Hatchery Water Quality

- High priority parameters
- Standards
- Situations
- Some solutions to problems

Temperature

- Nothing affects the development of eggs and fish more than temperature.
- “Each species has a temperature range it can tolerate and within that range it has optimal temperatures for growth and reproduction” (Fish Hatchery Management).
- Early egg development subject to low temps

Temperature ranges for salmonids

Note the variations

Genus and species	Upper threshold range	Optimum range
Oncorhynchus		
pink salmon	21.3-23.9	
		9.3-12.8[a]
		15.5[b]
chum salmon	21.8-23.8	
		14.1[a]
		13[b]
coho salmon	22.9-25.0	
		11.4-16.6[a]
		14.8[b]
		9-14
		11.8-14.6
sockeye salmon	21.5-24.8	15[b]
		10.6-14.5[a]
		10-15
chinook salmon	21.5-25.1	
		11.7-17.3[a]
		15.5[b]
		10-14
		12-18
cutthroat trout		12-15
rainbow trout	26.5	
		13-22[a]
		10-22
		16.5-17.2[b]
		10-16
		12-18
steelhead	23.9	10

From ADFG Fish Culture Manual

Table 1. Alaska Department of Fish and Game water quality standards for salmonid aquaculture.

Water Qualities	Standards
Alkalinity	undetermined
Aluminum	<0.01 mg/liter
Ammonia (un-ionized)	<0.0125 mg/liter
Arsenic	<0.05 mg/liter
Barium	<5.0 mg/liter
Cadmium	<0.0005 mg/liter (100 mg/liter alkalinity) <0.005 (≥ 100 mg/liter alkalinity)
Carbon Dioxide	<1.0 mg/liter
Chloride	<4.0 mg/liter
Chlorine	<0.003 mg/liter
Chromium	<0.03 mg/liter
Copper	<0.006 mg/liter (100 mg/liter alkalinity) <0.03 mg/liter (≥ 100 mg/liter alkalinity)
Dissolved Oxygen	>7.0 mg/liter
Fluorine	<0.5 mg/liter
Hydrogen Sulfide	<0.003 mg/liter
Iron	<0.1 mg/liter
Lead	<0.02 mg/liter
Magnesium	<15 mg/liter
Manganese	<0.01 mg/liter
Mercury	<0.0002 mg/liter
Nickel	<0.01 mg/liter
Nitrate (NO_3)	<1.0 mg/liter
Nitrate (NO_2^2)	<0.1 mg/liter
Nitrogen (N_2)	<110% total gas pressure (<103% nitrogen gas)
Petroleum (oil)	<0.001 mg/liter
pH	6.5 - 8.0
Potassium	<5.0 mg/liter
Salinity	<5.0 parts per thousand
Selenium	<0.01 mg/liter
Silver	<0.003 mg/liter (fresh water) <0.0003 mg/liter (salt water)
Zinc	<0.005 mg/liter
Sodium	<75.0 mg/liter
Sulfate (SO_4^{-2})	<50.0 mg/liter
Temperature	0° - 15°C
Total Dissolved Solids	<400.0 mg/liter
Total Settleable Solids	<80.0 mg/liter (25 JTU)

pH

- What is it?
- What is the measurement scale?
- What can affect it?
- Typical range in AK is 5.5 to 9
- Low pH may indicate a lack of mineral content
- Fertilization will be greatly affected <4
- Do you remember what might cause this?

YSI 1200 Laboratory pH Instrument

Simple, Accurate Lab-Grade pH, mV and Temperature

The YSI pH1200 is an accurate and reliable laboratory instrume
for the measurement of pH and mVs. An autolock feature will
hold the readings on the display once they reach stabilization.
Simple 1-, 2- or 3-point calibration routine with automatic buffe
recognition plus a sensor efficiency function to ensure the most
accurate data. The instrument can be powered by batteries or
through AC power. The pH1200 also features an easy-to-use
keypad with a large, easy-to-read backlit display ideal for the la

Dissolved Oxygen

- Ideally the water should be 100% saturated for the ambient water temperature and not fall below 80%.
- What factors might influence d.o.?
- Lower safe limit for salmon is 6.5ppm (or mg/L) for long term exposure (stress)
- DO levels lower than this will be experienced after feeding and during adult holding. DO levels can be measured with a meter or titration.
- Fry have higher metabolic rates
- Go to www.ysi.com for more info

Dissolved Oxygen cont.

Factors contributing to decreased oxygen saturation

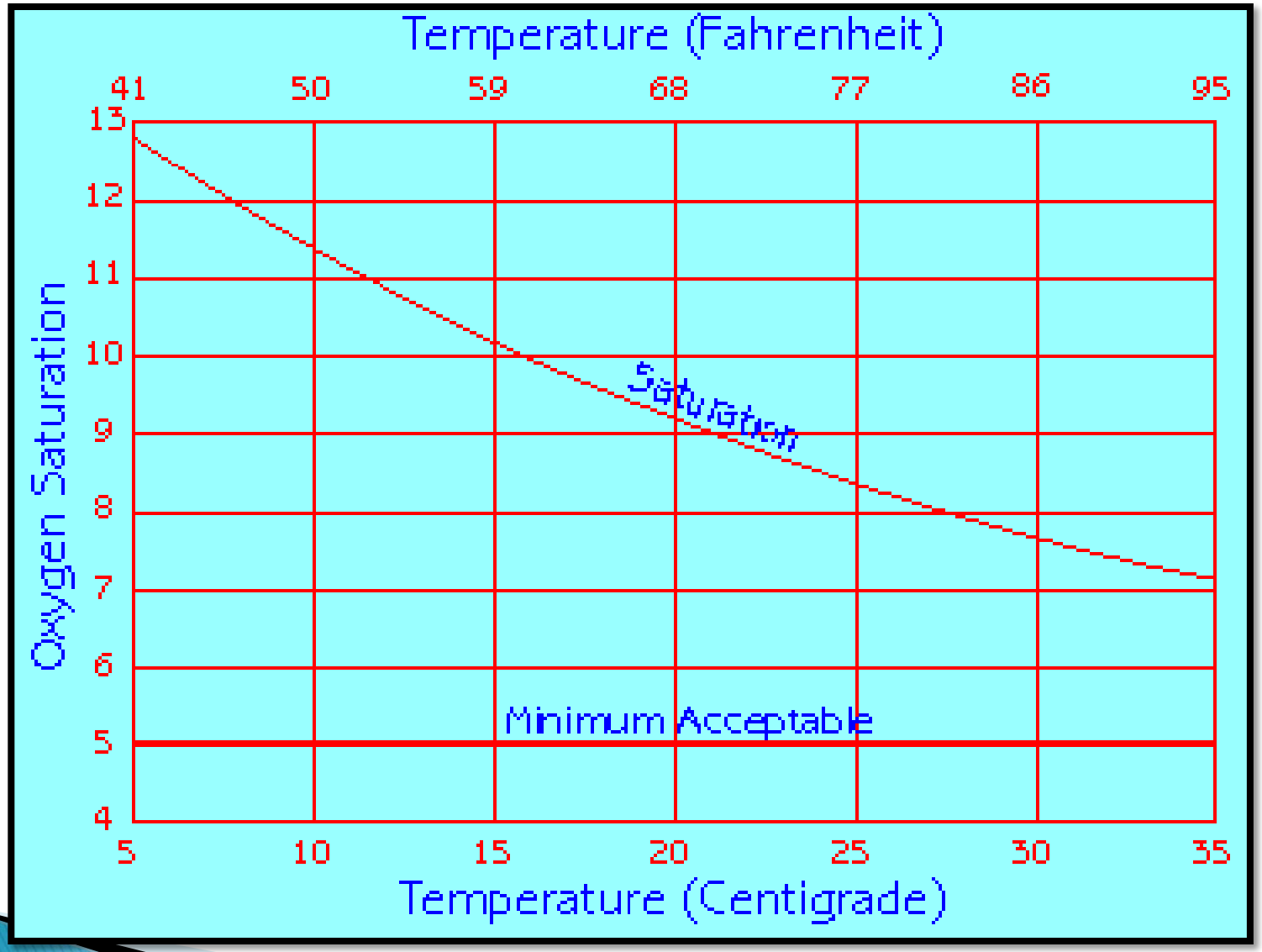
- Rising temperature or altitude
- Respiration by fish and “other organisms”
- Feeding fish metabolize more oxygen
- Any stressful event (examples?)
- Reduced flow

