15th Annual OSC Readiness Training Program

Waste Fires Landfillology

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Version
OSC 2012

Todd Thalhamer, P.E.

- Environmental Engineer with 19 years experience in waste issues
- 17 years of firefighting experience
- Currently a volunteer Lieutenant for El Dorado Hills Fire, California
- Developed a new firefighting concept called environmental suppression, which balances the impact of firefighting with the environment
- Consulted on over 45 waste fire projects in the US and Internationally
- IC for the Longest Burning Tire Fire in the US
- President of Hammer Consulting

Projects

- 2008 - Instructor/Presenter for Landfill Fire Seminar, B.C., Canada
- 2008 - Instructor/Presenter for International Tire Conference, San Diego California
- 2008 to 2007 - Waimanalo Gulch Landfill Heating Event, Hawaii
- 2008 to 2007 - Kailua-Kona Landfill Fire Suppression Project, Hawaii
- 2008 to 2007 - Lawson Illegal Disposal Site Subsurface Debris Fire, Riverside County, CA
- 2007 - City of Kingston Landfill Fire, Jamaica
- 2007 - Helotes Debris Fire, San Antonio, Texas
- 2006 - Landfill Fire Conference, Ohio
- 2006 - Landfill Fires Guidance Document Final, CIWMB
- 2006 - Candlestick Point Subsurface Fire, San Francisco, California
- 2006 - Minimize Landfill Fire and Losses, Panel Member, Washington D.C.
- 2006-2003 - Tracy Tire Fire Remediation Project, San Joaquin County, California.
- 2006 - Landfill Fire Conference, Instructor/Presenter, Ohio EPA
- 2006 - Landfill fire, Australia, Pollution Response Agency
- 2004 - Chalan Pago Kajiyama Hardfill Facility Fire, Guam
- 2003 - Archie GOH Debris Fire, Fresno, California
- 2003 - Woodlake Sanitary Landfill, Loretto, Minnesota
- 2003 - Idaho Tire Recovery Pile Evaluation, Lincoln County, Idaho
- 2002 - Greenhill Road Illegal Landfill/Debris Fire, Johnston, Rhode Island
- 2002 - Superior Greentree Landfill Fire, Kersey, Pennsylvania
- 2002 - Instructor/Presenter for Tire Fire Response, US EPA
- 2002 - Naco Landfill Fire, Naco, Mexico
- 2001 - Hunter's Point Landfill, US Navy, San Francisco, California
- 2001 - Shredded Tire Facility in Ohlsdorf, Austria
- 2000 - Tracy Tire Fire Suppression Project, San Joaquin County, CA
- 2000 - Instructor/Presenter for Environmental Suppression Workshop, Sacramento County, CA
- 2000 - Andersen Air Force Base Landfill Cap Evaluation, Guam, USA
- 1999 - Illegal Green Waste Pile, Guam USA
- 1999 - Cajon Illegal Landfill Fire, San Bernardino County, California
- 1998-1999 - Hawaiian Island Landfill Fires, Hawaii
- 1998 - Ordot Tire and Landfill Fire, Guam, USA
- 1998 - Tracy Tire Fire, San Joaquin County, California
- 1997 - Westley Tire Fire, Stanislaus County, California
- 1997 - Lone Pine Landfill Fire, Inyo County, California
- 1996 - Panoche Tire Fire, Fresno County, California
- 1994 - Gillespie Landfill Fire, San Diego County, California
- 1992 - Berry Street Mall Landfill Fire, Sacramento County, CA

Objective

- To be aware of the risks and hazards of waste fires whether you are an operator, responder, regulator, or consultant

Landfillology for 1st Responders

- What are the risks and safety concerns from a fire at a waste facility

Risk
- Community
- Containments
- Cancer

Safety
- Protection
- Prevention
- PPE

Hazards?

- Waste
- LF Engineering Controls
- Equipment
- Working Face MOVES – New Roads
- LF Gasses
- Confined Spaces
- Collapses
- Rescues

Safe Operations

Safe Operations?

Frequency of Waste Fires

1. Landfills (Closed/Operating LF and Transfer Stations)
2. Wood/Sawdust Storage
3. C&D Facilities
4. Tire Facilities
5. Recycling Facilities

Toxicity of Waste Fires

Source: Opinion of Mr. Thalhamer, P.E.

