Technical Workshop on Science and Policy of Short-Lived Climate Forcers

Industrial Sector (brick kilns and small industries)

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Outline

- Diagnosis studies in Mexican cities
- Artisanal brick production
- Wood burning for cooking and heating
- Challenges to implement mitigation strategies

Importance of ultrafine particle studies

Climate change influence

Health effects

Vegetation effects

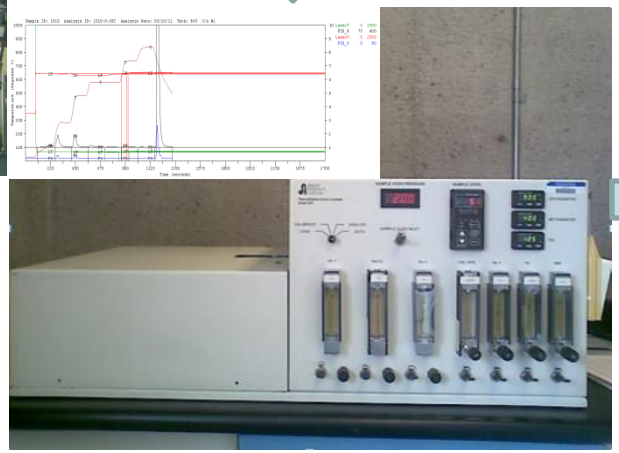
Visibility effects

Material effects

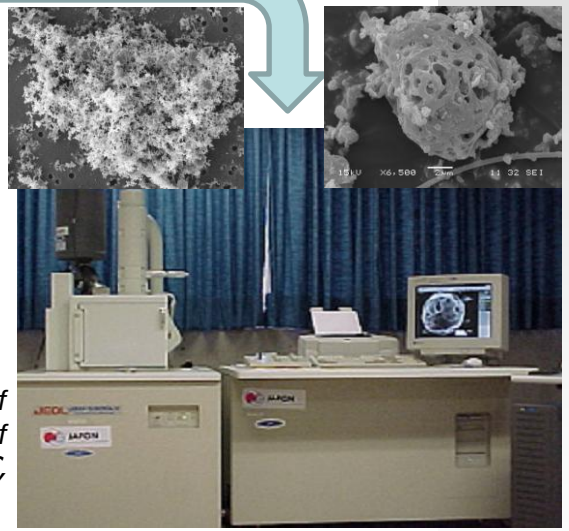
New compound formation

Analytical capacities at INE for characterization of carbon in particles

Sampler Manual High and Low Volume



Carbon Analyzer thermal / optical DRI 2001 Equipment



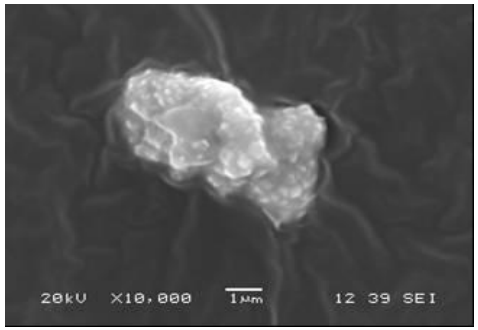
Scanning Electron Microscope

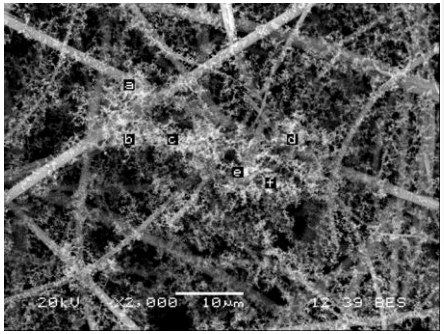
- *IMPROVE TOR protocol. Four sub-fractions of organic carbon (OC1, OC2, CO3, OC4) and three of elemental carbon (EC1, EC2, EC3). OC: 0 to 550 ºC, EC: 550 to 900ºC.*
- *Implementation and validation of organic carbon and elemental carbon analyses*
- *Determine morphological characteristics of carbon particles: 0.2 to 15 µm*

Research projects

- Diagnosis studies in mexican cities:
  - Salamanca, Gto (2007).
  - Tula, Hidalgo (2008)
  - Guadalajara, Jal (2009)
  - Toluca, EDOMEX (2009)
  - Tijuana, B.C (2010)