Dissolved Oxygen cont.

Factors contributing to increased saturation

- Cold water
- Reduction in biomass
- Wind
- Mechanical aeration
- Supplemental oxygen
- Photosynthesis

Oxygen's relationship to temperature



Hardness

.

- Hardness is expressed as the concentration of CaCo3 (Calcium Carbonate).
- Hardness is a measure of the water supply's ability to neutralize acid.
- Hard or Alkaline waters are able to act as buffers against changes in acidity.
- Most hatcheries in Alaska fall well below this range.
- Hardness can be improved by adding calcium and/or other minerals to the water

Explanation of Water Hardness

Water Hardness Scale		
	Miligrams Per Liter (mg/l)or Parts Per Million (ppm)	Classification
	less than 17.1	Soft
	17.1 – 60	Slightly Hard
	60 – 120	Moderately Hard
	120 – 180	Hard
	over 180	Very Hard

Ideal range for a hatchery water supply is 120 – 400mg/l

Dissolved Gases

Too Much or too Little Can Compromise Fish Health

Gas Saturation - terms

- **100% Saturation** occurs when water holds the theoretical maximum amount of gas possible at a given temperature and pressure when in equilibrium with the atmosphere. When air is in contact with water gases dissolve into the water until the pressure of the gas in the water equals that of the gas in the atmosphere resulting in 100% saturation for a given temperature and altitude.
- **Total Dissolved Gas Pressure** is a measure of the total combined pressure of all gases in a water supply and can be measured with TDGP meter.
- **Undersaturation** exists when the concentration of the gas in water is less than the amount of gas the water should hold at a given temperature and pressure.
- **Supersaturation** is a condition that occurs when water at a given temperature and pressure contains more gas than it would normally hold if the water and atmosphere were in equilibrium.

Carbon Dioxide

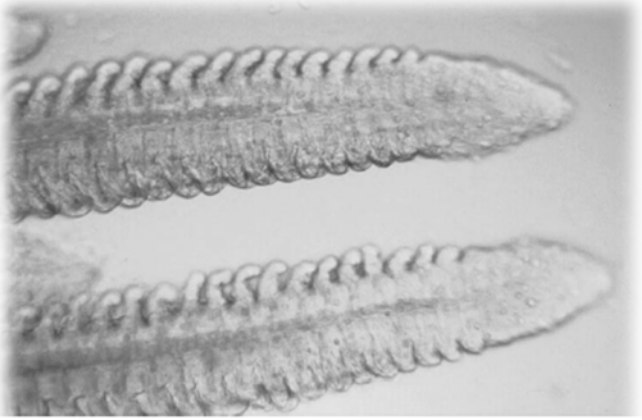
- Indicates a lack of oxygen
- CO2 in flow-through cold water systems does not usually become a factor limiting production or jeopardizing fish health.
- Recirc and fish transport systems – could be an issue. Why?
- CO2 is easily controlled. How?
- What affect would elevated CO2 have on pH, if any?
- http://www.youtube.com/watch?v=pJAKs2SgIHw – solar pond aerator
- aquaponics

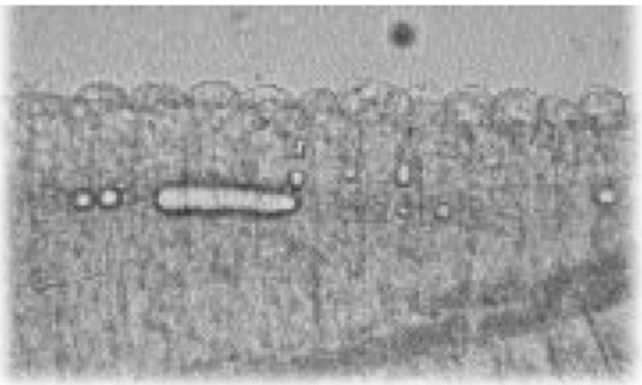
Nitrogen

- **Nitrogen supersaturation** can lead to gas bubble formation in the bloodstream of a fish and result in death. Bubble formation restricts oxygen flow to tissues.
- Bubble formation occurs when a gas comes out of solution.
- Nitrogen supersaturation can be caused by rapidly heating water.
  - Rapidly heating cold water does not allow time for gases in the water to equilibrate with the atmosphere. Cold water holds more gas than warm water and when heated becomes supersaturated.

Gas bubble disease

Commonly seen in fins and eyes





Heavy Metals

- Heavy metals will kill fish
- Do not use any galvanized plumbing – why not?
- PVC, Stainless Steel, Black Iron or Aluminum are recommended
- Zinc, Copper, Lead and Mercury are toxic in small quantities.
- 90 – 41,000ppb of zinc has been shown to kill fish, especially in poorly buffered (acidic) water supplies.

Gas Reduction/Stripping – How do you accomplish it?

- Aeration
- Packed Column
- Vacuum Degasser

Packed Column

- Some aeration occurs with a packed column but usually less than 1ppm.