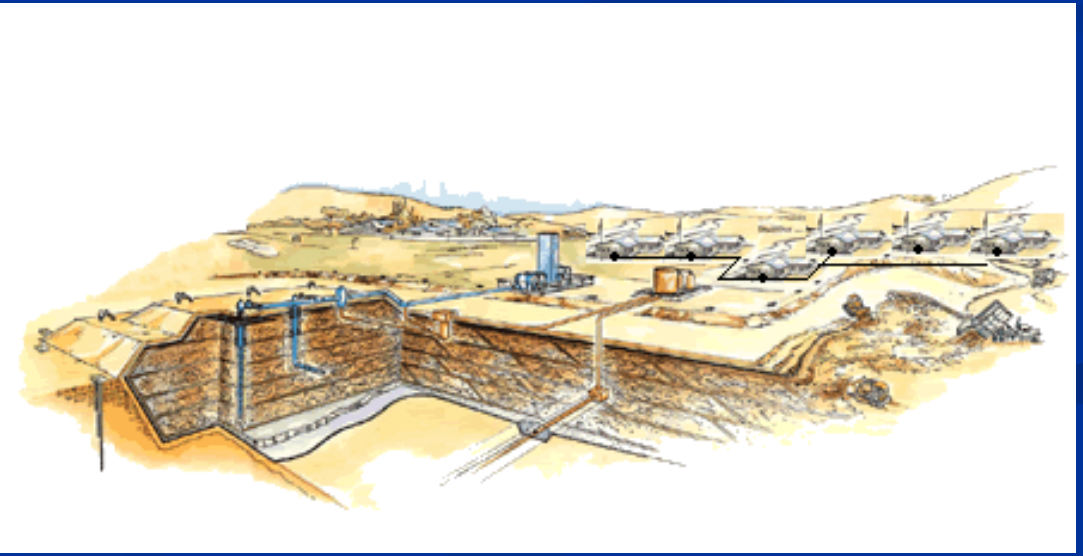
Landfill (LF) 101

- A specially engineered site for disposing of waste on land, constructed so that it will reduce hazard to public health and safety

- All landfills will have specific hazards to employees and responders

Types of Landfills (LF)

- Inert/Construction and Demolition
  - Class IV
- Municipal Solid Waste
  - Class III
- Industrial
  - Class II
- Hazardous
  - Class I



Other Storage Waste Sites

- Transfer Stations
- Waste Incinerators
- Plasma Converters
- Recycling Centers
- Tire Storage

Types of Waste

- Household Trash
- Yard Waste
- Construction and Demo
- Contaminated Soil
- Hazardous Waste
- Industrial Waste
- Tires
- Ag Waste
- Bio Solids
- Asbestos
- Liquid Waste
- E-Waste
- Medical Waste
- Auto Shedder Fluff
- Metal Waste
- Animal Waste
- Chemically Treated Lumber
- Appliances
- Radioactive
- Etc

How Much Trash Per Year

- In the US
  - 251 million Tons/year (CA 36% waste stream)
    - Per Truck @ 20 Tons = 12.5 million loads

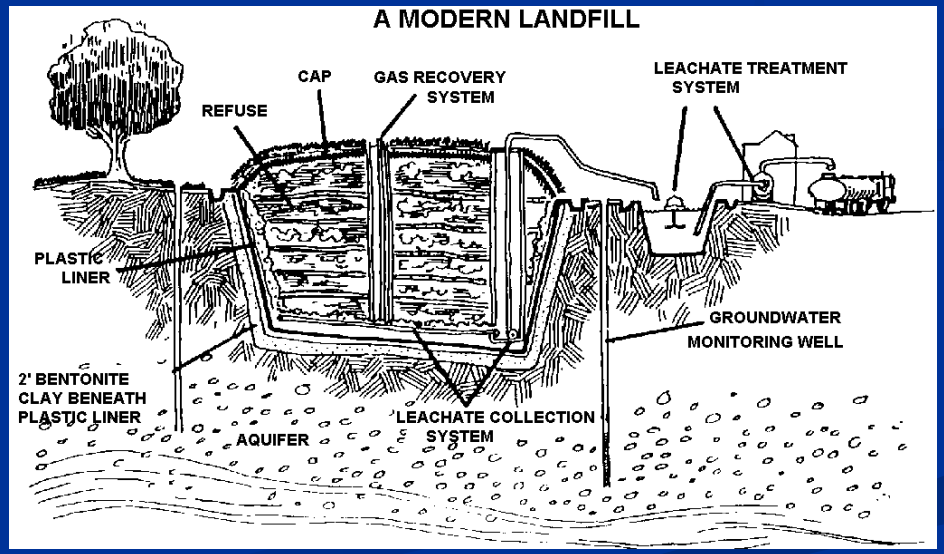
Source: www.usepa.gov

Energy of Waste

- Solid waste is a high energy fuel:
  - MSW is 4,000 to 7,000 BTU/lb
  - Demolition/Land-Clearing/Construction waste is 6,500 BTU/lb
  - Gasoline is 15,000 BTU/lb
- For example, Landfill Active Face:
  - Place 400 tons daily (CA – PH takes 7500 T/D)
  - equivalent to 42,666 gallons of gasoline

