The Use of Large Static Chambers to Compare Gaseous Emissions from a Traditional Soil Cover and a Biologically Active Cover at the Outer Loop Landfill

Project Team

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- Jeff Chanton, Florida State University

Introduction

- Methane production may begin prior to installation of gas collection systems
- Interim covers are not as effective as final covers at gas capture

Introduction

- The following reaction occurs in landfill covers:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

- Limiting Factors
  - O_2 availability
  - temperature
- A biologically active cover could stimulate methane oxidation

Introduction

- The effectiveness of biologically active covers has been demonstrated:
  - in Europe
  - on small sites with no gas collection system in Florida

Objective

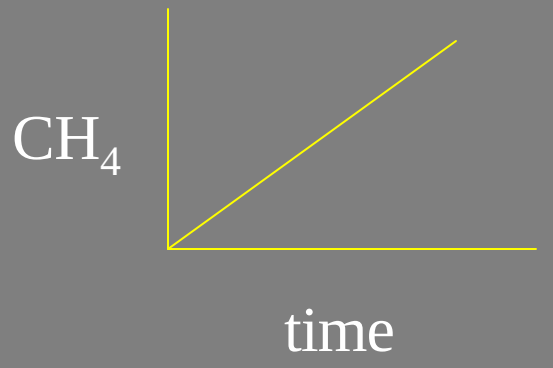
- Evaluate the use of yard waste compost as a biologically active interim cover
  - CH_4 emissions
  - NMOC emissions
  - HAP emissions
  - operation and longevity

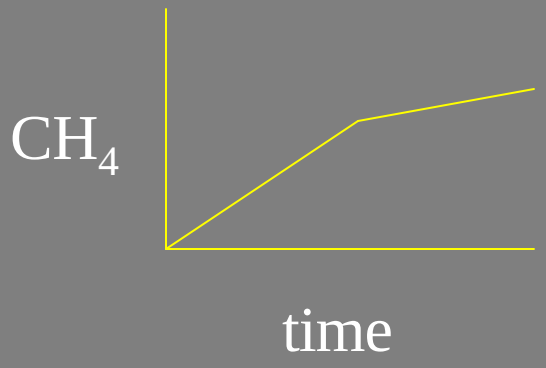
Experimental Design

- Emissions measurements conducted with static chambers on four landfill sections with interim cover:
  - flat section of a biocover
  - sloped section of a biocover
  - sloped section of a soil cover
  - flat section of a facultative landfill cell (to be fed NO_3-rich leachate)

Static Chambers

- An enclosed box that is set over a section of cover
- Methane concentration is measured over time
  - time must be sufficiently short that a pressure build up does not occur





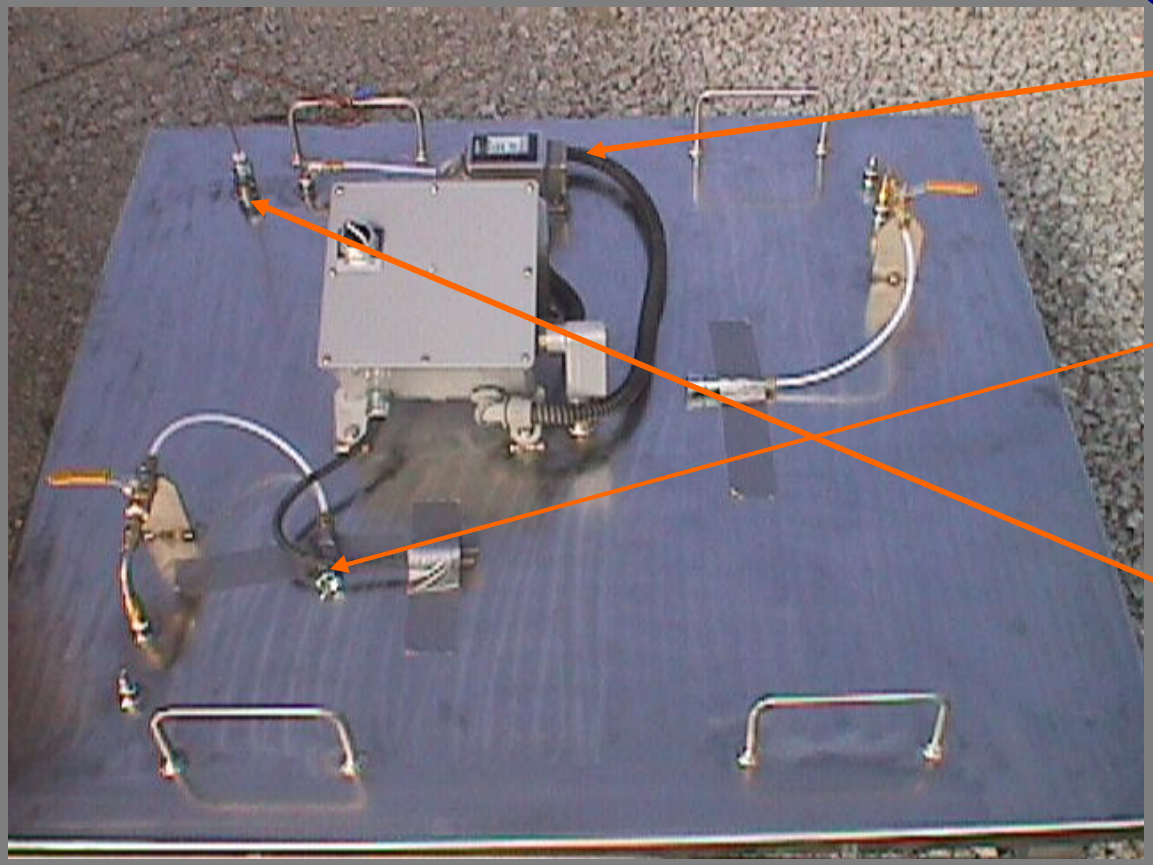
Static Chambers

- 1 m^2 surface area
- enclosed volume - 300 L (10 ft^3)
- include instrumentation to monitor temperature and pressure inside the chamber

Biocover

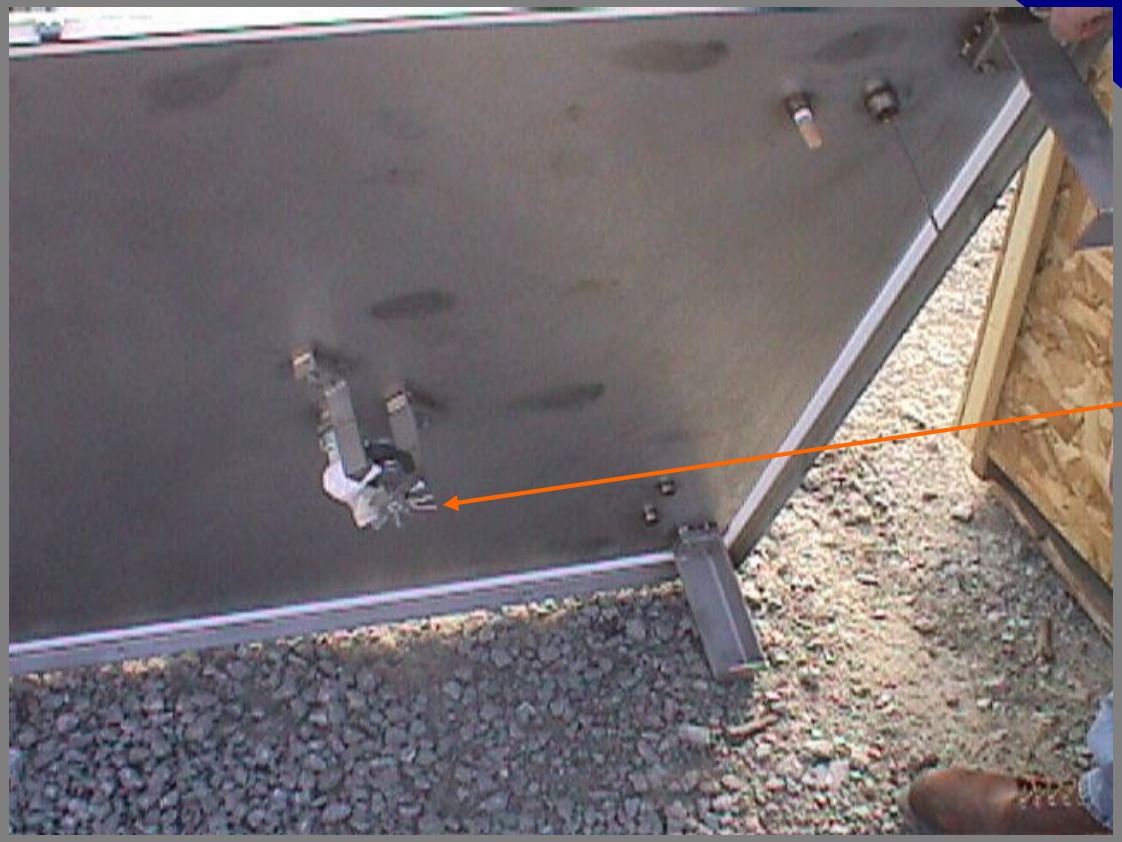
- 6-12” of shredded tires for gas distribution
- 3’ of yard waste compost

Top of Static Chamber



- pressure gauge
- quick connects for summa canisters
- syringe sampling port

Underside of Chamber Cover



Chamber Collar

- 12 chamber collars and three chamber lids were fabricated
- collars remain in ground throughout the test program

Chamber Sampling

- shaded to minimize solar radiation
- samples withdrawn by syringe and brought to on-site lab for CH_4 analyses

