Leak Detection & Measurement of Fugitive Methane Emissions

An EPA Best Management Practice for DI&M Programs

Milton W. Heath III
Heath Consultants Incorporated
Thursday, June 8, 2006
EPA Gas STAR Technology Transfer Workshop
Midland, Texas

Leak Survey Methods

- **Leak Detection**
  - Soap solution
  - Flame Ionization
  - Catalytic oxidation/thermal conductivity
  - Ultrasonic
  - LSI's Gas Imaging Camera, the "Hawk"
  - New Heath RMLD
  - Visual
  - Tag and number leaks on standard components

3 Main Categories of Leaks

- Standardized Components
  - Flange, Union, Thread & Tube Fittings, valve caps, fuel injector valves, stem packing leaks etc…
- Compressor Seal Systems
  - Rod Packing Vent or Combined Distance Piece and Packing Vent, Wet or Dry Seal Vents on Turbines
- Blow Down Systems
  - Unit Valves, Blow Down Valves, Pressure Relief Valves, Power Gas Vent, Condensate Tanks, ESD Vents

Screening & Tagging

- Recommend the use of a reliable pump-driven combustible gas indicator that can see down to 50 PPM.
- For Vented Components, recommend measuring as you go.
- For Standardized Components, recommend screening and tagging.

ency, Maximizing Profits

NaturalGas
EPA POLLUTION PREVENTER

HEATH CONSULTANTS

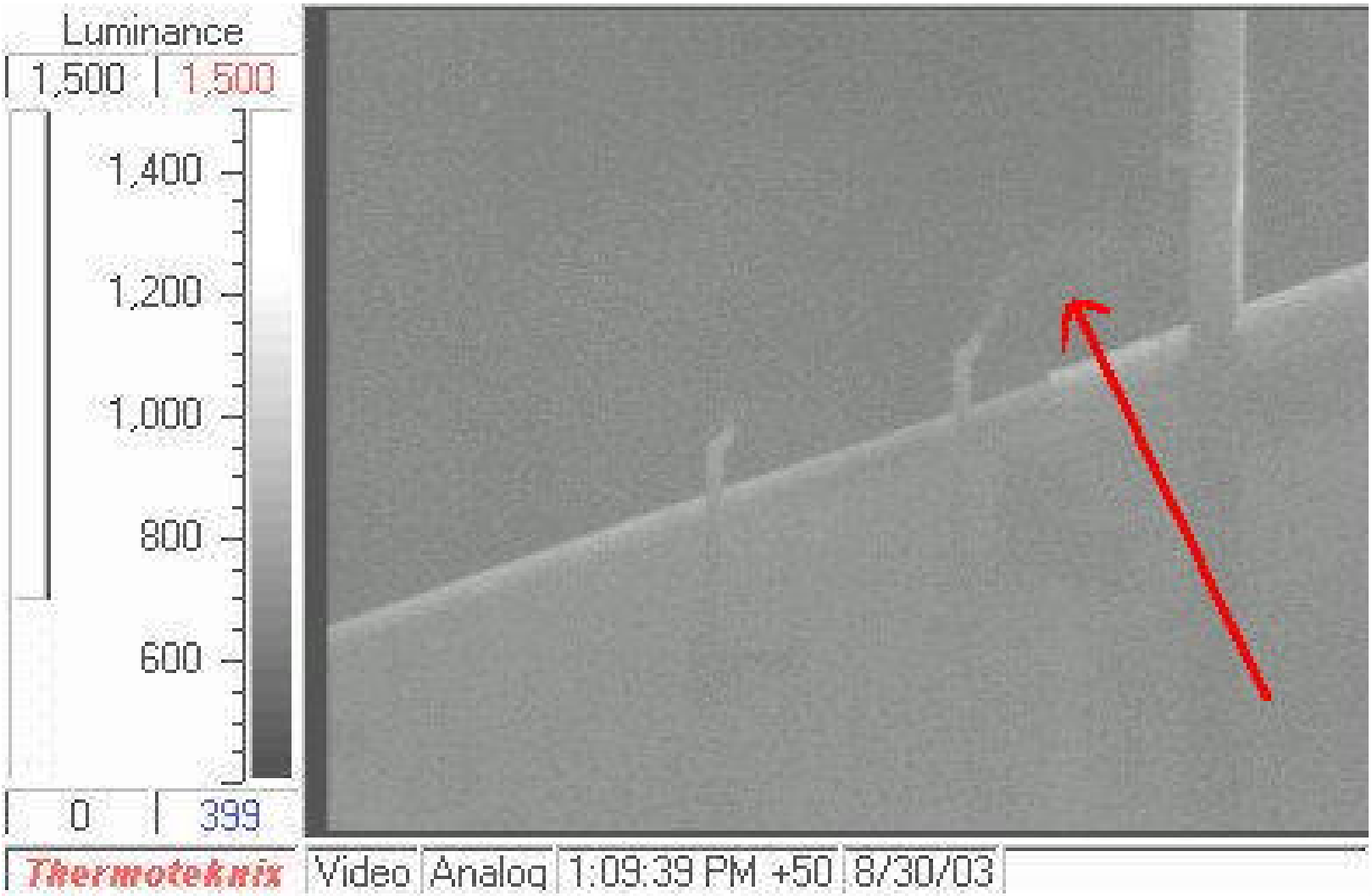
Reducing Emissions, Increasing Efficiency, Maximizing Profits

