Bio-Security Module BSM10:

OSTRICH DRINKING WATER TREATMENT
(Version 3.3: February 2012)

OBJECTIVE

To provide prescriptive guidance on the treatment of drinking water and maintenance of drinking water systems for ostriches. This BSM10 should be used in conjunction with BSM11: Ostrich Drinking Water Monitoring

DRINKING WATER TREATMENT

The water quality criteria specified are pH, suspended solids and free chlorine as all three of these are related to the efficiency of disinfection.

1. The drinking water source must be treated and must comply with the following water quality criteria after treatment:
   - Suspended solids < 5mg/l
   - pH: 6.0 - 7.6
   - Free chlorine: 2 - 4 mg/l
2. All drinking water, irrespective of its source, must comply with the following water quality criteria in the drinking water trough located at the closest and furthest end of the drinking water distribution system:
   - Suspended solids < 5mg/l
   - pH: 6.0 - 7.6
   - Free chlorine: > 0.5 mg/l

   NOTE: An exception may be made with regard to free chlorine for ostrich chicks in the age group day-old to 8 weeks as it may be necessary to slowly acclimatize ostrich chicks to the chlorinated water.
3. The water treatment must be implemented in the following sequence: suspended solids removal, then pH adjustment, then disinfection with chlorine.
4. Suspended solids removal can be done with normal sand filters and pH adjustment can be done by dosing normal pool acid (hydrochloric acid) or other acids such as sulphuric acid.
5. The initial treatment of the source water with chlorine must be done at a point that ensures a minimum of 30 minutes contact time between the chlorine dosing point and the closest drinking water trough at peak hourly consumption rate. The practice of hanging a container with chlorine tablets under the valve in the drinking trough is only appropriate to serve as booster dose of chlorine.
6. If normal irrigation water is used for drinking water, then the water treatment must be applied after the off-take from the irrigation pipeline.
7. The pH and disinfection dosing system should be applied in the following manner:
   - as a batch dosing system to a sealed tank which is then properly mixed and allowed to stand for at least 30 minutes before use; or
   - as an in-line dosing system at a point sufficiently upstream of the closest drinking water trough to allow for the 30 minutes contact time and in a manner where dosing rate is proportional to the flow rate through the system to ensure compliance with the water quality standards at all times, regardless of drinking water consumption rate.
8. An alternative disinfectant to chlorine may be used, provided that its efficacy as a disinfectant can be demonstrated and provided that there is a reliable procedure available for accurate on-farm testing of the concentration of the applied alternative disinfectant.
9. Drinking water distribution systems (including reservoirs) must be cleaned with a shock dose of chlorine or an approved biocide at least once every 6 months in order to ensure that biological growth in pipelines and reservoirs is prevented. Appropriate measures must be implemented during such shock dosing to ensure that such water cannot be consumed by ostriches, other livestock or humans.

DRINKING WATER SYSTEMS

This BSM applies to all ostrich farms irrespective of source of the drinking water.

10. Wherever possible, drinking water should be obtained from a source other than an open water body.
11. All drinking water provided to ostriches must be delivered to the point of drinking by way of closed, pressure pipelines or directly from closed tanks.
12. No ostriches may be permitted to be able to source drinking water directly from open water bodies such as dams or ponds and such open water bodies must be fenced off with a fence that is at least 3m away from the high water level of the water body in question.
13. Water supply should be capable of providing water at an average rate of at least 2.5 litres per kg/day dry feed intake for ostriches kept in feedlots.
14. Peak consumption rate (for the purpose of designing the water treatment system) should be calculated on the assumption that ostriches may drink 80% of their daily water intake over a 4-hour period. This implies that peak hourly water demand, for which the water treatment system should be designed, should be calculated as being equivalent to 20% of the total daily water intake.

This Bio-Security Module BSM10: Ostrich Drinking Water Treatment (Version 3.3: February 2012) is enforceable in terms of Veterinary Procedural Notice VPN04 and has been approved by the Director: Animal Health, Department of Agriculture, Forestry and Fisheries, South Africa

15. Drinking water troughs must be designed such that wild water birds cannot perch on the sides to drink from the trough and cannot swim within the trough. Drinking water troughs must be thoroughly cleaned and emptied a minimum of once per week.
16. Where drinking water is supplied in pipelines, a flow meter could be fitted to enable the rate of water consumption to be measured in order that system residence time can be calculated and compliance with the 30 minutes residence time can be determined.
17. Reservoirs used for storage of drinking water after its treatment must be sealed to prevent access by animals, birds and particulate matter and to prevent growth of algae and must be regularly inspected to ensure that they contain clean drinking water that complies with the water quality standards set out in this operational module.

USEFUL INFORMATION

Some useful information is provided on the microbiological contaminants that the water treatment programme is intended to address. Information is also provided on the volumes of different pipelines that could be used to convey drinking water, for use in calculating whether or not the 30 minutes minimum contact time for chlorine is obtained.