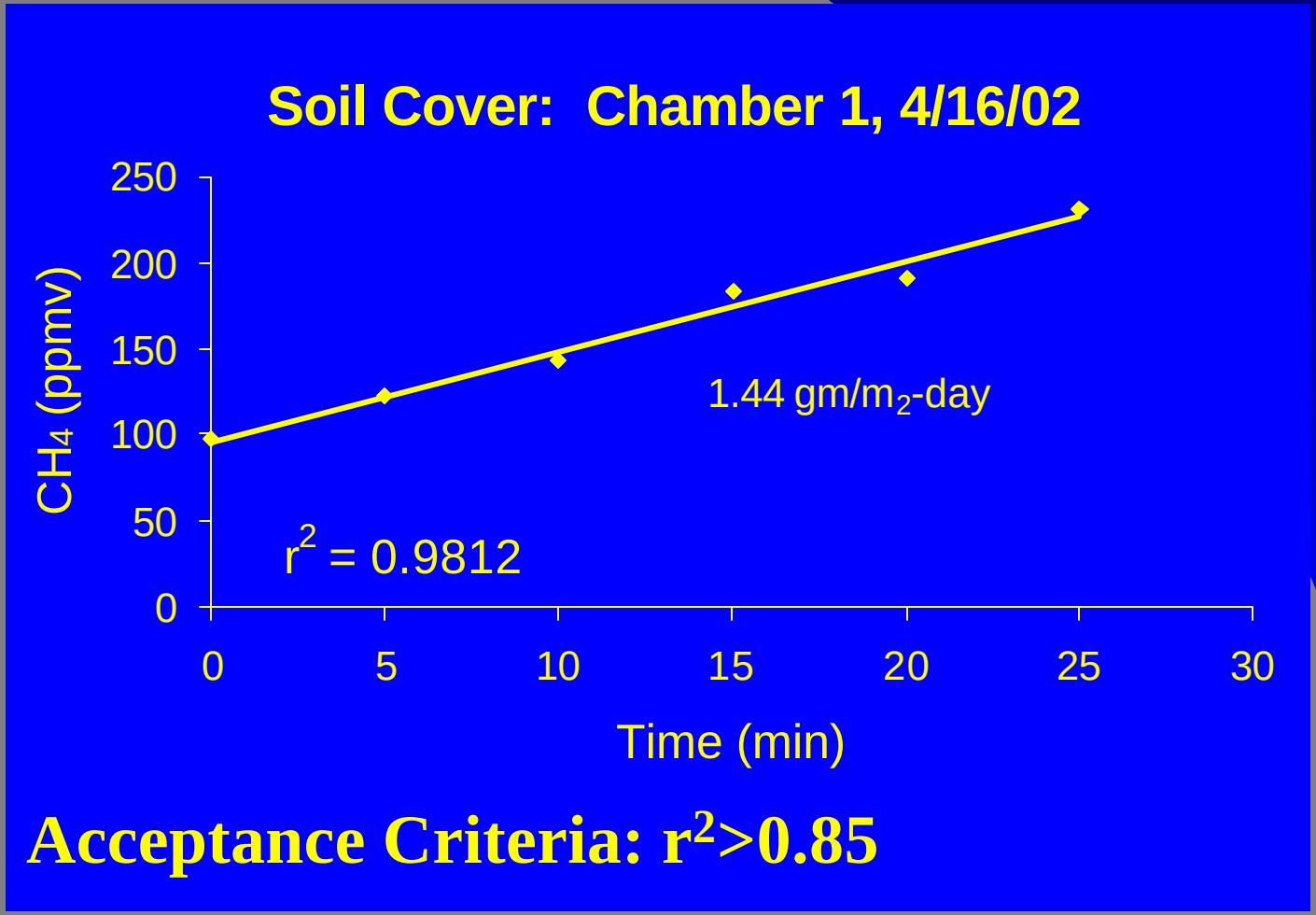
Experimental Program

- Sampling events have been conducted in
  - March, July and Sept., 2001
  - April and June, 2002
- Emphasis on more recent sampling events

Quality Assurance

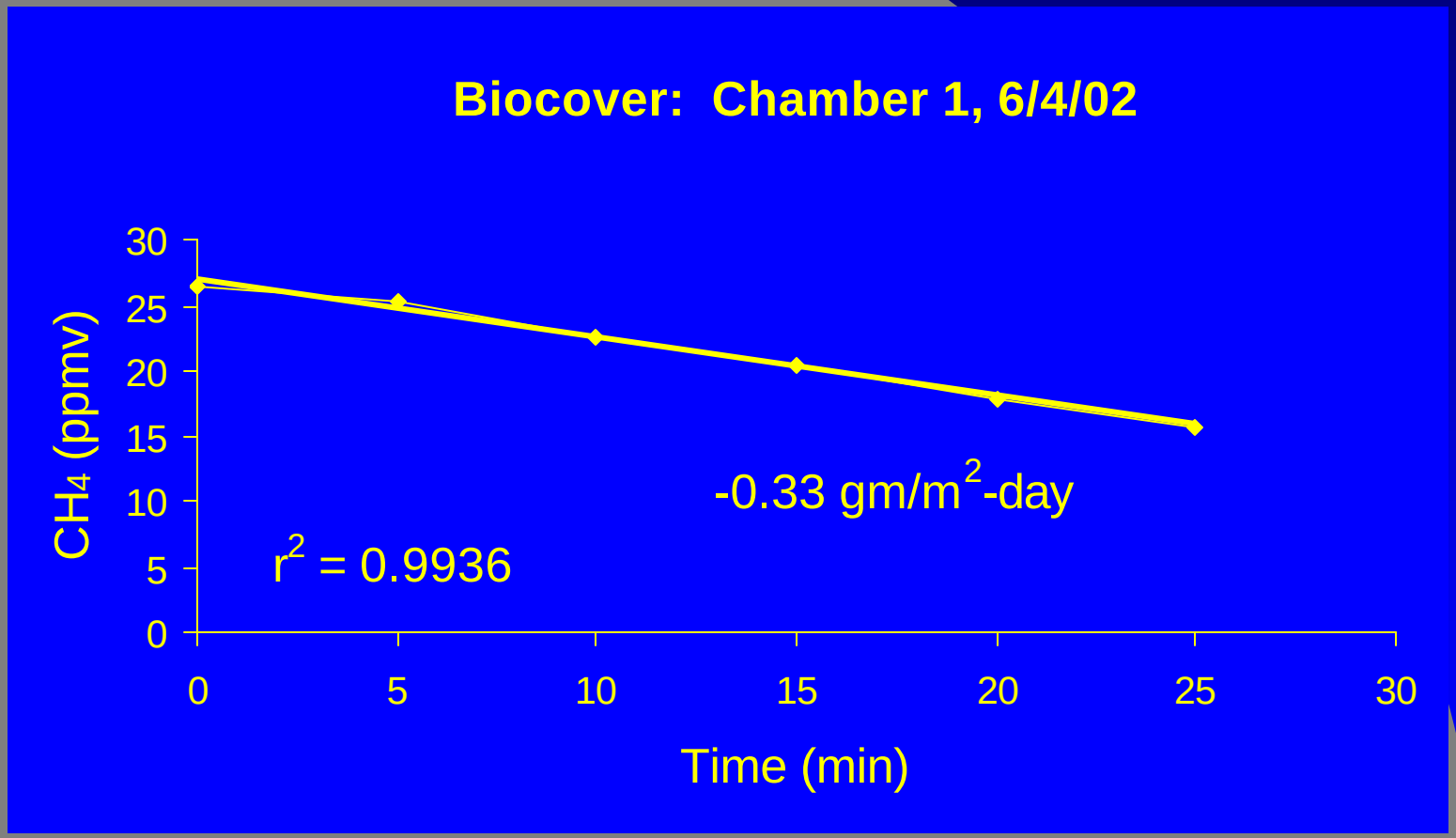
- Mixing Test
  - add known quantities of CH_4 and compare calculated and measured concentrations
- Detection Limit Study
  - add CH_4 over time and compare calculated and measured concentrations
    - current limit: 0.15 gm/m^2-day

