Wastewater Salinity Reduction Webinar

Applications Using Alternate Flow Sheets

December 3, 2019

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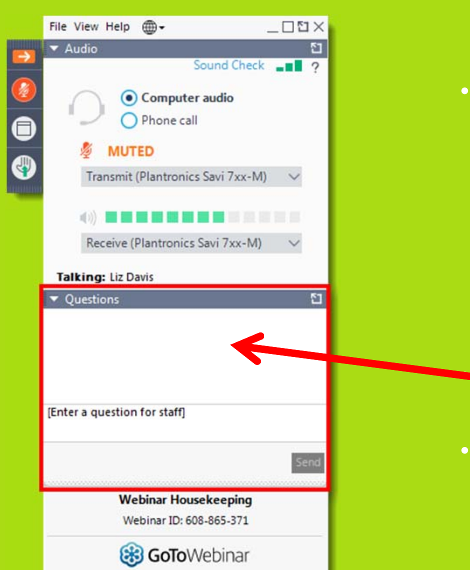
How to Participate Today



- **Audio Modes**
  - Listen using Mic & Speakers
  - Or, select “Use Telephone” and dial the conference (please remember long distance phone charges apply).

Submit your questions using the Questions pane.

- **A recording will be available for replay shortly after this webcast.**

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Today's Presenters

Jamie Vinsant
Product Manager for Electrodialysis Products, SUEZ Water Technologies & Solutions

Jason Haase
Global Business Intelligence Manager, SUEZ Water Technologies & Solutions

Patrick Girvin
Global Sales Leader for Reverse Osmosis & Electrodialysis Products & Systems, SUEZ Water Technologies & Solutions

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Agenda

- Review technology options for wastewater salinity reduction
- Discuss irrigation water application
- Overview of Bashneft-Ufa oil processing complex case study
- Q & A

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Technology Options

Jamie Vinsant
Product Manager
Electrodialysis Products

Salinity Reduction

Goals:

- Target product TDS or target specific ion concentration
- Brine with low volume and high TDS

There are generally two technologies involved in wastewater salinity reduction:

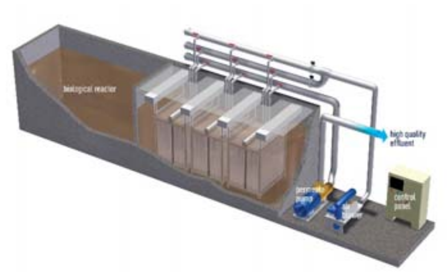
- Reverse Osmosis / Nanofiltration
- EDR (Electrodialysis Reversal)

Reverse Osmosis/Nanofiltration (RO/NF)

Commonly used and understood
Broad spectrum removal
- Salts (and general total dissolved solids -TDS)
- Metals
- Organic pollutants
- Pathogens, viruses, bacteria

WW treatment typically requires pretreatment such as MF or UF

Chemical dosing also common



MF/UF such as SUEZ's ZeeWeed* 500

RO such as SUEZ's PRO*flex*

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Electrodialysis Reversal (EDR)

Less commonly discussed

Target to TDS value or for removal of specific ionized species
Chloride, sodium, nitrate, etc.

Typically requires only MMF pretreatment for WW applications

Typically operates at higher recovery and reduced chemical dosing

EDR such as SUEZ's Ionics V Series EDR

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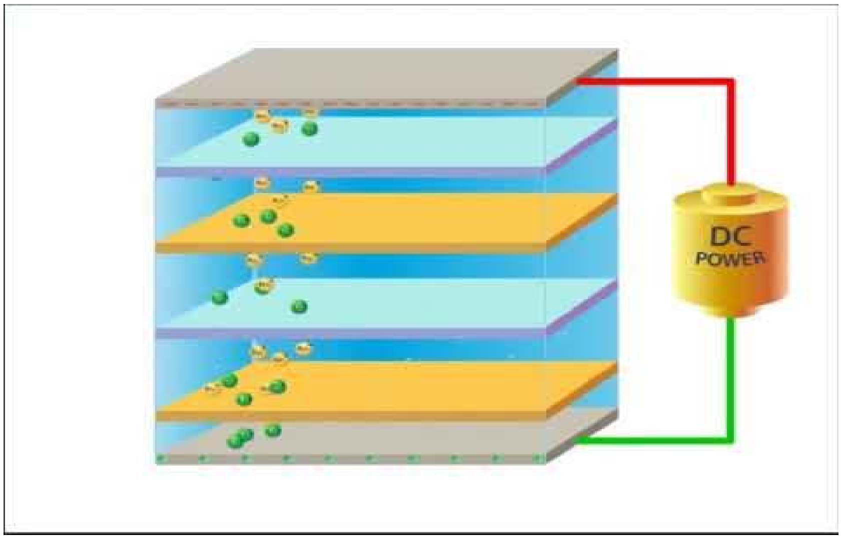
Electrodialysis Reversal: the less commonly discussed