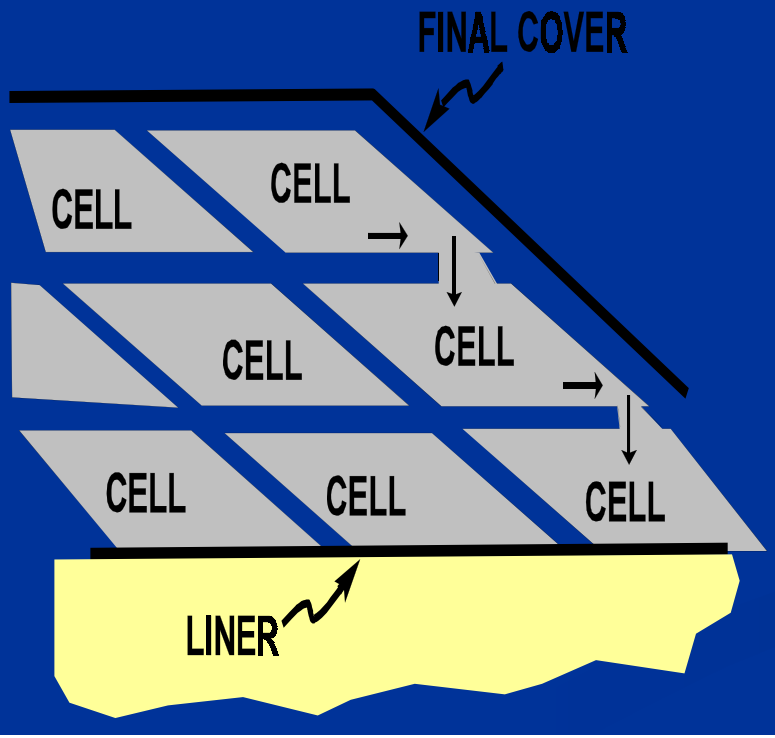
LF Engineering Controls

- Cover/Cap
- LF gas collection
- Liners
- Leachate collection
- GW monitoring wells



