

Pond Effluents

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Fisheries Resources Grant Program

Outline

- Brief history of the issue
- Specific challenges
- Characteristics of pond effluents
- Treatment alternatives
- Land application

Pond Effluent Challenges

- Physical
Barriers to water movement.
- Human
Public perception.
- Technical
Hurdles to meeting regulatory standards.

Background of problem

- Homeowners near farms complain of “green” water to Regional Director of Water Quality
- Sampling of discharge from farms found water quality at times exceeded standards (40 $\mu\text{g/L}$ chlorophyll-a and 5 mg/L BOD)

Coastal Effluents : Physical Challenges

- Flat topography of coastal area means low water velocity in receiving streams.
- Water movement mostly driven by wind instead of tides.



Rhodamine Dye Tracer Study



Culvert

Pond Effluents

Rhodamine dye study conclusions:

Less mixing and dilution of effluents than anticipated.

Discharge of effluents causes plug flow in receiving streams.

Little dilution in farm ditches.

Depending on location, effluents take a long time to reach open areas (important for record-keeping).

Pond Effluents: Human Challenges

Demographics of coastal areas changing

- Closer proximity to general population
- Increased scrutiny by public
- Visual properties of effluent water are cause of concern to public
- Pond effluents are visible and traceable.



Technical Challenge

- Large amounts of water required for pond aquaculture
 - 150-200 gal/lb production
- Water use also tied to effluents issue
 - daily water exchange increases discharge and annual drainings triple water use

Characteristics of pond effluents and inflow water

Variable	Castle Hayne well water	Phase II (3 -100 g)	Phase III (100 - 681g)	EPA Effluent Standards for wastewater treatment ¹
BOD (mg/L)	-----	19.20	13.70	30.00
TSS (mg/L)	-----	51.05	82.00	30.00
TP (mg/L as P)	0.68 ²	0.38	0.85	0.17
TN (mg/L as N)	2.30 ²	2.85	5.45	1.77
Chlorophyll-a (ug/L)	-----	112.0	300.0	-----

¹ Schwarz and Boyd 1994

² NCDA&CS Solution Analysis Lab. Sampled from Aurora area.

Characteristics of Effluents

Variable	Fish Pond Effluent	Hog Lagoon Effluent
Total Nitrogen (mg/L)	5.45	899
Total Phosphorus (mg/L)	0.85	163

Hydraulic limitation (fish effluents) instead of nutrient limitation (lagoon effluents)

Not necessarily what is in the water, but the overall amount of water that will drive choice of treatments (water budget).

Annual Farm Water Balance (Specific Challenge)

Month	Rainfall	Pump	Gain	Evap.	Seep.	Loss	Discharge	% Total
JAN	4.3	2.9	7.2	1.9	1.6	3.5	0.0	0%
FEB	3.1	1.2	4.3	2.3	1.6	3.8	2.2	6%
MAR	4.1	1.8	5.9	3.6	1.6	5.1	1.2	4%
APR	3.3	7.7	11.1	4.1	1.6	5.7	3.6	11%
MAY	4.3	7.5	11.8	5.2	1.6	6.7	4.4	13%
JUN	4.6	6.8	11.5	4.2	1.6	5.7	3.6	11%
JUL	5.9	5.3	11.1	5.9	1.6	7.5	6.7	20%
AUG	6.4	4.8	11.1	4.3	1.6	5.9	4.6	14%
SEP	4.6	1.6	6.1	3.7	1.6	5.3	2.2	7%
OCT	3.3	3.9	7.2	1.8	1.6	3.3	2.8	8%
NOV	2.9	5.8	8.7	2.5	1.6	4.0	1.8	5%
DEC	3.4	5.8	9.1	2.1	1.6	3.6	0.6	2%
	50.0	55.1	105.1	41.5	18.6	60.1	33.7	100%

Treatment Alternative

Description

Retain in the same pond

Water is retained on farm post-harvest for subsequent production in the same pond

Retain in different pond

Water is retained on farm post-harvest for subsequent production by pumping to another production pond

Retain/treat in holding basin

Water is pumped post-harvest to specially constructed holding basin and later returned to one of the production ponds for subsequent cycle or discharged once it reaches the standards

Retain/treat in converted pond

Water is pumped post-harvest to specially designated converted pond and later returned to one of the production ponds for subsequent cycle or discharged once it reaches the standards

Chemical treatment

Water is treated in production pond post-harvest with chemicals to meet quality standards prior to discharge

Passive treatment

Water is retained in production pond post-harvest to allow natural processes to bring it to standards prior to discharge

**Artificial wetlands
(100%)**

Water is pumped to specially constructed wetlands where aquatic plants remove nutrients prior to eventual discharge

Artificial wetlands (20%)

Some water (80%) is retained on farm post-harvest by pumping to another production pond. The last 20% of water is pumped to specially constructed wetlands where aquatic plants remove nutrients prior to eventual discharge

Land application

**Terrestrial plants (trees, grasses, etc.) are employed to utilize water and nutrients
(conversion of point-source to non-point source)**

Chemical Treatments

- Evaluated four chemicals (KMnO_4 , H_2O_2 , calcium hypochlorite, CuSO_4) at different concentrations to achieve water quality standards.
- KMnO_4 only chemical able to achieve simultaneous reduction of BOD and Chl-a.
- Polyacrilamide flocculant unable to reduce Chl-a.

Land Application onto Terrestrial Plants



La Paz, LLC Caldwell Co., NC

Land Application onto Trees Evapotranspiration and Percolation



City of Garner, NC wastewater treatment plant

Effluent Volume Considerations

- Average HSB production pond is 3 acres in area and 5 feet deep.
- Approximate pond volume is 5 million gallons.
- Peak farm discharge is between April and October – optimum time for plant growth and evapotranspiration.