- Area source monitoring
  - brick kilns
  - waste burning
  - rural stoves

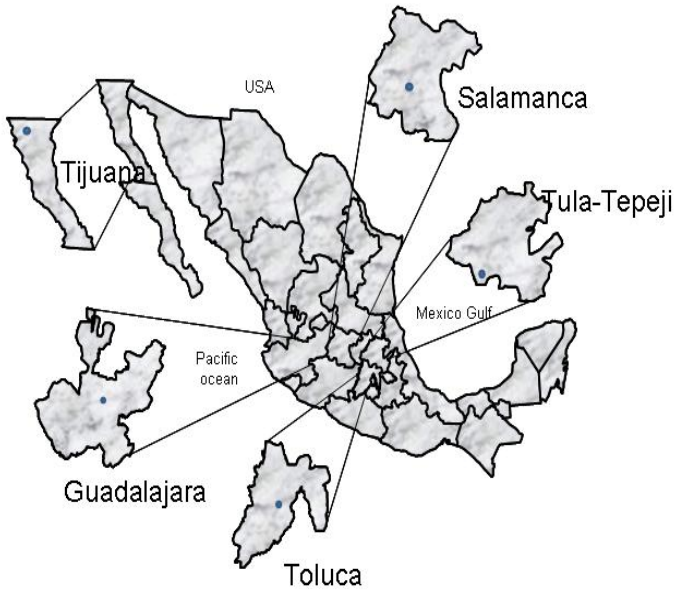




Determination of Elemental and Organic Carbon in Mexican Cities

- *Evaluation of toxic air pollutants in Mexican Cities*
  - *(PM2.5, VOCs, and criteria pollutants)*

City	Description of sampling sites	Period and frequency of sampling
Salamanca	Automatic air quality monitoring station located in Red Cross building	November 2006-November 2007
Tula	Tula of Allende, Tepeji of Ocampo, Atitalaquia, Ajacuba, Tepetitlan, Atotonilco of Tula	July 2008-February 2009
Guadalajara	Center, Miravalle, Guadalajara Unversity sites.	May-June 2009
Toluca	Children Hospital ISSEMYM and Monitoring Air Quality station Oxtotitlán	March – April 2009
Tijuana	Morelos Park and Metales y Derivados	June 2010






Determination of OC/EC in Mexican Cities and other countries

City	$PM_{2.5}$ $\mu g/m^3$	OC in $PM_{2.5}$ %	EC in $PM_{2.5}$ %
Salamanca	46	***22***	***7***
Tula	20	***31***	***10***
Guadalajara	37	***31***	***6***
Toluca	43	***34***	***8***
Tijuana	18	***39***	***5***
Ciudad de México	**40**	**41**	**7**
Santiago City, Chile	29	18	6
Barcelona, Spain	23	22	9
Amsterdam, Holland	26	21	8
Vienna, Austria	ND	ND	6
Ljubljana, Slovenia	ND	ND	5

Source contribution:

Stationary combustion sources with heavy fuels

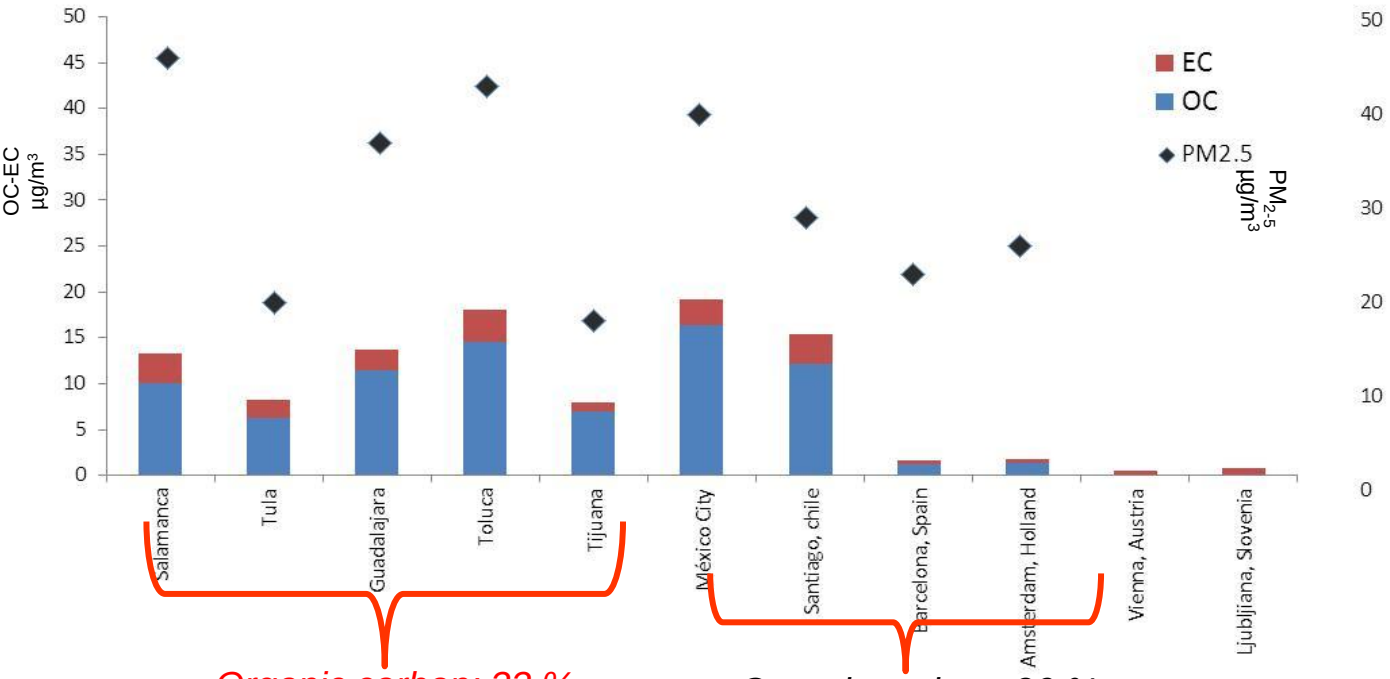
Gasoline and diesel

Cities of Mexico

- *The average OC/EC ratios at the five cities of Mexico ranged from 2.04 to 5.96.*
- *There is a higher contribution of OC in Mexican cities: Influence of source area and biomass burning.*
- *Organic Carbon (OC) concentrations in rush hour (vehicular traffic) tends to increase by a factor to 2.2 to 4 with respect to 24 hours averages and Elemental Carbon (EC) concentration increase 1.7 to 2.4.*

Total carbon in PM2.5 in Mexico City: 55% urban site, 30% suburban site (Querol et al., 2008)

Determination of OC/EC in Mexican Cities and other countries.



Organic carbon: 33 %
Elemental carbon: 7 %
EGU,2011. INE-CENICA

Organic carbon: 20 %
Elemental carbon: 7 %
Vega et al., 2006; Rodrigo Seguel et al., 2009; Hitzenberger R. et al ., 2006

Source contribution of OC/EC in Mexican cities:

Guadalajara, Toluca y Tijuana: Gasoline and diesel.

Tula y Salamanca: Stationary combustion sources with heavy fuels.

→

Mexican cities

There is a higher contribution of OC in Mexican cities: Influence of mobile sources and other area sources

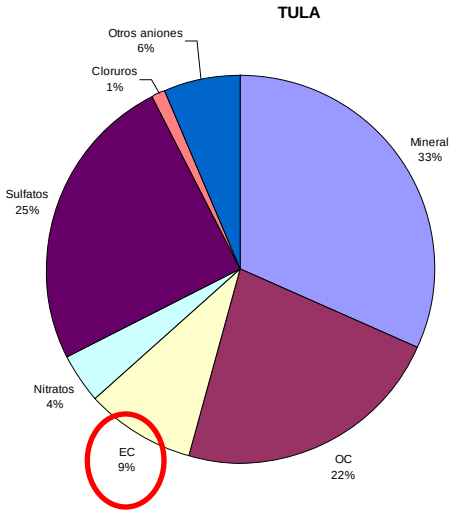
OC and EC concentrations obtained in traffic peaks periods in three Mexican cities

