ENVIRON INTERNATIONAL CORPORATION

THE USE OF A GAS-IMAGING DEVICE FOR DETECTING FUGITIVE EMISSIONS IN ETHYLENE FACILITIES

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ENVIRON

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- In a typical large U.S. refinery, the number of fugitive emission components is over 200,000 with annual LDAR operating costs exceeding $1,000,000.

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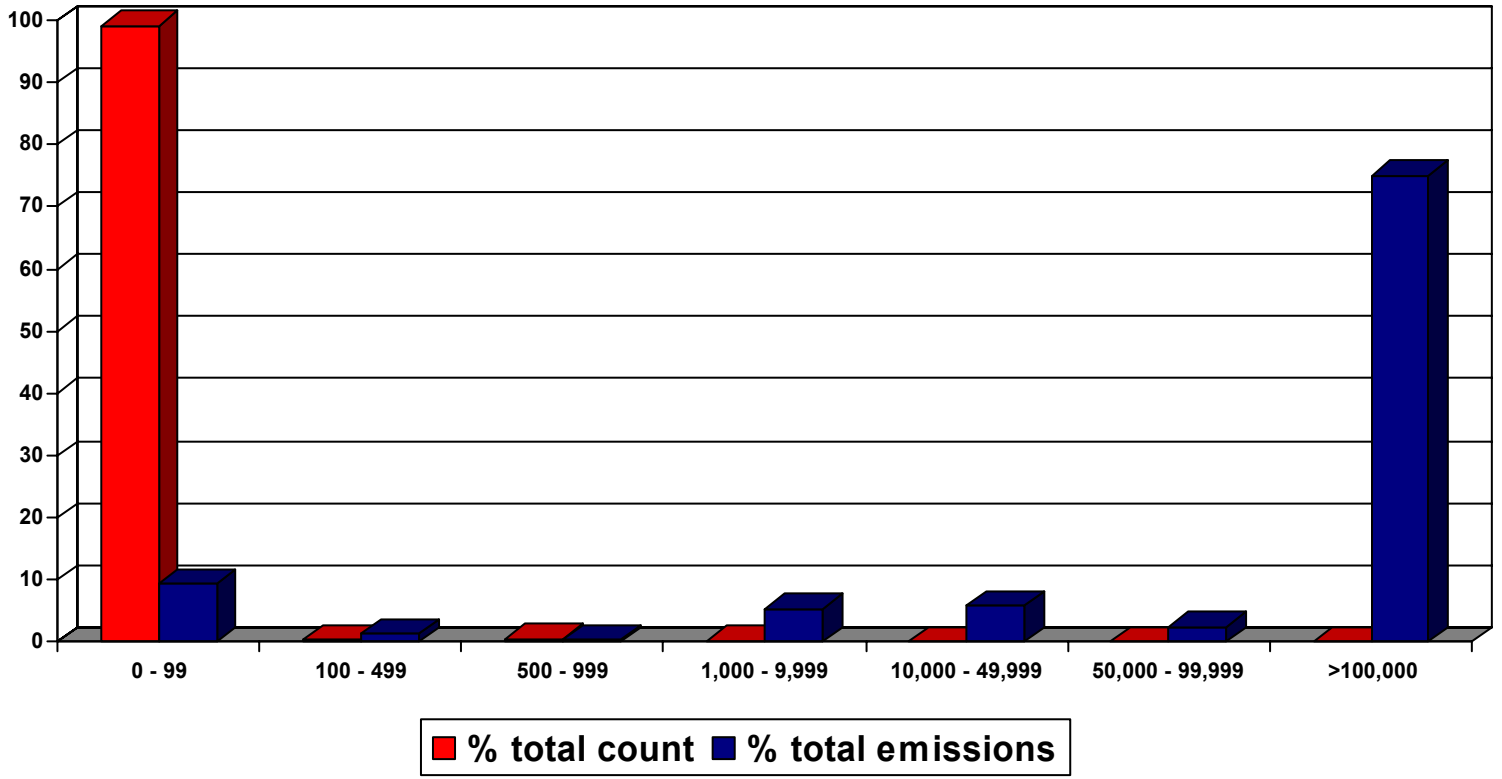

Source: American Petroleum Institute, "Analysis of Refinery Screening Data," API Publication 310, 1997.

