

The UVI Balanced Aquaponic System

Charlie Shultz

Aquaculture Boot Camp 2

OSU South Center

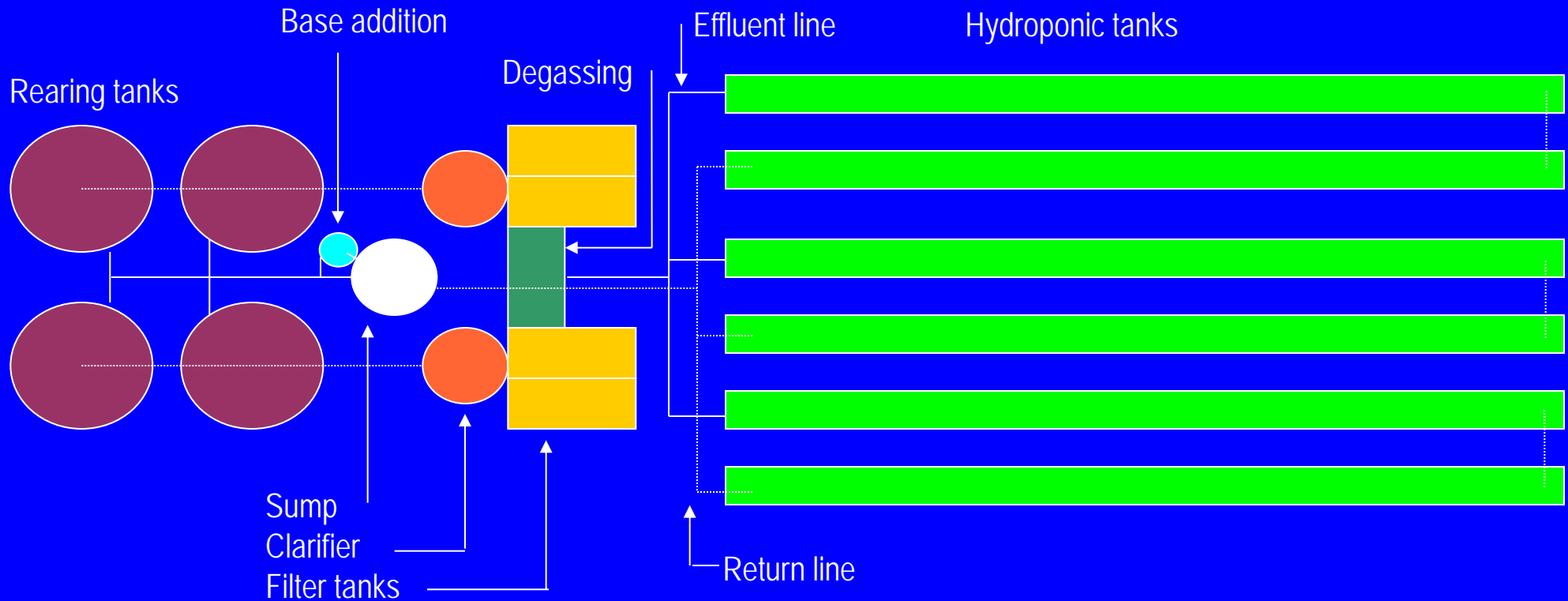
March 11, 2017

The GodFather....Dr. Jim Rakocy



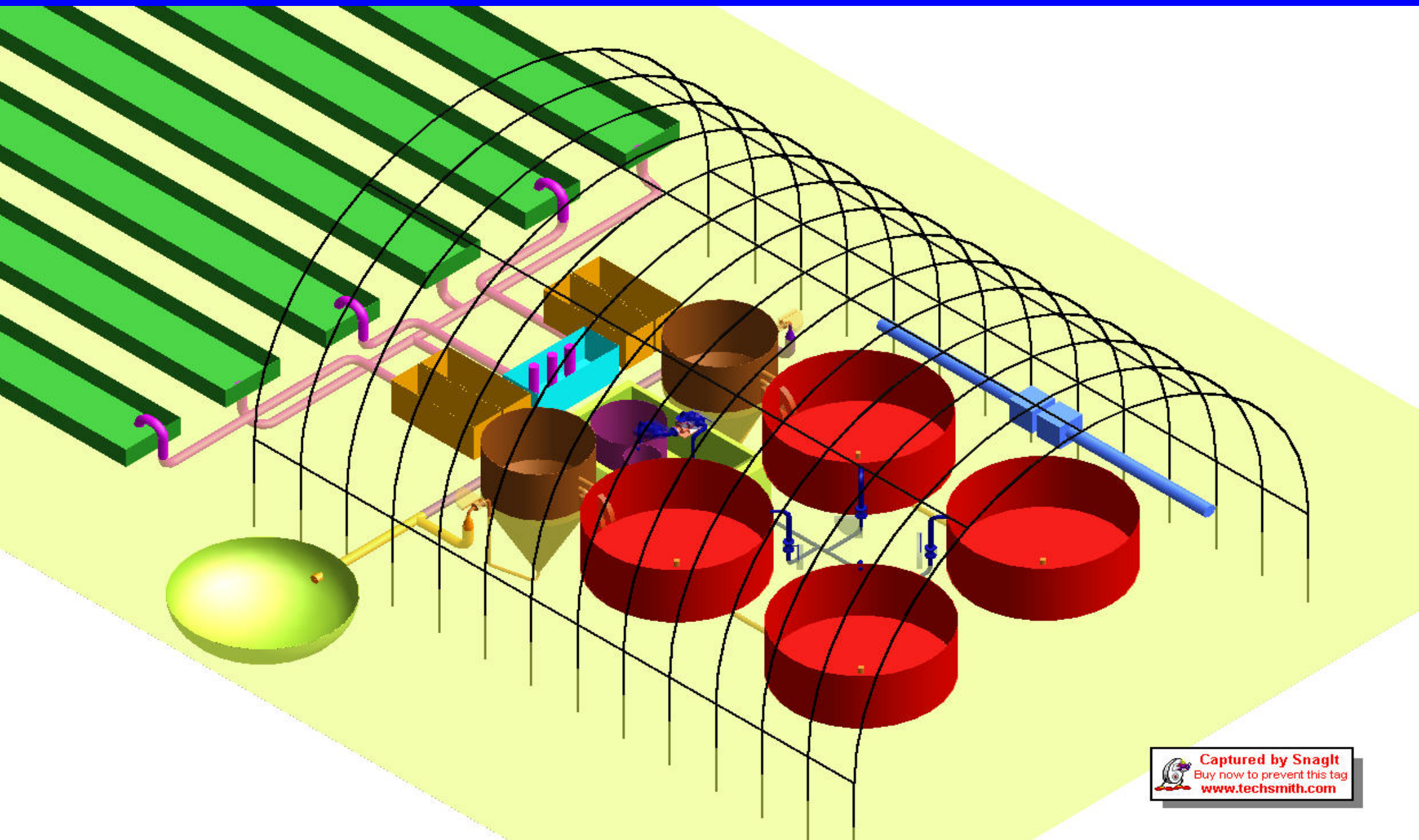


System Layout



Total water volume - 110m³

Land area - 0.05 ha



System Design

- ◆ Four fish rearing tanks, 7.8 m³ each
- ◆ Two cylindro-conical clarifiers, 3.8 m³ each
- ◆ Four filter tanks, 0.7 m³ each
- ◆ One degassing tank, 0.7 m³
- ◆ Six hydroponic tanks, 11.3 m³ each
- ◆ Total plant growing area, 214 m²
- ◆ One sump, 0.6 m³
- ◆ Base addition tank, 0.2 m³
- ◆ Total water volume, 110 m³
- ◆ Land area - 0.05 ha







