SUMMARY:
Minimum Concentration Determination of VIPROBAC a Copper/Zinc Biocide
(5minute contact time)

Author: Prof T. E. Cloete, MSc (UFS), DSc (UP), DSc (US)

Objective:
To determine the minimum effective concentration of a copper/zinc biocide on two water samples: Raw Dam Water and Before Wetland water.

Key Findings:

1. **Bacterial Load Without Biocide:**
   - Raw Dam Water: 5,100 bacteria/ml.
   - Before Wetland: 24,800 bacteria/ml (significantly higher).
2. **Biocide Effectiveness:**
   - **1/10 Dilution:** Achieved 100% bacterial kill in both samples.
   - **1/100 Dilution:**
     - Raw Dam Water: 95.7% kill.
     - Before Wetland: 98.3% kill.
   - **1/1000 Dilution:**
     - Raw Dam Water: 88.8% kill.
     - Before Wetland: 97.1% kill.
   - *Dilutions beyond 1/1000 were ineffective within 5 minutes – to contact extended contact time test)* .
3. **Impact of Biocide:**
   - The biocide was most effective up to a 1/1000 dilution with a 5-minute contact time.
   - Higher bacterial loads in the Before Wetland sample required slightly higher concentrations for effective bacterial reduction.

Conclusions:

- The biocide effectively reduced bacterial numbers in both samples up to a 1/1000 dilution.
- The Before Wetland sample had a significantly higher bacterial load, highlighting the wetland's role in bacterial reduction.

Recommendations:

1. Conduct additional tests to optimize the biocide dosing concentration and contact time.
2. Extend contact time to potentially improve the biocide's effectiveness.

SUMMARY:

Efficacy Test of VIPROBAC a Copper/Zinc Biocide with extended contact time

(1.5hour contact time)

Author: Prof T. E. Cloete, MSc (UFS), DSc (UP), DSc (US)

Abstract:
Copper, recognized for its antimicrobial effects, demonstrates potential as a disinfectant for treated wastewater by disrupting microbial membranes. This study evaluated its efficacy by measuring reductions in coliforms, *Escherichia coli*, and heterotrophic bacteria.

Introduction:

Disinfection of treated wastewater is essential for public health and environmental safety. Traditional disinfectants, such as chlorine, face challenges due to the formation of harmful disinfection by-products (DBPs). Copper, a sustainable and environmentally friendly alternative, has gained attention for its antimicrobial properties and minimal DBP formation.

Mechanism of Action:

Copper ions disrupt microbial cell membranes, cause enzyme dysfunction, and generate reactive oxygen species (ROS), leading to oxidative damage and cell death. Copper's multi-mechanism approach makes it effective against bacteria, viruses, and protozoa while minimizing resistance development.

Advantages of Copper:

1. **Broad-Spectrum Efficacy**: Effective against a wide range of pathogens, including chlorine-resistant microorganisms.
2. **Environmentally Friendly Residues**: Non-toxic residues provide ongoing microbial suppression.
3. **Chemical Stability**: Does not produce harmful DBPs.
4. **Sustainability**: Naturally occurring and reusable, supporting circular economy principles.

Environmental and Regulatory Considerations:

Copper concentrations in treated wastewater must comply with EPA and EU regulations to prevent bioaccumulation. Strategies like controlled dosing and regular monitoring can mitigate environmental risks.

Objectives:

This study aimed to assess the disinfection efficacy of copper on treated sewage effluent, specifically focusing on reductions in coliforms, *E. coli*, and heterotrophic bacteria.

Results:

Table 1: Efficacy of Copper at 150 ppm (1.5h contact time)

Parameter	Initial Count	After Treatment	Reduction (%)
HPC/ml	5,050	460	90.9%
Coliforms/100ml	50,000	450	99.1%
E. coli/100ml	22,000	220	99.0%

- The 150-ppm dose resulted in significant microbial reductions, achieving nearly complete elimination of coliforms and *E. coli*.
- The heterotrophic plate count (HPC) also saw a substantial 90.9% reduction, demonstrating the biocide's broad efficacy.

Conclusion:

VIPROBAC - Copper is a promising alternative disinfectant for treated wastewater, offering reduced DBPs, strong antimicrobial efficacy, and environmental sustainability.