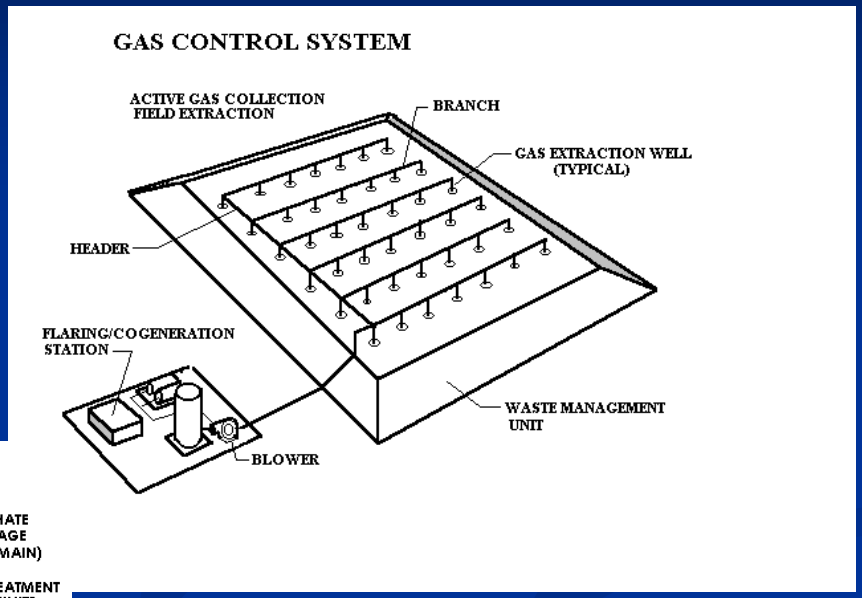
Construction

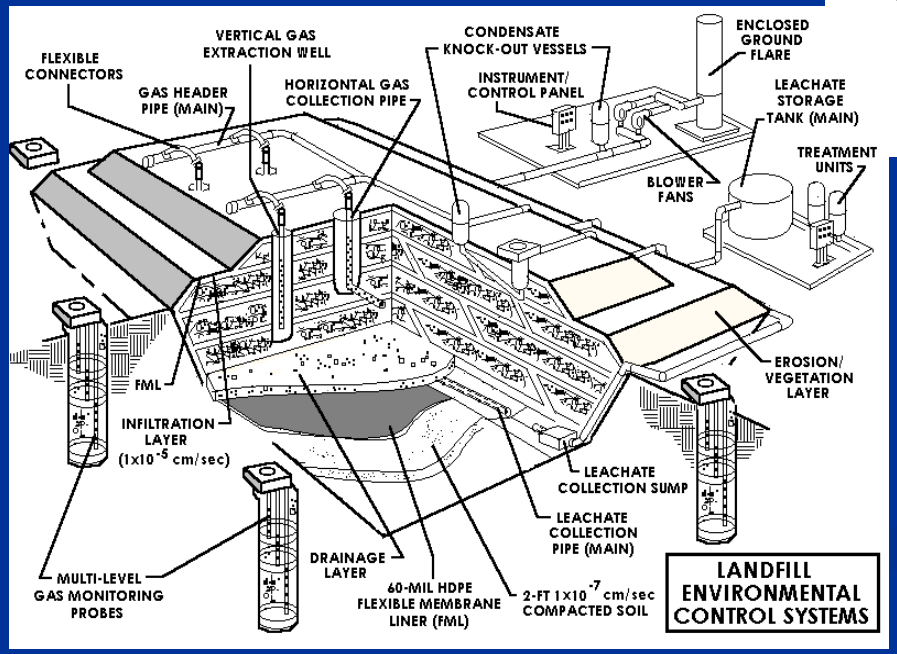
- Cell by Cell with daily cover
- What type of daily cover
- Compaction



Overview LF

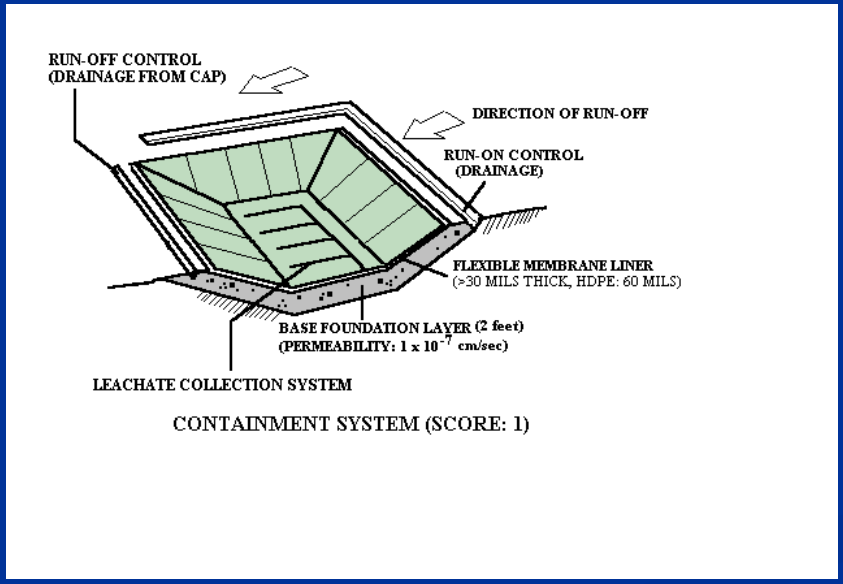
LF Gas Collection System (GCS)

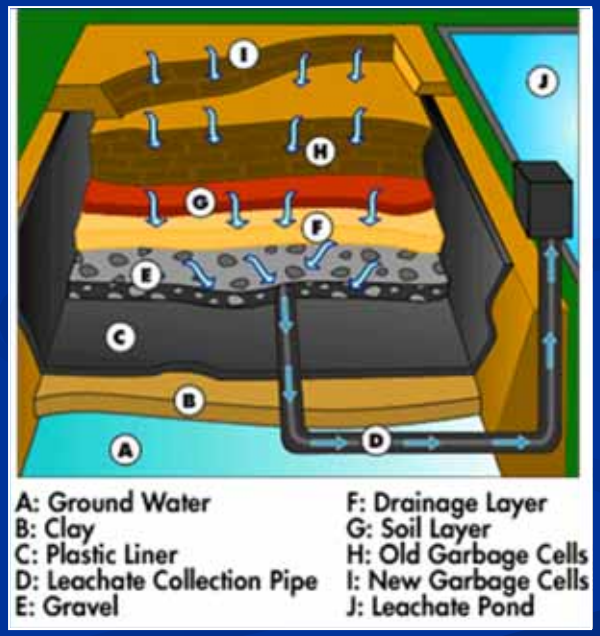




Liners and Leachate

- Issues
  - Using Leachate as suppression water?





