

KERRion AWS

Agriculture Well Station

July 23, 2017

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| Author: | Shervington Kerr |
| Date: | July 23, 2017 |

Version History

| Name | Change Description | Date | Version |
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| Shervington Kerr | Initial Draft | July 21, 2016 | v0.1 |
| Shervington Kerr | Edits to Applied Technology Solution | July 24, 2016 | v0.2 |
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Document Acceptance

Approval for the document is required by current members of the Project Delivery Committee.

| Stakeholder | Name | Position | Date | Signature |
|-------------|------|--------------------------|------|-----------|
| TBD | TBD | Research and Development | TBD | TBD |
| TBD | TBD | Financial Management | TBD | TBD |
| | | | | |

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1. Introduction

1.1. Document Purpose

The purpose of this document is to provide an overview of how the KERRion Agriculture Well Station (AWS) Technology produces highly filtered, bacteria free acidic well water for farming and irrigation.

1.2. Executive Summary

KERRion Technologies is a privately-owned company. The “KERRion System” was registered (registration #1118256) as Intellectual Property with the Canadian Intellectual Property Office on January 7, 2015, pursuant to sections 49 and 53 of the Copyright Act.

The lack of clean water and sanitation in many African regions leads to 1.5 million deaths a year from diarrhea and cholera. One in ten people globally (around 663 million people) lack first time access to improved drinking water sources. Agriculture is a primary water consumer and pivotal to the life of the community for which it supports.

How can the needs for improved drinking water sources for the community and water sources for agriculture be met as it intensifies to feed growing populations in Africa? Africa’s demand for clean bacteria free water is rising fast.

1.2.1. Sustainable Agriculture and Food Sovereignty

KERRion Technologies will partner and work with government and non-government organizations to make use of the hydrogeological knowledge base, and to assist in the development and implementation of appropriate policies and practices that focus on Sustainable Agriculture and Food Sovereignty that will aid in improving the standard of living of the African communities.

1.2.2. The KERRion Agriculture Well Station (AWS) Concept of Engineering

The KERRion Agriculture Well Station (CWS) is a CleanTech low-energy, high-volume Well Water technology solution. The AWS produces highly filtered, bacteria free acidic well water and pumps it to a cistern for farming and irrigation self-service.

A deep well water solar powered pump delivers the well water to the AWS. The well water is filtered through hollow-fiber technology membrane filters capable of highly filtering the well water to remove sediment. Electrolysis is applied to change the state of the water to acidic using “electro-plated platinum electrodes”. The electrodes are covered in a “super fine” mesh with very distinct high points and valleys and provide the highest level of conductivity and durability. The cutting-edge design and proven durability of the electrodes ensures the best oxidation reduction potential (ORP) alteration.

1.2.3. Intended Audience

This document is intended for stakeholders, technology vendors and members of the project team.

1.3. Related Research

The following is a list of required AWS Technologies and companies, Ground Water monitoring, and Aquifer researched.

| Related Research | Description |
|---|--|
| Emco Tech | <ol style="list-style-type: none"> 1. Electro-plated platinum mesh electrodes 2. Emco Tech: The patented DARC (Double Automatic Reverse Cleaning) system. It completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized. |
| Fibracast Ltd. | Hollow Fiber Technology Membrane Filters |
| SBT Aqua | Water Bacteria Detection sensors |
| Shenzhen Solartech Renewable Energy Co. Ltd. | Deep well water solar powered pump |
| Smartflower Solar Power Panels System | SmartFlower Solar Energy Company – Infrastructure Energy |
| Well station office | <p>A steel frame Well Station Office is a structure to house the CWS</p> <ul style="list-style-type: none"> • The well station office additionally serves as an office for the well station technician to manage, service and conduct reporting on the aquifer and CWS. • The well station office may serve as a community contact point |
| Global Ground Water Monitoring Network (GGWMN) | <p>Related groundwater and aquifer research: Form an alliance / working relationship for Cloud based Aquifer monitoring and regulatory compliance reporting</p> |
| Groundwater Monitoring in the SADC Region (SADC - Southern African Development Community) | <p>Related groundwater and aquifer research: Form an alliance / working relationship to provide water / waste and water sanitation education – supporting aquifer workshops for the southern African states. Overview prepared for the Stockholm World Water Week 2013</p> |
| Groundwater availability and use in sub-Saharan Africa: A review of 15 countries | <p>Related groundwater and aquifer research: Groundwater availability and use in sub-Saharan Africa: A review of 15 countries. Published by: International Water Management Institute PO Box No. 2075, 127, Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka http://www.iwmi.cgiar.org</p> |
| The Molecular Hydrogen Foundation | <p>A non-profit scientific organization supported by the leading international researchers in the study of hydrogen. Research of various articles on;</p> <ul style="list-style-type: none"> • Fundamental articles and hydrogen benefits • Chemistry of water and hydrogen gas • Ionized water history and relation to hydrogen gas • Ionized water basics • Oxidation-Reduction Potential (ORP) information |

