

# Air pollution impacts from dumps in Rural Alaska



## Acknowledgements:

This presentation was developed by Zender Environmental Health and Research Group and also uses some slides modified from presentations by Institute for Tribal Environmental Professionals

# Outline

What Goes to the Dump?

How is It Burned?

Health Effects of Burning Trash

Pollutants of Concern

Effective Waste Combustion

Burn Practices

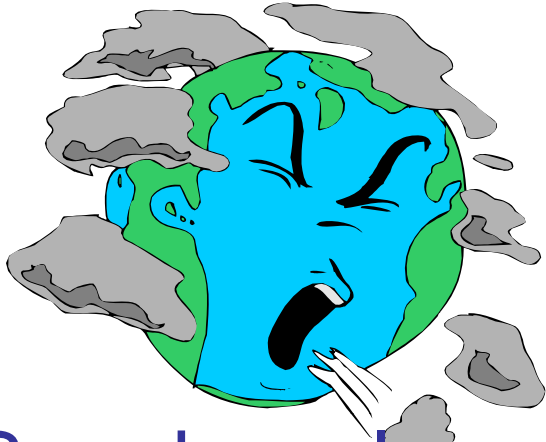
Regulations

# What Goes to the Dump?

- All types of waste
  - Household
  - Construction
  - Hazardous
  - Appliances
  - Vehicles
  - Carcasses
  - Honey-bucket wastes



# Contained Open Burning Methods



Burn barrels near the homes should be actively discouraged. If not successful, then help homes and stores modify for good design to get high temps





**Burn Boxes/Cages:** Homemade or purchased  
Emissions can be the same – as long as you  
have good draft and good burn procedures.





Photo source: Tek Welding



Photo: Denali Commission

## Purchased Burnboxes and units



## **Relative Health Risk Study – Aggregate results of 4 Villages (Zender Environmental study).**

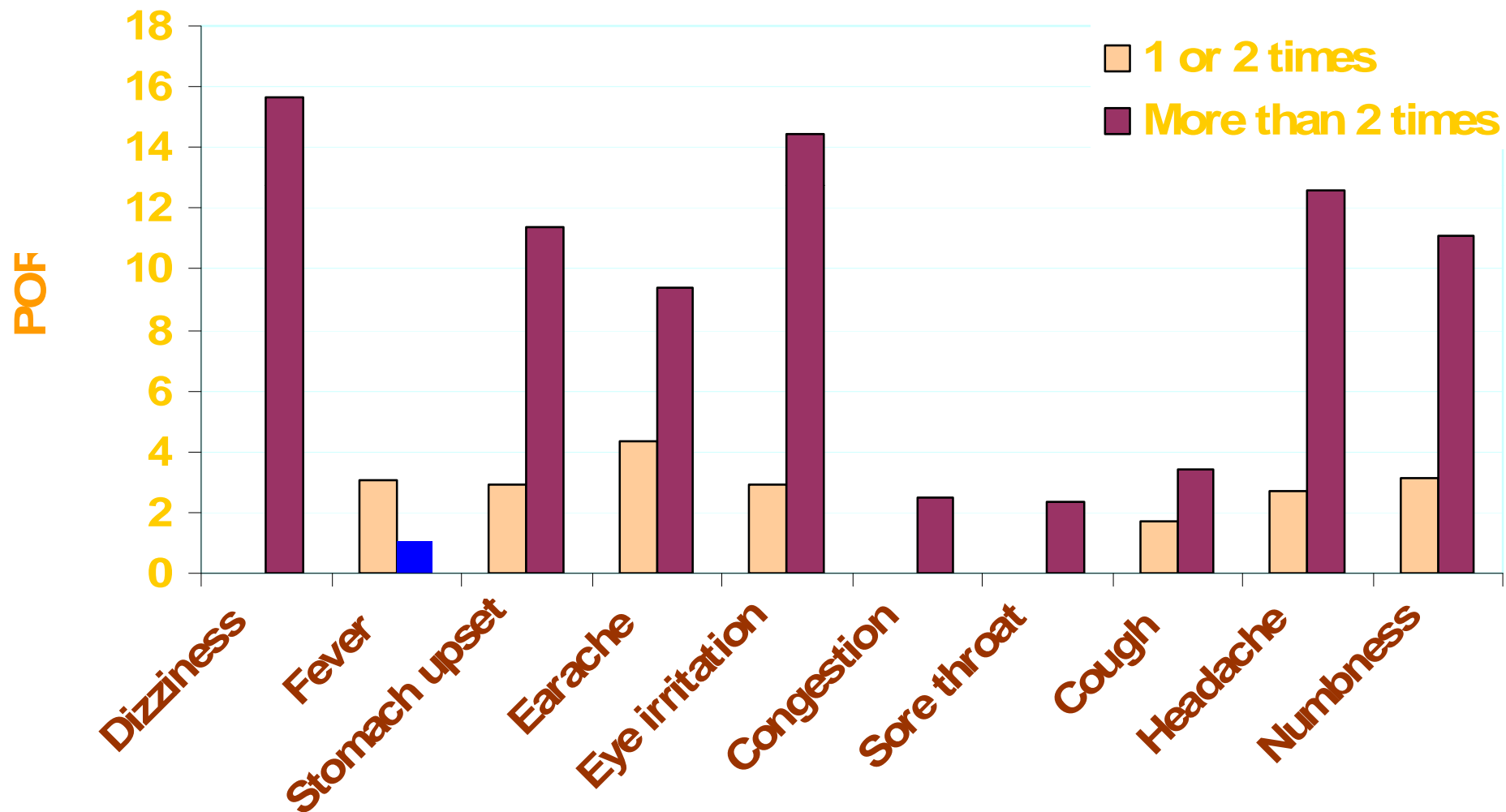
- Each had significant results with exception of 1 very small village that did not burn.
- House to House survey interview, over 95% participation representing 1250 people.
- Survey designed to National Institute Health Standards, given with trained interviewer and IGAP staff.
- Asked about each member of household and their short-term health symptoms in the previous 10 days. Information about their disposal habits, relative amount of subsistence diet, age, gender, smoking, tobacco use, diabetes, level of environmental concern, any asthma or diabetes diagnoses.
- Adjustments made for plumbing, education, environmental concern, gender, age, smoking, (i.e. coughing, congestion), asthma, diabetes.