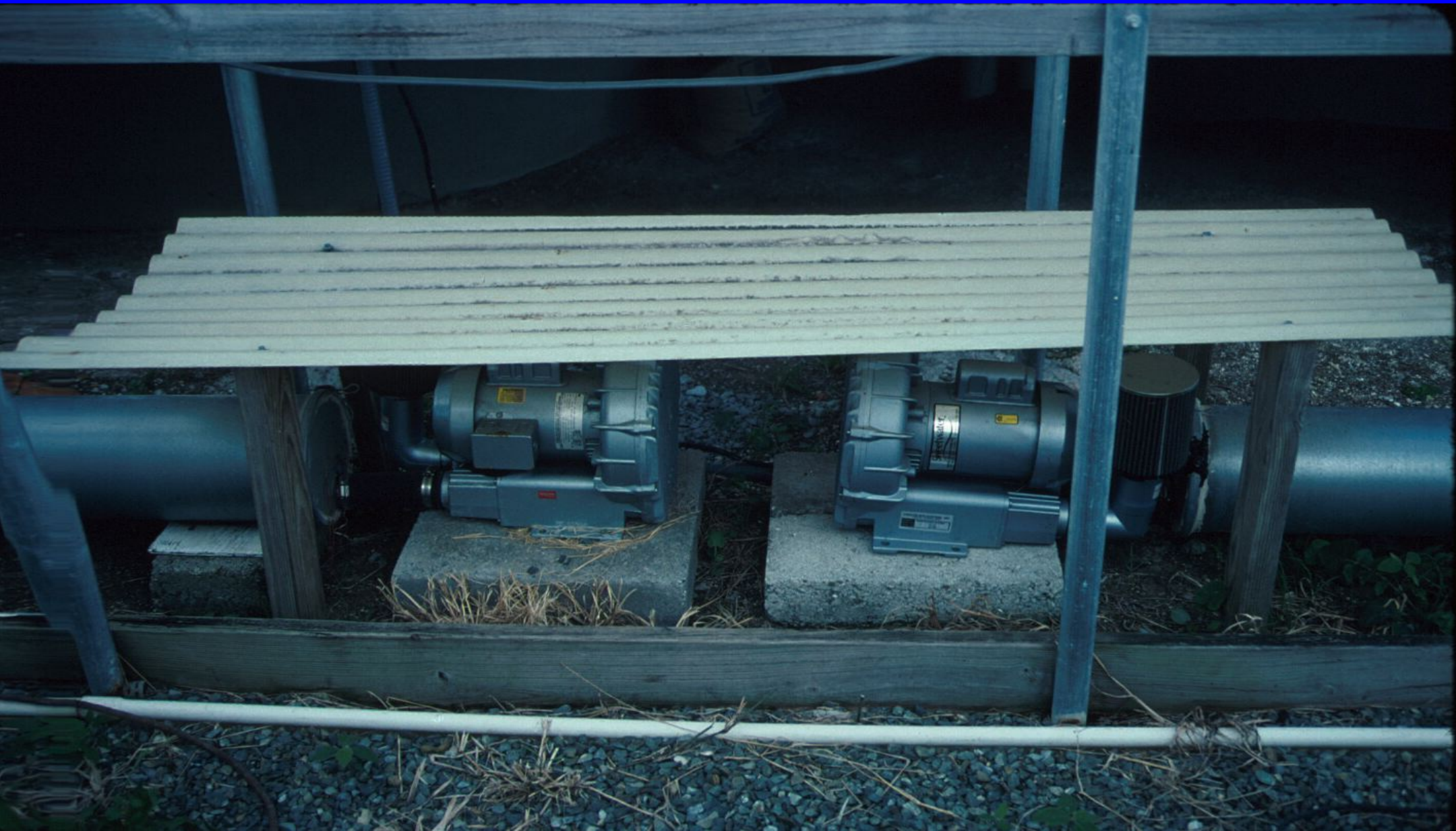


Treatment Processes

- ◆ Aeration: 22 air stones per rearing tank and 24 air stones per hydroponic tank
- ◆ Solids removal: three times daily from clarifier, filter tank cleaning one or two times weekly
- ◆ Denitrification in filter tanks
- ◆ Continuous degassing of methane, CO_2 , H_2S , N_2
- ◆ Direct uptake of ammonia and other nutrient by plants
- ◆ Nitrification in hydroponic tank
- ◆ Retention time: rearing tank, 1.37 h; clarifier, 20 min, hydroponic tanks, 3 h



