| | |
|--|--|
| The Kampala WASH Symposium (Water Sanitation Hygiene) | Related water, aquifer research: <ul style="list-style-type: none"> • Kampala WASH Symposium Public Agenda • Kampala WASH Symposium background note • Kampala WASH Symposium Projects to Services |
|--|--|

1.4. Document Scope

The scope of this document are the technology requirements for the design and build for the KERRion AWS.

In scope

The KERRion AWS Technology components:

- Shenzhen Solartech Renewable Energy Co. Ltd.
 - Deep well water solar powered pump
- Fibracast Ltd.
 - Hollow Fiber Technology Membrane Filter solution
- Emco Tech
 - Electro-plated platinum mesh electrodes
 - The patented DARC (Double Automatic Reverse Cleaning) system
 - Completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.
- SBT Aqua: Water Bacteria Detection sensors
 - Bacteria Sensor detection in the well water intake chamber
 - Bacteria Sensor detection in the well water holding chamber.

Out of scope

- Construction requirements for the well station office.
- Resource requirements
- Staffing schedules

1.5. Document Assumptions

The following assumptions have been identified for the AWS requirements contained in this document.

| ID | Assumption | Validation or Comment |
|----|--|-----------------------|
| A1 | A Vendor Management Business Strategy will be developed to facilitate vendor onboarding. | |

2. Applied Technology Solution

2.1. Agriculture Well Station (AWS)

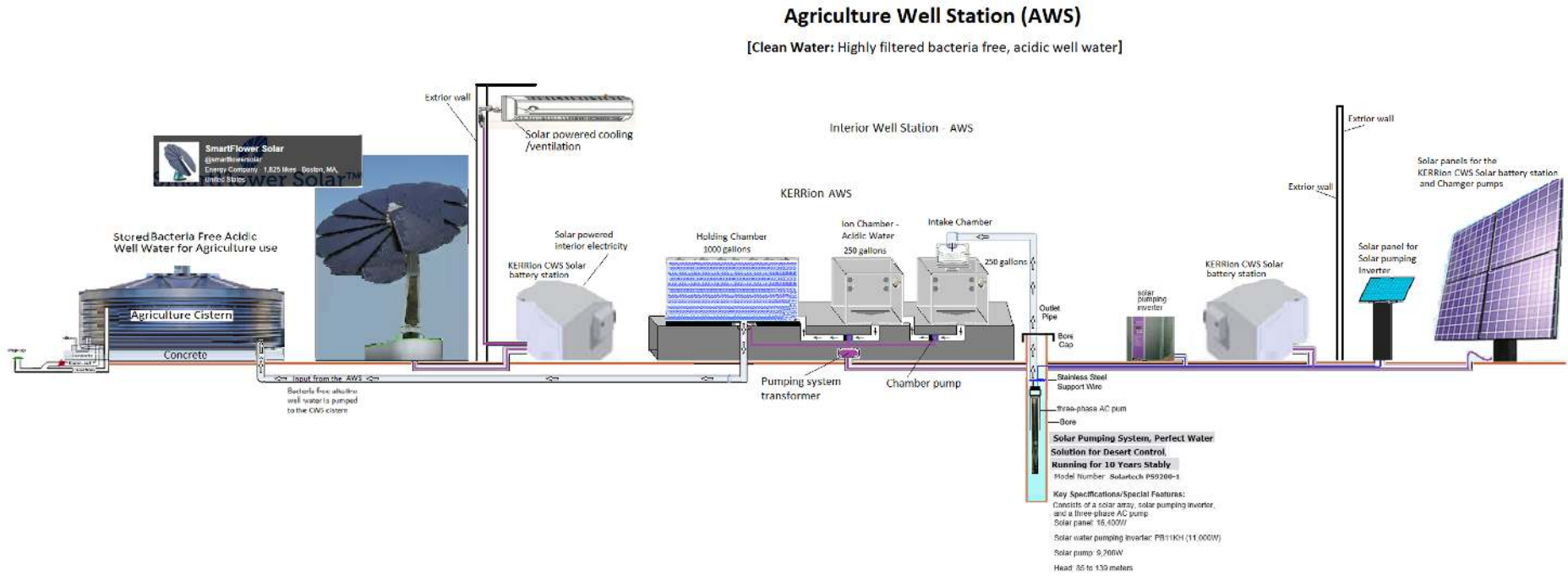
The Agriculture Well Station is a low-energy, high-volume solar powered well water technology solution. The AWS is situated inside the well station office. The well station office is designed for protection of the AWS and serves as an office for the well station technician. Community farmers will have access to the well water in the agriculture cistern. The well station office may serve the community as an access point.

