

## Assessing Poultry House Environments

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## Poultry House Environment

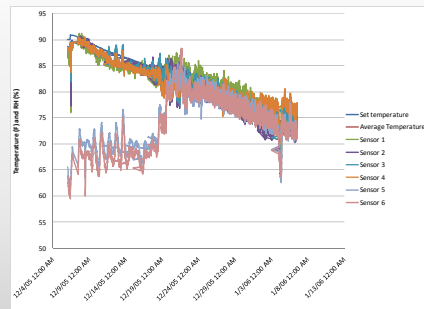
- ▶ Temperature
- ▶ Relative Humidity
- ▶ Light intensity
- ▶ Carbon Dioxide
- ▶ Carbon Monoxide
- ▶ Ammonia
- ▶ Litter moisture
- ▶ Water quality
- ▶ House tightness



## Temperature & RH



## Temperature



## Relative Humidity

Current Conditions			
5 Jun 2008	POWER mode	2:31p	
Set Temperature	85.7	Sensor Avg.	84.6
*Sensor 1	83.4	*Sensor 2	85.0
*Sensor 3	84.0	*Sensor 4	85.0
Sensor 5	88.5	Sensor 6	85.4
SP	05	RH	75



## Temperature, RH & Airspeed

- ▶ Kestrel Wind Meter



### Environmental Monitoring: Kestrel Anemometer

\$ 70      \$ 100      \$ 150

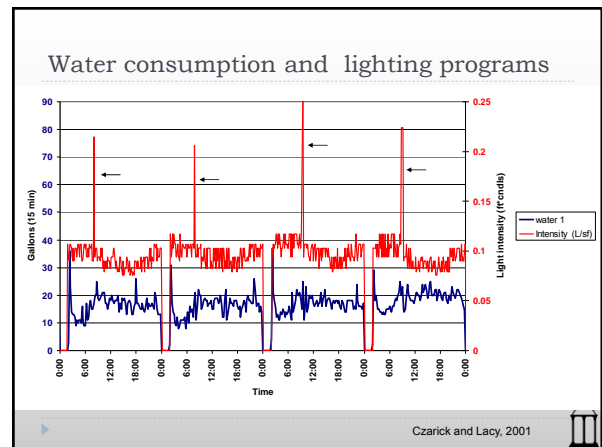
Kestrel® 1000 Pocket Anemometer - Wind Meter  
 Kestrel® 2000 Pocket Anemometer - Thermo Wind Meter  
 Kestrel® 3000 Pocket Anemometer - Thermo Wind Meter  
 Kestrel® 4000 Pocket Anemometer - Weather Tracker  
 Kestrel® 4100 Pocket Air-Flow Tracker - For HVAC Monitoring  
 Kestrel® 2500 Pocket Weather Anemometer  
 Kestrel® 3500 Pocket Weather Anemometer  
 Kestrel® 2500 NV Pocket Wind Meter  
 Kestrel® 3500 NV Pocket Wind Meter  
 Kestrel® 4000 NV Pocket Wind Meter

### Infrared Temperature Gun

\$35-\$40

### Data Loggers

- ▶ Temperature
- ▶ RH
- ▶ Light
- ▶ Gases
  - ▶ Ammonia
  - ▶ CO2
  - ▶ CO



### Infrared Camera

### Measuring Light intensity

- ▶ Angle of light meter
  - ▶ Straight up
  - ▶ Light source

## Litter Moisture

- ▶ Collecting Samples



Random Surface Samples



Trench method

## Litter Moisture

- ▶ Weigh ~100g of litter from composite sample
- ▶ Dry in oven for 24 h at 120 F
- ▶ Weigh dried sample
- ▶  $\frac{(\text{Wet Wt.} - \text{Dry Wt.})}{\text{Wet Wt.}} \times 100$



## Litter Moisture

- ▶ The best way to quickly determine litter condition is to grab a handful near a drinker and squeeze.
- ▶ If the litter clumps together in a ball, it is too wet.
- ▶ If the litter falls apart immediately, it is too dry, creating dusty conditions.
- ▶ If the litter clumps briefly and then crumbles apart, it has the correct moisture content — about 20 to 25 percent



## Evaluate Water Quality

- ▶ Minerals
  - ▶ Fe, Mn, Mg, Ca, SO<sub>4</sub>, etc...
- ▶ Microbe content
  - ▶ Total plate count
  - ▶ E. coli
- ▶ Conduct annually

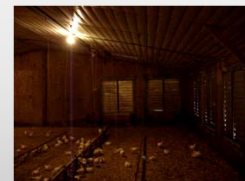


## Static Pressure Test

- ▶ Magnehelic Pressure Differential Gauge (Dwyer Model # 2000-00)
  - ▶ \$75 for gauge
  - ▶ \$35 for portable kit
- ▶ Turn on fan 48" or two 36"
- ▶ Conduct 2 or 3 times per year



