ELECTROCHEMICALLY ACTIVATED WATER FOR THE FOOD & BEVERAGE INDUSTRY

Philip Nel
Executive Manager - Technical and R&D
Agenda

- Water – facts and figures
- Radical Waters – The Company
- What is ECA?
- How does it work?
- Anolyte
- Catholyte
- Applications
  - Biofilm
  - CIP
  - Other applications
- Summary and Conclusion
• Water Facts Video -
  https://www.youtube.com/watch?v=zNdbj3PbX6o
**Challenges & the future**

**WATER**

- **48 Countries**
  "Within 15 years, 48 Countries will be unable to meet their basic water requirements."
  - CNBC "Liquid Assets: The Big Business Of Water"

- **50% of the world’s population**
  Currently, 11 countries totaling almost 1/2 the world’s population (including the U.S., India and China) have a negative groundwater balance; meaning they use more water than is naturally replenished.

- **66% of the world’s population**
  It is estimated that by 2025, two-thirds of the world’s population will face water scarcity.

- **40% increase in water demand**
  In February 2012, the U.S. Intelligence Community Assessment of Global Water Security predicted that by 2030 annual global water requirements will exceed current sustainable water supplies by 40%.

- **9 Countries in Europe**
  Nine countries in Europe are in the beginning stages of a water shortfall.
POPULATION

World population (billions)

Year

www.futuretimeline.net
HOW CAN INDUSTRY MAKE A DIFFERENCE?
“Radical Waters address hygiene needs, taking into account key sustainability issues, which are of critical importance to any eco-conscious F&B producer”

- Water
- Energy
- Chemical Free
Who
Is Radical Waters?

ECA: Not just for Beverage Producers

Radical Waters is the pioneering ECA supplier to the beverage market with installations in 23 countries around the world. While the company continues to
The Natural Hygiene Solution
Radical Waters

- Radical Waters ECA technology replaces traditional chemicals.
- Radical Waters (Pty) Ltd has spent 17 years focussing on developing and commercialising its patented green ECA hygiene technology.
- South African based & operated, owned by a major USA-based Shareholder.
- Patent Portfolio covering many areas of hygiene and health applications.
Innovative Leaders in ECA Technology
Green ECA Hygiene?

• Pioneers of the ECA Cleaning-Place application, that was accepted by the beverage market in 2007 and has aided them in achieving:
  
  – *Process Water Savings* – *Environment*
  
  – *Energy Savings* – *Environment*
  
  – *Chemical Savings* – 100% - *Environment*
  
  – *Zero Residues on products* – *Natural and Safe* – People & *Environment*

• ECA hygiene devices on 6 continents in 26 countries primarily for food & beverage companies around the world.
What is ECA Technology

Electrochemically Activated Water

• Innovative technology - converting Brine into an environmentally friendly disinfectant and cleaning agent

• Anolyte = Disinfectant

• Catholyte = Detergent
Reactor Development

Fundamentals of Commercial Electrolysis:

- Saturated brine
- High energy
- Concentrated chlorine gas production
- Limited separability of ECA solutions
- High concentration of gas evolution (Chlorine & Hydrogen)
ECA Electrolysis

- Minimum Brine concentration
- Minimum power regime
- Maximum separability of ECA solutions
- Minimal gas evolution
**How Does it work?**

- Dilute brine flows into the reactor.
- Electrical current applied.
- Transfer of electrons
- Two streams formed
  - Anolyte
  - Catholyte

Anolyte (+ve)  Catholyte (-ve)

Brine In
Anolyte Disinfectant

- Carries a positive charge
- Oxidizing solution (ORP < +1000mV)
- pH range 2.0 to 9.0 - different radical species
- Microbiocidal – disinfectant/sterilant
- Eliminates microbes “electrically”
- No resistance capacity
- Diverse range of disinfecting applications
- Range of natural mixed oxidants and radicals
- Hypochlorous Acid (HOCl), Chlorine Dioxide (ClO₂), Ozone (O₃), Hydrogen Peroxide (H₂O₂), Hypochlorite (OCl⁻)
Radical Waters pH
Why we prefer Neutral
Efficacy

Anolyte

• Anolyte (hypochlorous acid) is up to 300 times more effective than Sodium Hypochlorite (Bleach)
• Broad Microbiocidal capacity – bacteria, mycobacteria, viruses, fungi, moulds, bacterial and fungal spores, microbial toxins and protozoa.
• Eliminates Biofilm and prevents re-growth
• Enhanced surface activity results in decreased contact time and hence greater disinfectant properties
• Low dosages required to achieve anti-microbial effect.
• Eliminates microbes “electrically”
• Use Redox potential to predict the antimicrobial activity.
• Cold sterilant
Mechanism

Oxidation/Anolyte

- The Anolyte water molecule (high +ve ORP) scavenges the electrons from the microbe surface.
- Alters the cell wall structure (proteins)
- Ineffective cell regulation
- Resulting in cell death through leakage and eventual lysis.
- Dual mechanism – secondary effect of HOCL
Catholyte Detergent

- Carries a negative charge
- Reducing solution (excess of electrons)
- Potent anti-oxidant (ORP> -900mV)
- pH 10 to 12
- Surface Active Properties:
  - Cleaning – emulsification, saponification, peptisation.
  - De-agglomeration
  - Sedimentation
  - Flocculation
- Sodium Hydroxide (NaOH), Hydroxide (OH-), Hydrogen (H2), Hydroxyl (HO2-)
ECA
General Information

