

AQUACULTURE INFORMATION SERIES NO. 5

METHODS OF ADMINISTERING TREATMENT CHEMICALS IN WATER

It has been said that treating fish diseases with water-administered chemicals has killed more fish than did the disease being treated. The most common cause of this is overdosing, which is usually the result of inadequate planning.

Descriptions of methods for treating fish with external infections of protozoa, metazoa and bacteria often do not include methods of administering the chemicals in intensively managed systems; i.e., systems having high water flows and fish densities.

All treatments must include a bioassay to establish the proper dose and duration of treatment. The process is quite straightforward. For example, a population of rainbow trout is affected by *Gyrodactylus* and formalin is selected as the chemical to be used. The approach is:

1. Prepare at least three 10-15 liter concentrations of the selected chemical. Measure 10-15 liters of water from the pond to be treated into each of three plastic buckets. The three concentrations of formalin - 1:4,000, 1:5,000, and 1:6,000 - are prepared; i.e., 1 ml:4,000 ml. Provide aeration to each bucket.
2. Place 2-3 clinically ill and 2-3 clinically healthy fish into each bucket. The usual duration of treatment is 60 minutes during which the fish are monitored for signs of toxicity.
3. At the end of the treatment period examine the clinically affected fish for the presence of the organism.
4. The concentration to be administered is that which did not affect the fish negatively and killed the infecting pathogen.

At this point the pond characteristics, the amount of formalin to administer, and the method of administration are considered.

For a 60-minute static bath treatment in a trough or rectangular pond:

1. Calculate water volume

$$V = L * W * D$$

Where: V = water volume (ft³ or m³)
 L = total length (ft or m)
 W = total width (ft or m)
 D = total depth (ft or m)

2. Calculate water volume displaced by fish

$$V_f = W / 1.018$$

Where: V_f = water volume (l) displaced by fish

W = biomass (kg) of fish
1.018 = kg of fish displacing 1.0 l water

3. Calculate amount of required medicament

$$M = ((V - V_f) * R_x)$$

Where: M = grams or ml medicament to be administered

V = total water volume (liters)
V_f = water volume displaced (liters) by fish
R_x = mg/l concentration of medicament required

Example

1. Fish: rainbow trout; 40/lb; 7,5000 lb
Pond: raceway; 100' long; 10' wide; 3' deep
Water: 950 gpm inflow
Medicament: 0.2 ml/l formalin for 60 minutes via static bath method
2. Calculate total water volume
 $100 * 10 * 3 = 3,000 \text{ ft}_3$
 $3,000 * 28.32 = 84,960 \text{ liters}$
3. Calculate water volume displaced by fish:
(1.018 kg fish displace 1.0 liter water)
 $7,500 / 2.2 = 3,401.9 \text{ kg}$
 $3,401.9 / 1.018 = 3,341.7 \text{ liters}$
4. Calculate treatment volume
 $84,960 - 3,341.7 = 81,618.3 \text{ liters}$
5. Calculate the amount of medicament to be delivered
 $0.2 * 81,618.3 / 1000 = 16,323.7 \text{ ml (16.3 liters)}$
6. Shut off the water inflow and provide supplemental aeration
7. Dilute 16.3 l of formalin in 40-50 l water
8. Distribute the solution as evenly as possible through the pond
9. Monitor the pond for signs of toxicity or discomfort for 60 minutes
10. If clinical signs of toxicity occur: (1) pull the sump; (2) start the water inflow; (3) provide additional water.
11. Examine a few fish within 18-24 hours for efficacy.

For a 60-minute drip treatment in a flow-through rectangular pond:

1. Calculate the amount of medicament to be administered:

$$R_{xt} = V_w * R_x * 60$$

Where:

R_{xt}	=	total amount of medicament (ml or mg)
V_w	=	water volume (l) - volume displaced by the fish (l)
R_x	=	dosage (ml/l or mg/l)
60	=	minutes per hour

Example

- a. Fish: rainbow trout; 40/lb; 7,500 lb
Pond: raceway; 100; long; 10' wide; 3' deep
Water: 950 gpm inflow
Medicament: 0.2 ml/l formalin for 60 minutes via continuous drip
- b. Calculate the water volume (liters) to be treated:
Total water volume: $3,000 \text{ ft}^3 \times 28.32 = 84,960$ liters
Water volume displaced by fish: 3,341.7 liters
 $84,960 - 3,341.7 = 81,618.3$ liters to be treated
- c. Calculate the amount of medicament required
 $81,618.3 * 0.2 = 16,323.7$ ml
 $16,323.7 / 60 = \underline{272 \text{ ml/minute}}$
- d. Dilute 16.3 liters of formalin to 60 liters of water.
- e. Set up the drip container to deliver 1.0 lpm
- f. Initiate the treatment
- g. Monitor the progress; i.e., signs of toxicity, at 10-15 minute intervals
- h. Discontinue treatment if signs of toxicity appear.
- i. Examine 2-3 fish 18-24 hours after treatment to evaluate efficacy.
- j. Re-treat if necessary.

