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The J. Paul Getty Museum
The Getty Conservation Institute



Nitrogen Treatment

Nitrogen Set Up – Large Scale

Liquid Nitrogen Dewar: ~ 110,000 liters of gas

Home made "bubbler" for humidification with high flow and low flow meter sets

Teledyne Portable Oxygen Sensor

Rentokil 6 m³ PVC reusable bubble





Nitrogen Set Up – Medium Scale

Home made "bubbler" for humidification with high flow and low flow meter sets

Liquid Nitrogen Dewar: ~ 110,000 liters of gas



Heat sealed Aclar and Marvelseal bubble

PBI Dansensor Checkmate 2 Oxygen sensor (syringe sampling)

PVC tubing frame





Controllable Vent Continuous 2 Ipm flow during treatment





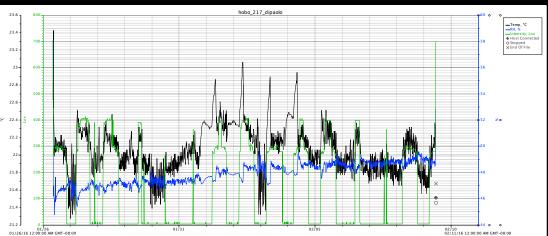
Liquid Nitrogen Dewar



- High flow possible
 125 lpm fast flush
- High capacity (have never used more than one tank)
- Icing does occur during initial flush!

HOBO monitoring

- 46-49% RH
- 21.4°- 23.4°C.





Monitoring Routine

Handy checklist for monitoring.

| | | | - | | | | | | | | | |
|-------------------------------------------------|---------------------------------------------------|-----------------------------------------|-------------|------------------|-------------|------------------|--------------------|--------------|----------------|-----------------|---------------|------------|
| Nitrogen Tan | Type: | | Bubble Typ | e: | | Bub | ble size: | | | | | |
| * list outflo | was being open, | Regulator | lated with | a syringe Wet | Dry | Humidifier | Humidifier | Bubble | Bubble | Oxygen | Tank | I Outflow* |
| 10 1 1 2 to 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | W. (2004) 11 11 | psi | Psi | flow | flow | RH | Temp | RH | Temp | level | Level | Outrow |
| Date/Time: | Settings: | 920 | | 400 | | | 1744,000 | | 1159 | | | |
| | Resettings: | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Observations | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | Regulator psi | Tank Psi | Wet | Dry | Humidifier | Humidifier Temp | Bubble RH | Bubble | Oxygen | Tank Level | Outflow |
| Date/Time: | Settings: | psi | PSI | TIOW | now | KII | Temp | KII | 1cmp | ievei | Level | |
| | | | | | | | | | | | | |
| | Resettings: | | | | | | | | | | | |
| | Observations | لــــــــــــــــــــــــــــــــــــــ | | | | | | | | | | |
| | COSCIVALIONS | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| | | Regulator | Tank | Wet | Dry | Humidifier | Humidifier | Bubble | Bubble | Oxygen | Tank | Outflow |
| Date/Time: | Settings: | psi | Psi | flow | flow | RH | Temp | RH | Temp | level | Level | |
| Date Time. | Stungs | | | | | | | | | | | |
| | Resettings: | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Observations | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | Regulator | Tank | Wet | Dry | Humidifier | Humidifier | Bubble | Bubble | Oxygen | Tank | Outflow |
| | | psi | Psi | flow | flow | RH | Temp | RH | Temp | level | Level | - Cumu- |
| | 1.0 | pos | | | | | | | | C 1000000 | | 1 |
| Date/Time: | Settings: | - por | | 1000 | 16.00 | | | | | | | |
| Date/Time: | Settings: | - | | | | | | | | | | - |
| Date/Time: | 2 350 | ,m | | | | | | | | | | |
| Date/Time: | 2 350 | | | | | | | | | | | |
| Date/Time: | Resettings: | | | | | | | | | | | |
| Date/Time: | Resettings: | | | | | | | | | | | |
| Date/Time: | Resettings: | Regulator | Tank | Wet | Dry | Humidifier | Humidifier | Bubble | Bubble | Oxygen | Tiank | Outflow |
| Date/Time: | Resettings: | | Tank Psi | Wet | Dry | Humidifier RH | Humidifier Temp | Bubble RH | Bubble Temp | Oxygen level | Tank Level | Outflow |
| Literature | Resettings: Observations | Regulator | | | Dry flow | | | | | Oxygen | | Outflow |
| Literature | Resettings: Observations | Regulator | | | Dry flow | | | | | Oxygen level | | Outflow |
| Literature | Resettings: Observations Settings: Resettings: | Regulator psi | | | Dry flow | | | | | Oxygen level | | Outflow |
| Literature | Resettings: Observations Settings: | Regulator psi | | | Dry flow | | | | | Oxygen level | | Outflow |