Gas Collection

Typical Modern LF

Combustion 101

Ignition

- Ignition can be divided into two types
  - Due to external heating
  - Due to internal heating (aka self-heating)

- External – match ignites paper
- Internal – hay pile ignites/linseed-oil rags

Source: Vytenis Babrauskas, Ignition Handbook, 2003

Low Temperature Ignition

- Lowest documented temperature at which a fire was report involved a hot-water pipe operating at 77ºC (170ºF)

Source: Vytenis Babrauskas, Ignition Handbook, 2003

Spontaneous Ignition

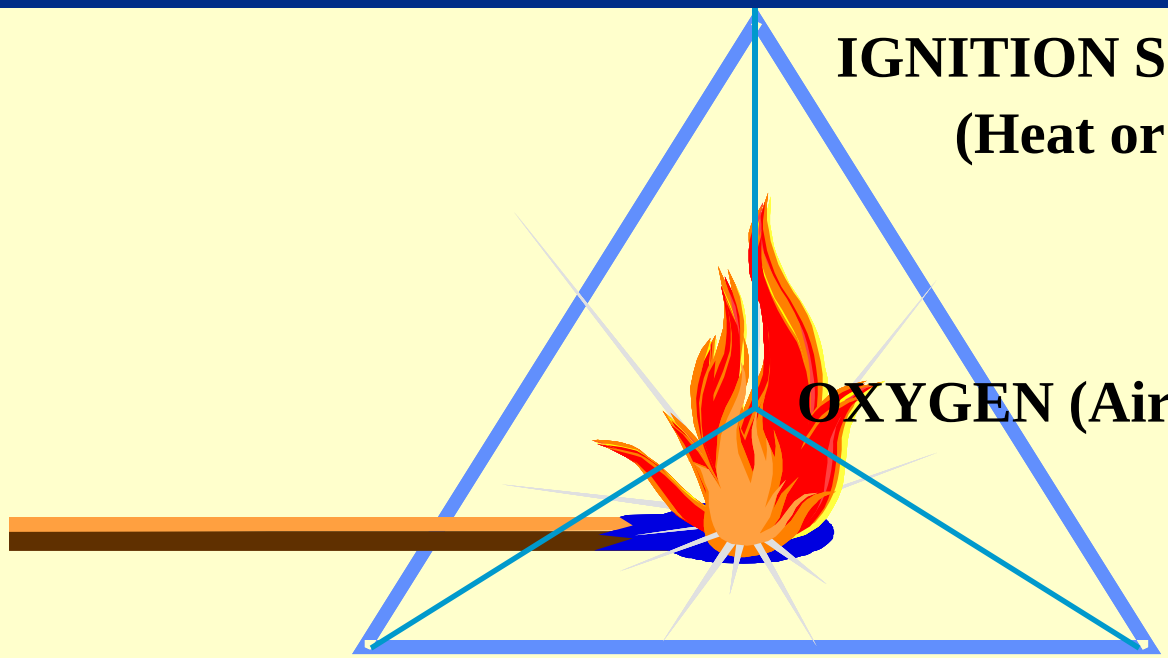
- Definition
  - “Chemical or biological process that generates sufficient heat to ignite the reaching materials”

Combustion

- Fire is an self-sustaining exothermic oxidation reaction that generates heat and light
- Two Types
  - Flaming
  - Smoldering

Source: Kirk's Fire Investigation, 2007

Fire Tetrahedron



Flaming

- Typically requires oxygen from 21 to 15 %
- Eventually the oxygen concentration (15% to 10%) reaches a limiting concentration that will not support flaming combustion
- Below 10% flaming fire growth is impossible except in post-flashover fires
- That limit is dependent on nature of the fuels and the temp of the combustion gases

Source: Kirk's Fire Investigation, 2007

Flaming with Limited O_2

- Yes
  - Oxygen concentrations between 5% and 8% have been observed in room tests with flammable liquids where the ceiling temps are 900 to 1000ºC (1652 to 1832ºF)
  - Post-flashover room fires oxygen concentrations between 0% to 5% when temps in hot gas layer were over 1000ºC (1832ºF)