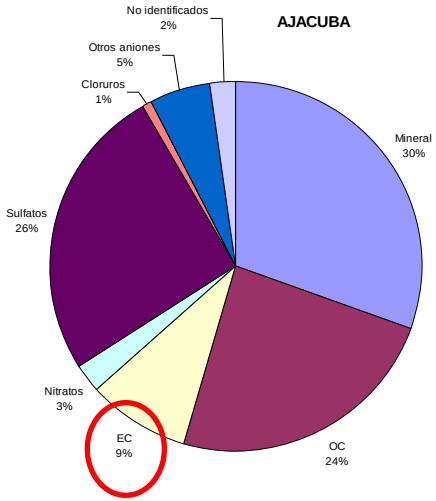
	TIJUANA		TOLUCA			GUADALAJARA	
	Day Average	Rush Hour Morning	Day Average	Rush Hour Morning	Rush Hour Afternoon	Day Average	Rush Hour Morning
OC (µg/m3)	4.8	17.4	8.9	31.7	18.5	6.0	13.7
EC (µg/m3)	0.8	2.0	3.5	6.7	5.0	2.3	3.9
OC/EC	6.0	8.8	2.5	4.7	3.7	2.6	3.5
EC/TC	0.3	0.1	0.3	0.2	0.2	0.3	0.2

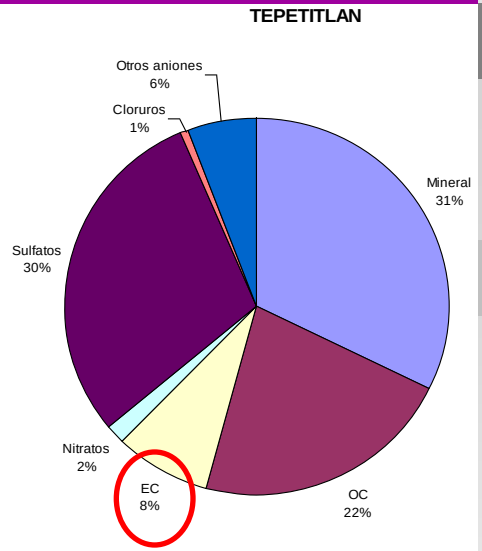
- *Organic Carbon (OC) concentrations in rush hour (6:00 to 9:00) tends to increase by a factor to 2.2 to 4 with respect to 24 hours averages.*
- *Elemental Carbon (EC) concentration increase 1.7 to 2.4.*
- *The average OC/EC ratios at the five cities of Mexico ranged from 2.04 to 5.96.*

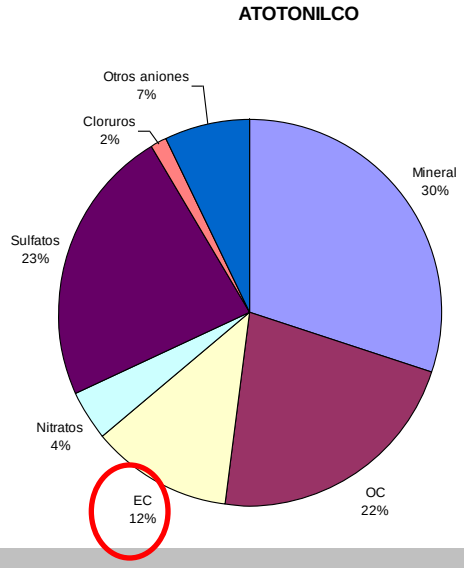
“Preliminary results of organic and elemental carbon in Tula, Hidalgo