- Nitrogen is generally easily removed as it is more soluble in water than oxygen

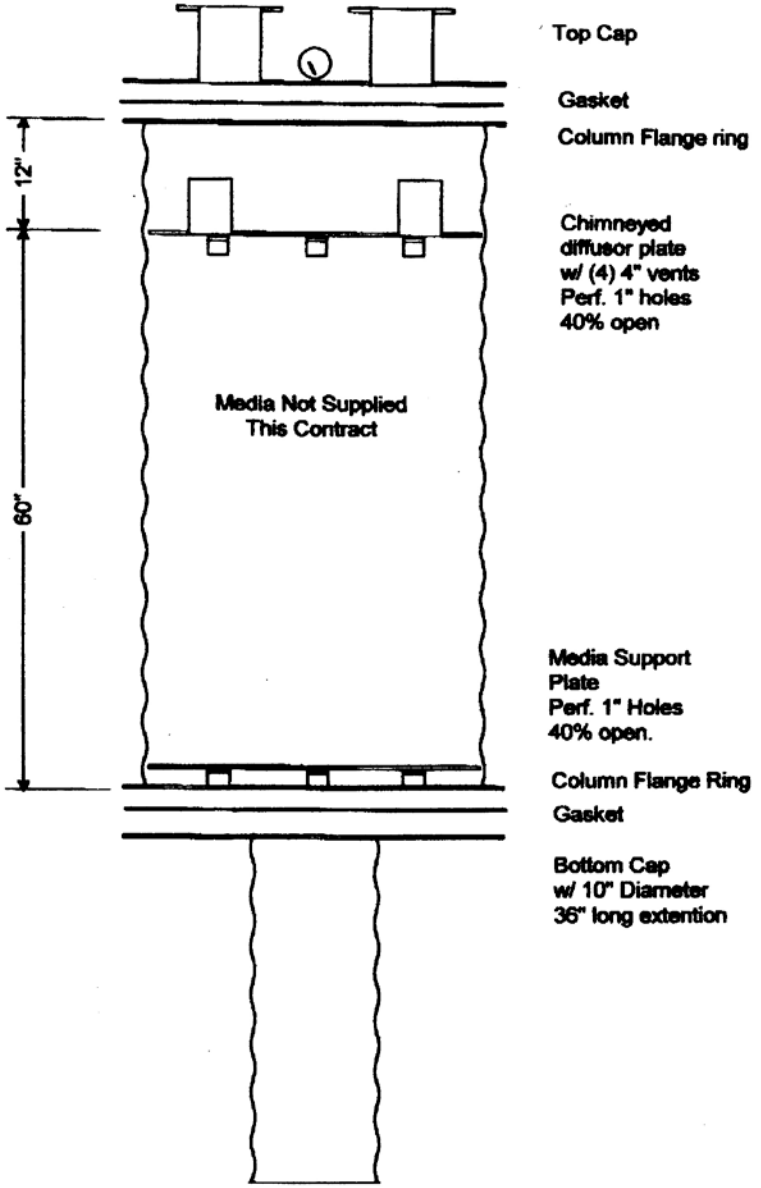
-Packed column is a passive device useful for reducing Total gas

-Pipe is typically filled with substrate which creates more surface area to allow for off-gassing

-Simple device

Vacuum Degasser

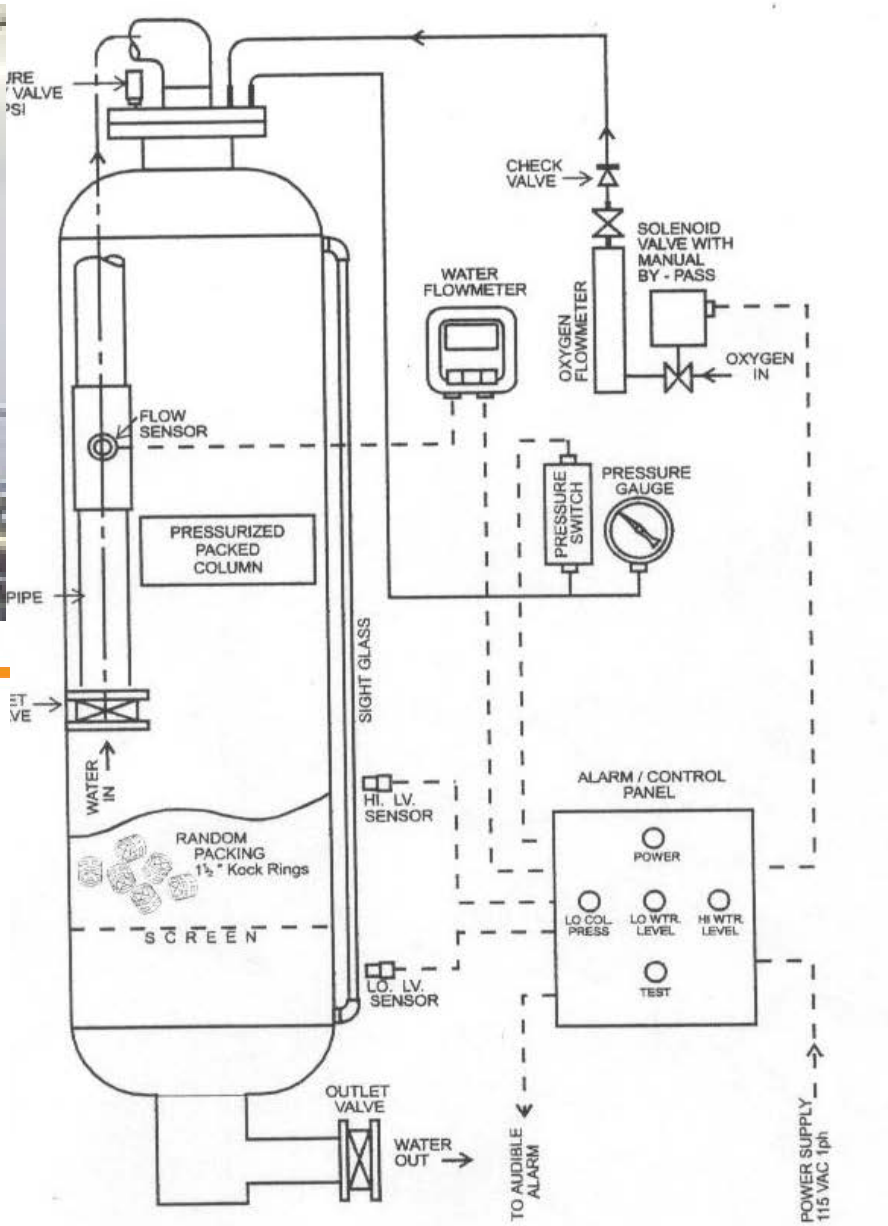
- A vacuum degasser creates a vacuum in the chamber reducing the internal pressure making it easier to remove the gas. The gas is discharged in large bubbles along with the water exiting the column.
- A vacuum degasser is non specific for removing gas and will decrease oxygen as well as nitrogen.
- more aggressive than packed column. Here you draw a vacuum to create low pressure inside the column.