2.2. Technology Solution Catalogue

The following table illustrates the vendor technologies

| Actor | Description |
|--|---|
| Shenzhen Solartech Renewable Energy Co. Ltd. | Deep well water solar powered pump |
| SBT Aqua | Water Bacteria Detection sensors |
| Fibracast Ltd. | Hollow Fiber Technology Membrane Filter solution |
| Emco Tech | <ol style="list-style-type: none">1. Electro-plated platinum mesh electrodes2. Emco Tech: The patented DARC (Double Automatic Reverse Cleaning) system. It completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized. |

2.3. Technology Solution design concept



2.4. Technology Vendor - Solartech



Shenzhen Solartech Renewable Energy Co. Ltd.

2.4.1. Technology Application

The Solartech deep well water solar pump delivers the well water to the High Filtration Chamber.

Shenzen Solartech Renewable Energy Co. Ltd.

Solar Pumping System, Perfect Water Solution for Desert Control, Running for 10 Years Stably

| | |
|------------------------|--|
| Port | Shenzhen |
| Minimum Order Quantity | 1 to 99Set |
| Payment Terms | Telegraphic Transfer (TT,T/T) |
| Brand Name | Solartech |
| MOQ | 1 to 99 Set |
| Main Export Markets | Eastern EuropeMid East/AfricaCentral/South AmericaAsiaWestern Europe |
| Place of Origin | China (mainland) |
| Model Number | Solartech PS9200-1 |
| Lead Time | 15-20days |
| Category | Other Solar Energy Related Products |

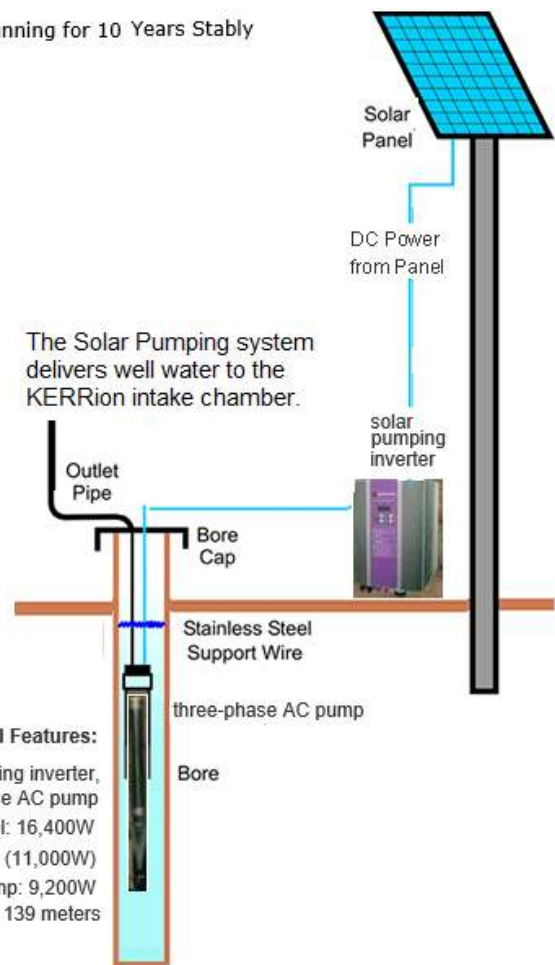
Solar Pumping System, Perfect Water Solution for Desert Control, Running for 10 Years Stably

