can we compare with to tell a more complete story
• How does this source compare to other sources for BC and Methane