Exploded Cutaway View

EMA Engineered Products Div.	SSRAA	Page 2 of 2

Pressurized Packed Column

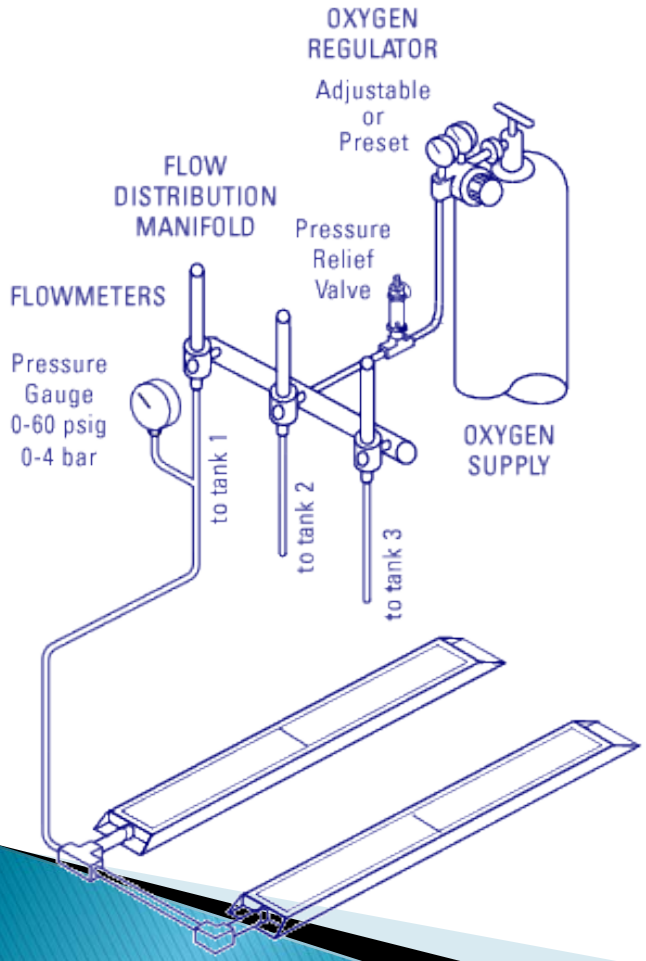


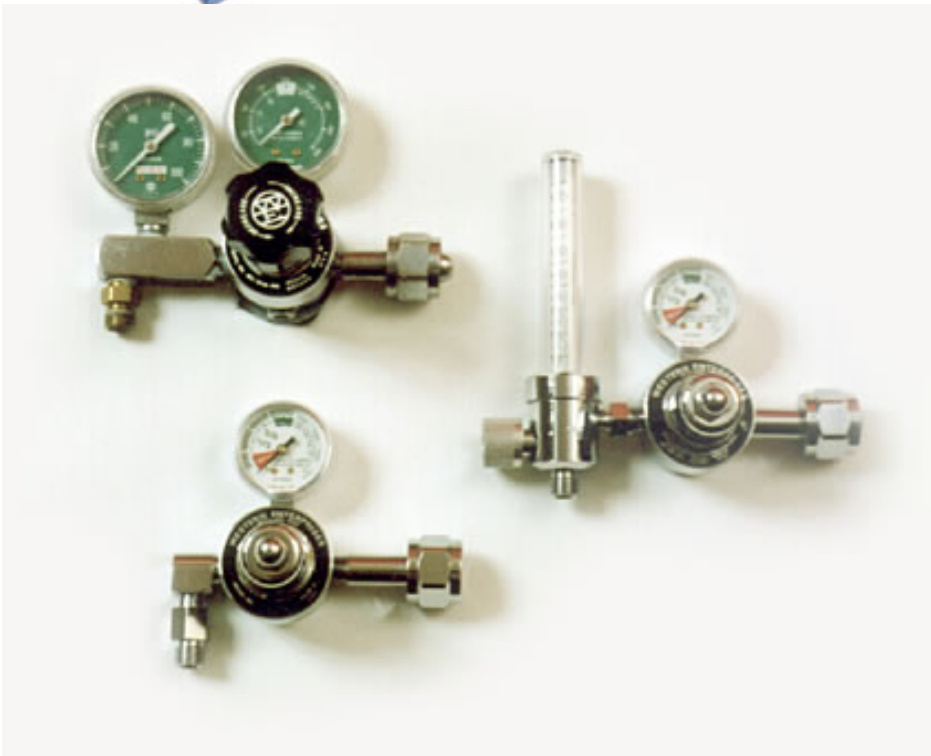
PRESSURIZED PACKED COLUMN SCHEMATIC

Oxygen Addition

- Aeration
- Air Stones using pure oxygen
- Oxygen Generator
- Oxygen Contactors using liquid, bottled or generated oxygen.
- Side streaming of supersaturated water

Ceramic Air Stones





MICROBUBBLE DIFFUSERS MBD600

Oxygen Generator

Oxygen Contactor

Combination of Vacuum Degassers & Ceramic Stones

- Use of ceramic stones injecting oxygen into a raceway combined with the degassing capability of a vacuum column is a very effective method of reducing total gas pressure and nitrogen while boosting oxygen saturation.

Some tools of the trade

MAKING YOUR WATER BETTER

PORTABLE METERS

PT4 TRACKER

The Tracker is a portable Total Gas Pressure (TGP) meter, also known as a saturometer or a tensionometer. It provides measurements for TGP (mmHg or % saturation), delta P (TGP-BP) as well as barometric pressure (BP) (mmHg) and temperature (°C) in a compact, easy-to-use device. [More...]

OXYGUARD CO2 ANALYZER

The OxyGuard portable CO2 Analyzer is a reliable and easy-to-use instrument that measures dissolved carbon dioxide in the water. The meter is unaffected by carbonates or other dissolved substances and provides accurate readings of only the CO2 that affects fish. [More...]

OXYGUARD HANDY POLARIS

The OxyGuard Handy Polaris is a portable Dissolved Oxygen (DO) meter for measuring % saturation, mg/L (ppm) and temperature. It has salinity, temperature and barometric pressure compensation. [More...]

OXYGUARD HANDY METER

The OxyGuard Handy is a portable dissolved oxygen meter available in 3 different models — the Alpha, Beta and Gamma. The Handy meter range provides measurements for ppm (mg/l), % saturation and temperature with salinity compensation. [More...]

ION WIRELES Monitors and Control Systems | Point Four Systems Inc.
http://www.pointfour.com/Products/index_monitors.htm
The Point Four I
unlimited control options and is designed for use with commercial Aquaculture applications. [More...]

PT4 MONITOR &CONTROL SYSTEM
The PT4 Monitor is a cost-effective, multi-channel system for measuring and controlling water quality parameters such as dissolved oxygen, temperature, pH, salinity, gas pressure, TDGP, ORP/Redox and conductivity. [More...]