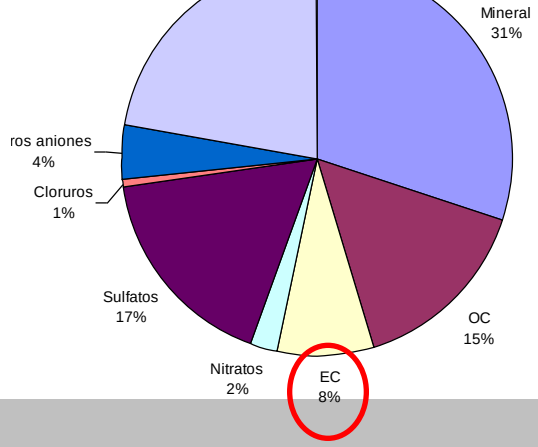
7-12 % elemental carbon in PM2.5

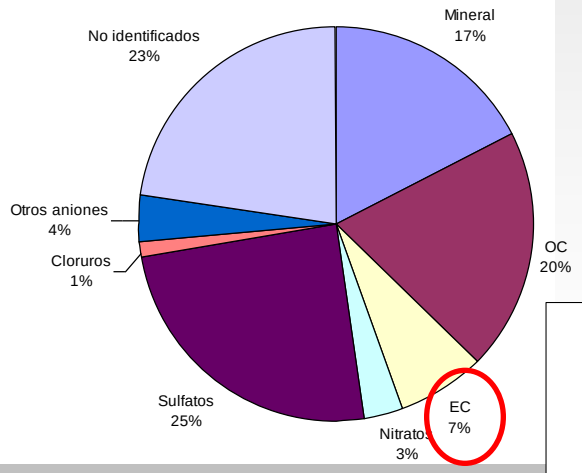


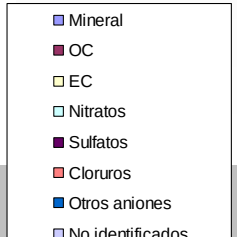












Mitigation strategies in Mexican Cities

Air quality and SLCF measures (a new stage of Proaires)

- *Transportation sources*
  - *Newer technologies (particulate filters)*
  - *Retrofit existing fleet*
- *Off road sources*
  - *Construction*
  - *Pavement*
- *Control of small combustion sources*
- *Large industrial facilities*
  - *Stricter particulate matter emission standards*
- *Banning of open burning of waste*
- *Banning of agricultural open burning*

Artisanal brick production

- The Artisan fabrication of bricks for construction in Mexico is an activity performed for hundreds of years in the same way and thousands of families depend on it, with impacts on health and ecosystems.
- Its production using available materials and fuel elements: tires, spent oil, wood, sawdust, plastic, cardboard, etc.
- There is no formal inventory of the number of artisanal brick producers in Mexico but some data indicate that there are about 20,000. Approximately 4 families are depending on each brick oven and most are living in extreme poverty, lack of access to services and marginality.
- The brick manufacturing processes have low energy efficiency and consume too much fuel, they also emit greenhouse gases, criteria pollutants and toxic air.
- Activity rate and emission factors have been determined for some types of kilns
  - Emission factors for GHG, PCDD/F and elemental carbon

$PM_{2.5}$, EC and OC from artisanal brick production in Mexico

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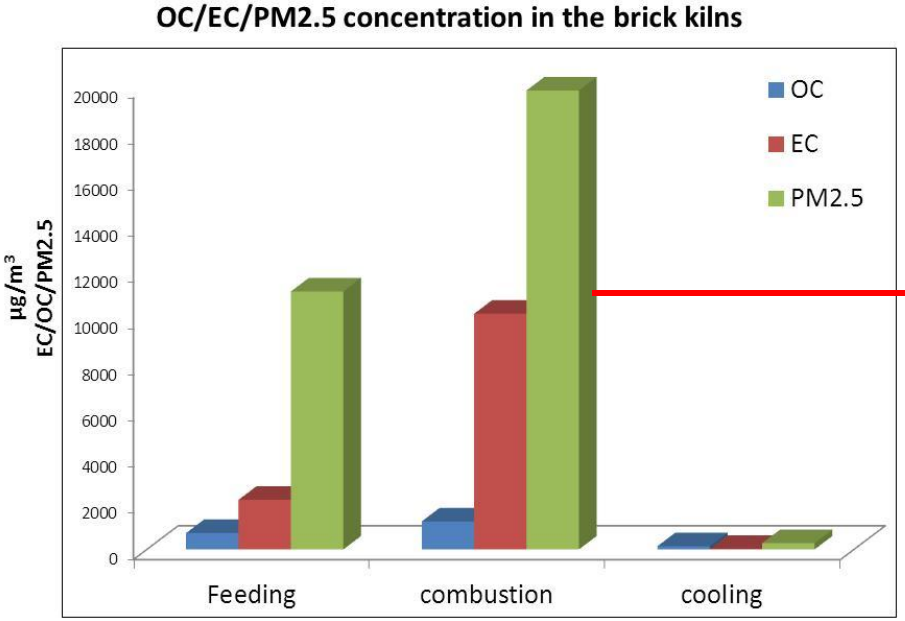
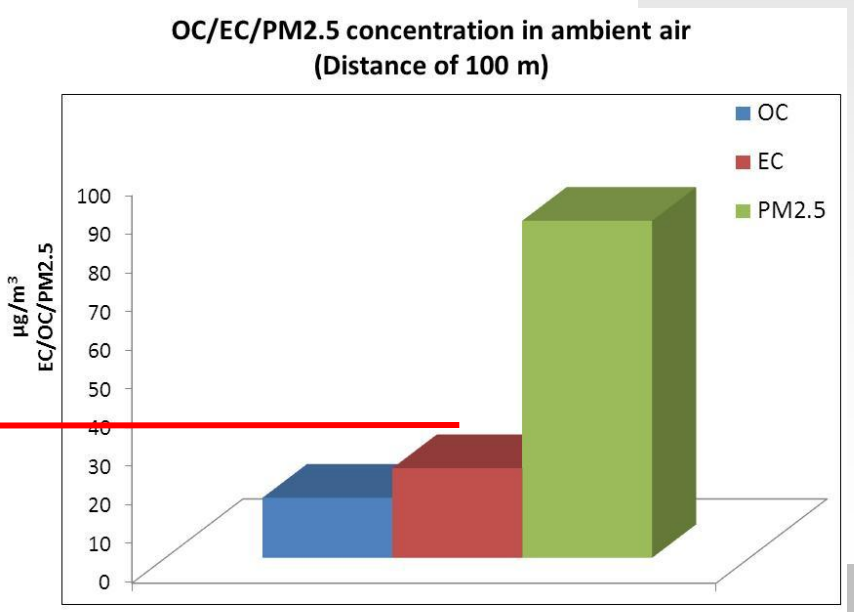