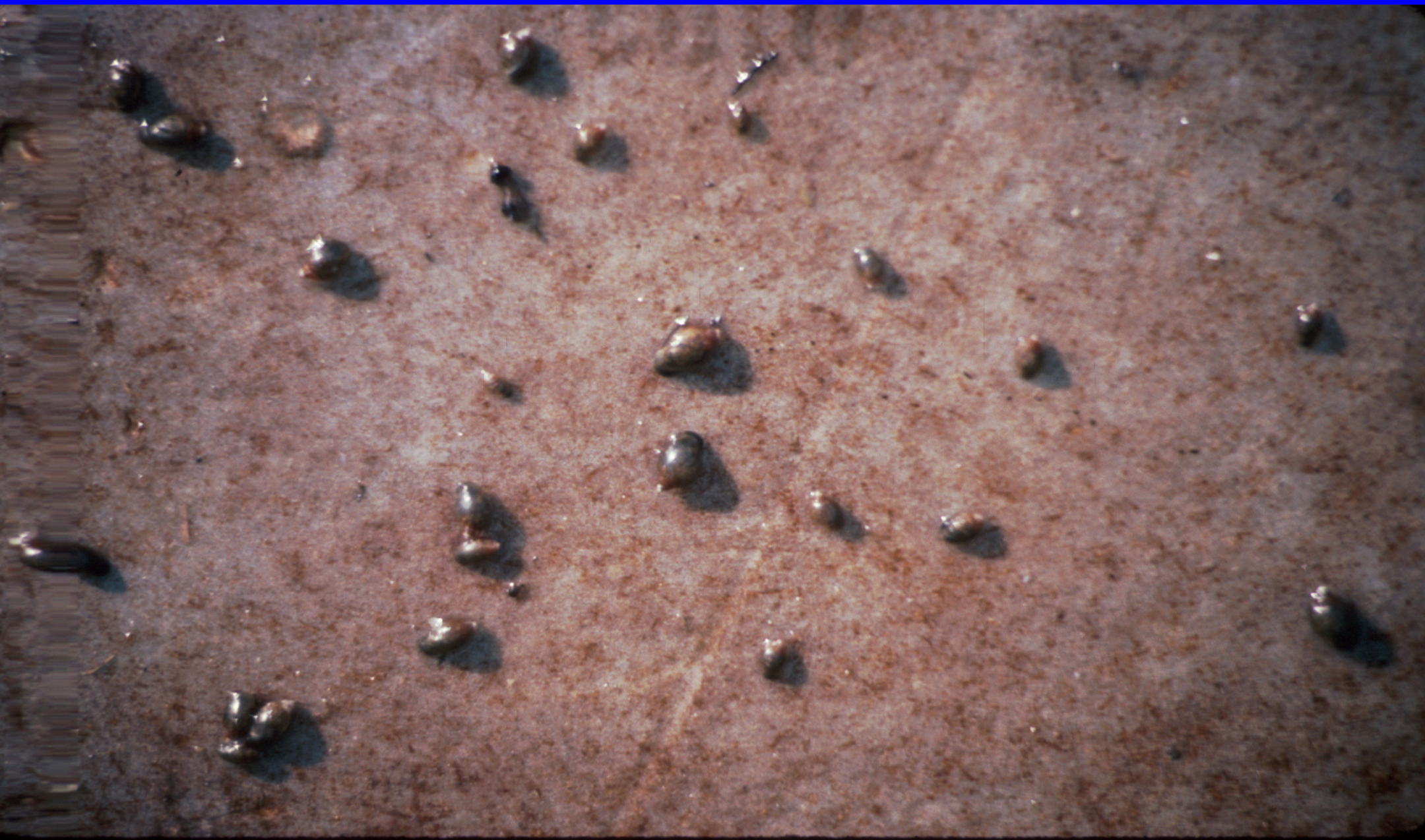






Raft Hydroponics

- ◆ Advantages: no tank size limitation, no root clogging, maximum exposure of roots to water, sheets shade and cool water, plants not affected when water pump stops, easy to harvest
- ◆ Disadvantages: roots and nitrifying bacteria vulnerable to injury or consumption by tilapia, zooplankton, snails, leeches and other organisms (use tetras to control zooplankton and red ear sunfish to control snails and leeches, tilapia must be removed manually)