For a 60-minute drip treatment in ponds having circulating water patterns:

1. Calculate the water volume:

Square-end (Burrows) pond

$$V = (L * W * D) - (L_w * T_w * D_w)$$

Where: V = water volume (ft³ or m³)
 L = total length (ft or m)
 W = total width (ft or m)
 D = total depth (ft or m)
 L_w = length of center wall (ft or m)
 T_w = thickness of center wall (ft or m)
 D_w = depth of center wall (ft or m)

Round-end pond

$$V = ((3.1415927 * R^2 * D) + (L * W * D)) - (L_w * T_w * D_w)$$

Where: V = water volume (ft³ or m³)
 R = radius of the D-end (ft or m)
 D = water depth of the D-end (ft or m)
 L = length of the rectangular portion (ft or m)
 W = width of the rectangular portion (ft or m)
 D = depth of the rectangular portion (ft or m)
 L_w = length of center wall (ft or m)
 T_w = thickness of center wall (ft or m)
 D_w = depth of center wall (ft or m)

Circular pond

$$V = 3.1415927 * R^2 * D$$

Where: V = water volume (ft³ or m³)
 R = radius (ft or m)
 D = depth (ft or m)

2. Calculate the medicament depletion time:

Rectangular ponds

$$T_d = ((-V / R_w) * \ln 0.5) / 60$$

Where: T_d = 50% medicament depletion time (minutes)
 V = water volume (ft³ or m³)
 R_w = water inflow (cfs or m³ps)
 0.5 = percent (10⁻²) reduction of medicament
 60 = seconds per minute

Circular ponds:

$$T_d = ((-V / R_w) * (\ln 0.5 / 1.830)) / 60$$

Where: T_d = 50% medicament depletion time (minutes)
 V = water volume (ft³ or m³)
 R_w = water inflow (cfs or m³/ps)
0.5 = percent (10⁻²) reduction of medicament
60 = seconds per minute
1.830 = mixing coefficient

Example

- a. Fish: rainbow trout; 5/lb; 20,100 lb
Pond: rectangular circulating D-end; 100' over-all; 20' wide; 3' deep; center wall 90' long; 1' thick
Water: 500 gpm inflow
Medicament: 0.2 ml/l formalin constant exposure for 60 minutes

- b. Calculate total water volume.

$$((3.1415927 * 10^2 * 3) + (20 * 80 * 3)) - (90 * 3) \\ = (942.48 + 4,800) - 360 = 5,382.48 \text{ ft}^3$$

$$5,382.48 * 28.32 = 152,431.83 \text{ liters}$$

- c. Calculate the water displaced by the fish.

$$20,100 \text{ lb} = 9,117.2 \text{ kg}$$

$$9,117.2 / 1.018 = 8,956.0 \text{ liters}$$

- d. Calculate the treatment volume.

$$152431.83 - 8,956.0 = 143,475.8 \text{ liters}$$

$$143,475.8 / 1000 = 143.5 \text{ m}^3$$

- e. Calculate the amount of medicament required for the initial dose.

$$143,475.8 * 0.2 = 28,695.2 \text{ ml}$$

- f. Calculate the 50% depletion time of the medicament.

$$((-143.5 / 0.0316) * -0.693) / 60 = 52.45 \text{ minutes}$$

- g. Calculate the amount of medicament discharged per minute (50% of the required dose / minutes required for depletion = dosage to be administered per minute).

$$14,347.6 / 52.45 = 273.5 \text{ ml}$$

- h. Calculate the amount of medicament discharged in 60 minutes (equal to the total dose to be administered).

$$273.5 * 60 = 16,412.8 \text{ ml}$$

- i. Dilute the 28.7 l of the medicament in 40-50 liters of water.
- j. Distribute the medicament solution as evenly as possible throughout the pond.
- k. Dilute 16.4 l of the medicament in 60 liters of water for drip delivery at the rate of 1.0 lpm
- l. Monitor the progress; i.e., signs of toxicity, at 10-15 minute intervals.
- m. Discontinue the treatment if signs of toxicity appear.
- n. Examine 2-3 fish 18-24 hours after treatment to evaluate efficacy and re-treat if necessary.

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