Source: DeHaan, Dynamics of Flash Fires, 1996

Smoldering Combustion

- Definition
  - “The direct combination of a solid fuel with with atmospheric oxygen to generate heat in the asbsence of gaseous flames”
- Can result from runaway self-heating
- Smoldering can be started simply by creating a large enough organic pile

Source: Kirk's Fire Investigation, 2007

Spontaneous Combustion

- A process that increases the temperature of a material without drawing heat from an outside source.
  [Introduction to Fire Science]
- The process where a waste material is heated by chemical oxidation via biological decomposition to the point of ignition [Thalhamer]
- Smoldering can be started simply by creating a large enough pile of self-heating materials (waste, hay, sawdust, etc.)

Smoldering Fires

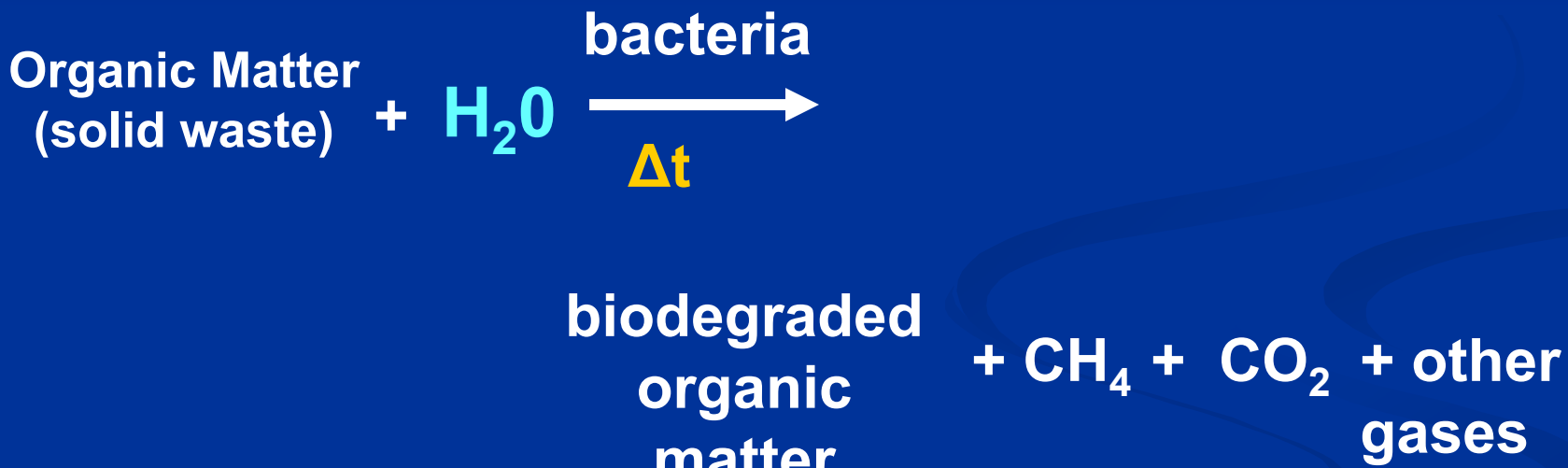
- Smoldering Fires will propagate even at oxygen concentrations below 3%
- Produce extensive amounts of carbon monoxide (CO)
- Concentration will range from 1 to 10% (10,000 to 100,000 ppm)
  - Note: well-ventilated free burning fires produce less that 200 ppm (0.02%)