## Use Smoke Emitters

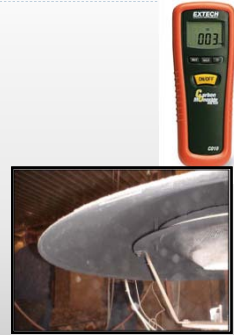


## Air Quality

- ▶ To manage air quality, gases must be able to be detected and quantified
  - ▶ Identify problems
  - ▶ Know when to address problems
  - ▶ Know if solution is effective



## Carbon Monoxide (CO)



## Carbon monoxide meters are a useful tool

- ▶ Reasonable cost \$200 - \$300
- ▶ Most major instrument manufacturers .....  
Fluke, Extech, Telaire etc.
- ▶ Google to find these products



## Using a carbon monoxide meter

- ▶ Check for CO prior to chick placement
  - ▶ In the morning,
  - ▶ cold weather.
- ▶ Check individual brooders.



## Another useful tool is a carbon monoxide data logger

- ▶ Low CO levels may be incorrect conclusions.
- ▶ Levels are highest when you are not there.

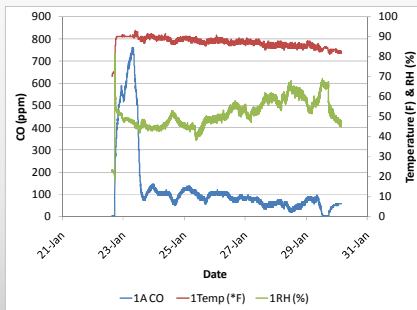


## Carbon monoxide data logger

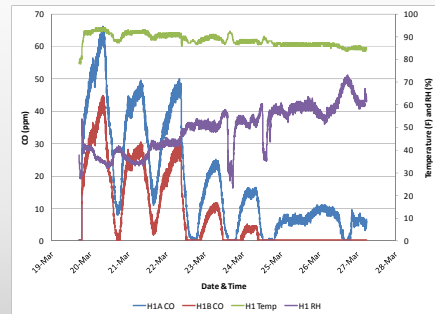
- ▶ Monitors CO levels on a continuous basis for .....
  - ▶ Day, week, month(s)
- ▶ Downloadable to a PC → easy to produce graphs.



## Extremely High CO Concentrations



## Acceptable CO Concentrations



## Carbon monoxide data logger

- ▶ Data logger & software \$125



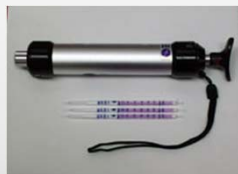
To truly determine if Carbon Dioxide is a problem you have to measure it.

- ▶ Telaire 7001 (\$430)
- ▶ Good for spot checking and can be connected to data logger for long term monitoring.



## Draw Tubes

- ▶ Tubes for multiple gases
  - ▶ CO<sub>2</sub>, CO, NH<sub>3</sub>, etc..
- ▶ Pump = \$150
- ▶ Tubes = \$30/box of 10

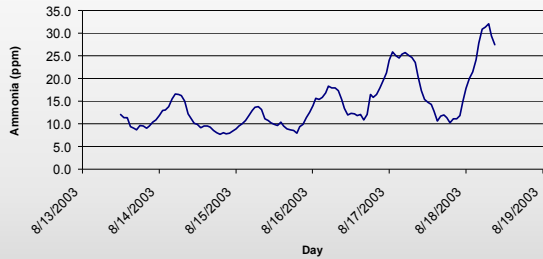


## Detecting and measuring NH<sub>3</sub>

- ▶ Produce in the litter
  - ▶ More concentrated at bird level
  - ▶ Measuring at bird level is important
- ▶ Ventilation
- ▶ Time of day



## NH<sub>3</sub> levels vary throughout the day



## Detecting and measuring NH<sub>3</sub>

- ▶ **Smell**
  - ▶ Humans – 5-50 ppm and above
  - ▶ Loose sensitivity over repeated exposure
    - ▶ Not able to detect reliably
    - ▶ Can not depend solely for bird health

In most cases, if you can smell ammonia, then the levels are probably all ready too high.



## Detecting and measuring NH<sub>3</sub>

- ▶ **Smell**
  - ▶ In most cases, if you can smell ammonia, then the levels are probably all ready too high
  - ▶ Increase ventilation
  - ▶ Monitor relative humidity



## Ammonia Measurement

- ▶ **Hydrion Ammonia Test Paper**
- ▶ **Draw Tubes**
- ▶ **Passive Tubes**
- ▶ **Electric meters**
  - ▶ Electrochemical
  - ▶ Electrochemical combinations

## Hydrion Ammonia Test Paper

- ▶ Wet a small piece of the paper with distilled H<sub>2</sub>O
- ▶ Expose it to the air (~15 sec)
- ▶ Chemical react in the paper and a color change occurs - compare to chart
- ▶ Fairly accurate, but not precise
- ▶ Can determine if it is high
- ▶ Sampling error



## Gas Detection Tubes

- ▶ **Most common**
- ▶ **Requires pump**
- ▶ **One point in time**
- ▶ **Accuracy can be variable**
  - ▶ Sampling errors
  - ▶ Errors in reading
- ▶ **Tubes intended for single measurement**
  - ▶ Multiple measurements can be done