SM-1 MONITOR
The SM-1 Monitor by Common Sensing is a simple, reliable and accurate monitor for keeping a check on Total Dissolved Gas Pressure (TDGP). [More...]

TBO-F MONITOR
The TBO-F Monitor has a built-in barometer and a three-sensor probe for measuring Total Dissolved Gas Pressure (TDGP), Temperature and Oxygen and comes in a rugged waterproof fieldcase. [More...]

TBO-DL6F MONITOR
The TBO-DL6F Monitor by Common Sensing has all the advantages of the TBO-F Monitor plus a built-in datalogging system capable of storing up to 1Mb of information in a range of set intervals from 1 minute to 24 hours. [More...]

OXYGUARD COMMANDER
The OxyGuard Commander is a multi-channel system designed to measure, monitor and control dissolved oxygen, pH, temperature levels and redox potential. [More...]

OXYGUARD 1W MONITOR
The OxyGuard 1W Monitor is a single channel instrument for the continuous measurement and control of dissolved oxygen and gaseous oxygen. [More...]

OXYGUARD 840 MONITOR
The OxyGuard 840 Monitor is a single channel dissolved oxygen measuring system

YSI.® Professional Plus Multiparameter Instrument

Can measure combinations of D.O., temperature, pH, conductivity, salinity, TDS, ORP, ammonium, nitrate, chloride and barometric pressure.

- Automatic temperature, salinity and barometric pressure compensation.
- User selectable probe and cable options.
- Automatic buffer recognition.

Test up to 11 different parameters with one meter and only a simple cable change! Meter has a backlit display and keypad, graphic display with detailed messages and instructions plus a gauge that continuously shows the battery level. The rubber over-molded case has an IP67 waterproof rating and is drop rated to 1 meter. Instrument can log data (2,000 data-set memory with site identity and GLP event logging) and download it to a PC. Data Manager software, a communication dock and USB cable are included. Meter measures 3.3" x 8.5" x 2.3", weighs 1 lb. Requires 2 C batteries (included). Three-year warranty on meters, two years on cables and one year on probes (six-month warranty on ammonia, chloride and nitrate ISEs).

Click image to view larger image

AQUATIC ECO-SYSTEMS, INC. Since 1978

Search Keyword or Part # GO

1-877-347-4788

My Account | Quick Buy | View Cart 0 Items | Questions? Contact Us

Home | Aquaculture | Lake & Pond | Water Garden | Aquarium | Classroom

Aquaculture

AES Home » Aquaculture Supplies » Water Quality » **FF1A Aquaculture Test Kit**

FF1A Aquaculture Test Kit

This popular freshwater aquaculture test kit includes all the necessary apparatus and reagents for 100 tests each of nine critical parameters. The kit uses the drop-count method for titration tests, and Hach® color comparators for colorimetric tests. Colorimetric tests provide results directly in mg/l and drop-count tests require, at most, a simple multiplication or division step to determine concentration. Ship weight 10 lbs. Alkalinity: 6.4 to 136, Ammonia: 0 to 3, Carbon Dioxide: 5 to 100, Chloride: 5 to 400, Dissolved Oxygen: .2 to 20, Hardness: 17 to 510, Nitrite: 0 to .5, pH: 4 to 10, Temperature: -30 to 120°F.

Click image to view larger image

Products | Reviews

Part No.	Name	Shipping	In Stock	Price	Quantity
FF1A	FF1A Aquaculture Test Kit	HAZ-AIR HAZ-AG	In Stock	$260.00	1 Add

Some water quality – related situations

Air transports may not allow for constant monitoring and/or making adjustments mid-flight

Boat transports can be monitored routinely. Watch for carbon dioxide and/or oxygen supersaturation

Saltwater WQ issues

Low d.o. at chum rearing sites

Sure, he's smiling now……

Always use caution when working at remote rearing sites.

No telling what you will encounter!