Model Number Solartech PS9200-1



Key Specifications/Special Features:

Consists of a solar array, solar pumping inverter, and a three-phase AC pump
 Solar panel: 16,400W
 Solar water pumping inverter: PB11KH (11,000W)
 Solar pump: 9,200W
 Head: 85 to 139 meters



2.5. Technology Vendor – SBT AQUA



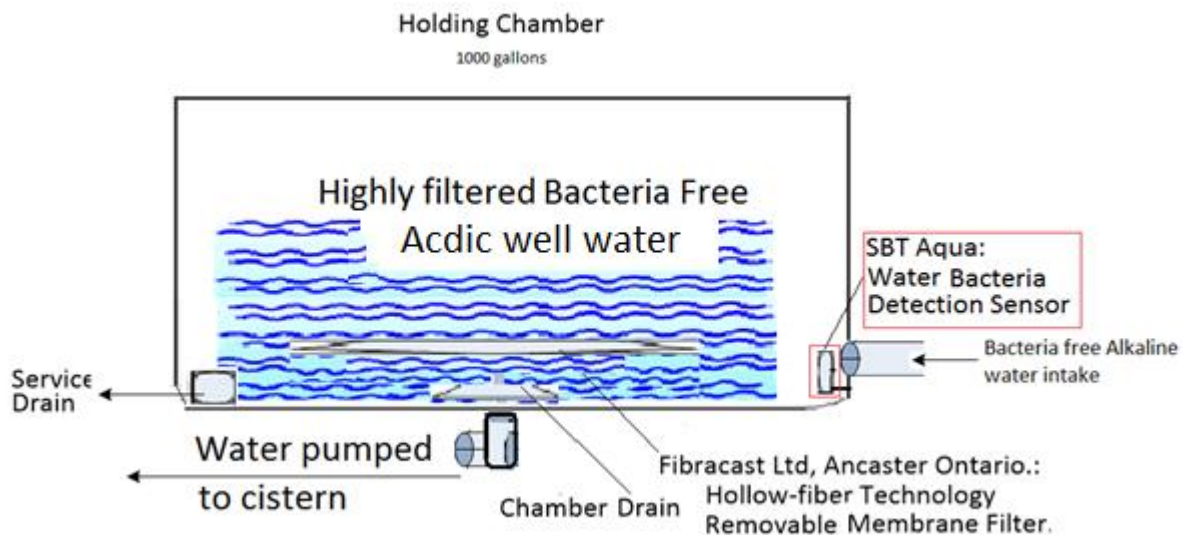
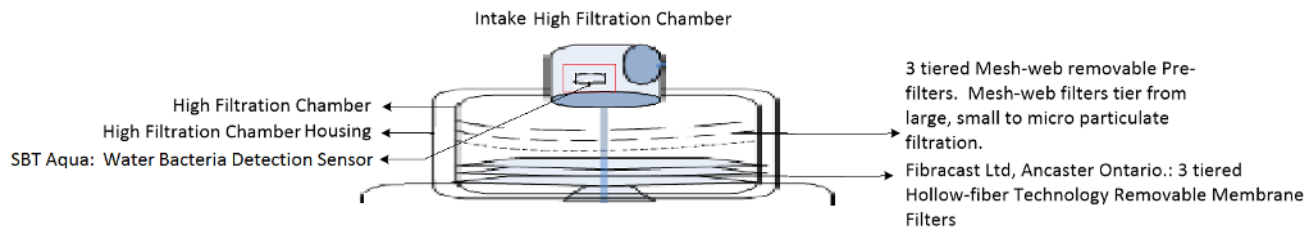
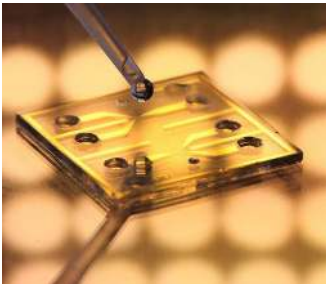
2.5.1. Technology Application

The well water flows over the SBT AQUA BIOSENSORS located in the Intake Chamber and the Holding Chamber. The level of bacteria is detected.