**Relative risk of symptoms related to waste disposal factors in four Alaska Native Villages, 2001.**

Symptom	% Affected	Live near dump (1 mile)	Dump smoke or odor concerns	Burns near home	Visits dump
Rash	7.2	-----	2.3	29.7	2.9
Faintness	3.6	4	6.3	5.4, 13.2, 17.4 frequency	3.5
Fever	8.7	-----	1.7	2.3	2.0
Stomach pain	10.3	-----	2.2	-----	3.0
Vomiting	2.6	-----	1.6	-----	3.6
Diarrhea	5.2	-----	1.5	-----	-----
Ear irritation	4.4	-----	5.5	-----	2.1
Eye irritation	5.9	18.9	2.3	-----	3.7
Congestion	19.4	-----	1.8	-----	1.4
Sore throat	14.1	-----	1.8	2.0	1.6
Cough	18.4	-----	1.5	1.9	1.7
Headache	14.1	2.9	2.0	-----	3.0
Numbness	3.5	-----	2.6	4.8, 5.2, 10.1 frequency	3.4

# Visits to Dumpsites



**Nearly three-quarters of households had changed their subsistence practices somewhat or a lot due to concerns over dumpsite pollution or odors.**

**But subsistence actually protects people from ill health associated with open dumps:**

**Symptom**      **Eating subsistence foods most of the time (more than 50% of time) decreased the likelihood of having the symptom by this much:**

**fever**

***2.3 times***

**stomach  
pain**

***1.5 times***

**vomiting**

***3.4 times***

**cough**

***1.6 times***

**The best thing about a study like this: it produced significant results even with small populations and was/is relatively cheap to do for a village (if want all the stats will need to send data to a statistician).**

**Problem with a relative health risk study like this: it does not say exactly what associated with the dumps might be contributing to these effects.**

**However.....**

We do know that toxics are produced in the emissions and people are smelling the smoke. And smelling the smoke means they are exposed to these toxics.

In an EPA Study, 15 minutes of open burning trash was enough to produce potential health effects from dioxin 26 feet away from the source.