Source: Kirk's Fire Investigation, 2007

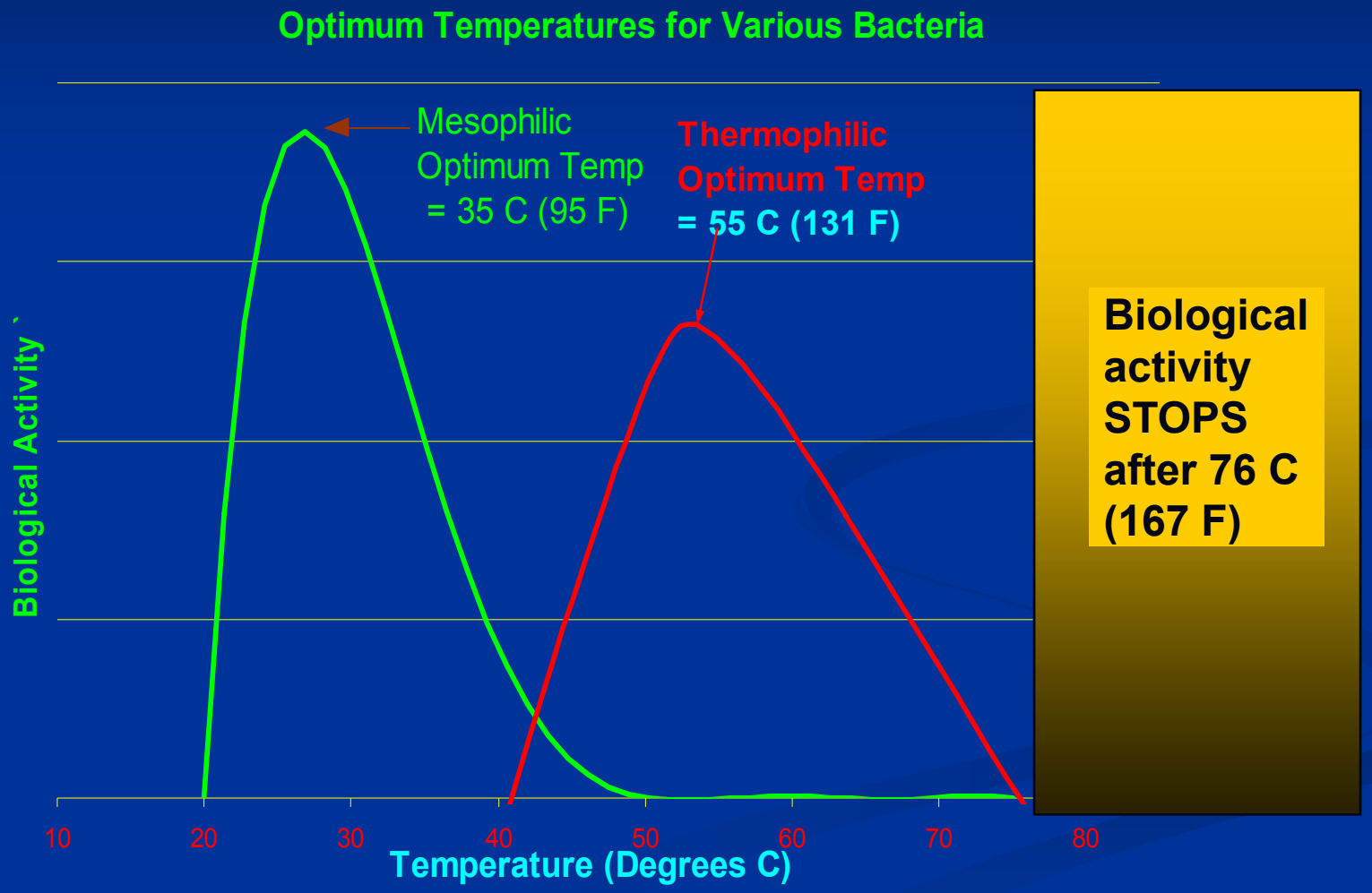
Underground Fire

- Is where spontaneous combustion has occurred in waste materials below the surface.
- An underground fire is a smoldering fire