NaturalGas
EPA POLLUTION PREVENTER

HEATH CONSULTANTS

Reducing Emissions, Increasing Efficiency, Maximizing Profits

NaturalGas
EPA POLLUTION PREVENTER


Luminance
1,500
1,500
1,400
1,200
1,000
800
600
0
399
Thermoteknix
Video
Analog
1:09:39 PM +50
8/30/03

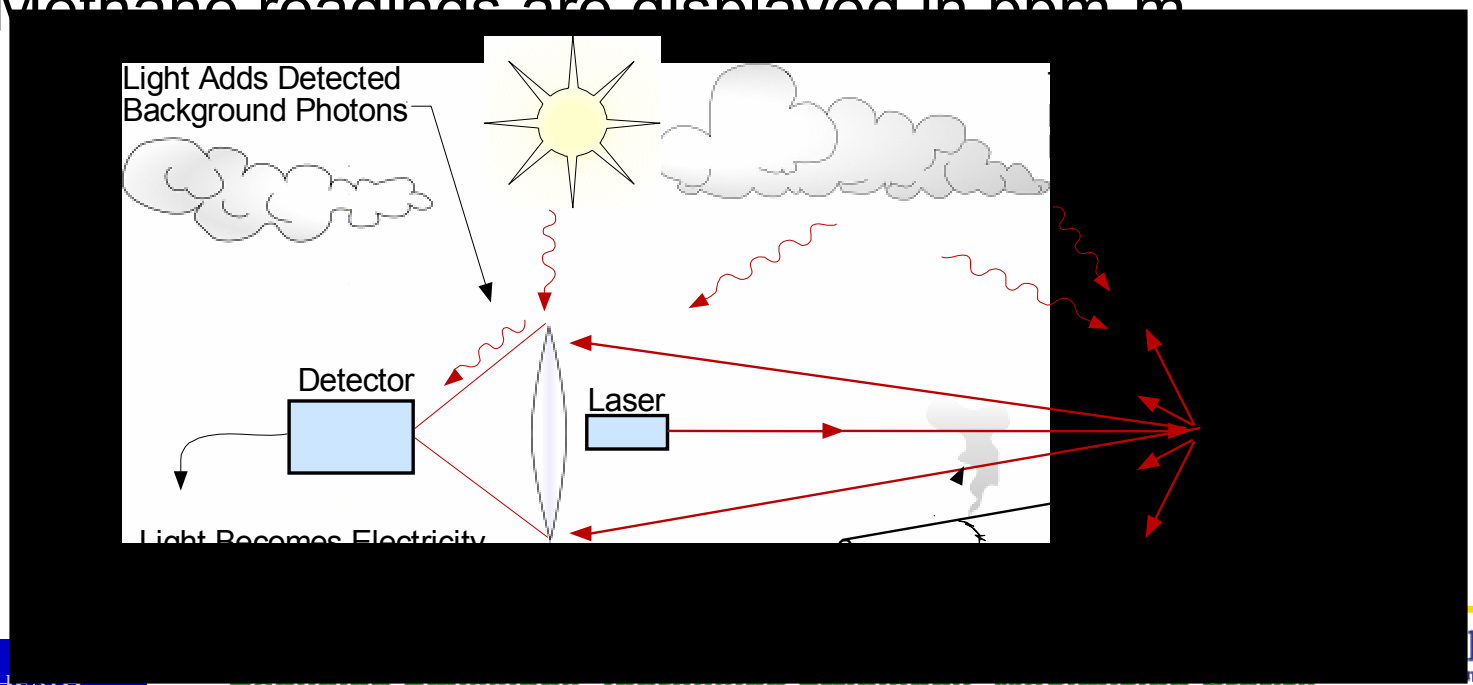
Remote Methane Leak Detection

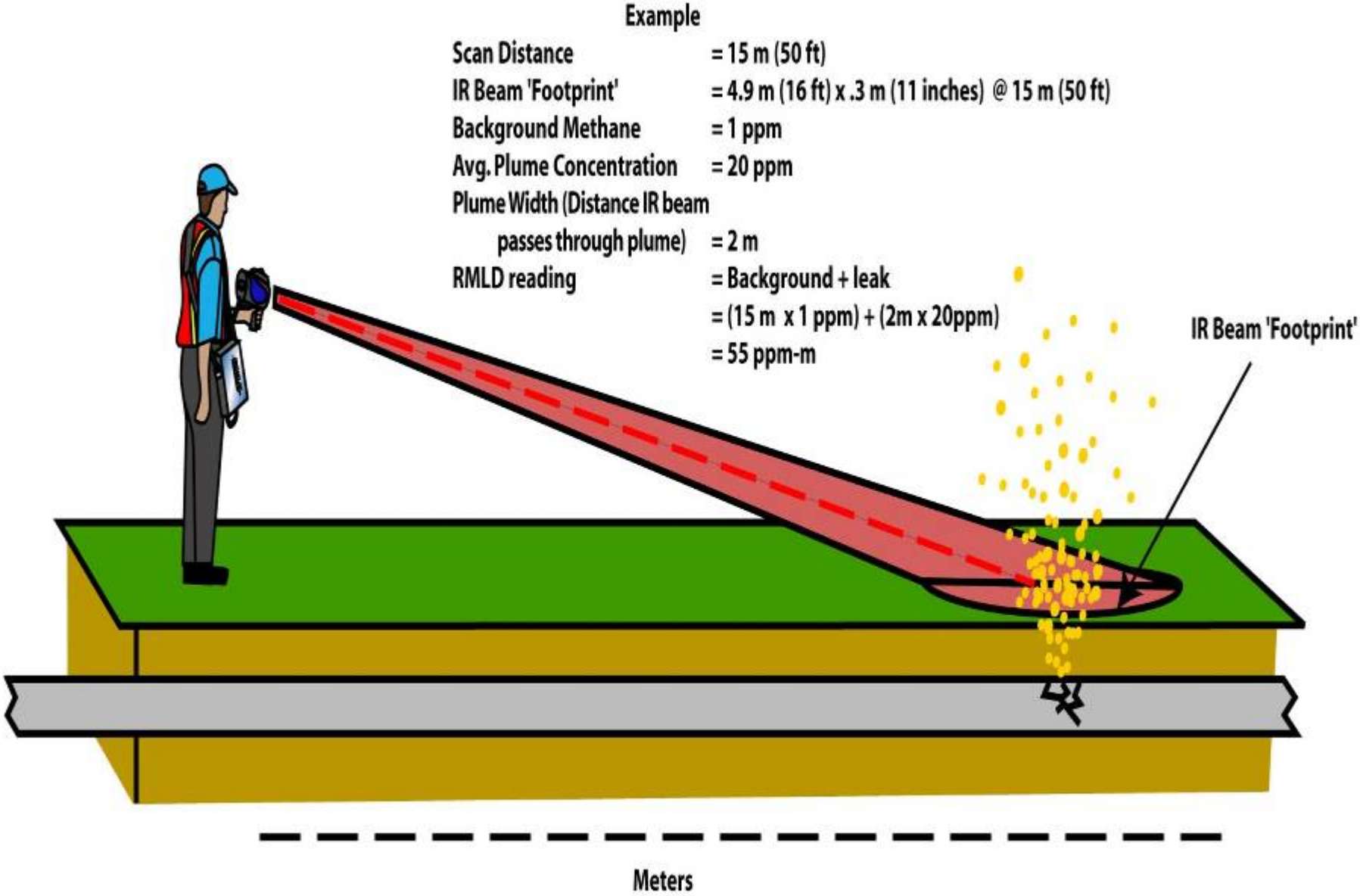
BASED ON TDLAS TECHNOLOGY

- Tunable Diode Laser Absorption Spectroscopy (TDLAS)
  - Every gas absorbs specific wavelengths (frequencies) of light
  - The RMLD laser beam emits a specific wavelength which is absorbed by methane
  - The amount of laser light absorbed is proportional to the total amount of gas in the path of the laser beam
  - Concentration is then expressed as parts-per-million-metered, or “ppm-m”