Results - Methane Emissions

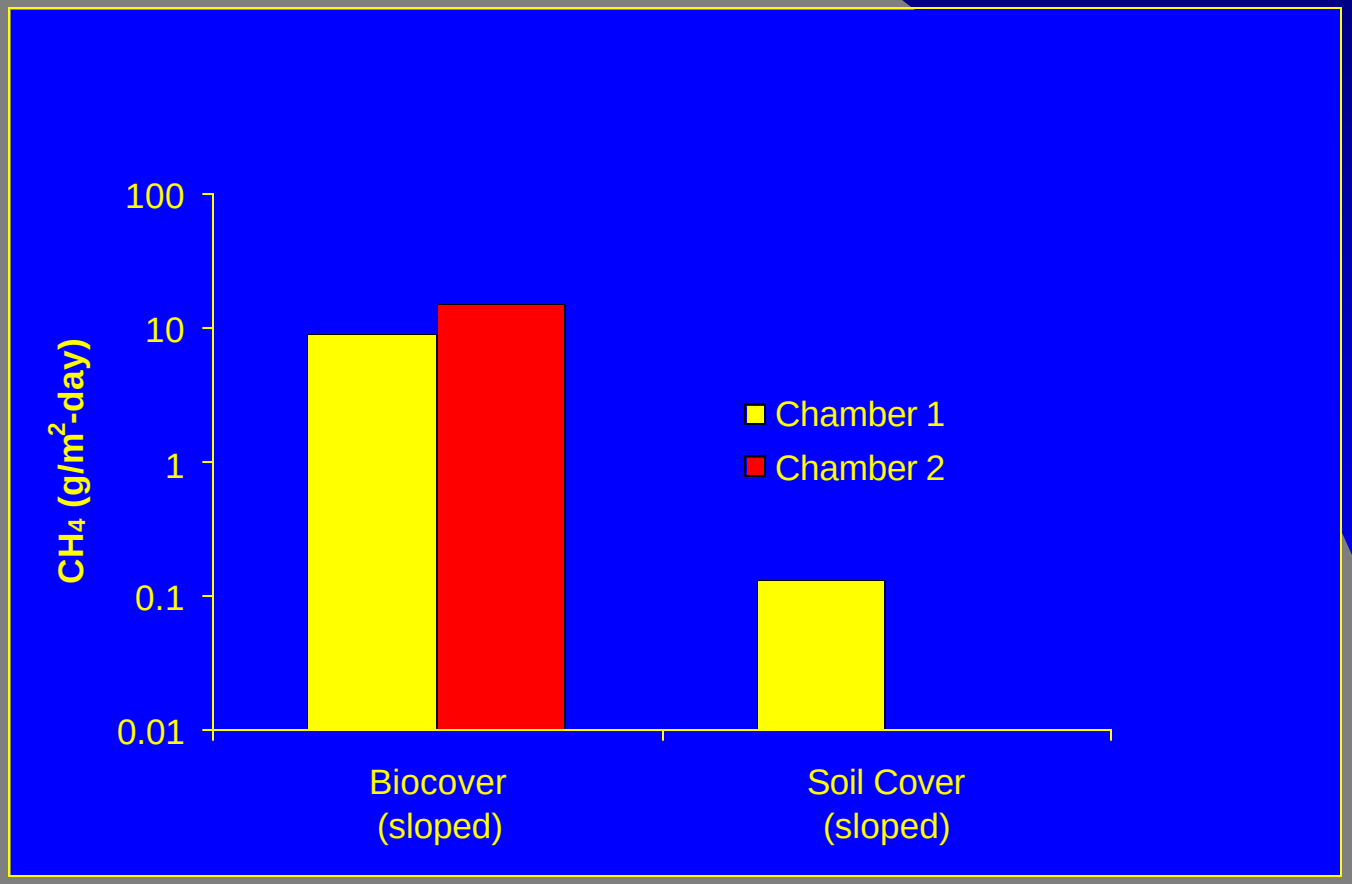


Acceptance Criteria: r^2>0.85

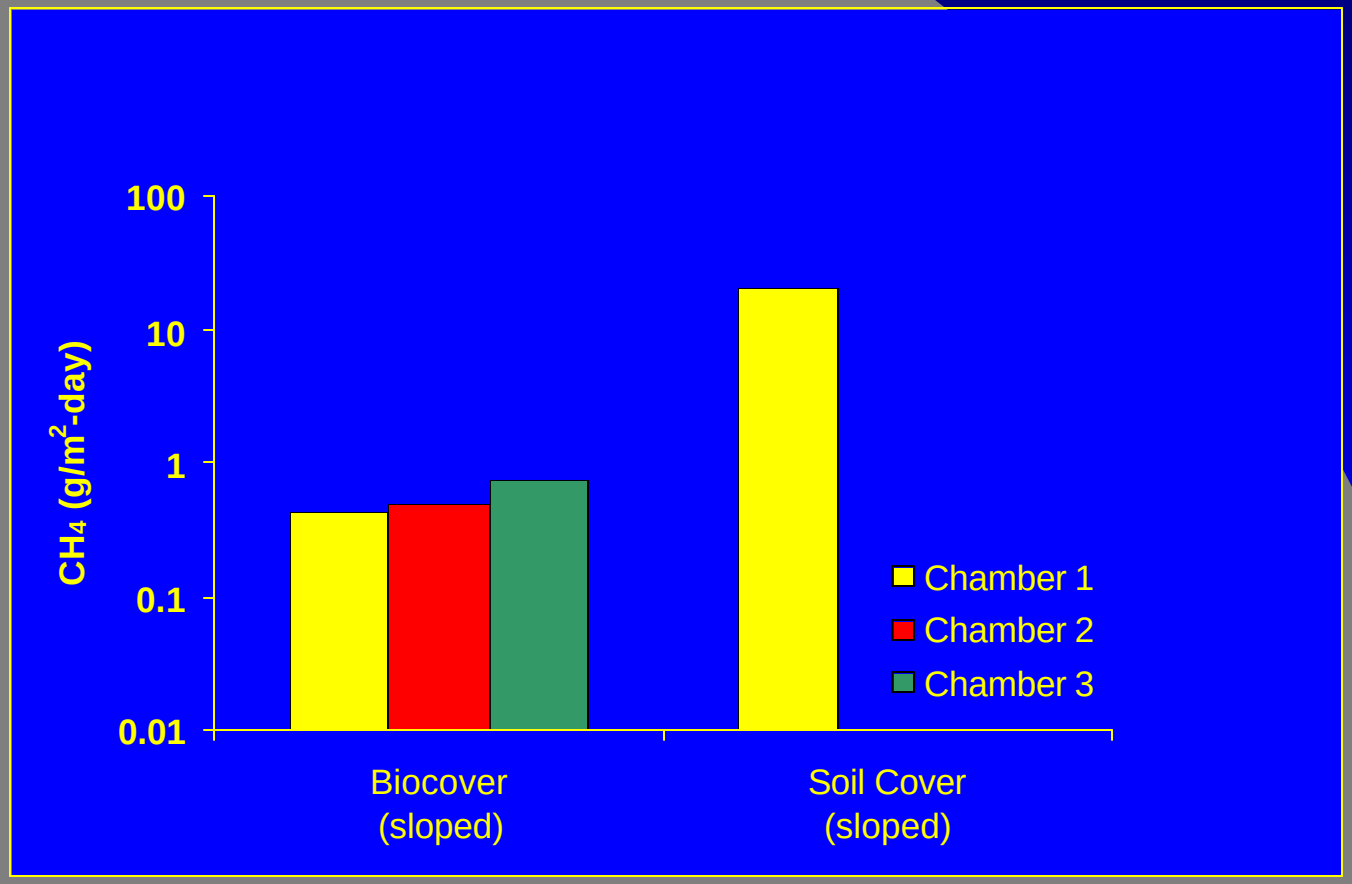
Results - Methane Consumption



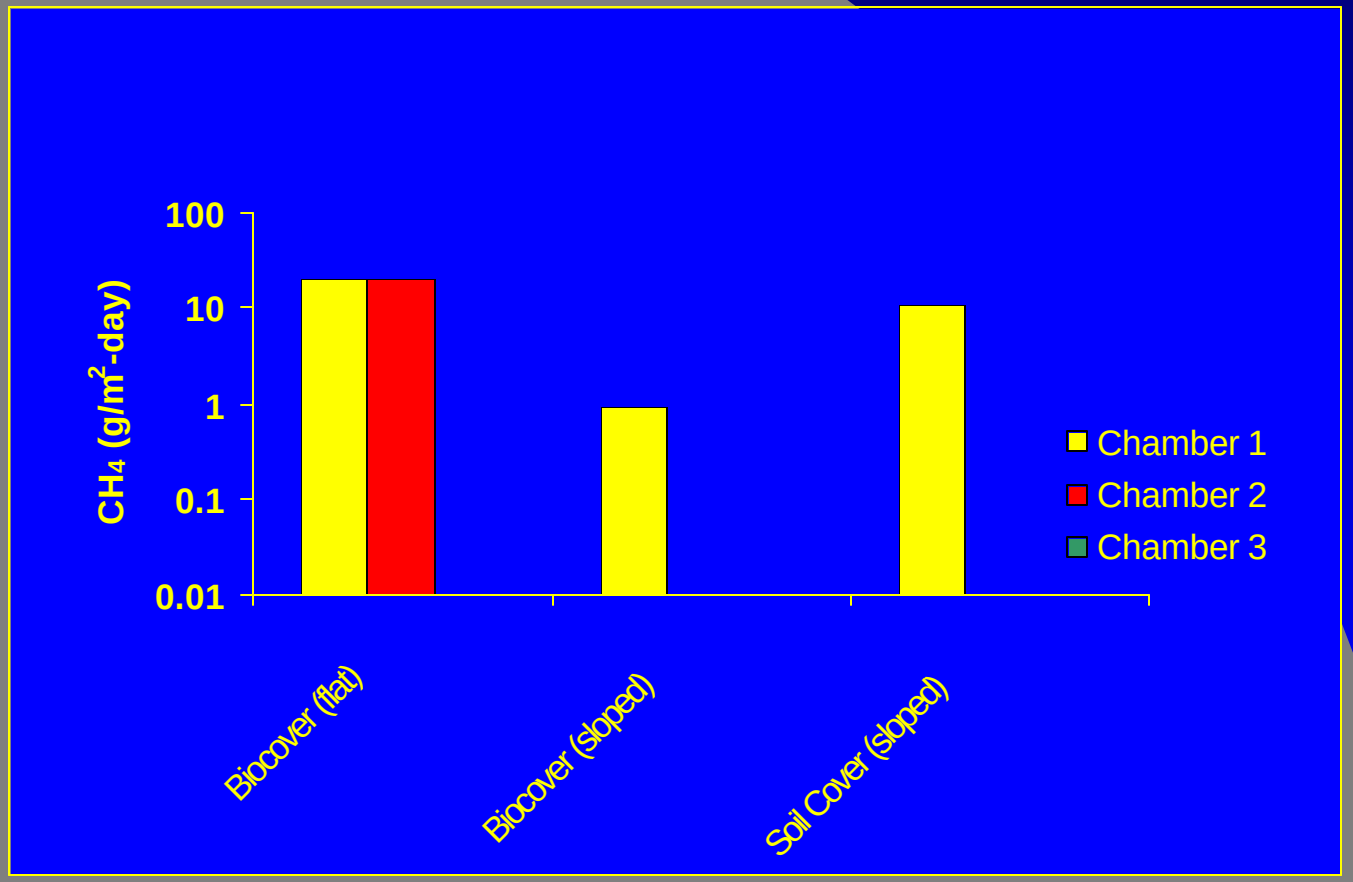
Summary Results: March, 2001



Summary Results: July, 2001