INFORMATION RELATING TO DISINFECTION

Table 1: Properties of microbiological water contaminants

Determinand	Properties
Enterobacteria	Enterobacteria are used as an indicator of faecal pollution
E. coli	E coli counts are used as an indication of overall bacteriological quality and to establish the efficacy of disinfection procedures
Coliphages	Coliphages are used as an indicator of viral pollution
Standard plate count	This is a measure of the total viable aerobic microorganisms in the water sample
Streptococci, faecal	Faecal streptococci are one of the bacterial types found in faeces. The ratio of faecal streptococci (Fs) to faecal coliform bacteria (Fc) is indicative of the origin of the faecal pollution. A Fc/Fs ratio of > 4,0 is indicative of human faecal pollution, while a Fc/Fs ratio of < 0,6 is indicative of animal faecal pollution

Table 2: Characteristics of chlorine-based disinfectants

Characteristic	Ideal	Chlorine gas	Sodium hypochlorite	Calcium hypochlorite
Toxicity to microorganisms	Highly toxic at low conc.	High	High	High
Toxicity to man	Non-toxic	Highly toxic	Toxic	Toxic
Solubility	Soluble in water	Slight	High	High
Stability	Effective after storage	Stable	Unstable	Stable
Interaction with ammonia	Should not interact	Strong interaction	Strong interaction	Strong interaction
Penetration	Must penetrate scale	High	High	High
Corrosivity	Should not corrode metals	Highly corrosive	Corrosive	Corrosive
Availability	Available in large quantities and low cost	Low cost	Moderately low cost	Moderately low cost
Handling	Safe to handle	High hazard	Medium hazard	Medium hazard

The common chlorine compounds form hypochlorous acid on reaction with water. The hypochlorous acid (HOCl) is in equilibrium with the hypochlorite (OCl^-) ion, and the equilibrium changes with pH as shown in the Table below.

Table 3: Effect of pH on chlorine disinfection efficiency

pH	5	6	7	8	9	10
%HOCl	100	93	70	22	4	0
$\%OCl^-$	0	7	30	78	96	100

The pH is important because the HOCl has a disinfection power 40 - 80 times higher than OCl^-. This is why BSM10 includes a water quality specification for pH.

INFORMATION RELATING TO PIPE SYSTEMS

Pipe volumes per m of pipe have been calculated for the different types of pipes typically used on farms, and using information for maximum wall thickness for all external diameter pipes. NOTE: Internal diameter pipes are connected using fittings that push into the pipe, while external diameter pipes are connected using fittings that fit around the outside of the pipe.

Table 4: Pipe volumes for LDPE internal diameter pipes (litres/m pipe)

15mm	20mm	25mm	32mm	40mm	50mm	65mm	80mm
0.2	0.3	0.5	0.8	1.25	2	3.3	5

Table 5: Pipe volumes for HDPE Type 4 external diameter pipes (litres/m pipe)

Class	20mm	25mm	32mm	40mm	50mm	63mm	75mm	90mm	110mm
6	0.18	0.3	0.58	0.92	1.45	2.31	3.28	4.73	7.09
10	0.18	0.3	0.5	0.77	1.22	1.95	2.77	4.0	6.03
12	0.16	0.26	0.42	0.69	1.09	1.75	2.46	3.59	5.59
16	0.14	0.22	0.37	0.58	0.93	1.48	2.09	3.02	4.54

Table 6: Pipe volumes for uPVC pipes (litres/m pipe)

Class	20mm	25mm	32mm	40mm	50mm	63mm	75mm	90mm	110mm
4	-	-	-	-	1.71	2.79	4.03	5.80	8.67
6	-	-	-	1.05	1.66	2.71	3.86	5.54	8.52
9	-	-	0.64	1.02	1.59	2.55	3.61	5.19	8.05
12	-	0.37	0.61	0.95	1.5	2.37	3.36	4.85	7.63
16	0.22	0.34	0.56	0.86	1.36	2.16	3.06	4.42	7.09

PRACTICAL EXAMPLE

The design of the drinking water treatment system can be undertaken by the farmer himself or with assistance from specialists. The key parameters in designing the disinfection system (after filtration and pH adjustment) is to determine whether or not the specified 30 minutes contact time are provided between dosing of chlorine and the closest drinking water trough. This could be determined as shown for the following hypothetical example.

- Maximum daily feed supplied to ostriches: 10000 kg
- Therefore design daily flow rate for chlorination system (in accordance with paragraphs 4 & 5 above): 10000 kg x 2.5 litres/kg = 25000 litres/day
- Maximum hourly flow rate: 25000 l/day x 20% = 5000 l/hr
- Maximum 30 minute flow = 2500 l/hr, therefore volume of drinking water system between chlorine dosing point and nearest drinking water trough must be 2500 litres.
- Dosing system must be capable of dosing 25000 l/day at up to 4mg/l = 100 grams/day of chlorine at a peak dosing rate of 20 grams/hour
- If we assume that distance between proposed chlorine dosing point and nearest drinking water trough is 300m, containing 200m of 40mm HDPE Class 6 pipe and 100m of 20mm HDPE Class 6 pipe, then the volume of the pipeline can be calculated as follows, using the data in Table 5 above:
  - 200m of 40mm HDPE Class 6 pipe: 200m x 0.92 l/m = 184 litres
  - 100m of 20mm HDPE Class 6 pipe: 100m x 0.18 l/m = 18 litres
  - Total volume of pipeline = 184 + 18 = 202 litres
- Required volume for 30 minutes contact time at peak flow rate = 2500 litres, therefore shortfall on system volume is 2298 litres and either the chlorine dosing point must be moved backwards, or a storage tank of at least 2300 litres must be installed directly after the chlorine dosing point.
- Monthly dosage of free chlorine = 100 grams/day x 30 days = 3 kg/month. If, for example, use is made of a 12% sodium hypochlorite solution with an available chlorine concentration of 120 g/l, then the farm will need to dose this at a rate of 25 l/month.