

A Pilot Aquaponic System Design and Water Quality Analysis

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Tianyu Han (Graduate Research Assistant),
Jiangjun Li (Undergraduate Research Assistant),
Dr. Lubo Liu* (Professor)

Department of Civil and Geomatics Engineering
Lyles College of Engineering
California State University, Fresno

- Introduction
- Objectives
- Methodology
- Results & Discussion
- Future Research

OUTLINE

1. Introduction

Background

- An ecosystem combined of aquaculture and hydroponics
- A promising method for agriculture by balancing the production, energy and environmental impact
- Impressive potential as a sustainable solution to water and nutrient saving and waste treatment

1. Introduction

Dissolved Oxygen

- Monitor and control of water quality is significant for food production
- Water quality will deteriorate obviously by high density of fish
- Dissolved oxygen (DO) is an important water quality parameter and is critical for fish
- DO at least more than 5mg/L

2. Objectives

- To design and build an aquaponic system with a fish tank and a plant growth bed in a pilot scale
- To quantitatively explore the impact of DO aeration method on water quality and the system performance

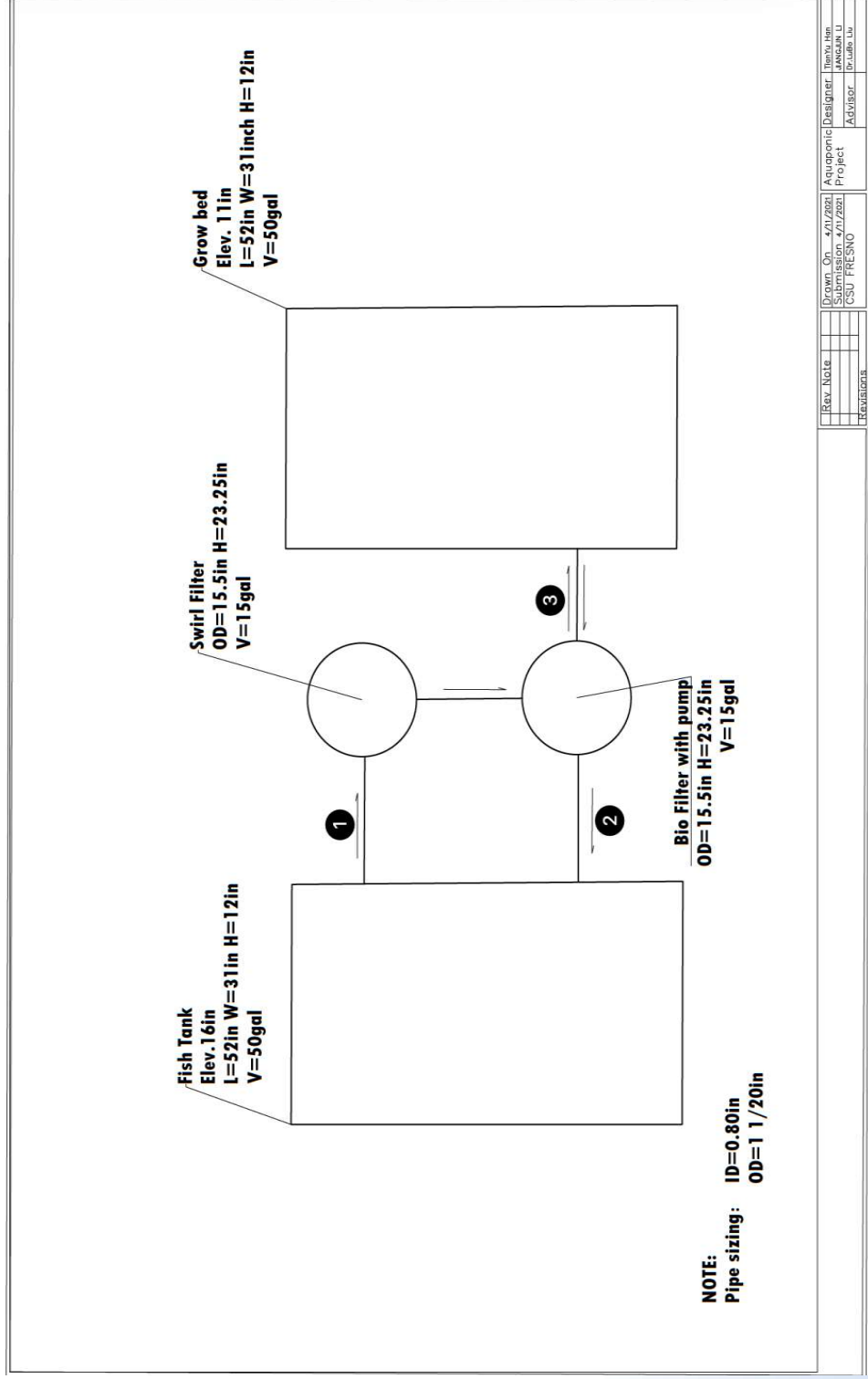
3. Methodology

The system design is based on the concepts of

- Excellent ecological recycling
- Metabolic products in the aquaculture as pollutants, the source of nutrients via microbial conversion
- Pollutants removal by vegetables in the hydroponics section
- Recycled water from the effluent of hydroponics section for aquaculture

3. Methodology

Aquaponic system



Pilot scale aquaponic design diagram

3. Methodology

Aquaponic system



3. Methodology

Fish Tank



Aquaculture (Catfish):