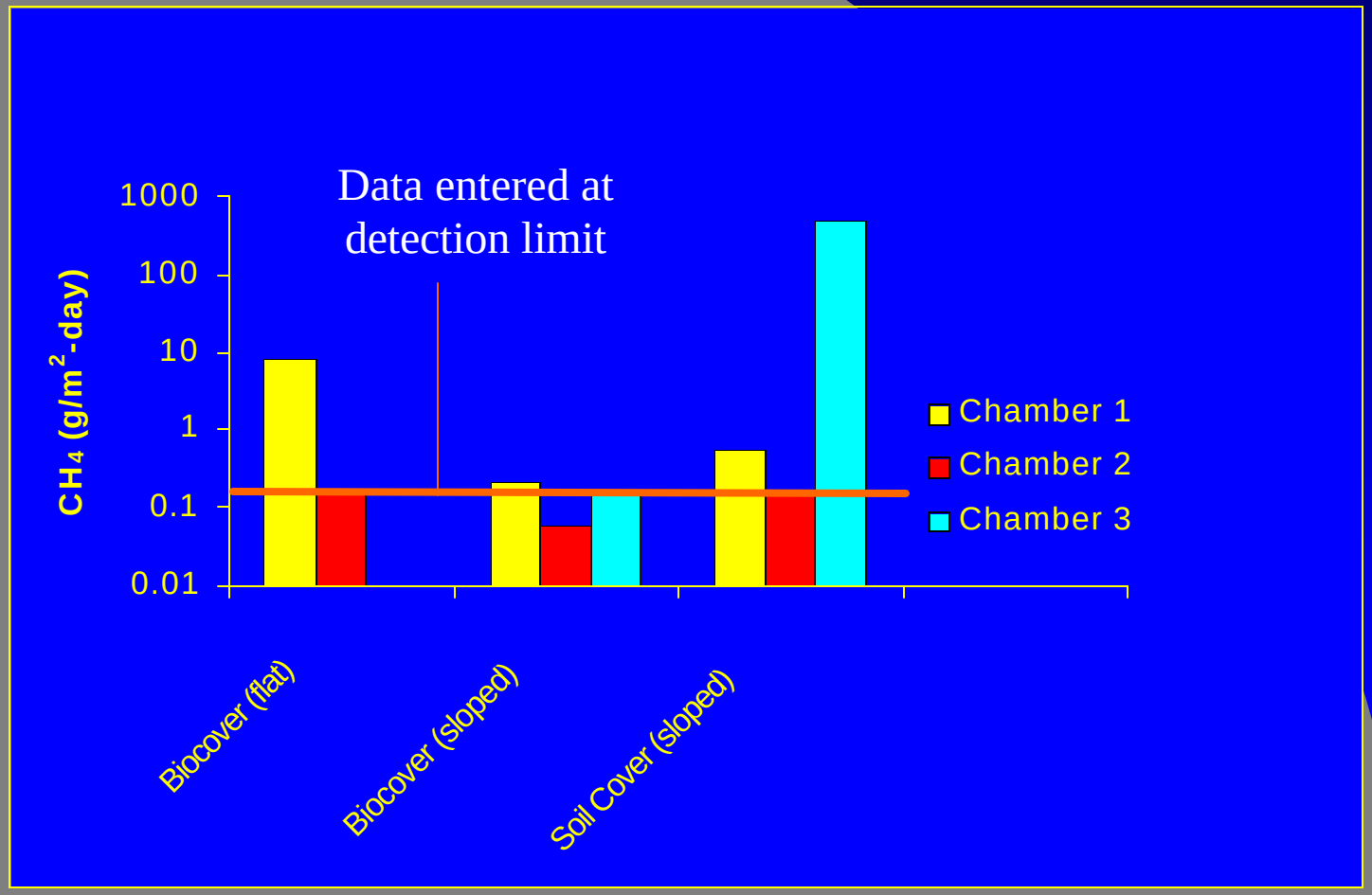
Summary Results: October, 2001



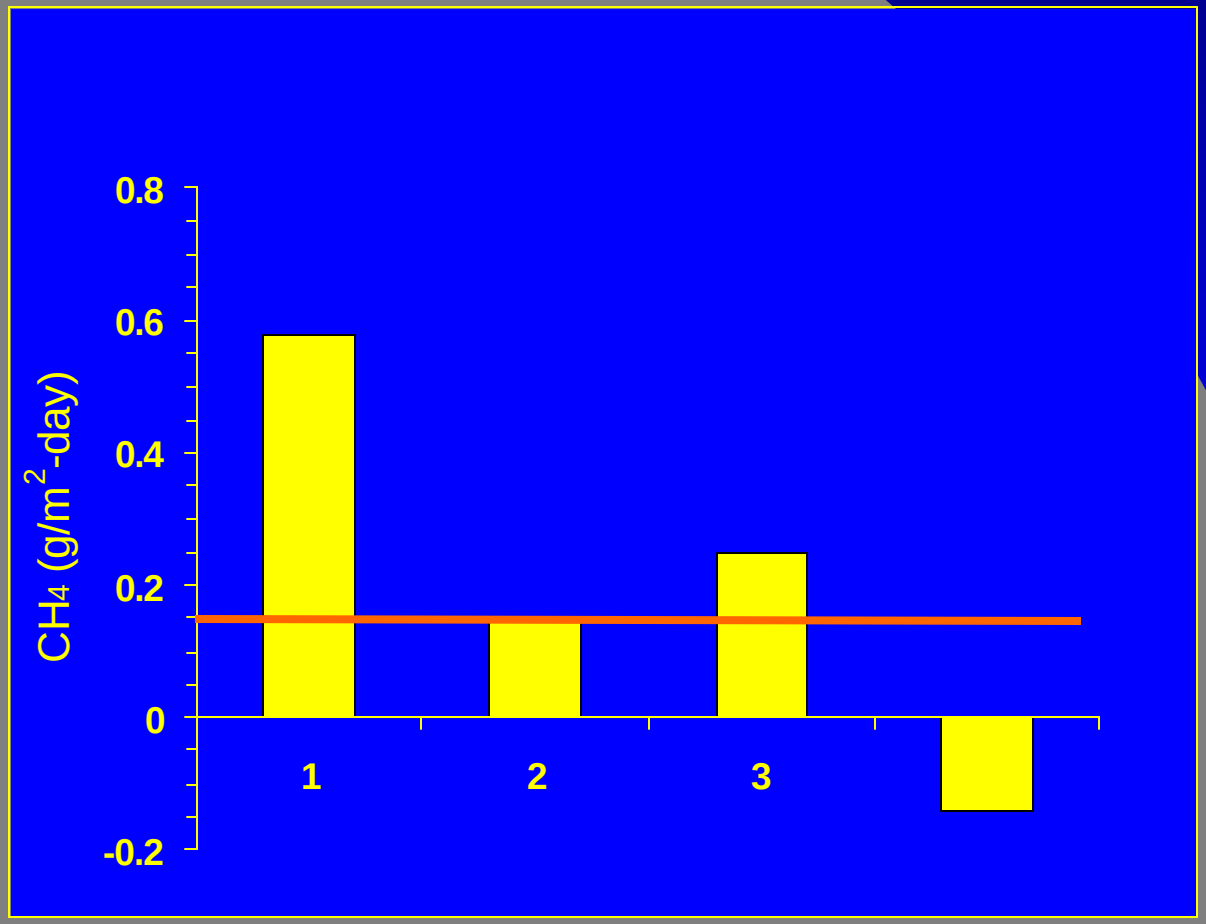
Summary of 2001 Testing

- Windy conditions preclude use of flux chambers
- A number of erratic results with no consistent pattern
- Insufficient body of data to draw conclusions