Artisanal brick production in Mexico

- Challenges to implement mitigation strategies
  - Social
    - Poverty, lack of access to education and other health services
    - Necessity to implement integrated public policies with focus on social development
  - Economical
    - One person business, informal, lack of access to credits
  - Political- governance
    - Municipal, state and federal jurisdiction for this activity
  - Technological
    - Long list of interventions not successful
    - Matching appropriate technology for each case
    - Need to determine OC/EC emission factors to evaluate scenarios

Artisanal brick production in Mexico

- Mitigation strategies
  - Technification (both brick making process and cooking)
  - More energy efficient kilns
    - Modern kilns (vertical kilns, multichamber, gasification-tunnels)
    - Simple improved kilns (MK2)
    - Modifications to kilns (fuel feeding, thicker walls)
    - Changes in fuels (high energy content, briquettes)
  - In Mexico there are some integrated programs to improve energy efficiency, production, living standards of producers
  - Energy efficiency through technology to reduce fuel consumption (GHG mitigation)

Integrated intervention strategies are needed with inter-agency participation

- Model considering social, economic and technological aspects

Use of firewood in México for cooking and heating

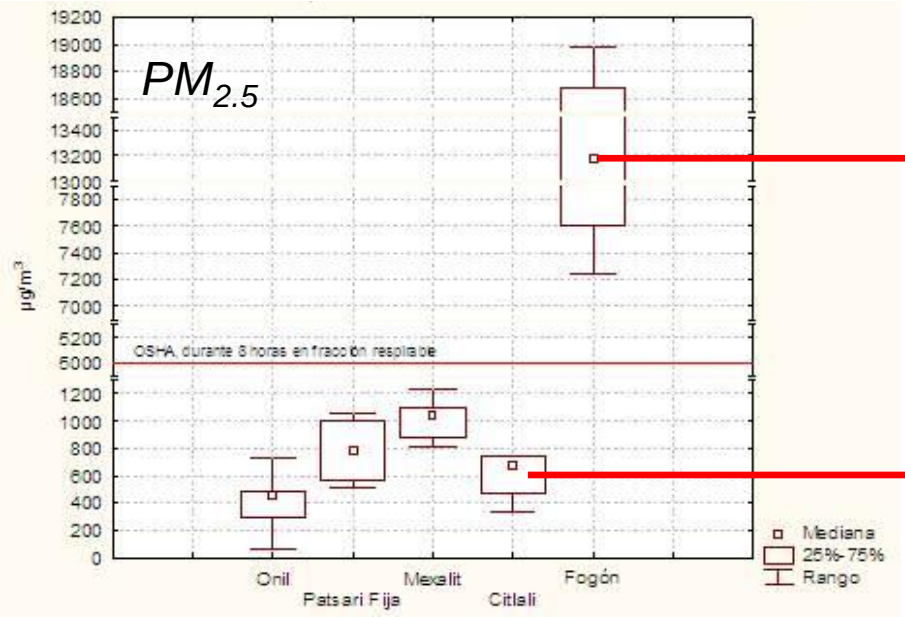
- In Mexico 1 in every 5 households (80% of them rural) use some type of biomass for cooking or heating in open stoves:
  - Inefficient use of fuels from renewable resources
  - Greenhouse gas emissions
  - Indoor and ambient emissions (gas and particles)
  - Health effects of women and children
  - In States with an indigenous population, where the use of open stoves is common, acute respiratory diseases are the primary cause of mortality in children under 5 years old. (Riojas et al., 2001)

Improved stoves for cooking and heating in rural areas.