- Anolyte & Catholyte are generic terms
- Anolyte = any solution originating from exposure to Anode
- Catholyte = any solution originating from exposure to Cathode
- ECA solutions from different providers will be different
- HYDRAULIC CONFIGURATION is specific & unique to Radical Waters
- Generates
  - pH 6.5 - 7 Anolyte,
  - pH 11 Catholyte
  - 70:30 ratio or 50:50 option
The ECA industrial Generator

- Electrical enclosure (left)
- Hydraulic (right)
- Scalable to suite application
- Low Chlorides
- Robust
- S&M Contract
Applications

ECA

Numerous applications to add value and address challenges

- Possible applications
  - Biofilm removal application
  - Cleaning and sanitation (CIP)
  - Product Inclusion
  - General Surface Sanitation
  - Other
Aggregate of microorganisms in which cells that are frequently embedded within a self-produced matrix of extracellular polymeric substance (EPS) adhere to each other and/or to a surface.

“When bacteria are in a film, they are very resistant to biocides. (Borenstein 1994).

Biofilm

Related Problems

- Increased downtime to clean
- Increased use of chemicals during cleaning
- MIC (Microbial Induced Corrosion)
- Scale buildup
- Often in inaccessible places
- Constant recontamination
Radical Waters ECA
Biofilm Control Application

1. Initial clean with Catholyte
   • Strip existing biofilm effectively

2. Sterilization of piping with Anolyte

3. Ongoing control of biofilm due to addition of Anolyte
   • Constant reduction of micro-organisms
   • Affects ability of organisms to adhere due to electrostatic interactions
   • MINIMISED BIOFILM FORMATION & REDUCED DOWNTIME
Biofilm Industry Examples

Centrifuge funnel –before CIP

Centrifuge funnel –after CIP
Biofilm

Industry Examples

Drip tray with mature Biofilm before cleaning

Drip tray after high pressure wash with ECA
Biofilm
Industry Examples

Before ECA

After ECA
Rinse with treated water

NaOH (Hot)
75 – 85°C
Continue for 15 to 25 minutes after reaching desired temperature

Rinse with treated water

5-10 min.
40-60 min.
5-10 min.

Typical Time = 50 to 80 minutes
Radical Waters ECA CIP
3 Step CIP

Typical Time = 15 to 32 minutes

Energy Savings
Chemical Savings
Water Savings
Time Savings

5-10 min.
10-12 min.
5-10 min.

Treated Water
10 min. As from EC = 20% Anolyte
10 min. As from EC = Treated Water
Traditional Cleaning-in-Place

5 Steps

Typical Time = 70 to 105 minutes

1. **Rinse with treated water**
   - 5-10 min.

2. **NaOH Hot**
   - 75 – 85°C
   - Continue for 15 to 25 minutes after reaching desired temperature

3. **Rinse with treated water**
   - 5-10 min.

4. **Sanitizer Hot**
   - 75–85°C
   - Continue for 15 to 25 minutes after reaching desired temperature

5. **Rinse with treated water**
   - 5-10 min.
Radical Waters ECA CIP

4 Steps

- Energy Savings
- Chemical Saving
- Water Savings
- Time Savings

Treated Water

5-10 min.

10 min. As from EC = 20% Catholyte

10-12 min.

10 min. As from EC = 20% Anolyte

10-12min.

10 min. As from EC = treated water

5-10 min.

Typical Time = 30 to 45 minutes
Radical CIP

Benefits

- Enhanced safety – non toxic
- Environmental friendly – better effluent management
- Microbiological efficacy – no resistance
- Lower water usage – water savings
- Ambient temperature – energy savings
- Reduced CIP contact time – time savings
- Flavour neutralisation – quality assurance
- Reliable onsite generation – maintenance friendly
- Real time measurement – monitor & control solutions
ECA Ingredient for Product Inclusion

• Anolyte included in the water of sauce production facility
• Purpose – sanitation and to prevent product spoilage
• Increased shelf life of products
• Potential to use it in any product composition
• Establish compatibility with product ingredients.
ECA Surface Sanitation

- Anolyte can be used as a general surface disinfectant.
- Requires a pre-cleaning step (Catholyte or standard detergent)
  - Decrease surface tension and impact on angle.
- ECA is approved for use on food contact surfaces
- No negative carry-over onto product or surface
Other Applications

ECA

- Breweries
- Wine
- Biofilm
- Carbon Column treatment (GAC)
- Boreholes/water wells
- Red meat abattoir
- Processed meats
- Fish processing
- Poultry processing
- Milling
- Starch extraction
- Baking
- Dairy
- Cut Flowers
- Fogging
- Medical

- Surface disinfection
- Dental
- Live Animal
- Yield enhancement
ECA Green Hygiene
Replacing Your Chemicals

- Disinfection times may be reduced by up to 70% due to shorter contact time that is required relevant to chemicals – **Time savings**
- ECA is applied at ambient temperatures providing substantial **energy savings**
- **Water savings** may be achieved due to shorter cleaning and disinfection cycles as well as the ability to reclaim for subsequent **re-use**.
- **Chemical savings**, No More Chemicals.
Sustainable Green Hygiene
Hygiene Solutions

• **On-site production** removes the need for transportation and storage of chemicals
• **Reduced chemical handling** by staff results in increased labour efficiency
• Effective at removing and controlling **Biofilm**
• ECA is **approved** for use on food contact surfaces
• ECA is **safe** to handle and be in contact with **food** and **beverage** products.
Radical Waters
Happy Customers
TOGETHER WE CAN
OVERCOME OUR WATER CHALLENGES
The best minds are working on it.