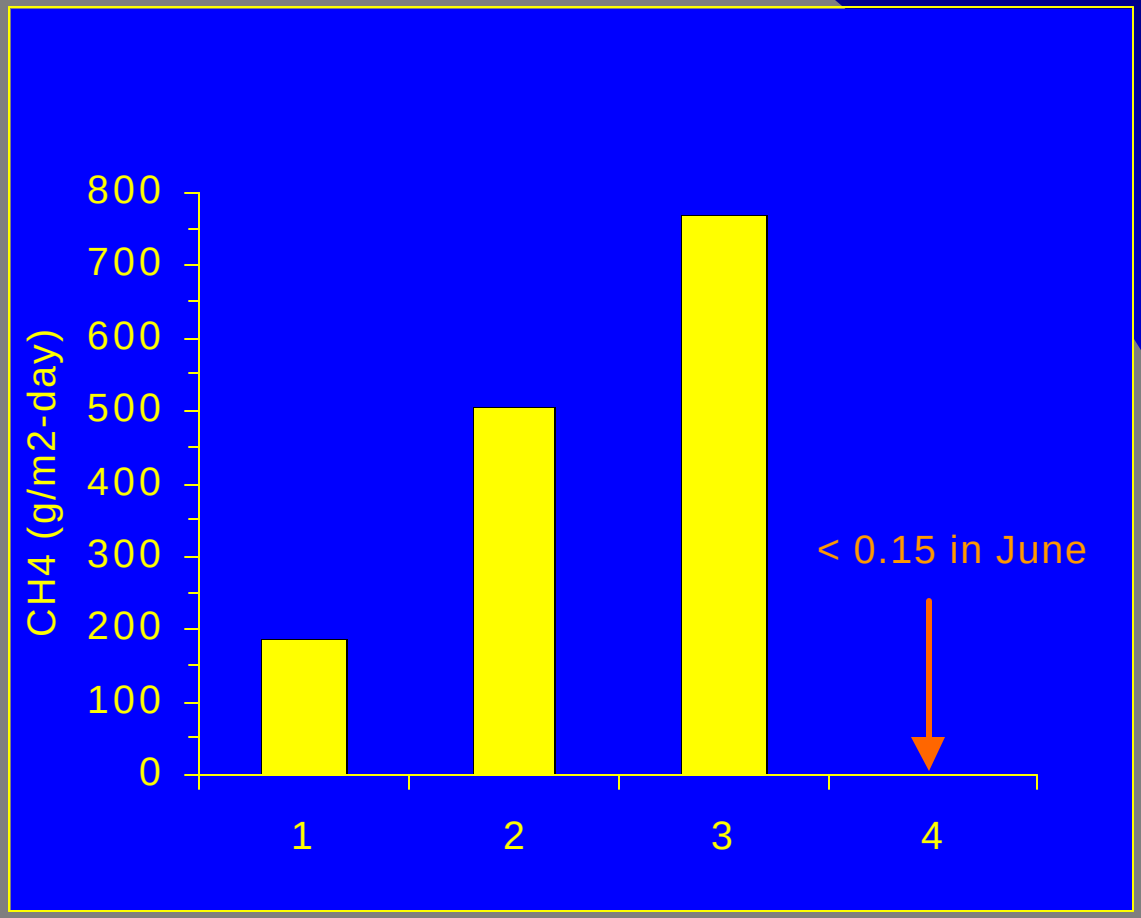
Summary Results: April, 2002



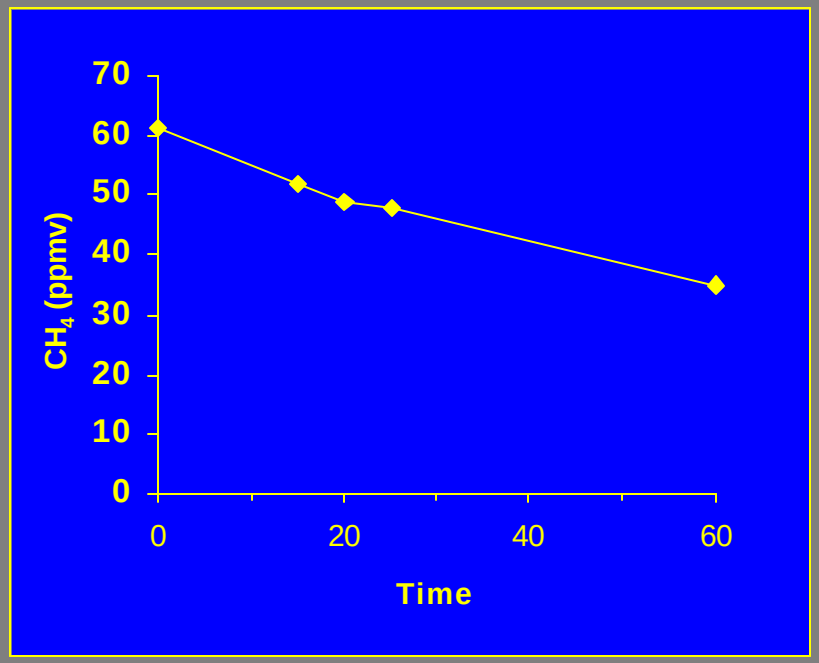
Individual Measurements for Sloped Biocover Chamber 1: April, 2002



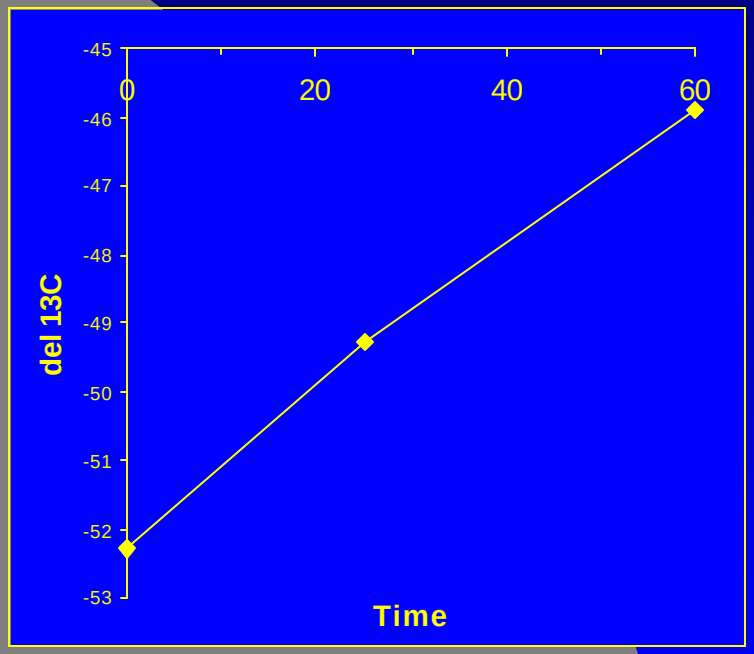
Individual Measurements for Sloped Soil Cover Chamber 3: April, 2002



Confirming Research with Stable Isotopes



CH_4 is decreasing which suggests methane uptake



The CH_4 is getting heavier which is consistent with microbial oxidation

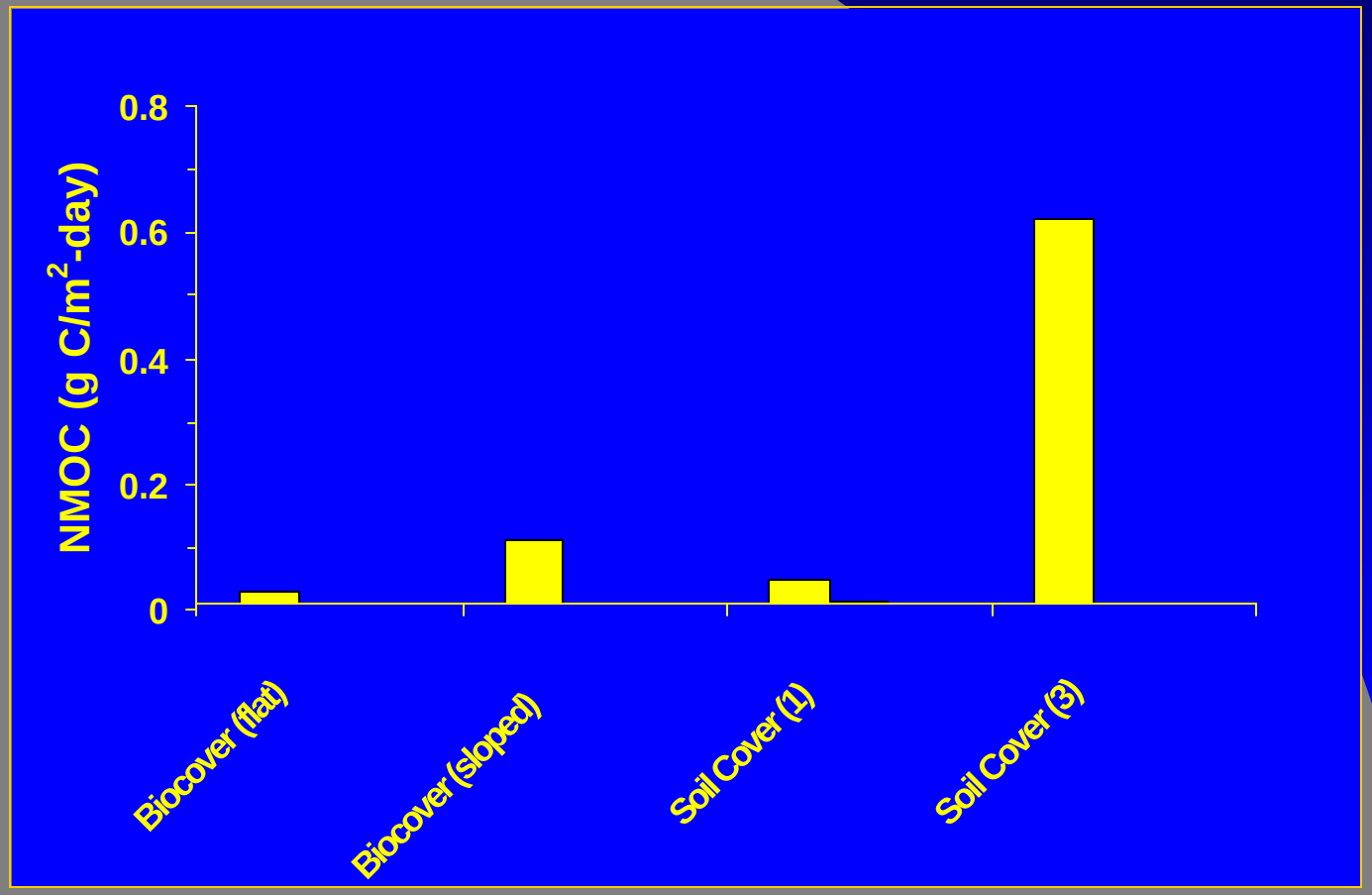
Stable Isotopes

- The stable isotope data allow differentiation between uptake by the gas collection system and microbial methane consumption
- All tests to date have shown consistent results between measured flux and stable isotope results for both positive and negative fluxes