1. An extremely hardy group of fish tolerating wide swings in DO, temperature and pH
2. Air breathers and benthic fish
3. Can be easily stocked at very high densities

3. Methodology

Growth Bed

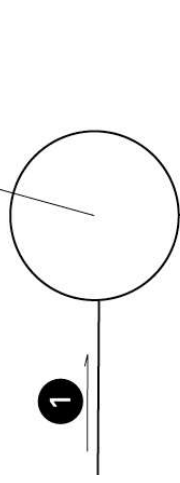


Hydroponics (Lettuce):

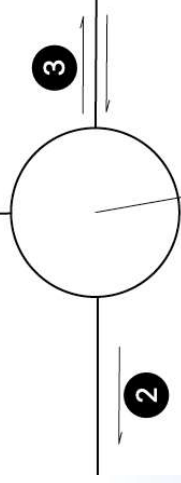
1. Make floating rafts as the growth bed
2. Grow particularly well in aquaponics owing to the optimal nutrient concentrations in the water.

3. Methodology Swirl Filter & Bio Filter

Swirl Filter
OD=15.5in
V=15gal



Bio Filter with pump
OD=15.5in H=23.25in
V=15gal



Swirl filter:

- Force the water to swirl in a circular motion
- Waste will be collected on the bottom

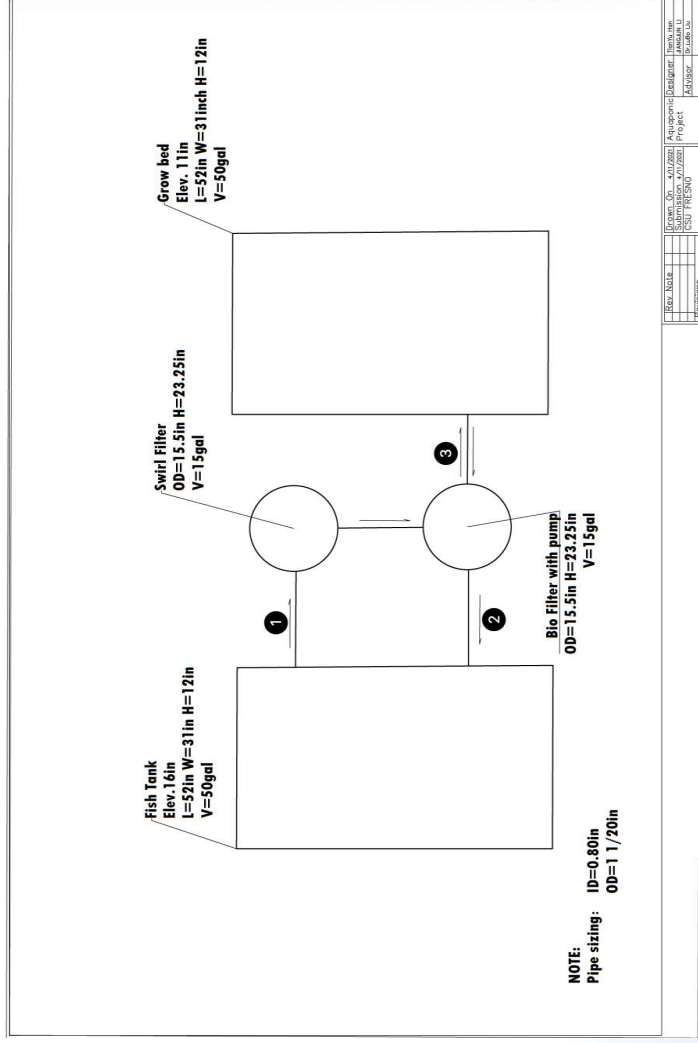
Bio filter (with submersible water pump) :

- Provide a large surface area (bioball) for the bacteria to colonize and transform ammonia (NH_3) into nitrite (NO_2^-) then nitrate (NO_3^-)
- Don't need to do anything to add the bacteria

3. Methodology

Aquaponics Water Flow

- ① Water flows from the fish tank to swirl filter and bio filter by gravity
- ② Water flows from the bio filter to fish tank (80%) and grow bed (20%) by submersible pump
- ③ Water flows back to the bio filter from growth bed



3. Methodology

Aeration Method (To Increase DO Level)



Nano bubble nozzle:

- Stainless steel micro/nano air bubble oxygen nozzle for aquaculture
- Different pore sizes allowing small bubbles to flow through it
- Compare the nano bubble with the traditional aeration method

3. Methodology

Data Collection



- HQd Portable Meter:
pH, DO, Conductivity, TDS
(total dissolved solids),
Ammonia, Temperature
- DO Measurement Range:
0.01 to 20 mg/L (ppm)
- DO Accuracy: ± 0.1 mg/L
(for 0 to 8mg/L)

4. Results & Discussion

- The aquaponic system can operate successfully
- The metabolic products and residues as pollutants in the aquaculture can absorbed eventually by vegetable plants in the hydroponics section as nutrients
- The effluent of growth bed can recycled as clean water for the fish tank section

5. Future Research

- Monitor and collect water quality data
- Quantitatively investigate the influence of different aeration methods
- Compare the growth of plants and fish under different DO concentrations
- Find relationships among DO concentrations, fish production and plant yield

Thank you Questions?

Welcome to your questions or comments.

Please feel free to contact

Tianyu Han via Email: hantianyu@mail.fresnostate.edu

Or Dr. Lubo Liu via Email: llubo@csufresno.edu