METHOD 21 CAN BE COSTLY AND INEFFICIENT

API analysis conclusions…

- Leaks occur randomly
- Few significant repeat leakers
- Need improved method to more cost-effectively find and repair high leakers

OPTICAL GAS IMAGING

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- Optical gas imaging devices offers an operator the ability monitor components from a distance and identify - in some cases instantaneously - leaking components (of a sufficient mass) within the line of sight of the optical imager

OPTICAL GAS IMAGING

	Laser Imaging Systems	Sandia National Laboratory	Pacific Advanced Technology	Ion Optics	Argonne National Laboratory	Block Engineering
Principal of operation	IR	IR	IR	IR	mm-wave	FT-IR
Active or passive	active	active	passive	passive (?)	active and/or passive	passive
Real-time imaging	yes	yes	being implemented	possible	possible	yes
Status	commercially available	portable prototype tuneable laser developed	methane leak detector developed	methane leak detector proposed	R&D done, DOE field test performed; prototype design not started	commercially available for SF6; looking to expand to VOCs
Expected availability		6 to 12 months	6 months	12 to 24 months	12 to 24 months	6 to 12 months
Expected cost/unit	$125,000	$150,000	$50,000 to $75,000	$50,000 to $60,000	$50,000	?
VOCs tested	ethylene	aliphatic hydrocarbons	methane, propane, butane, acetone		methylchloride, butanol	

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- Gather data that could be used to establish the mass emission detection capability of the portable gas imaging device
- Gather data that could begin to establish the sensitivity of the portable optical gas imaging device to various factors that might be encountered during routine use at a chemical plant

FIELD STUDIES

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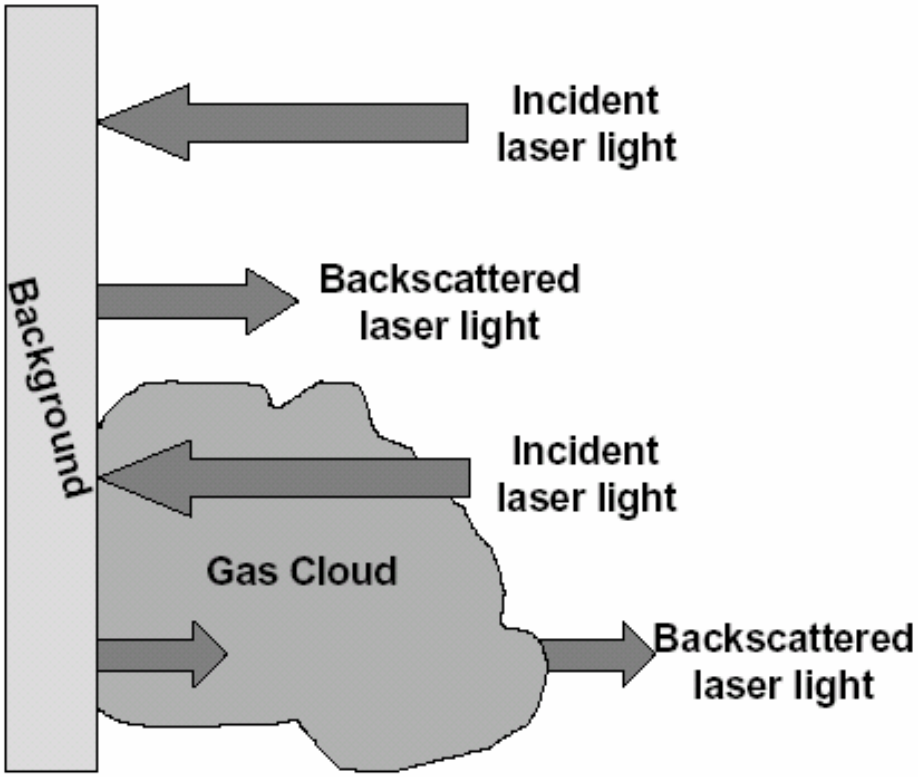
  - Both sites located in the Houston-Galveston area

CO_2 LASER PERFORMANCE

- Three critical parameters for CO_2 laser performance...
  - Range - For the technology to visualize a leak, there must be a reflective or “backscattering” surface behind the leak.

SCHEMATIC DESCRIPTION OF BACKSCATTER/ABSORPTION GAS IMAGING PROCESS



Source: McRae, Tom, GasVue®: *A Rapid Leak Location Technology for Large VOC fugitive Emissions* (Presentation at the CSI Petroleum Refining Sector Equipment Leaks Group, Washington, DC, Sep. 9, 1997)