Key Factors for Selection of EDR

Customer Need		Key Factor
Reuse for irrigation landscape and agriculture **Discharge limitation** sodium, chloride **Wastewater** industrial use	→	**EDR** Often 40-60% less wastewater generated with the same feed flow rate (higher recovery) Higher tolerance to suspended solids, enabling the alternate flow sheet to MF/UF-RO Variability of feedwater
Indirect/Direct potable reuse **Industrial reuse** boiler feed water	→	**RO/NF** When pathogens/viruses/bacteria need to be removed by RO When silica and non-charged species need to be removed

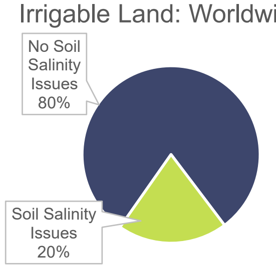
Application – Irrigation Water

Jason Haase
Global Business Intelligence Manager
Reverse Osmosis, Electrodialysis, Electrodeionization

Farmers have widely voiced concern over long term effects of salinity

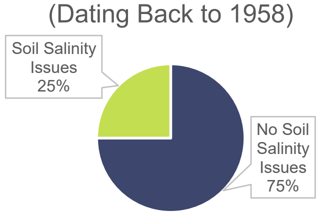
Example Geographical Data

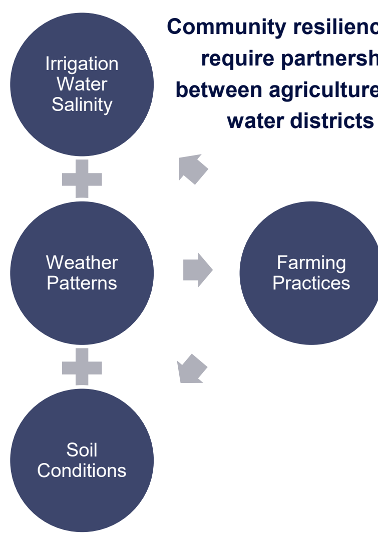
Irrigable Land: Worldwide [2]



Salinity damaged soil increased almost 40% since the early 1990s to 153 million acres (approximate size of France)

Irrigable Land: USA [1]
(Dating Back to 1958)





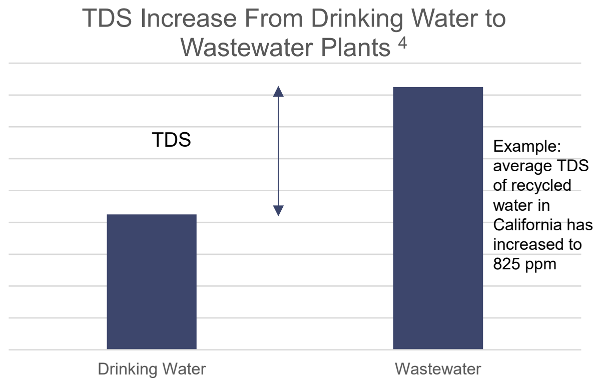
Community resilience will require partnership between agriculture and water districts

[1] Salt problems in irrigated soils, United States Department of Agriculture, Agriculture Information Bulletin No. 190, 1958
[2] Salinisation of Land and Water Resources, F.Ghassemi, A.J.Jakeman, and H.A. Nix, Sydney: University of New South Wales Press, 1995

Water TDS should be < 1,000 ppm to enable wide ranging crop choices

Worldwide trend toward increasing salinity in drinking water (saltwater intrusion, deeper and declining quality of brackish wells, home softener use)

Crop	Threshold Soil Salinity (ppm TDS, value where yield loss begins) [3]
Corn	≈ 1,100
Green Beans, Carrots, Strawberries	≈ 640
Tomatoes (Several Species)	≈ 1,050-1,600
Citrus (Lemon, Grapefruit, Orange)	≈ 800-960
Almond/Blackberry/Grapes	≈ 960
Note irrigation water must be diluted (i.e. rain) to exceed these values	



Multiple variables impact and create wide ranging individual agricultural needs. Choice of plant, soil, local weather, sodium and chloride content of water, and irrigation practices are all relevant factors, as are many more.