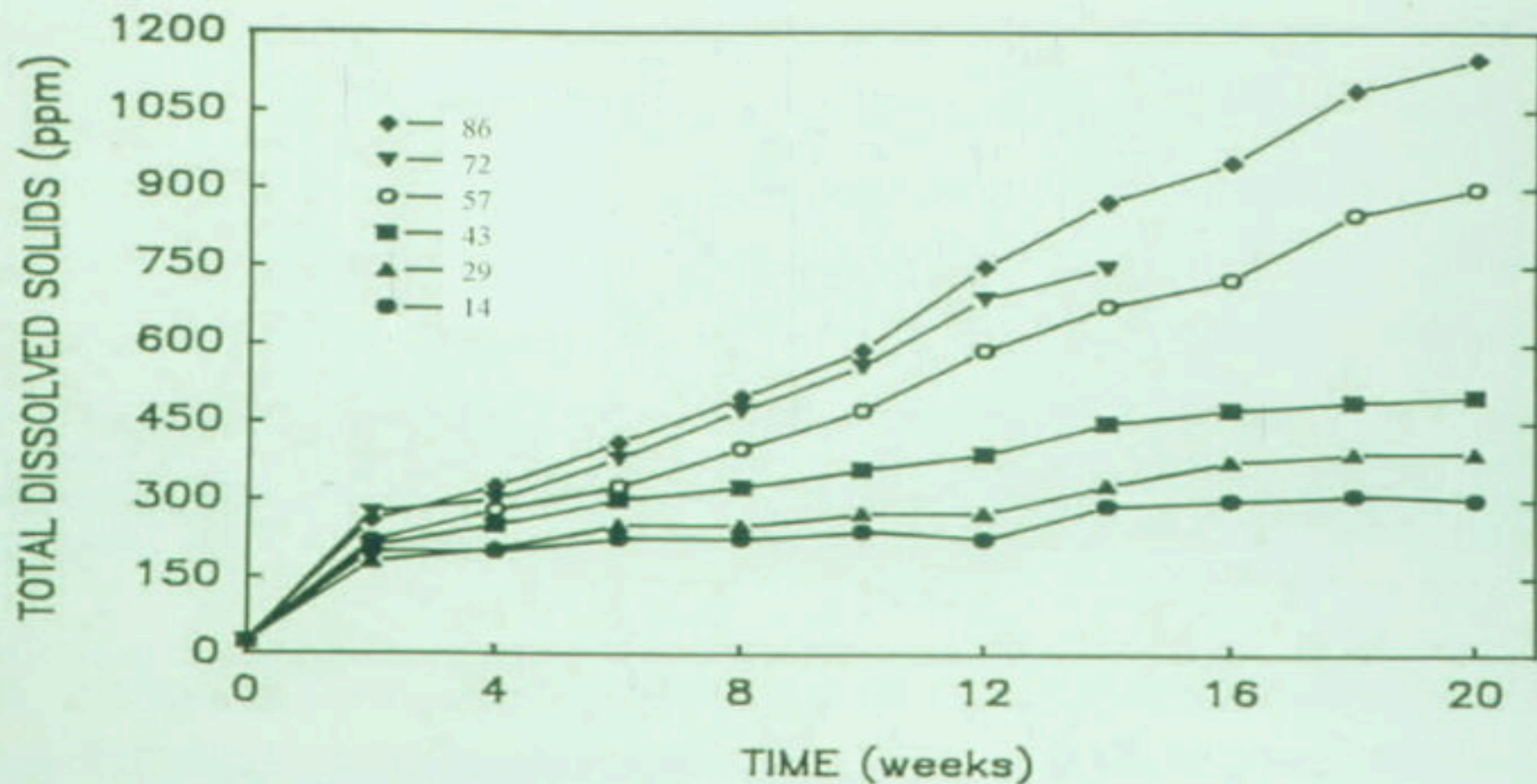




Important Principles

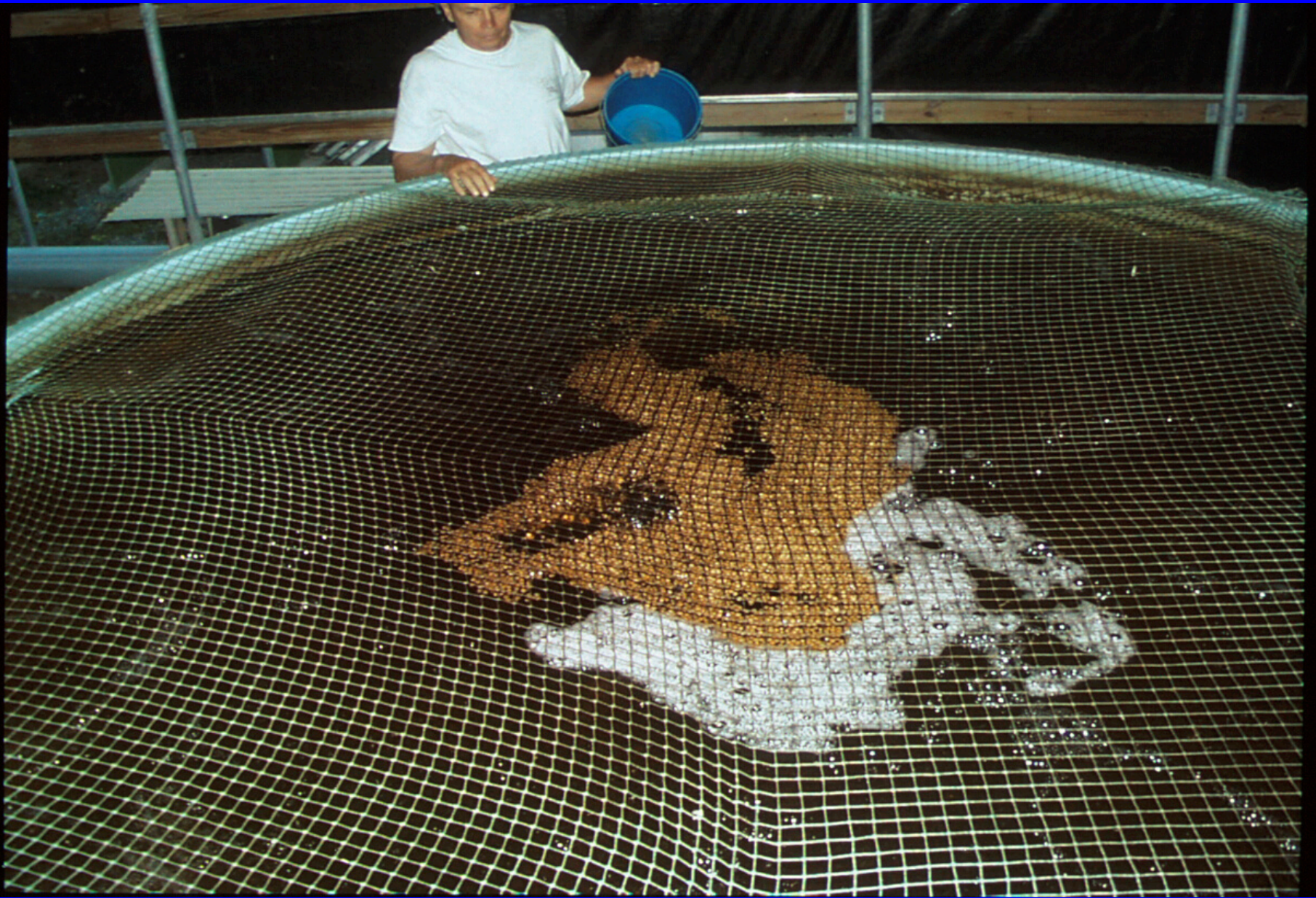
- ◆ Optimum feeding rate, 60 - 100 g/m² plant area/day prevents nutrient accumulation or deficiency
- ◆ Slow removal of solids increases mineralization
- ◆ Frequency of filter tank cleaning controls nitrate levels through denitrification
- ◆ Treatment capacity of hydroponic tanks is equivalent to 180 g of feed/day/m² of plant area

A ccumulation of total dissolved solids at six feeding rates (g/m²/day) using raft hydroponics to produce 18 crops of bibb lettuce.



Production Management

- ◆ Feeding: three times daily *ad libitum*
32% protein, floating, complete diet
- ◆ Stagger fish production, 24 week cycle, harvest every 6 weeks
- ◆ Stagger plant production
- ◆ Use biological insect control
- ◆ Monitor pH daily, maintain pH 7.0 by
alternate and equal additions $\text{Ca}(\text{OH})_2$ and KOH
- ◆ Add chelated iron (2 mg/L) every 3 weeks
- ◆ Add makeup water daily, about 1.5% of system volume
- ◆ Purge fish for 4-5 days before sale