### Draeger CMS Analyzer

- ▶ Draws air sample through chip
- ▶ Provides a numerical reading



### Passive Dosi-Tube

- ▶ Time weighted measurement of ammonia
- ▶ No pump is required
- ▶ Accuracy can vary
- ▶ Price will limit use

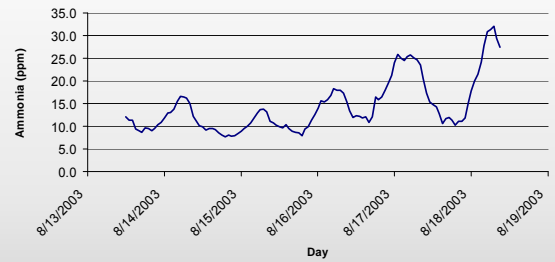


### Electric Ammonia Meters

- ▶ **Electrochemical**
  - ▶ Most common
  - ▶ Can be very accurate
- ▶ Disadvantages
  - ▶ Environment
  - ▶ Calibration
  - ▶ Cost
- ▶ Electrochemical combinations



### Electric meters – continuous monitoring



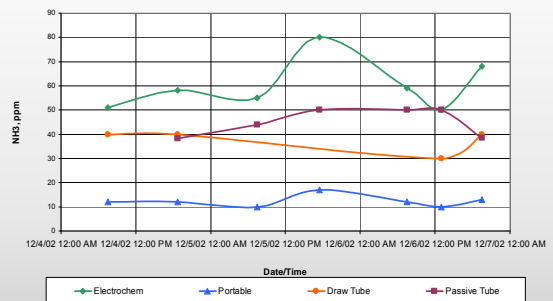
5 minute readings – averaged by hour

### UGA Electrostatic Study



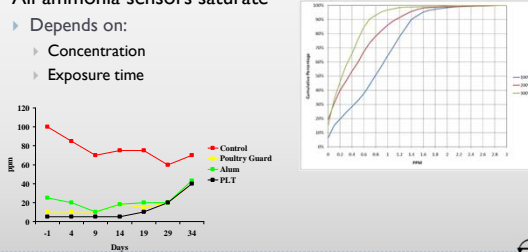
Ritz et al., 2004

### Ammonia Concentrations



## Measuring Ammonia Accurately

- ▶ More accuracy and sensitivity
- ▶ Requires more expensive equipment
- ▶ All ammonia sensors saturate
  - ▶ Depends on:
    - ▶ Concentration
    - ▶ Exposure time



## Portable Measurement Unit (PMU)

- ▶ PAC III x 2
- ▶ Infrared sensor ( $\text{CO}_2$ )
- ▶ Data logger
- ▶ Pump
- ▶ Purge Cycle
- ▶ \$3,500.00



Pescatore, 2004

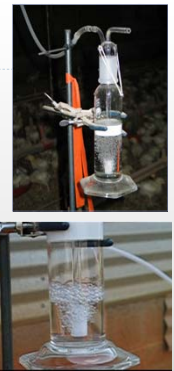
## Photoacoustic Analyzer

- ▶ Uses combination of infrared light and sound to detect gases
- ▶ High sensitivity
- ▶ Expensive
  - ▶ \$42,000

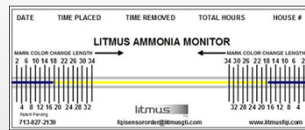


## Gas Washing Bottles

- ▶  $\text{NH}_3$  trapped in Sulfuric Acid
- ▶ N content analyzed by spectrophotometer
- ▶ Time weighted average
- ▶ Accuracy & sensitivity good
- ▶ Labor intensive
- ▶ Approximately \$15 per sample



## Ammonia Detectors



	TOTAL HOURS																											
PPPM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
10	4	4	4	5	5	5	6	6	7	7	8	8	9	9	9	10	10	10	11	11	11	12	12	13	13	14	14	15
20	6	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19
30	7	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21
40	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22
50	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22
60	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23
70	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24
80	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25
90	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26
100	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	27	27
110	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	27	27	28	28
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150	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	27	27	28	28	29	29	30	30	31	31	32	32
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320	36	36	37	37	38	38	39	39	40	40	41	41	42	42	43	43	44	44	45	45	46	46	47	47	48	48	49	49
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420	46	46	47	47	48	48	49	49	50	50	51	51	52	52	53	53	54	54	55	55	56	56	57	57	58	58	59	59
430	47	47	48	48	49	49	50	50	51	51	52	52	53	53	54	54	55	55	56	56	57	57	58	58	59	59	60	60
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490	53	53	54	54	55	55	56	56	57	57	58	58	59	59	60	60	61	61	62	62	63	63	64	64	65	65	66	66
500	54	54	55	55	56	56	57	57	58	58	59	59	60	60	61	61	62	62	63	63	64	64	65	65	66	66	67	67

## Ammonia Measurement

- ▶ Be aware of the limitations for each method
- ▶ Be aware of potential for errors
  - ▶ Improper