**See Health effects from Burning Trash handout and pages 7 and 8 of Village air toxics sheet for potential (unburned) fume sources at dumps.**



# Emissions from Burning Waste

Acid gases from burning waste that has high levels of chlorine and sulfur (e.g. plastics and paper)

- Hydrogen chloride (HCl), sulfur dioxide (SO<sub>2</sub>)

Heavy metals from slick colored papers (magazines)

- Lead (Pb) and cadmium (Cd)
  - Nickel-cadmium batteries (Ni-Cd), electronics

Everything burned at low or high temperature produces

- Particulate matter (PM10 and below)
- Nitrogen Oxides (NO<sub>x</sub>)
- Carbon monoxide (CO)

# Emissions from Burning Waste

Dioxins generally form in the temperature range of 400°F – 1600°F, highest around 600 to 800F - human carcinogen.

- Formed when chlorine and organic material > 400°F, complex reactions with metals affect formation

Polyvinyl chloride (PVC): drainpipe, children's toys, household, pharmacy, and cosmetic products

- Forms dioxins and hydrochloric acid when burned.

Polystyrene and styrenes: foam cups, yogurt containers, egg cartons, plastic forks and spoons

- Releases styrene and benzene when burned.
- Forms dioxins and chlorinated furans

# How to get an estimate of a particular chemical produced:

- The “AP-42” is EPA’s guidance on emission factors for all kinds of air pollution sources. For Open burning of municipal solid waste (i.e. not in an incinerator, but in a barrel, box, or ground), see handout for the table. Note they have not tested for all contaminants.

For example, Benzene:  $EF = 1.88 \text{ lb/ton burned}$ .

400 pp village x 3 lb trash per person per day  
going to burnbox = 1200 lb per day = 0.6 ton  
trash/day.

Benzene emissions =  $1.88 \times 0.6 = 1.13 \text{ lb per day}$ ,  
or 411 lbs per year.

# Effective Waste Combustion

Full burning and less pollution:

Produces ash that is inert

Produces ash that doesn't attract animals

Minimizes air pollution

Need: good design that works for village

good draft

supplemental fuel (usually)

method to retain heat

# Combustion Process



- Water driven out by heat
- 250-1200°F waste converted into burnable gases
  - start-up and cool-down
  - smoke produced (most contaminants)
- More effective combustion begins at 1200°F (higher is better) and mixed w/ oxygen.
- Temperatures can reach 1800°F or higher (almost no dioxins then).
- Contaminants in ash (fly and bottom) and smoke depend on completeness of combustion process, and the mix and types of what is being burned.

# Combustion Process

Completeness of combustion:

- Holding time
  - length of time needed to completely burn waste
  - higher temp decrease time needed
- Very high temps may allow some “non-burnables”
- Lower temp burns require more attention
  - separation of wastes required prior to burning
  - bottom ash likely to contain unburned waste
- Turbulence-thorough mixing of air in high temp



# Why Separate Wastes?

Goal to convert waste into inert bottom and fly ash with minimal amount of smoke / hazardous gases

Ash disposal site should be planned to minimize runoff

- Separate wastes that contain heavy (toxic) metals, high chlorine, and other hazardous (including explosive) wastes
- Metals, glass and moisture rob heat

# Burn Practices

## Siting your burn box

- Wind speed, direction and distance from community and subsistence resources
- Temperature inversions may trap smoke low

## Separate non-combustible waste and hazardous waste

- Metal, glass, high moisture content don't burn effectively – more essential for burn barrel, burn cage, burn boxes
- Prohibited wastes

# Burn Practices

## Manage and monitor combustion cycle

- Clean/dry wood and paper can be stored and used to achieve effective start-up most of the time.

## Keep the Waste Dry

- Household garbage ~20% water
- Smoke production increases with moisture
- Cover at residences, at any transfer stations, at the disposal site (issue with burn cages)

## Remove ash when thoroughly cooled

- No longer cause unburned waste to catch fire
- Make sure operator wears mask

Maintain your burnbox, too many get filled with ash and reduce combustion efficiency through blocked drafts, ice build-up (moisture), rusted-through seals

Keep people away from dump when burnbox is going.