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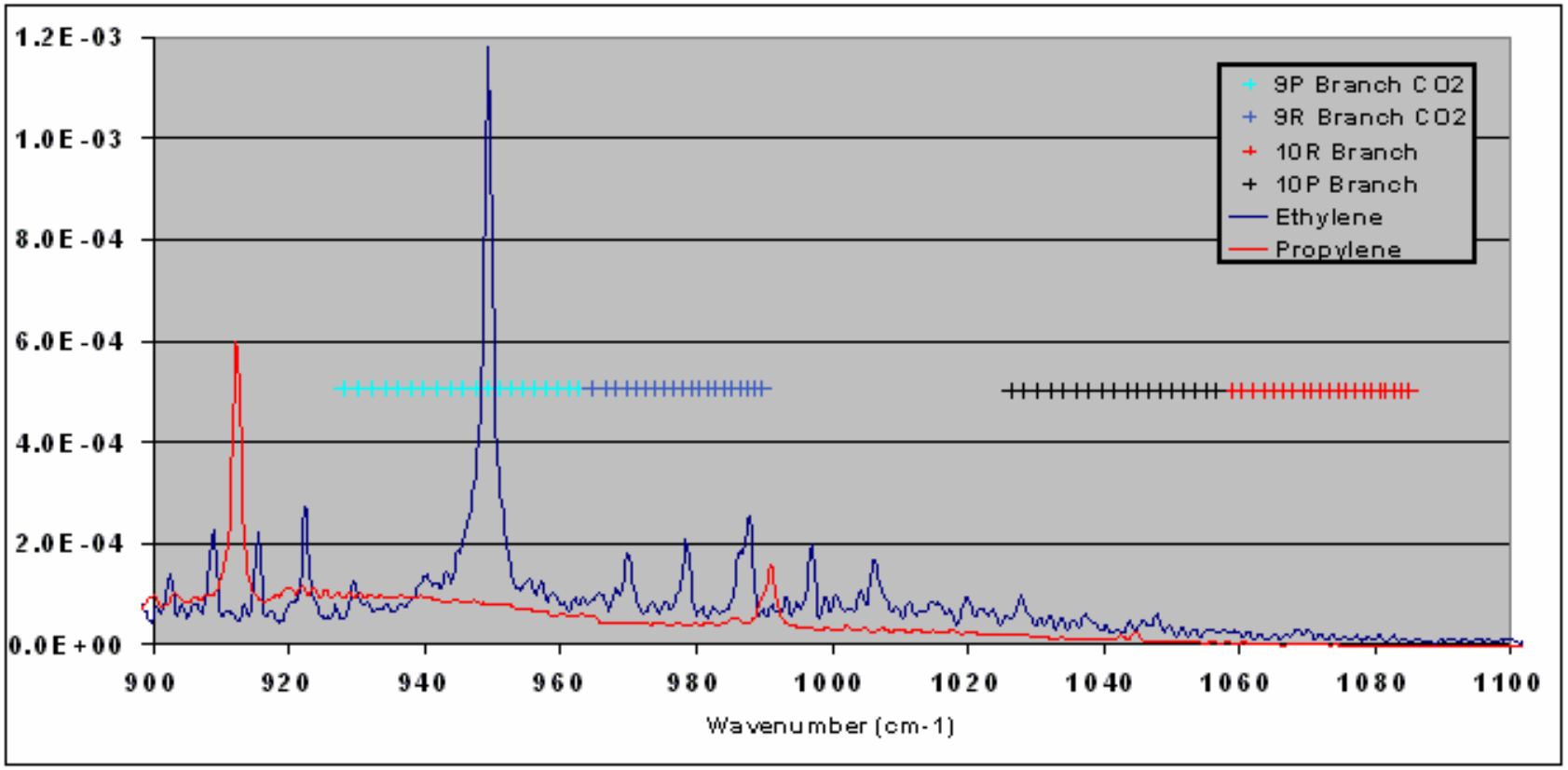
LASER WAVELENGTH



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  - Atmospheric Window - an “atmospheric window” is defined as a region of the spectrum where there is minimal or no light absorption by oxygen, nitrogen, carbon dioxide, and water vapor that are normally found in air.
    - major atmospheric windows in the infrared region are found in the 3 to 4.2 micron and 8 to 13 micron wavelength regions

VISUAL VERSUS INFRARED IMAGE

Visual image of Open-ended Drain

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Infrared image from gas imaging device of open-ended drain