Flooding issues

Indian River, Sitka

Water quality issues at Medvejie

Oxygen generators have become commonplace

The SeaReady Process

PRAqua carbon dioxide stripper tower and low head oxygenation system

- note blower
- and oxygen injection site

Oxygenated water returns to raceway

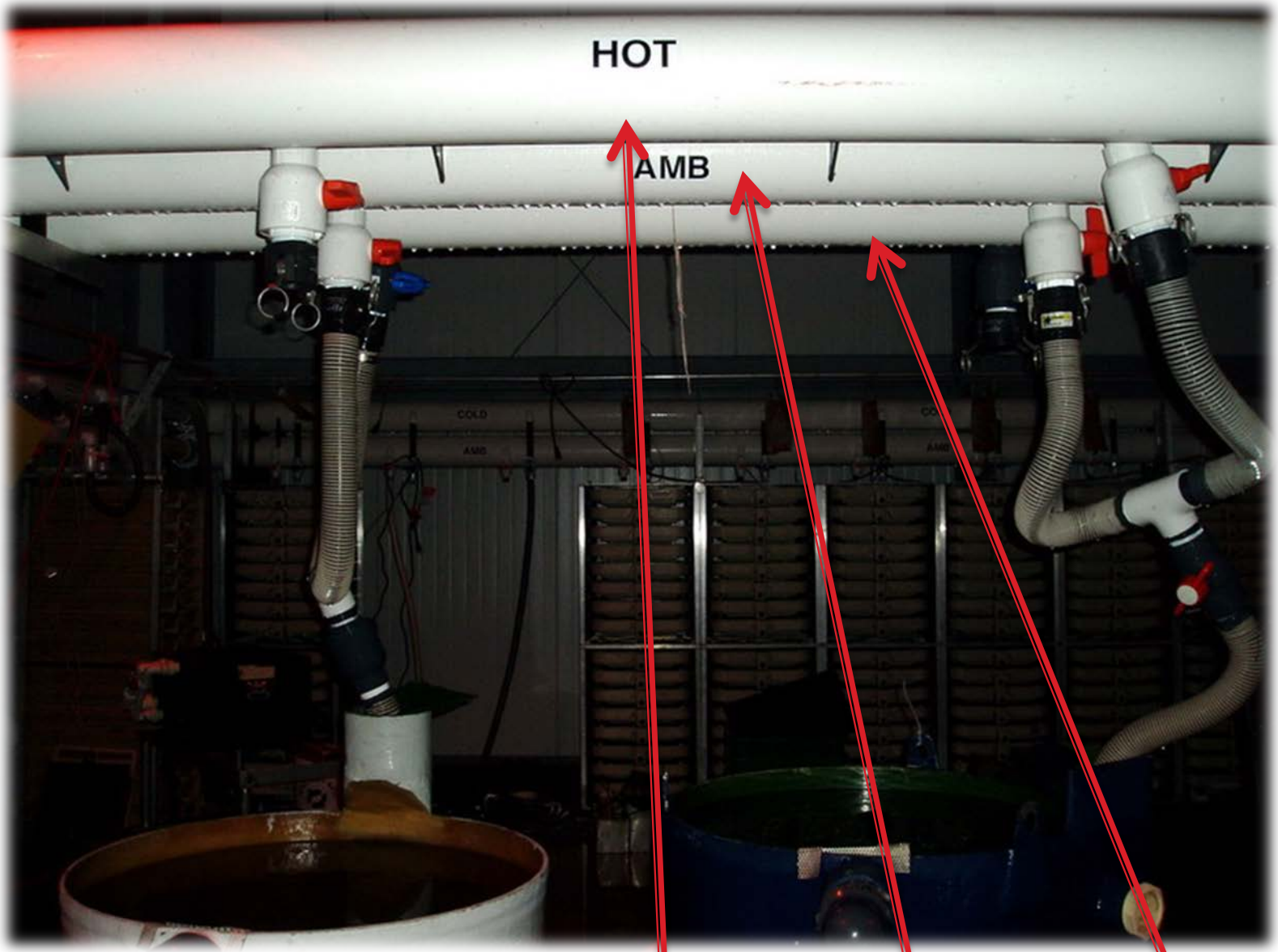
Low head oxygenation chamber

Note the re-use water line into the top of the unit

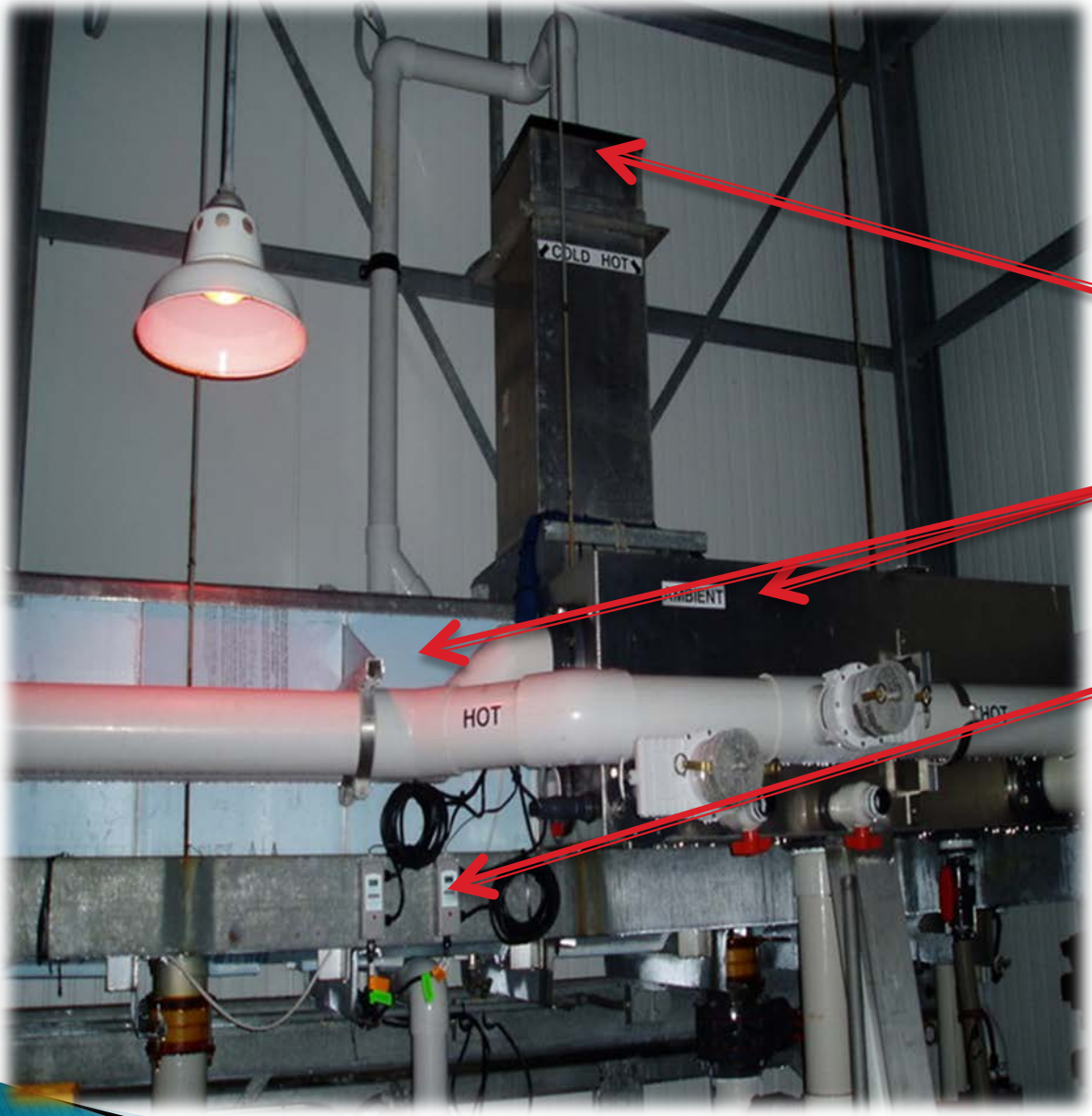
Flowmeter for re-use system

Temperature Control

Heat exchanger at Medvejie allows for otolith marking as well as incubation rearing temp adjustments



3 lines: hot (+3C), ambient, and cold (-3C)