- 25 million people in Mexico use wood as fuel for cooking and heating
- There is an ongoing program to substitute open fires with improved stoves
- Work done at the National Institute of Ecology on wood for cooking and heating and black carbon:
  - Emission factors for EC/OC have been determined in Mexico (Christianson et al. 2010)
  - Emission factors for GHG, TOC and PCDD/F for open fire and improved stoves have been determined
  - Indoor measurements
- There are different options for improved stoves with important reduction in fuel consumption. However all existing options do not control black carbon emissions. BC mitigation is a result of lower fuel consumption
- Standard protocols for evaluation of improved stoves (black carbon/EC emissions are ready to be incorporated).

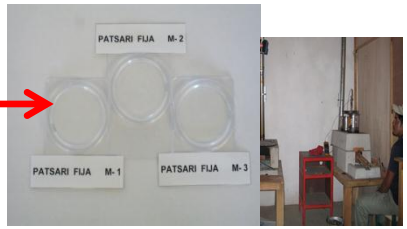
Experiences using wood: Comparative study of stoves

Cooked tortilla test: 22-33 min

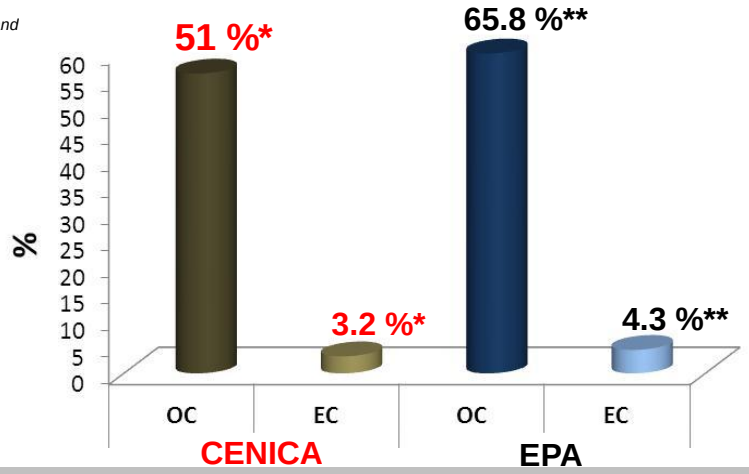


Filter Open Fire

Filter Stoves



OSHA: The proper standard to compare to is the OSHA standard for indoor air quality for respirable for nuisance dusts and smoke. That standard is 5000 ug/m3 on a time-weighted average (8 hours a day, 5 days a week) and is intended to be protective of health over an average working life of 30 years!



* ***Preliminary Data: INE-CENICA***

** *Reference: SPECIATE Data Browser (EPA).Wood Product Drying – Simplified.*

Public policy challenges

- Reducing emissions of greenhouse gases, criteria pollutants, air toxics (including POPs) and black carbon.
- Monitoring programs and creation of databases at the local and regional levels
- Incorporation of cleaner fuels
- Changing cropping practices
- Control of biomass burning sources
- Incorporation of new technologies
- Poverty reduction
- Strengthening of capabilities in research and monitoring





Challenges for mitigation strategies

- Integrated air quality and climate change programs are needed in Mexican Cities (Air quality and SLCF measures)
  - multipollutant approach to account for all co-benefits

- Modernization program for small combustion devices is feasible
  - Energy consumption, air quality, personal exposure co-benefits
  - Coordination with state and other agencies (Ministry of Energy, Economical Development)

- Integrated intervention programs need to be implemented for successful mitigation strategies
  - Social, economical, political and technological issues need to be considered for sources such as artisanal brick production, use of wood for cooking and heating
  - A good characterization of the different type sources is advisable

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