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  - At Site A:
    - 7,187 components were monitored in four days
    - 95 leaking components were found (70 traditional and 25 nontraditional)
    - The mass emission rate from leaking components (as determined by bagging) ranged from 0.000563 g/hr to 23.2 g/hr.
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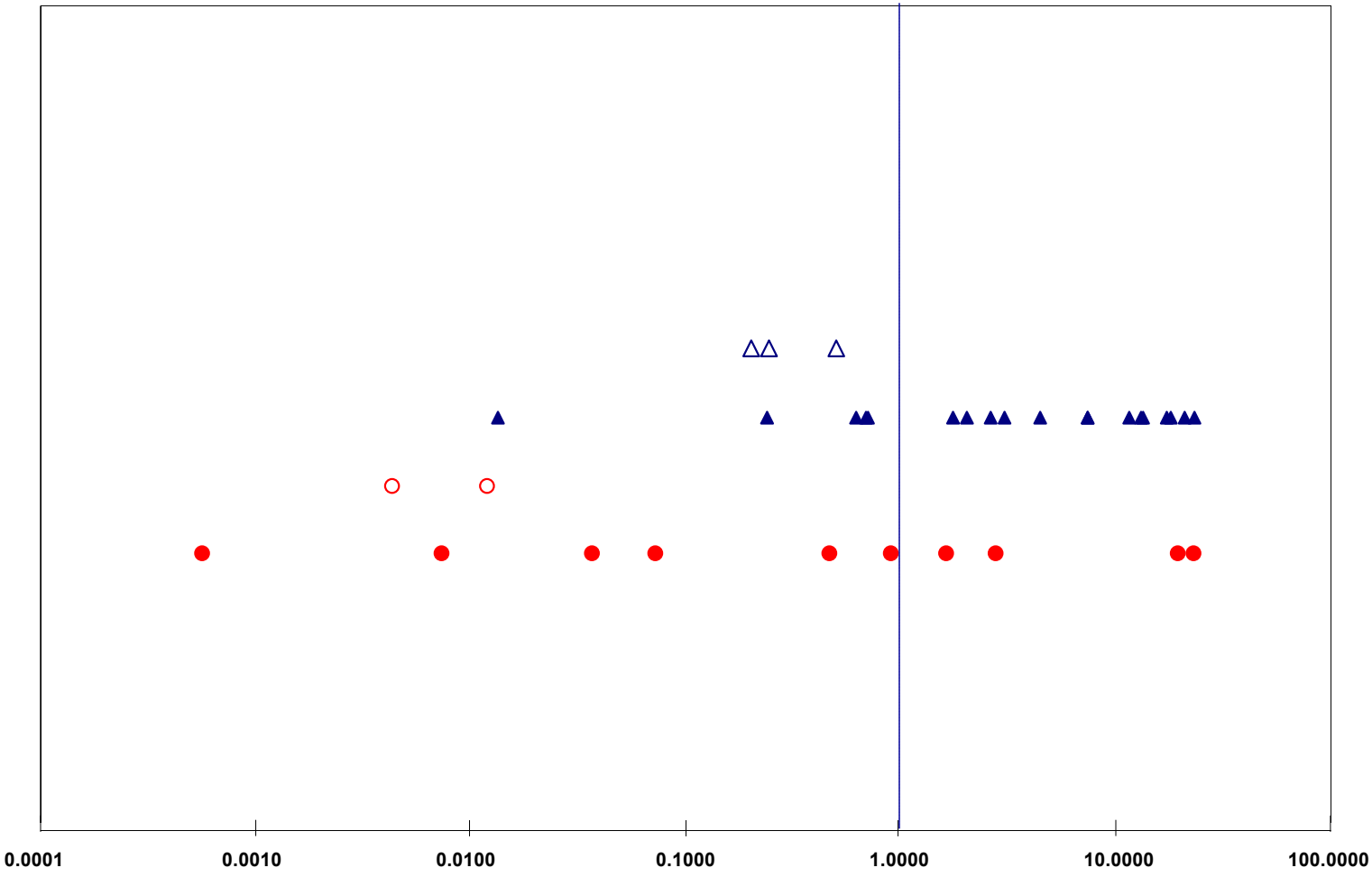
  - At Site B:
    - 1,178 components were monitored in four days
    - 52 leaking components were found (49 traditional and 3 nontraditional)
    - The mass emission rate from leaking components (as determined by bagging) ranged from 0.013 g/hr to 23.4 g/hr.
    - 18 of the 19 bagged leaks detected by the CO_2 laser had a mass emission rate in excess of 0.1 g/hr. 15 of the 18 components were above 1 g/hr.

EMISSION RATE OF BAGGED COMPONENTS



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  - At Site B:
    - 83.0% of detected leaking components had screening values over 1,000 ppmv
    - 56.0% of detected leaking components had screening values over 10,000 ppmv

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    - component with the lowest mass rate was detected from a distance greater than 10 feet.
    - component with the highest mass rate was detected from a distance of 8 feet, 1 inch

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  - The CO_2 laser successfully detected leaks with wind speeds ranging from 0 meters/second to 3.9 meters/second.

NEXT STEPS

- Determine the ability of gas-imaging technology to detect leaks of other chemicals

propylene	all pentenes
formaldehyde	all trimethylbenzenes
acetaldehyde	all xylenes
isoprene	all ethyletoluenes
all butenes (butylenes)	all hexenes
1, 3, butadiene	all butanes
toluene	all pentanes

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- Develop an EPA protocol for the use of a gas-imaging device as an alternative to current leak detection and evaluation methods