SBT Aqua is developing a biosensor based on impedance flow cytometry that is able to monitor the bacteria and particle level of drinking and process water online and in real-time. The sensor provides accurate and instantaneous results regarding the bacteria concentration with low maintenance requirements.

The working principle behind impedance flow cytometry is simple. A liquid sample is continuously injected into a microfluidic channel with integrated electrodes over which a multi-frequency voltage signal is applied. Bacteria and particles transition across the electrodes which results in a change in impedance.

SBT AQUA BIOSENSOR



2.6. Technology Vendor – Fibracast



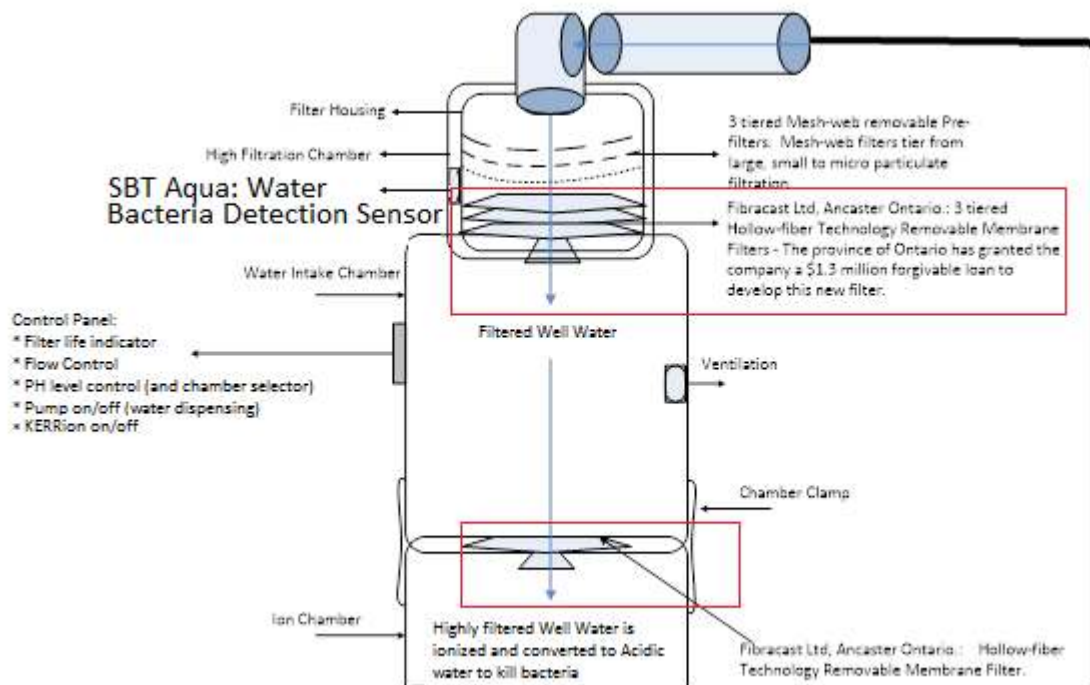
2.6.1. Technology Application

The water enters the high filtration chamber and passes through the 3 tiered FibrePlate™ filtration-membrane product. The water flows through a FibrePlate™ filtration-membrane product into the Water Intake Chamber

Fibracast is a global leader in the research, development and manufacturing of advanced membrane technologies for water and wastewater treatment. Founded in Ancaster, Ontario, in 2010, by an expert team of water-technology veterans, Fibracast created the next generation of membrane filtration technology that improves on the robustness, performance and operational flexibility of existing membrane designs. We are currently looking for machine operators to join the company.

With support from federal, provincial and municipal governments and agencies in Canada, Fibracast's extensive development effort resulted in a breakthrough filtration-membrane product — FibrePlate™ — designed to revolutionize membrane filtration for municipal and industrial water and wastewater applications.