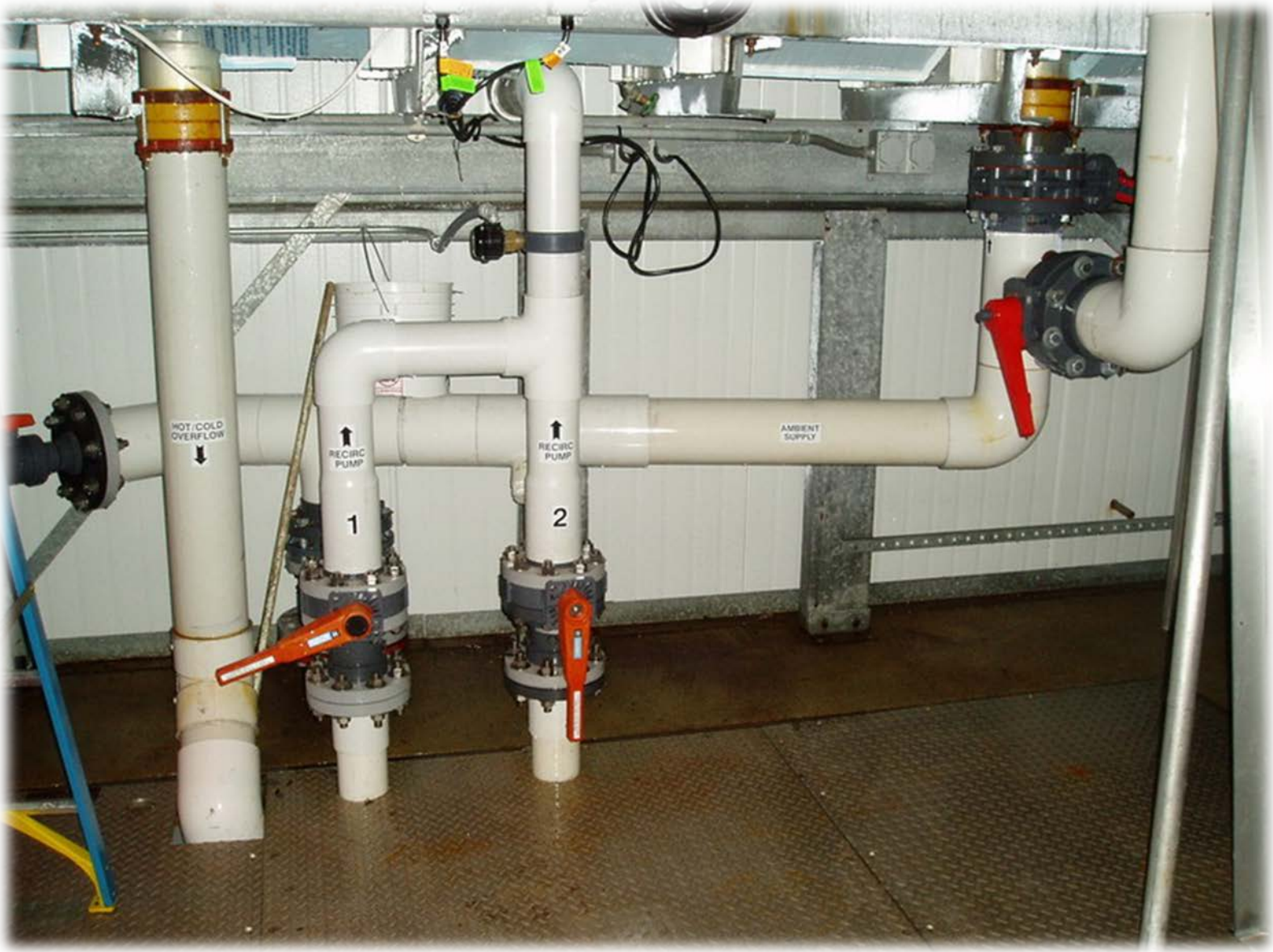


Incubation recirc system

Note degassing tower

Multiple head box configuration

Heater controls



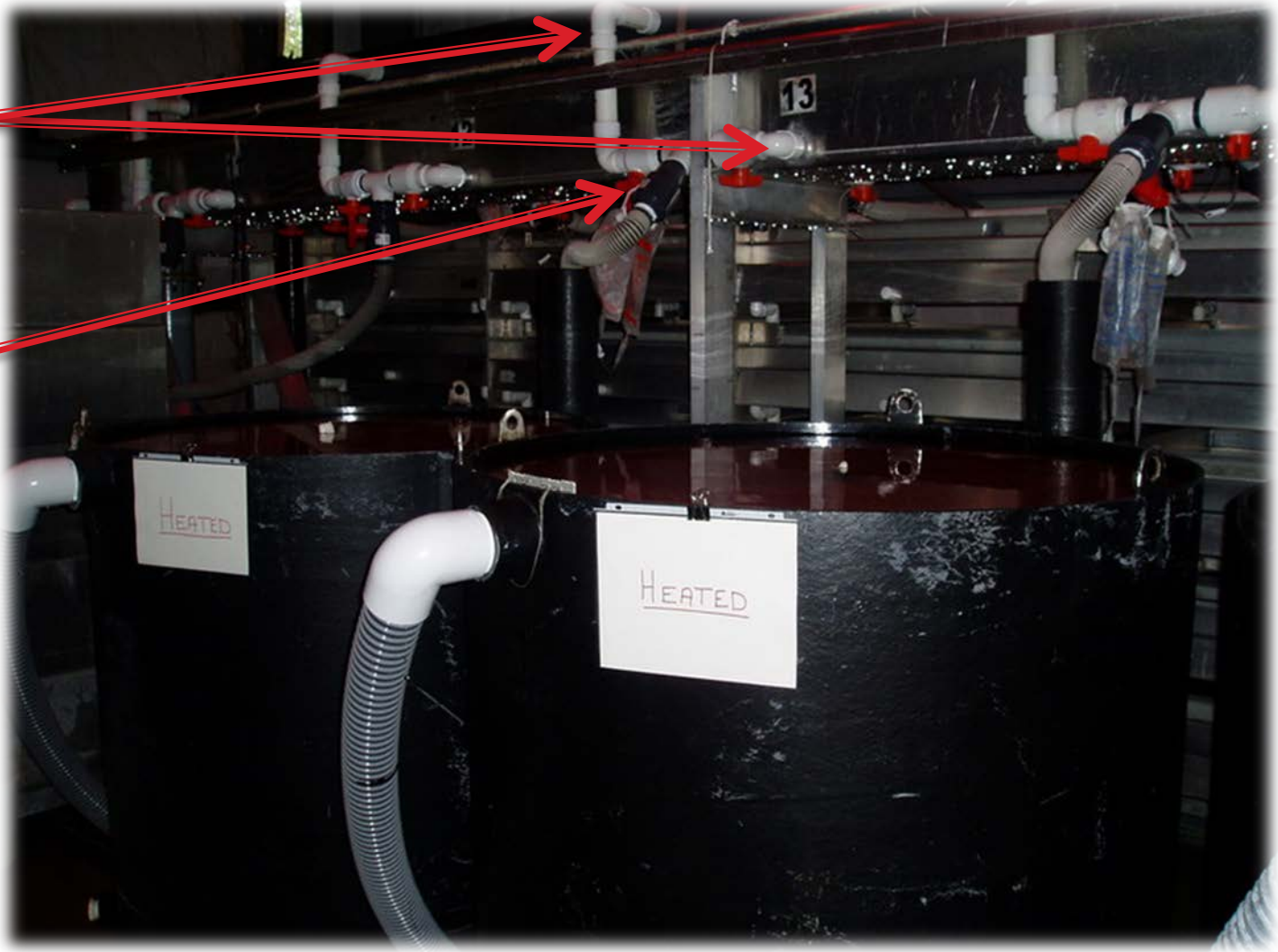
Recirc pumps

Heath trays with dual water sources

Otolith marking / advancing eggs

Dual water supplies

Flow control valve

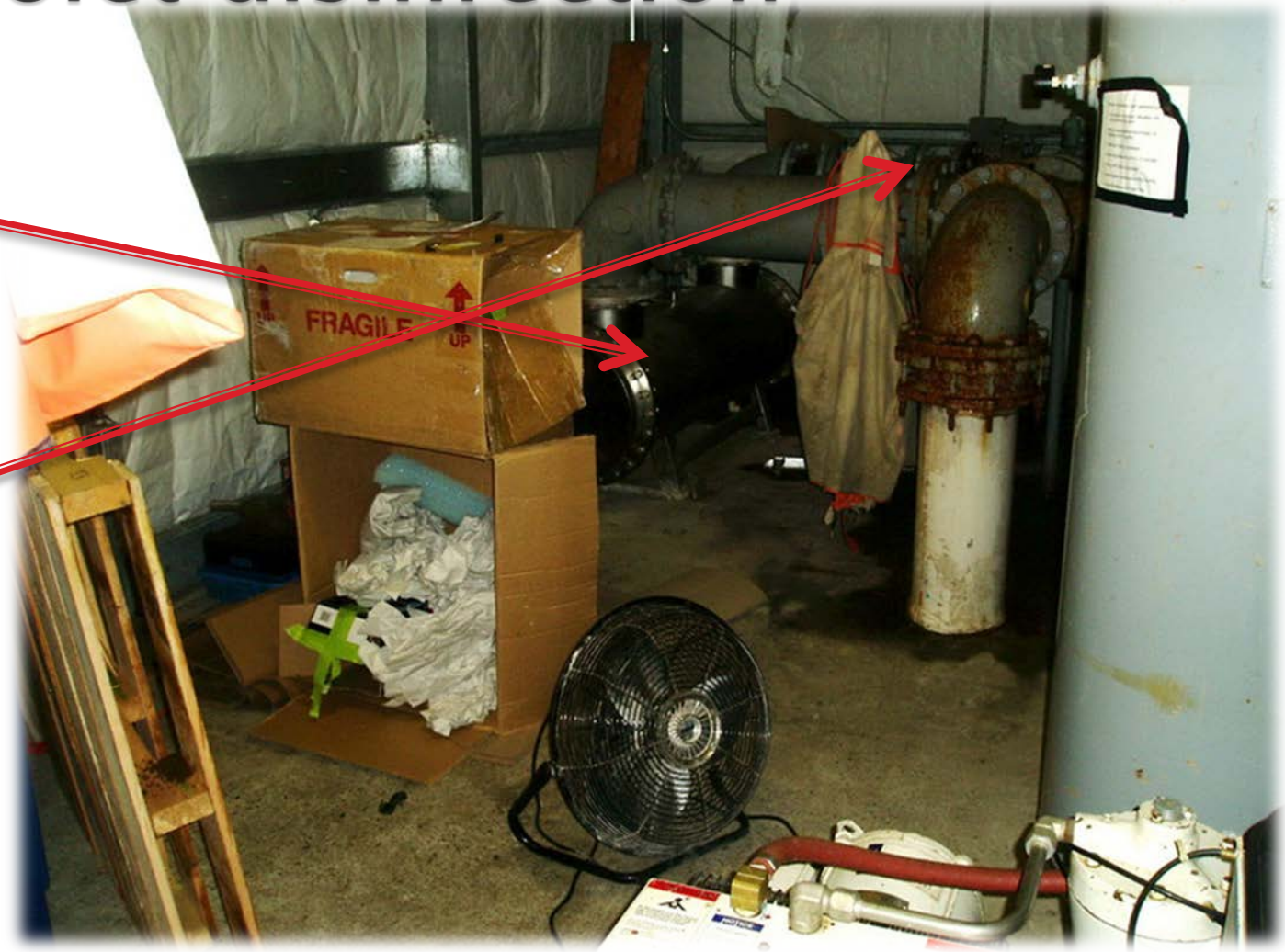


More of the same – degassing and recirc as backup water supply

Ultraviolet disinfection

Large, 32 bulb unit for raceways

Isolation valves



Some items we did not discuss:

- Suspended solids
- Settleable solids
- Ammonia/ nitrite and nitrate

- Will discuss in detail at a later date

- PLEASE try to have this back to me by 12/5!
- We will cover otolith marking next week. Q2 + 3 pertain to otolith marking – don't try to answer them ahead of time.

Alaska Salmon Culture 1 - Exam 3
11/25/15
Due: 12/5/15 by 5pm No Late Work Accepted!

1. Describe gas super saturation, why it is a problem in fish culture, and list some methods of reducing it. Give a brief description of each method. **10pts**

2. Go to http://mtalab.adfg.alaska.gov/OTO/reports.aspx and perform the following operation:
   a. go to Voucher Summary Report
   b. Run a report to find marks for Broodyr 2004 chinook at NSRA, all hatch codes
   c. list the results
   d. what is a "Hatch Code"? The answer can be found at the website. **15pts**

3. Describe three different methods of temperature manipulation for otolith marking. For each, list some of the advantages and disadvantages. Provide detail for why a facility might use one method over the other. (note: this relates to methods of varying water temperature) **15pts**

4. Describe your ideal hatchery facility. Address at least the following criteria:
   - water source
   - species you want to rear
   - rearing (saltwater/freshwater?)
   - location: remote, near town, other **15pts**

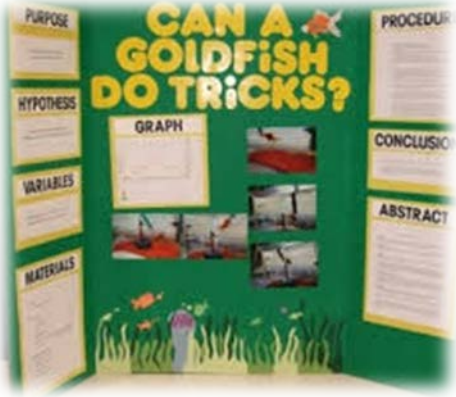
5. We talked about the various types of salmon enhancement projects this semester. For each of the following provide: name of the project, location, organization associated with it, basic objectives and how they achieve them.
   a. Lake rearing
   b. Lake fertilization
   c. Fish stocking
   d. Remote rearing
   e. Hatchery facility **20pts**

6. There are some tools that enhancement facilities can use to "stretch" their water. One of these is use of a "biofilter". Using the Pentair website (www.pentairaes.com) and other sources, find out what biofilters can do for a facility. What do they do? How do they work? What is the result? Are there different sizes? Explain the process in some detail. Are there different types of biofilters? I have put the William Jack Hernandez Production Planning document in Resources. Check out section 4.2 for application examples. **15pts**

7. Regarding project planning: go to http://pentairaes.com/learn-about-aquaculture/customer-spotlight and check out the variety of projects this company is working on. Choose 3 projects in which you can identify:
   a) Project location
   b) The challenge this facility is facing (upgrading, water problems, increased production?)
   c) The solution **10pts**

Semester projects

- Turn in anytime now
- Drop dead date – 12/5/15



DIY
Jelly Fish

Assignment 10

- Read over two articles regarding water quality in aquaculture. Both are listed under Resources on our website.
- Provide a short summary of your findings