Dansensor Headspace Analyzer Fast, accurate, precise.
But... \$7,500.00
No consumables



Build Time

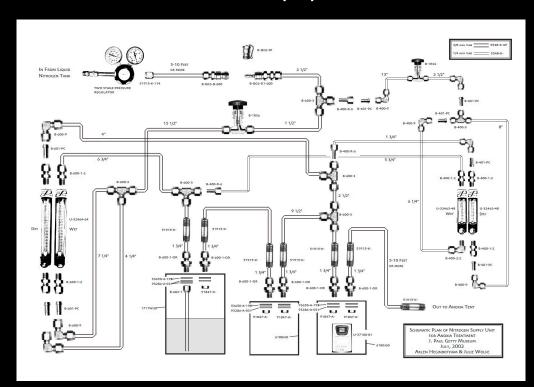
About a week to build our bubbler and order equipment.











Set Up Time

Normally 1-2 days to set up because we don't do it often!



Flush Time

2-5 hours to 0.05% with periodic vacuum assist Up to 125 liters per minute

| | 1 | Nitrogen Fl | us | h Works | 16 | et | Date: | | | | _ | | |
|------------------------------------|----------|----------------|----|-------------|----|------------|-------------------|---|---|------|--------------------------|-------|---------------------|
| Approx Bubble | Siz | ze | T | | Γ | | | | | | | | |
| Height (cm) | x | Width (cm) | × | Length (cm) | = | | | | V | olur | me in Liters | | |
| 50 | x | 150 | X | 250 | = | 1875000 | divided by 1000 | = | | | 1875 | | |
| Elush Flow | П | | Т | - | I | | | | | | | | |
| Flush Flow Dry flow (Lpm) 50 | + | Wet flow (Lpm) | = | Total Flow | | | | | | | | | |
| Dry flow (Lpm) | + | | _ | | | | | | | | | _ | |
| Dry flow (Lpm) | + | 50 | _ | | | | | | | | | 7 | |
| Dry flow (Lpm) 50 | + Sub | 50 | _ | | | Time to ch | ange air one time | × | 6 | = | Approx. flush time (min) | Appro | x. flush time (hour |

| | | | | | _ | | | | | | | |
|----------------------|-----|----------------|----|-------------|----|-------------|------------------|---|---|-----|--------------------------|---------------------------|
| | N | litrogen Flu | ıs | h Worksh | ıe | et | Date: | | | | <u>_</u> d | |
| Approx Bubble | Siz | e | Г | | П | | | | | | | |
| Height (cm) | × | Width (cm) | × | Length (cm) | = | | | | 9 | lur | ne in Liters | |
| 200 | × | 200 | х | 200 | = | 8000000 | divided by 1000 | = | | | 8000 | |
| | _ | | _ | | 7 | | | | | | | |
| Flush Flow | П | | Г | | Ī | | | | | | | |
| | + | Wet flow (Lpm) | = | Total Flow | | | | | | | | |
| | + | Wet flow (Lpm) | = | Total Flow | | | | | | | | |
| | + | | Н | | | | | | | | | |
| Dry flow (Lpm) 50 | + | 50 | Н | | | | | | | | | 1 |
| Dry flow (Lpm) | + | 50 | Н | | | Time to cha | nge air one time | X | 6 | - | Approx. flush time (min) | Approx. flush time (hour: |



Kill Time

Wood Boring Insects Our Normal Target 2 weeks above 21° C





Euvrilletta sp.

Anobium sp.

Acknowledgements:

Shin Maekawa Gordon Hanlon Brian Considine