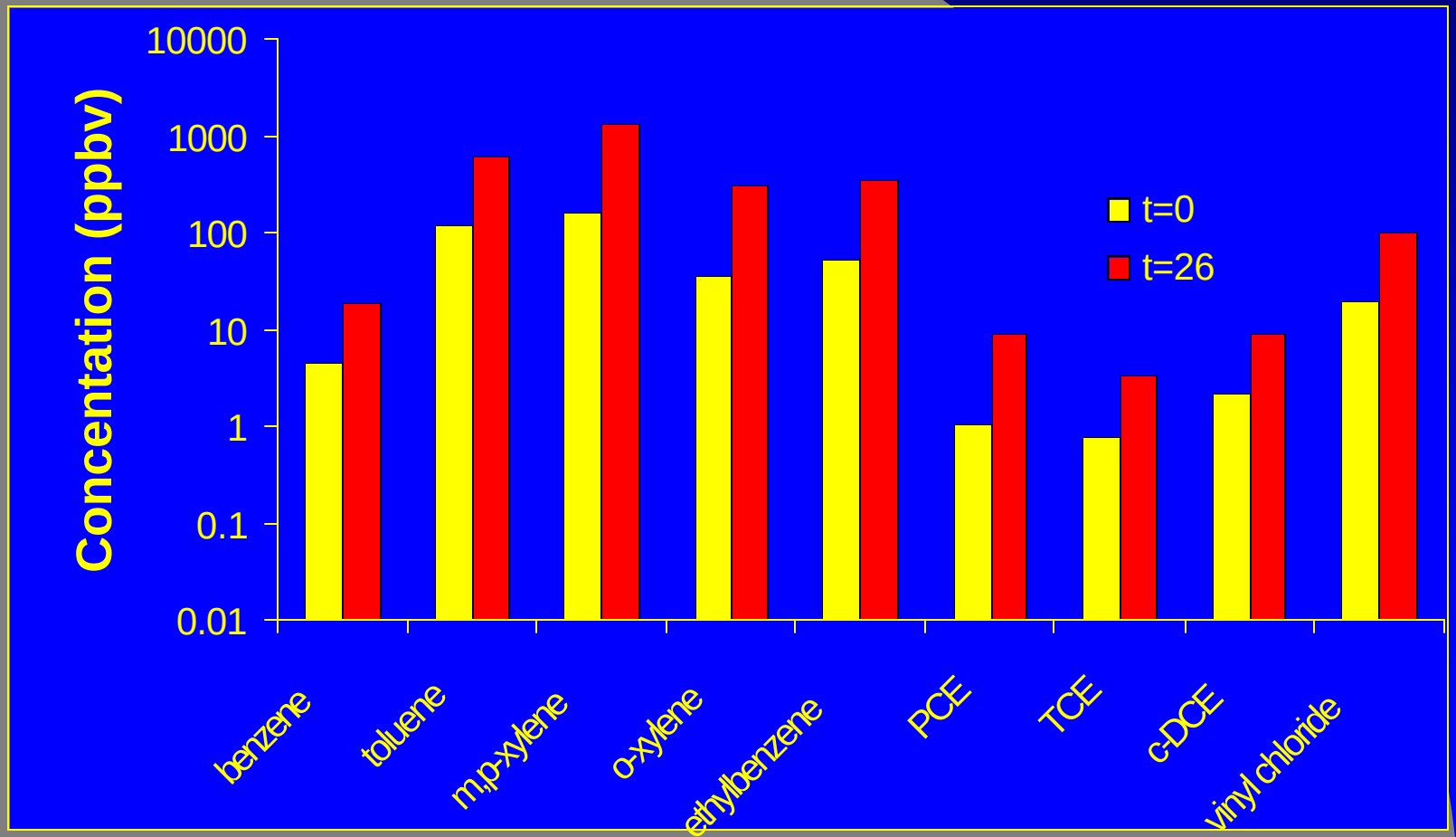
NMOC and HAP Analyses

- Samples collected in a summa canister prior to lid placement and at termination of test
  - sampling during a test induces a large vacuum