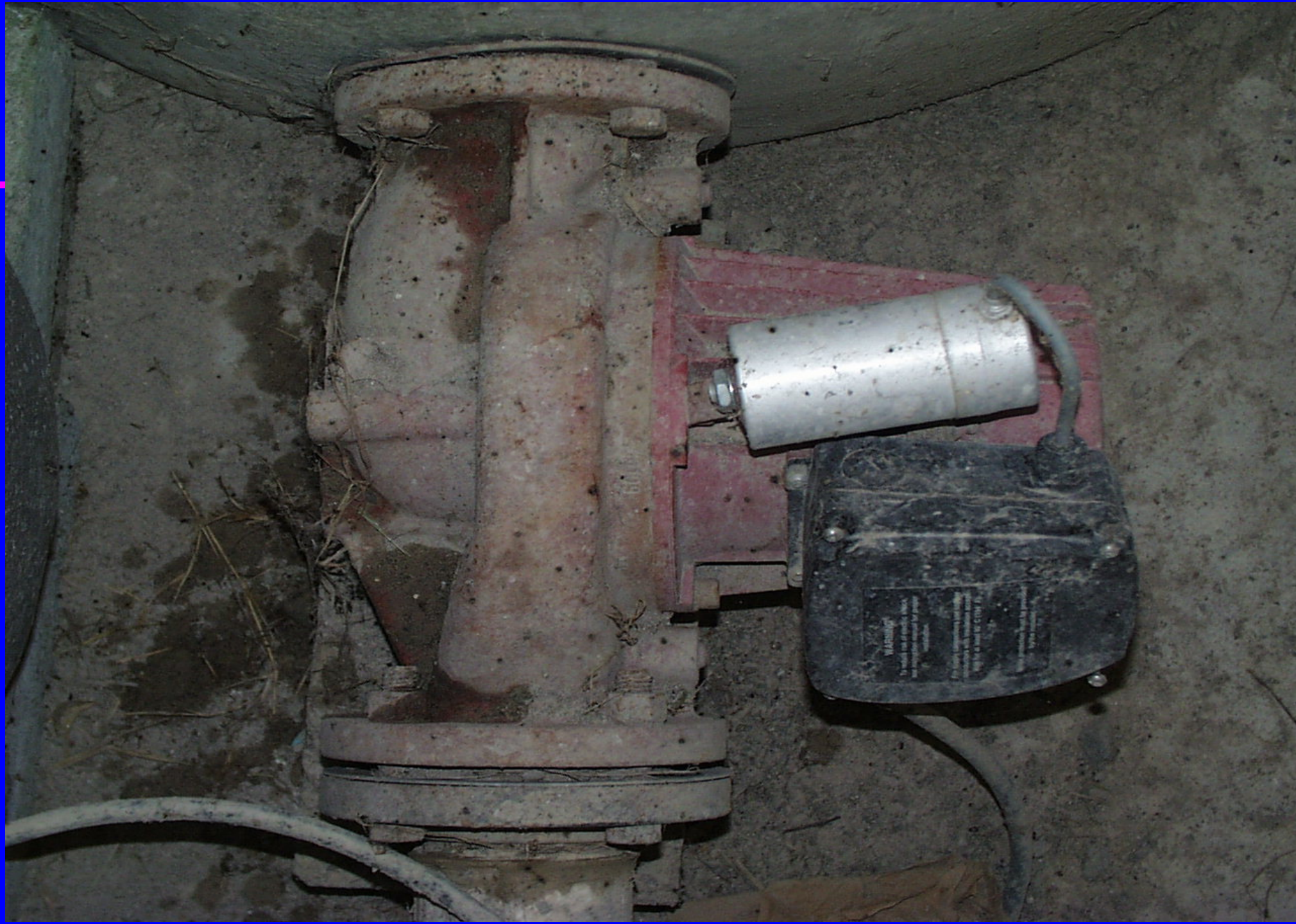












Energy Consumption

- ◆ One blower for fish and degassing, 1.5 hp
- ◆ One blower for hydroponics, 1.0 hp
- ◆ One water pump, 0.5 hp
- ◆ Total energy consumption 3.0 hp

(1 hp = 746 Watts)

Production

- ◆ Tilapia - 5 mt annually , 580 kg every 6 weeks,
160 kg/m³/yr
- ◆ Stocking rate: Niles, 77 fish/m³; reds, 154 fish/m³
- ◆ Leaf lettuce - 1,248 cases annually, 24-30
heads/cs
27 cases/week
- ◆ Basil – 5 mt annually