# What shouldn't be burned?

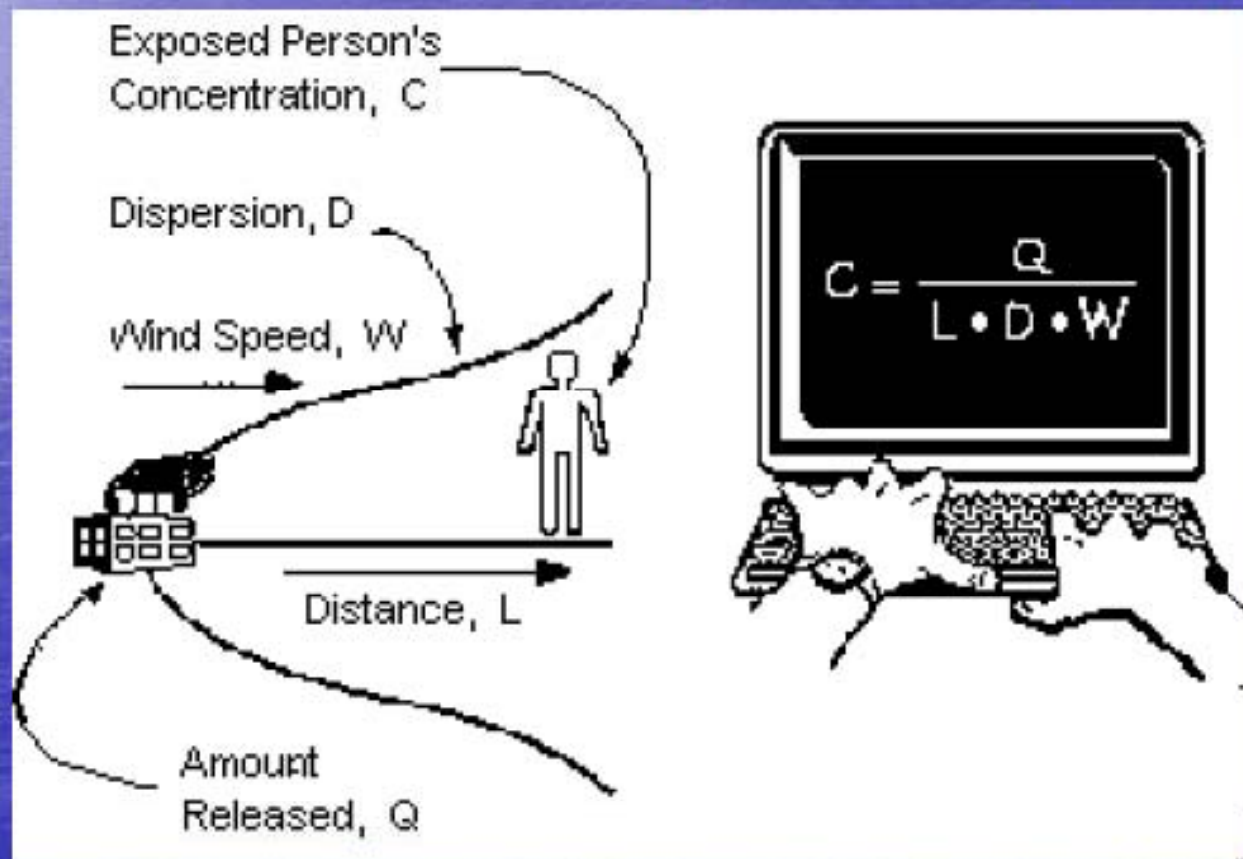
See handout from ADEC's "Burning  
Garbage and Land Disposal in Rural  
Alaska"

<http://www.dec.state.ak.us/eh/docs/sw/Burning%20Garbage%20Factsheet.pdf>

# Summary: Exposure is what matters in health.

- **Higher temps (drier, good venting, combustible) and less haz waste in will produce less haz waste out.**
- **Remember – nearer face level, and nearest downwind of source is the highest dose.**
- **Homes near dump or dominant downwind face chronic exposure.**
- **People near barrel burning face relatively high doses and chronic exposure.**
- **People using the dump are also exposed to fumes, and they track dirt/dust into their homes, which then can become airborne. Dump users were more likely to experience a number of symptoms, increasing with increasing visits.**

**Simple Model of Exposure Factors:** Note, the higher the "hazard" of a chemical, the lower the concentration (C) needs to be for bad effects. Also, chemicals breakdown differently once they enter the body. Some get more toxic, others less toxic, and some are eliminated without being absorbed. Also, animal and birds have different tolerances. Birds have very sensitive respiratory systems.



Source: EPA - ATW - Risk Assessment for Toxic Air Pollutants A Citizen's Guide.htm



# Applicable State Regulations

## Air Quality Control regulations (18 AAC 50)

- Cover standards for limiting air pollution
- Open Burning Policy and Guidelines  
(in appendix)

## Solid Waste Management regulations (18 AAC 60)

- Cover standards for disposing of combustion ash and other municipal waste
- Set standards for handling, treatment, disposal

# Taikuu