TECHNICAL APPROACH

- Laser light beam is remotely projected on to a target (e.g., grass, wall, etc.)
- A fraction of the beam is scattered from the target surface and returned to the source
- Returned light is collected and focused onto a detector
- The presence of methane is encoded within the returned light
- Methane readings are displayed in ppm-m




Example
Scan Distance = 15 m (50 ft)
IR Beam 'Footprint' = 4.9 m (16 ft) x .3 m (11 inches) @ 15 m (50 ft)
Background Methane = 1 ppm
Avg. Plume Concentration = 20 ppm
Plume Width (Distance IR beam passes through plume) = 2 m
RMLD reading = Background + leak
= (15 m x 1 ppm) + (2m x 20ppm)
= 55 ppm-m
IR Beam 'Footprint'
Meters

HEATH CONSULTANTS

Reducing Emissions, Increasing Efficiency, Maximizing Profits

NaturalGas EPA POLLUTION PREVENTER

HEATH CONSULTANTS

Reducing Emissions, Increasing Efficiency, Maximizing Profits

NaturalGas EPA POLLUTION PREVENTER

Measuring Fugitive Methane Emissions

- **Leak Measurement**
  - Hi Flow Samplers
  - Vent-Bag™
  - Hot Wire Anemometer
  - Rotameter

Measurement Methods

- For leaks up to 10 cfm – Hi Flow Samp
  10 cfm @ $5/Mcf = $26,280

- For leaks 10 – 240 cfm – Vent-Bag Method
  50 cfm @ $5/Mcf = $131,400
  100 cfm @ $5/Mcf = $262,800

- For leaks >180 cfm - Anamometer

Hi Flow Sampler Applications

Advantages:

- Total Leak Capture
- Measures Leak Rate Directly
- Can Measure 30 components per hour
- Repair Decision Based on Leak Rate & Repair Costs

HEATH CONSULTANTS

Reducing Emissions, Increasing Efficiency, Maximizing Profits

NaturalGas IS
EPA POLLUTION PREVENTER

Hi Flow Sampler Technology

- Captures Entire Leak
  - Measures Flow Rate (F) and Concentration (sample)
  - Subtracts the background (back) Concentration
  - Leak Rate = F x (sample – back)

Condensate Tank Leakage Identified Loses/Savings

Estimated Annual Loss
$67,575/yr
Or
13,515 Mcf/yr

Routine Monitoring of known culprits and plan for future DI&M

Partner Experience

Leaking Actuator on Methanol Injector Pump. Leak Rate at 3.5 cfm or $9,198/yr. Estimated repair <$500.

Partner Experience

Leaking Valve Actuator. Leak measured at 6.74 scfm or $17,713/yr. Estimated to have been leaking at current leak rate for last three years or more. Successfully repaired next day and reduced to zero emissions.

$$$$$

Entire Survey Paid For in recovered gas, Including hands on training with Hi Flow Sampler

$$$$$

HEATH CONSULTANTS

Reducing Emissions, Increasing Efficiency, Maximizing Profits

NaturalGas EPA POLLUTION PREVENTER

Partner Experience

Midwest Compressor Station September 2005

	Component Category	Leak Rate (scfh)	Leak Rate (Mcf/Yr)[1]	Leak Rate ($/Yr)[2]
Leak Rate from Standard Components	Standard	390	3,415	$20,492
Leak Rate from Compressor Packings [Units 1-5]	Rod Packing	12,585	63,869	$383,216
Leak Rate from Blowdown System (Unit Valves/Blowdown Valves/Pressure Relief Valves)	Blow Down System	520	4,552	$27,310
Total =		13,495	71,836	$431,018.00

[1] Takes into account engine activity factors tracked by station personnel.
[2] Cost of Gas = $6/Mcf

Partner Experience

Midwest Packing Leak
75 CFM when Running
98 CFM when idle & pressurized

$297,489 @ $5 gas

$475,982 @ $8 gas

About Rod Packing Leakage

- Under best conditions leak rate can be expected at a minimum of 11.5 scfh
- Leakage can be reduced through proper monitoring and a cost effective schedule for replacing packing rings & piston rods.
- Step one is to monitor and record baseline packing leakage and piston rod wear.
- Establish a replacement threshold

Annual Station Monitoring Program

- Inspect significant leaks identified from recent survey and verify repairs remain intact.
- Inspect all critical components for new leakage
  - Compressor Packings
  - Unit Valves, Blowdown Valves, Dump Valves
- Spot check yard for leaks