Fresh, Local Production







































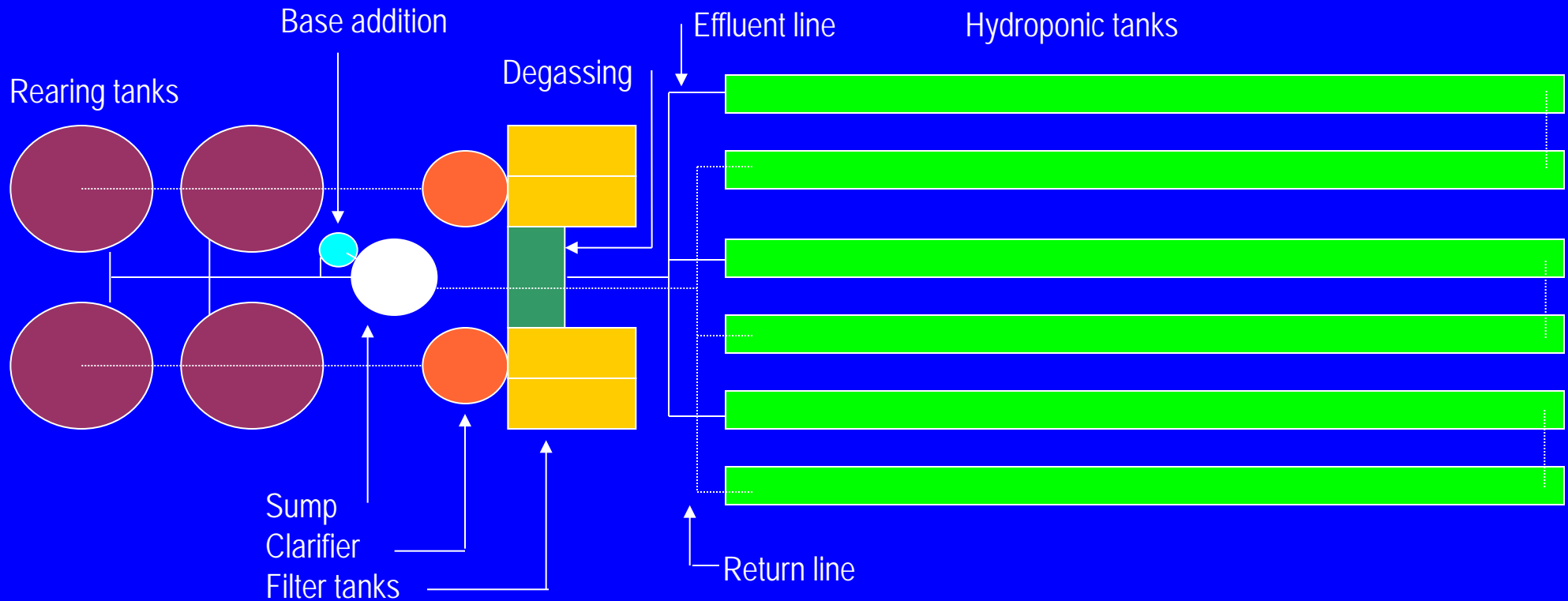








System Layout



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Advantages of Aquaponics

- ◆ Fish provide most nutrients required by plants
- ◆ Plants use nutrients to produce a valuable by-product
- ◆ Hydroponic component serves as a biofilter
- ◆ Hydroponic plants extend water use and reduce discharge to the environment
- ◆ Integrated systems require less water quality monitoring than individual systems
- ◆ Profit potential increased due to free nutrients for plants, lower water requirement, elimination of separate biofilter, less water quality monitoring and shared costs for operation and infrastructure
- ◆ Can be located close to markets in any environment

Perspective on UVI Aquaponic System

- ◆ The system represents appropriate or intermediate technology
- ◆ It conserves water and reuses nutrients
- ◆ The technology can be applied at a subsistence level or commercial scale
- ◆ Production is continuous and sustainable
- ◆ The system is simple, reliable and robust
- ◆ Management is easy if guidelines are followed
- ◆ SRAC 454!

Guiding Principles

- ◆ Use stocking rates and planting densities that produce rapid growth and high yields
- ◆ Manage fish and plants so that nutrient generation and utilization are fairly consistent and in balance
- ◆ Create an excellent environment for both fish and plants
- ◆ Do not push the system to the absolute limit. Instead strive to minimize stress and maximize health of fish, plants and bacteria

Solid Waste

- ◆ The best solid removal devices produce sludge that is 2% dry weight
- ◆ Therefore the wet weight of sludge is 50 times greater
- ◆ For example, 1,000 lbs of fish might produce 250 lbs of dry weight solids, but the wet weight of sludge is 50 times greater or 12,500 lbs (1,500 gallons)
- ◆ Consider this factor when deciding to remove solids from an aquaponic system or leave the solids in the system to decompose.





Questions?



Charlie Shultz

aquaponics@hotmail.com