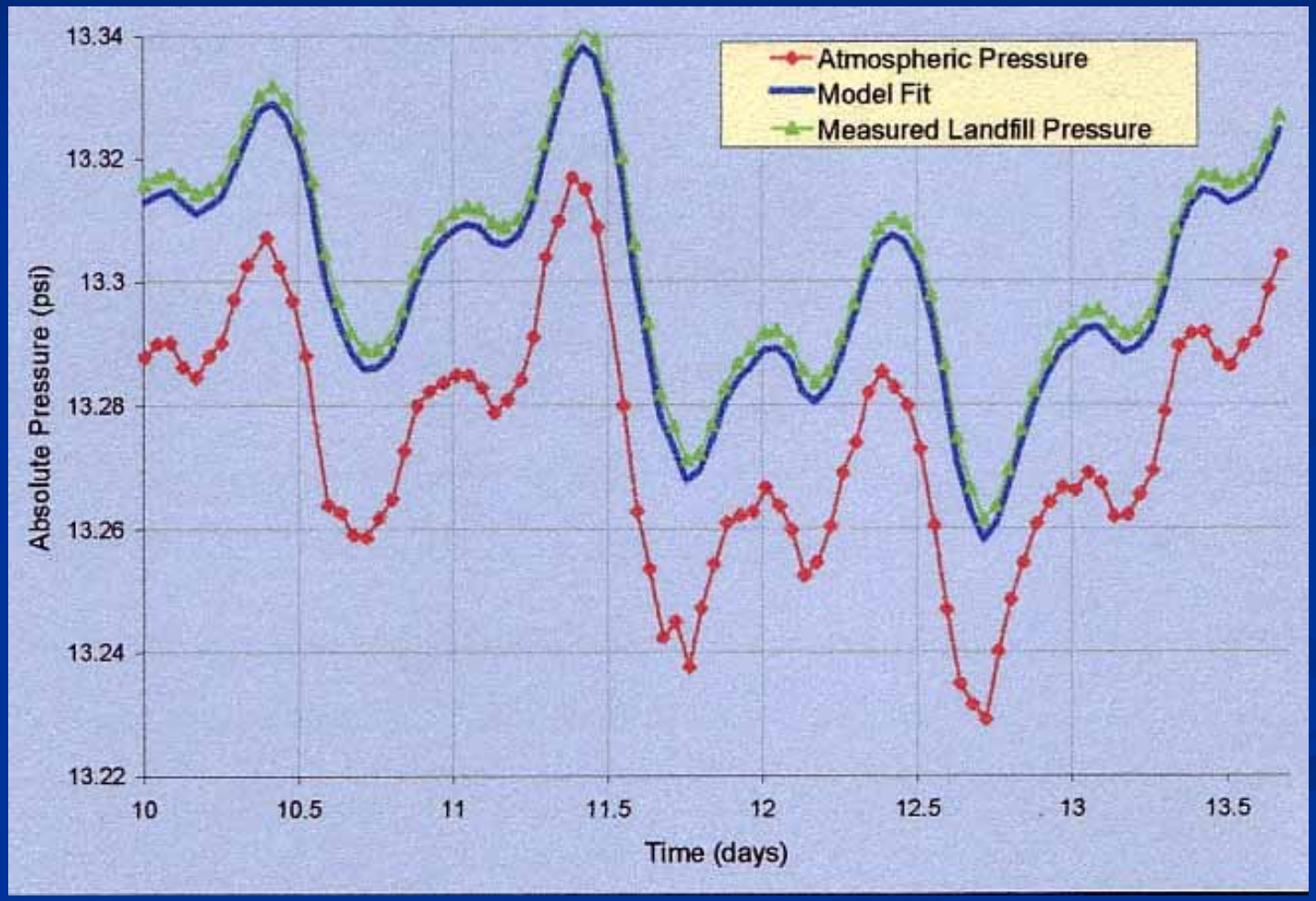
Anaerobic Decomposition



Temperature



Barometric Pressure



2002 Walter, Gary

Hay Fire

- One of the earliest substances known for self-heating
- Keys
  - Microbial Actions
  - High Moisture
  - RH from 25% to 95%
  - RH of 45% is worse case
  - Chemical Oxidation

Source: Vytenis Babrauskas, Ignition Handbook, 2003

Hay Fire

- Three Phases
  1. Biological Decomposition
  2. Chemical Oxidization
  3. Mallard Reaction that forms a dark colored polymer
- Aromatic smell
- Color changes in side
  - Greenish-brown to gold-brown to dark brown to chocolate to black

Other Factors

- Gas Extraction Rates
- Overpulling
- Compaction
- Cover
- Barometric Pressure
- Moisture

Subsurface LF Fire Season?

- Yes, based on empirical data most subsurface fires occur during the spring and fall when barometric pressures are at their greatest Δ
- Any holiday or after 5:00 pm on F/S/S

1. Empirical Data: This is information based on observation and experience, not scientific reasoning. Empirical data is often very accurate, although it is not accepted as scientifically sound; however, no area of science is devoid of a real-world/empirical component.

Definitions

- ROSE
- SOE
- Chemical Reaction
- Pyrolysis
- All the same?

Bottom Line as of 10/2008

- Wood has been show to ignite as low as 77ºC (170ºF)
- Smoldering fires have been shown to ignite at 172°C (341°F) and as low as 65°C (°149F)
- All anaerobic bacteria die off at 76ºC (169ºF)
- HDPE melts at 140ºC (287ºF)

Safe Landfill Temperatures

- NSPS 57ºC (135ºF) for LF gas
- Liner Manufacture recommendation 65ºC (150ºF)
- Keep Landfill under 150ºF, preferably below 135°F

Video Break