FibrePlate™



2.7. Technology Vendor – Emco Tech

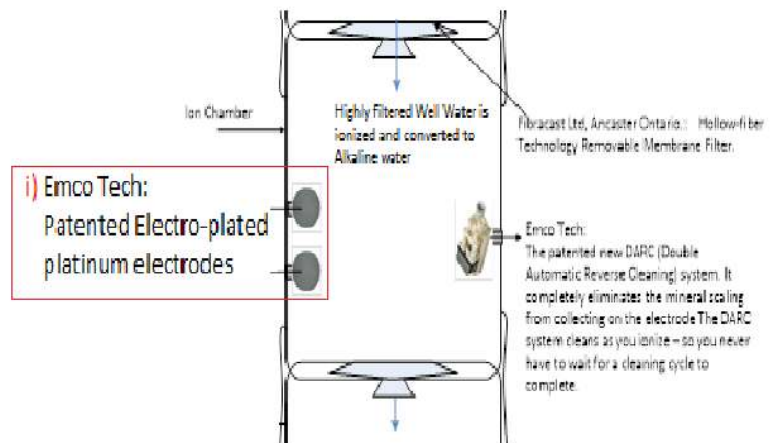
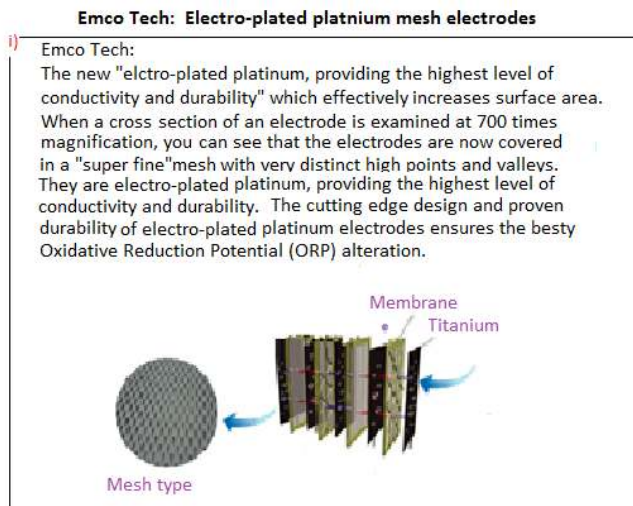


2.7.1. Technology Application

In the Ion Chambers, a small electrical charge is applied to the electro-plated platinum mesh electrodes. The resulting electrolysis changes the state of the water to Acidic, eliminating all bacteria.

2.7.1.1. Electro-plated platinum mesh electrodes

The following diagrams illustrate the cutting edge design of the Electro-plated Platinum Mesh Electrodes.



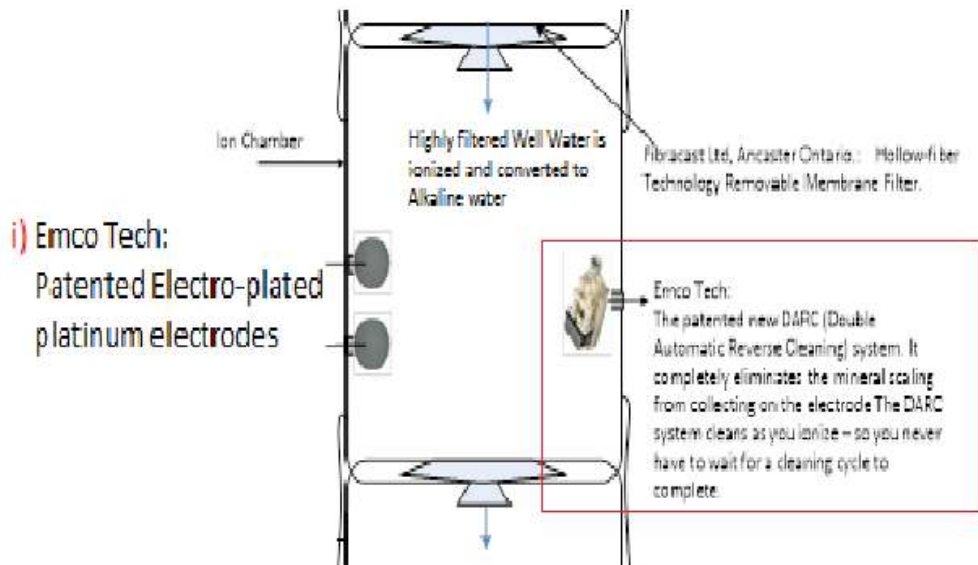
2.7.1.2. The patented DARC (Double Automatic Reverse Cleaning) system

The patented DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.