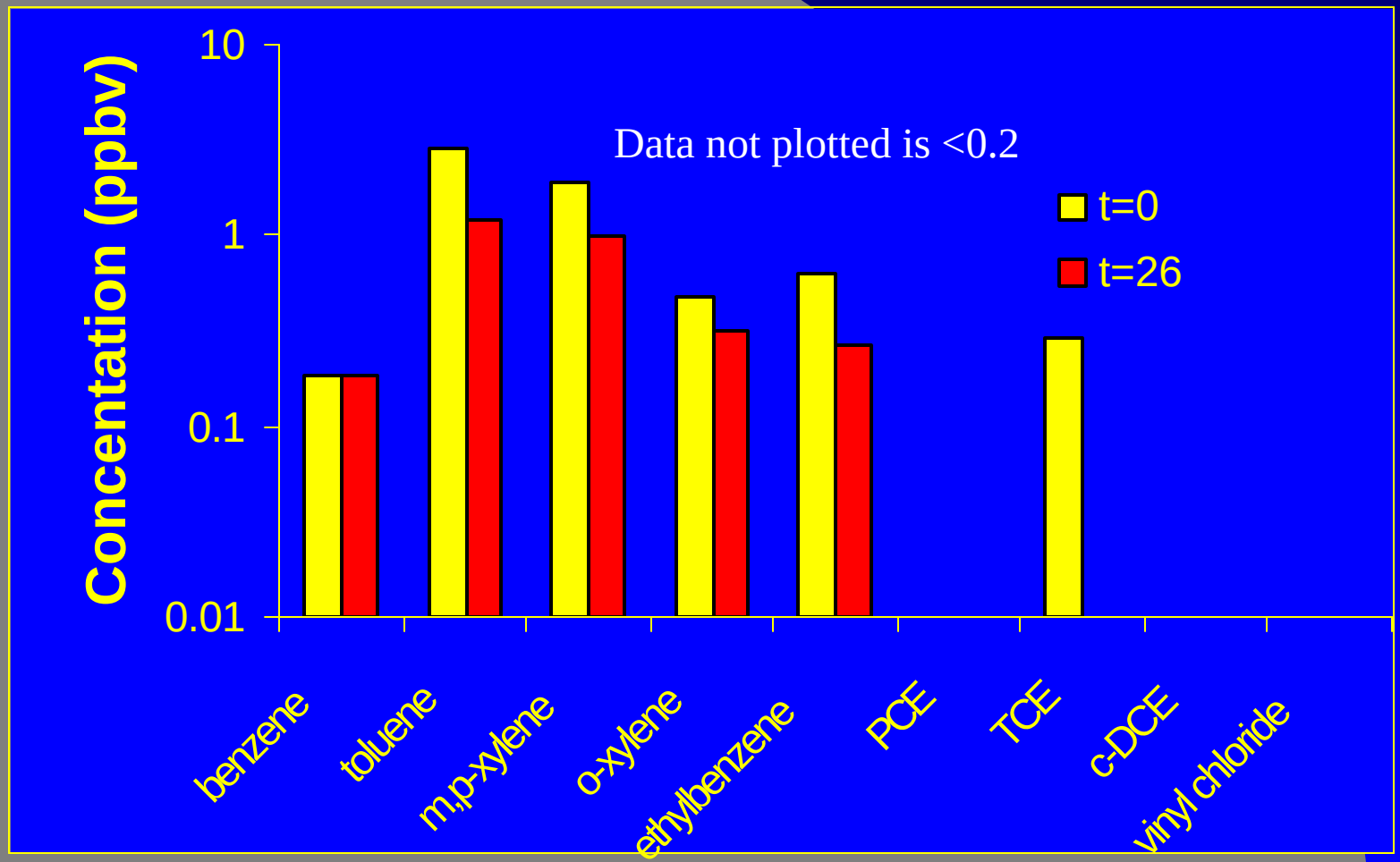
NMOC Analyses: April 2002



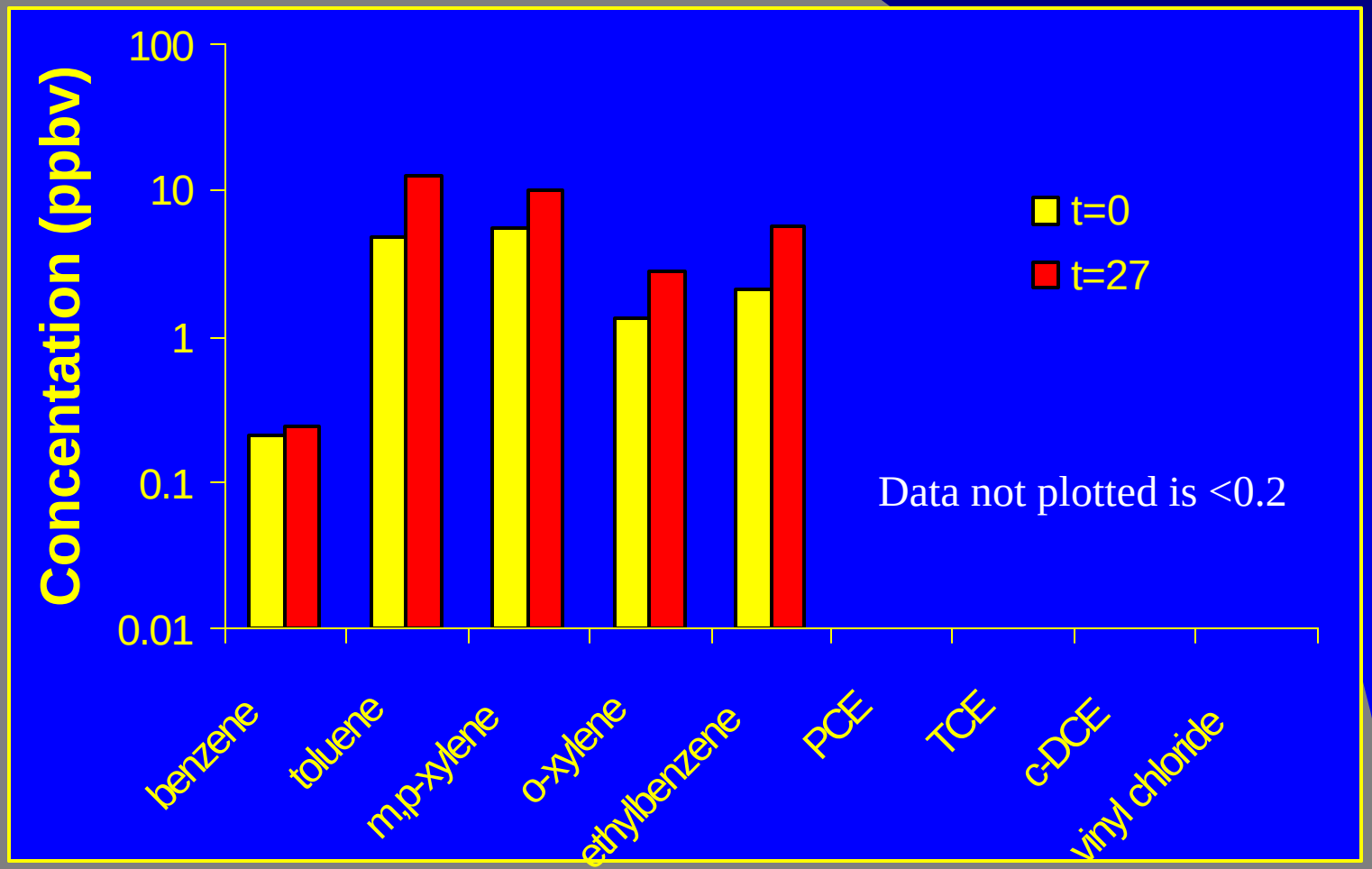
HAP Analyses: SC-3



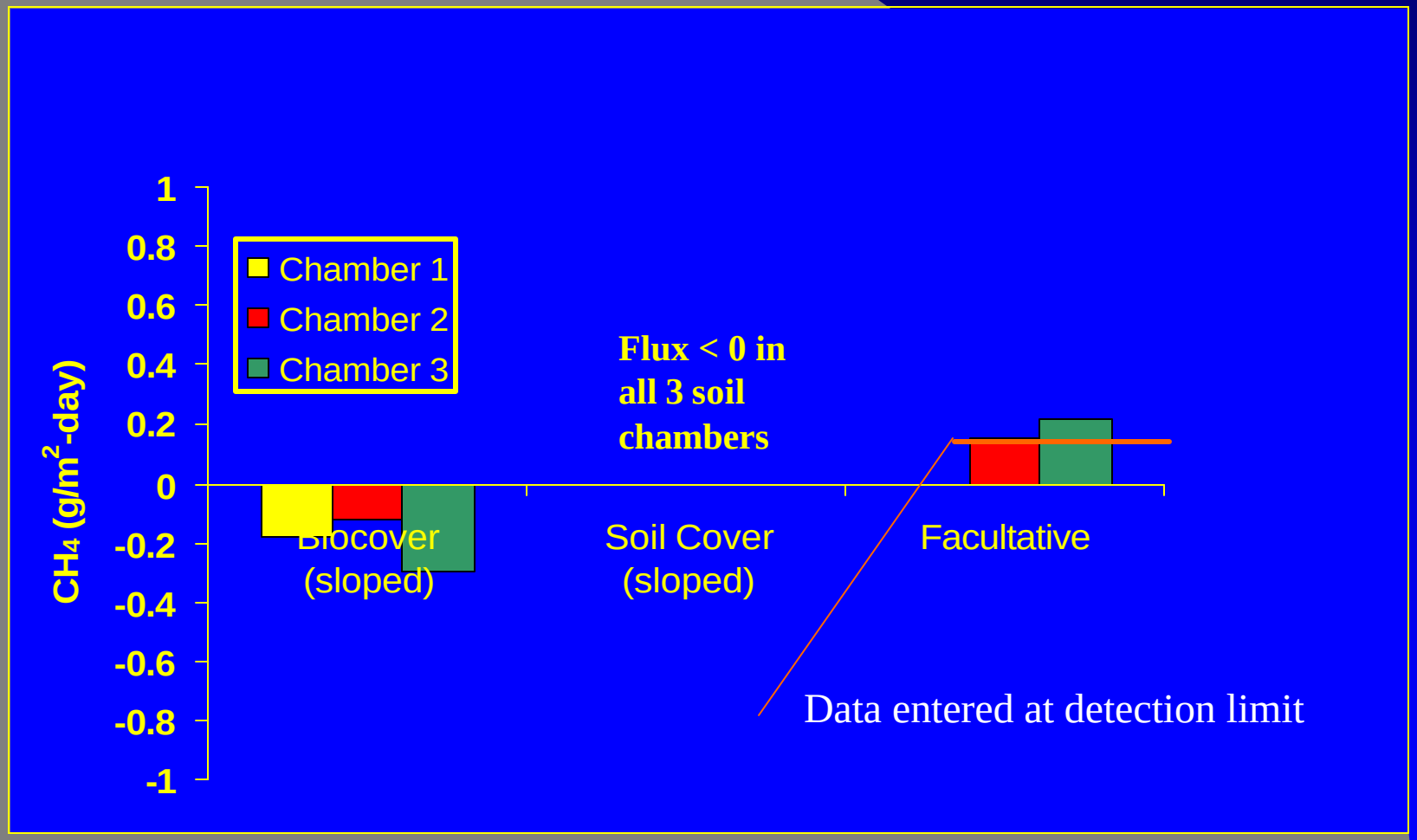
HAP Analyses: SC-1



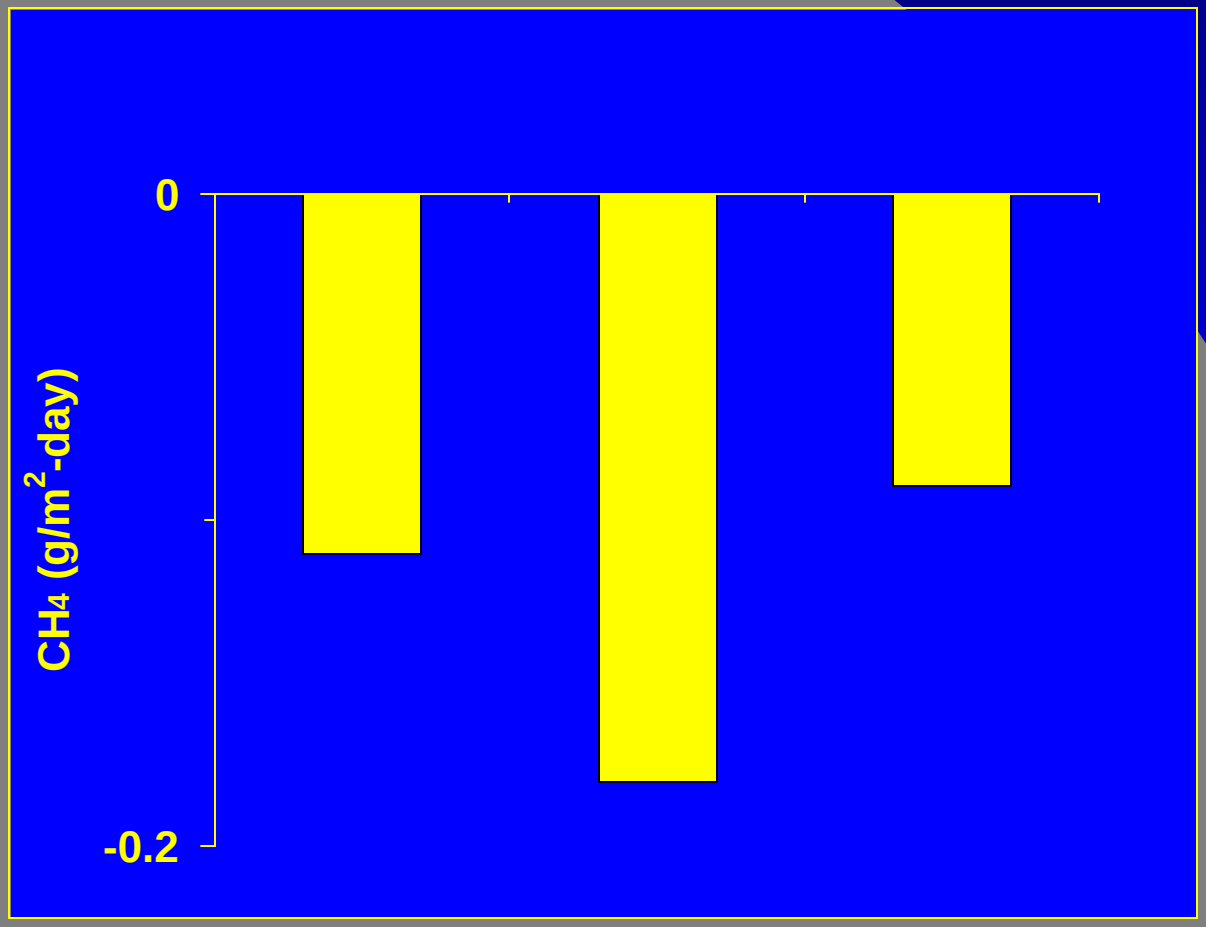
HAP Analyses: BC-1



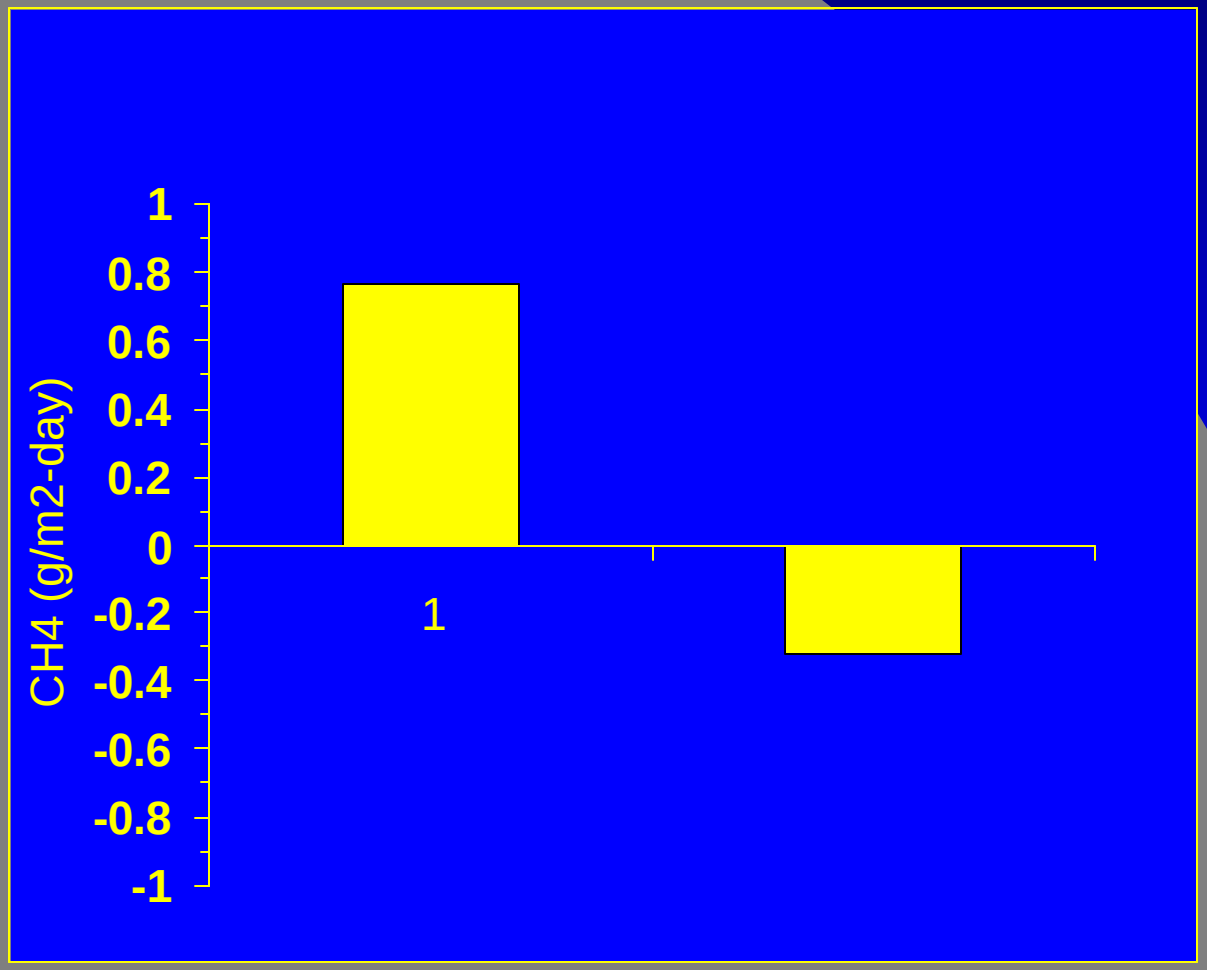
Summary Results: June, 2002



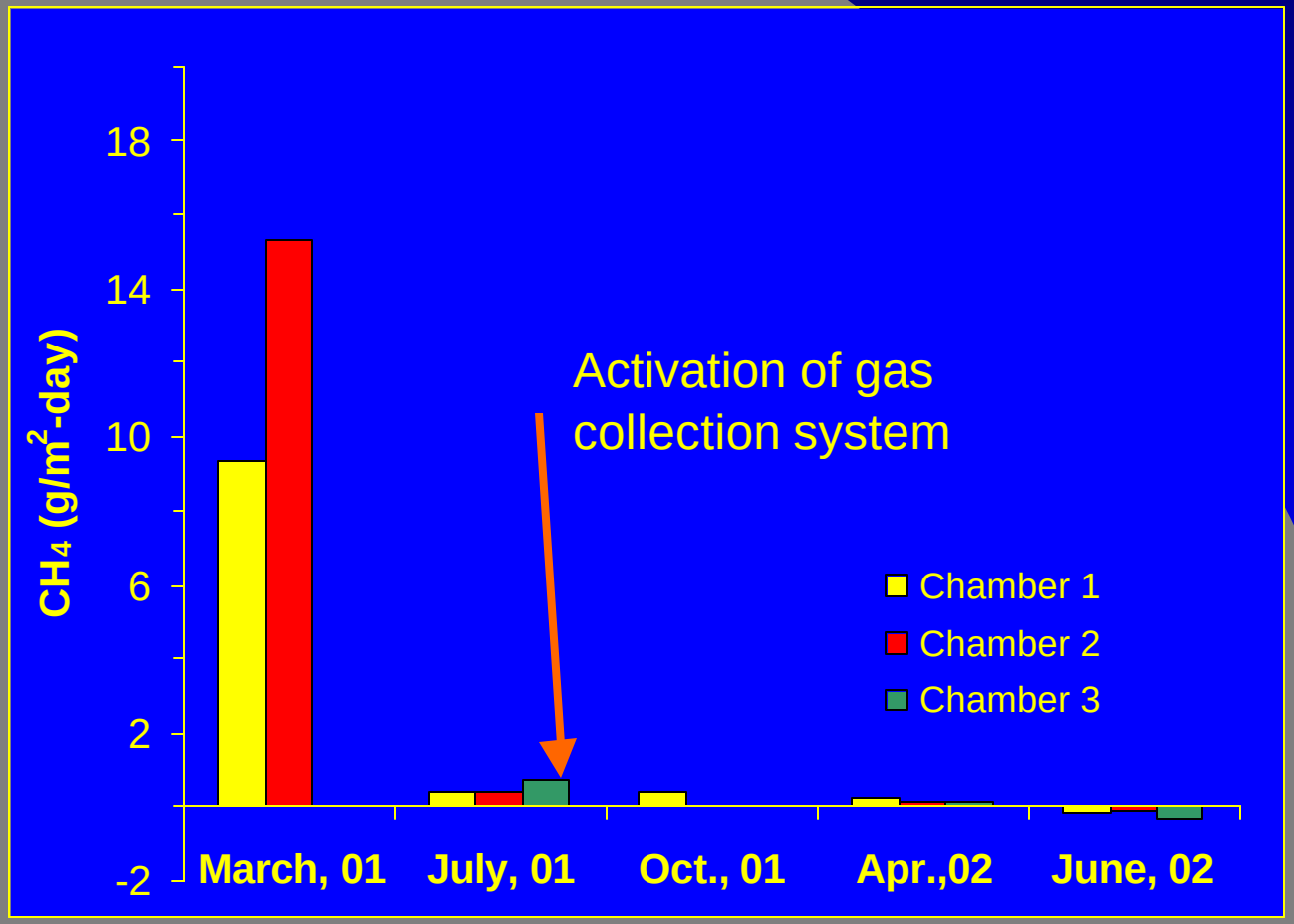
Individual Measurements for Sloped Biocover Chamber 2: June, 2002



Individual Measurements for Facultative Bioreactor-3: June, 2002



Summary of Biocover Flux Data



Additional Work

- Stable isotope analyses to rigorously document methane oxidation (Jeff Chanton)
- Modeling to develop annualized emissions estimates that consider effect of temperature (Helene Hilger)

Preliminary Conclusions

- Static chamber testing is very labor intensive
  - this is not a standard monitoring tool!
- the gas collection system is effective, hence emissions are generally low, zero or negative
- the biocover is less susceptible to cracking due to the high organic content

Future Work

- Testing in fall in parallel with remote sensing techniques to be conducted by EPA
- Additional data analysis
  - NMOCs and HAPs
- Cold weather performance
- Modeling to estimate annualized emissions

Acknowledgements

- Environmental Research and Education Foundation
- Waste Management Inc.
- All the field support personnel