[3] United Nations Food & Agriculture Organization, http://www.fao.org/3/y4263e/y4263e0e.htm
[4] Agricultural Use of Recycled Water: Impediments and Incentives, The Water Research Foundation, 2019

Reuse for irrigation in the USA is prevalent and has potential

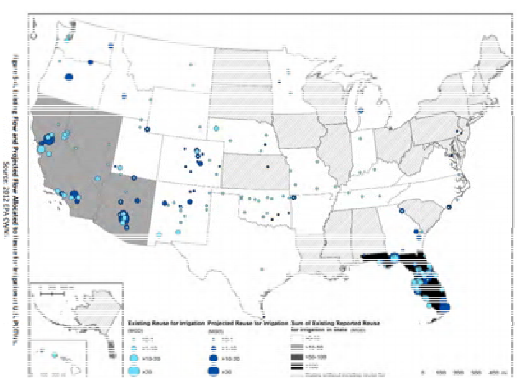
***Source: The Water Research Foundation, Agricultural Use of Recycled Water, 2019**

It's practiced:

41 states
791 wastewater plants
821 MGD

It's part of future plans:

922 plants project reuse for irrigation totaling 1,864 MGD of peak flow



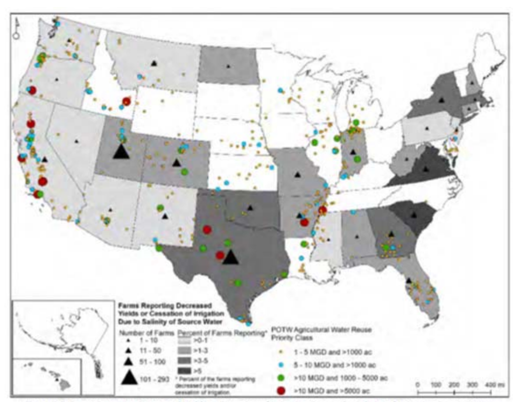


Figure 6-5. Farms Reporting Decreased Yields or Cessation of Irrigation Due to the Salinity of Irrigation Source Water.

Agriculture near wastewater facilities

80% of irrigated cropland within 10 miles
44% of irrigated cropland within 5 miles

How is reuse for irrigation different than potable reuse?

Treatment objectives are different:
- Pathogen removal vs. EPA drinking water standards
- TDS is not a public health concern, but is for irrigation
- Sodium and chloride are primary ions needing removed for plant health
- Many divalent ions, minerals, and nutrients can be left behind and are beneficial for a circular economy

Perception and science:
- Contaminants of emerging concern have been reported to have reduced uptake by plants resulting in reduced human exposure to recalcitrant compounds versus IPR/DPR [4]

It's a case where the concept of not overtreating to potable standards makes sense if it can be practically implemented

[4] Agricultural Use of Recycled Water: Impediments and Incentives, The Water Research Foundation, 2019

Parallel Case Studies: California, USA

	City of San Diego, California, USA	Carmel Area Wastewater District & Pebble Beach Community Services District [4]
Flow Sheet	Tertiary Treated WW + Cartridge Filters + EDR → Direct agricultural use	MF + RO → Direct agricultural use or groundwater recharge
Treatment Objective	Adjustable TDS removal from influent peak 1,300 ppm to 300-1,000 ppm.	Reduce sodium from 150 ppm to 55 ppm
Capacity	6.6 MGD (EDR effluent)	1.5 MGD (RO effluent)
Key Notes	85% recovery	80% recovery
	Filter + EDR was 25% lower CapEx than MF/RO at install (1998)	Reuse for irrigation began in 1994, MF+RO added in 2009

[4] Agricultural Use of Recycled Water: Impediments and Incentives, The Water Research Foundation, 2019

Case Study:
Bashneft-Ufaneftekhim oil processing complex

Patrick Girvin
Global Products Sales Leader
Reverse Osmosis, Electrodialysis, Electrodeionization

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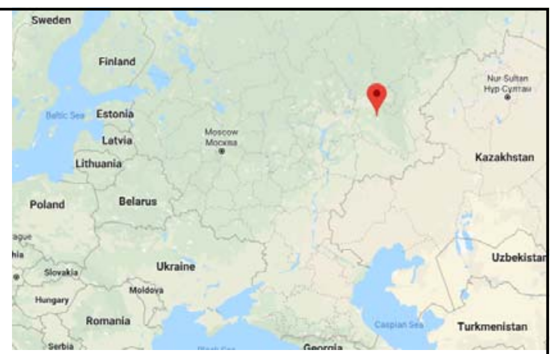
Challenge