The electrodes are the crucial operating component. The patented new DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes.



The DARC System.
(Double Automatic Reverse Cleaning)



2.8. AWS System Functional Use Case

2.8.1. Pre conditions

The following pre-conditions exist for this use case:

All of the following conditions must exist and/or be available to support operational use of the AWS.

1. **WASH, (WAter, Sanitation, and Hygiene)**, Community workshops have been held with the community residents
2. The community aquifer(s) must be operational/functional
3. The community aquifer(s) must feed the existing well(s)
4. The Well Station Office has been constructed to house the AWS
5. A AWS is installed, inside the well station, and is operational in servicing the existing well(s)
6. The AWS has been tested and approved for the delivery of highly filtered, bacteria free, acidic well water.
7. The Well Station Technician has been introduced to the community
8. The Well Station Technician has been fully trained to provide customer service to the community
9. The Well Station Technician has been fully trained to service and support the AWS
10. The Well Station Technician has been trained or certified in potable water regulatory compliance

2.8.2. Trigger event

A community farmer has activated the AWS. The highly filtered, bacteria free, acidic well water pumped from the holding chamber of the AWS to the agriculture cistern.

2.8.3. Basic flow

The functional technology operations of the AWS are noted below.

1. The deep well water solar pump delivers the well water to the KERRion high filtration chamber.
2. High Filtration Chamber:
 - a. The incoming well water flows over the SBT AQUA BIOSENSOR. The level of bacteria is detected.
 - b. The water passes through the 3 tiered FibrePlate™ filtration-membrane product.
 - c. The water flows into the Water Intake Chamber.
3. Water Intake Chamber:
 - a. The water enters the Intake Chamber and flows through a FibrePlate™ filtration-membrane product into the Ion Chamber.
4. Ion Chamber:
 - a. The water enters the Ion Chamber
 - b. A small electrical charge is applied to the electro-plated platinum mesh electrodes. The resulting electrolysis changes the state of the water to Acidic, eliminating all bacteria.
 - c. The patented DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.
 - d. The water flows through a FibrePlate™ filtration-membrane product into the Holding Chamber.

5. Holding Chamber:
 - a. The incoming water flows over the SBT AQUA BIOSENSOR. The level of bacteria is detected.
 - b. The highly filtered, bacteria free, acidic well water is stored for agriculture use.
 - c. The acidic water is pumped from the holding chamber to the agriculture cistern.

End use case.

2.8.4. Post conditions

The post condition is as follows:

The highly filtered, bacteria free, acidic well water is pumped from the Holding Chamber to the agriculture cistern.

2.8.5. Business Rules

The following business rules exist for this use case.

| ID | Business Rules |
|------------|---|
| BR.2.8.5.1 | The Well Water Technician provides assistance to the community patrons. |
| BR.2.8.5.2 | The Well Water Technician manages the service and support of the KERRion AWS. |
| BR.2.8.5.3 | The Well Water Technician will assist in community WASH workshops delivered by KERRion. |
| BR.2.8.5.4 | TBD |
| BR.2.8.5.5 | TBD |
| BR.2.8.5.6 | TBD |

3. Non-Functional Requirements

The following non-functional requirements are required to support the use case.

| Requirement ID | Area | Requirement Description | Priority |
|----------------|-------------|-------------------------------|--|
| NFR.001 | Reliability | Overall Targeted Availability | 99% Targeted operational availability of the AWS |
| | | Maintenance Period | Scheduled as required to maintain vendor technologies (to be determined) |
| NFR.002 | Reporting | Regulatory Compliance | Documenting the SBT AQUA BIOSENSOR bacteria detection readings for regulatory compliance reporting. <ol style="list-style-type: none">1. Document the bacteria reading in the untreated well water as it flows into the Water Intake Chamber.2. Document the bacteria reading of the highly filtered, bacteria free, acidic well water as it flows into the Holding Chamber. |