End-User: Bashneft, an oil company in Russia

Location: Ufa, Republic of Bashkortostan

Technical details:
84,000 m^3/day (22.2 MGD) wastewater influent
Combined waste flows from oil refinery and other industry in region

Two drivers for new treatment facility:
New discharge regulations and fees
Drive to reuse to minimize river discharge and raw water usage

Project challenges:
Difficult feed water, River disposal requires ppb levels of contaminants
Extensive piloting required to optimize process and maximize recovery

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Feed Water Challenges

Parameter in mg/L unless noted	Raw Feed-water Quality	Guaranteed River Discharge Quality
Ammonium, NH_4	40	0.5
Iron	0.4	0.099 (as Fe)
Manganese/Mn^{2+}	0.2	0.01 (as Mn^{2+})
Sulfates	250	100 (as SO_4)
Chloride	300	273.9 (as Cl)
Nitrate, as NO_3	25	40
Phosphate, PO_4	0.,2	0.13
Dry residue TDS	1,250	1,000
pH (pH Units)	6.5 – 9.5	6.5-8.5
COD	450	30
BOD_5	135	3
Non-ionic or non-anionic surfactants	2.0	0.35
Phenols	7.0	0.001

Parameter in mg/L unless noted	Raw Feed-water Quality	Guaranteed River Discharge Quality
Oil	25	0.05
Anionic Surfactants	2.0	0.396
TSS	50	6.4
Copper	0.025	0.001
Aluminum	0.250	0.04
Cobalt	0.010	0
Nickel	0.025	0.01
Chromium ion (Cr^{6+})	0.007	0.006
Zinc	0.100	0.01
Vanadium	0.025	0.001
Nitrites, as NO2	8.0	0.08
Sulfides	10	0

Metals

Organics

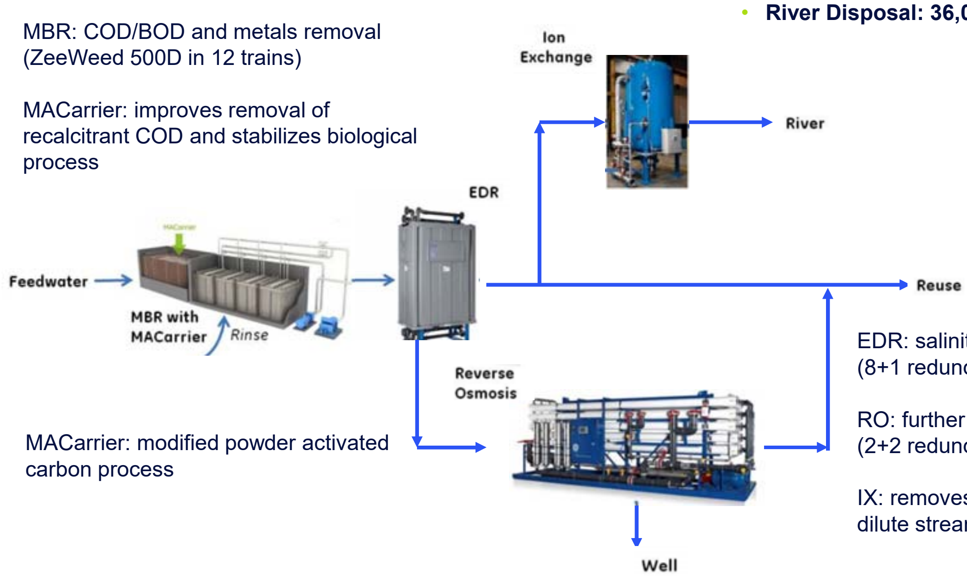
Phenols

Solution

- **Reuse flow: 45,800 m³/day (12.1 MGD)**
- **Well Disposal: 2,200 m³/day (0.6 MGD)**
- **River Disposal: 36,000 m³/day (9.5 MGD)**

MBR: COD/BOD and metals removal (ZeeWeed 500D in 12 trains)

MACarrier: improves removal of recalcitrant COD and stabilizes biological process



MACarrier: modified powder activated carbon process

EDR: salinity reduction (8+1 redundancy)

RO: further brine concentration (2+2 redundancy)

IX: removes heavy metals from EDR dilute stream

Results

Benefits of Bashneft process train:

- **Meets surface water discharge regulations - avoid discharge penalties**
- **High recovery process - minimize payments for well discharge (less than 3%)**
- **High quality product - up to 55% of the wastewater can be reused**
- **Maximizes reuse - reduce costs incurred for raw water**

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Thank you for your time.

Are there are any questions?

For more information
visit www.suezwatertechnologies.com

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