Under the Patronage of **HRH Prince Faisal bin Bandar bin Abdulaziz**
Governor of Riyadh Region

وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture

VISION رؤية 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

HYBRID حضوري/ افتراضي
منتدى المياه السعودي
saudi water forum SWF 2022
Water Sustainability.. A Responsibility for All

ACWA POWER أكوا باور

KSA Desalination Code

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ORGANIZING PARTNERS
EXECUTED BY
TECHNICAL ADVISOR

6-8 March 2022 • Hilton Riyadh Hotel & Residences

Executive Summary:

The main purpose is:

To demonstrate a business case to authorities for revisiting the current Desal Code from a Transmitted Water Quality perspective. To improve and update Product Water Quality based on health and safety while maintaining both Drinkable Water parameters & pipeline requirements.

To enable a room for Optimizing:

1. CAPEX/OPEX to up-coming RO Desal Projects. In particular to reduce corresponding specific energy consumption.

2. The quality of water intended for human consumption.

3. More flexible range of Operation.

Code Progress:

Standard	revisions	Compliance Points	REFERENCE		Code target	Standard code & priority	Way forward
			Local	Internal			
ECRA standard (Seawater Desalination Code)	2011	Transmitted Water (Pipeline facilities)	The Saudi Arabian Standards Organization standards (from cogeneration Plant)	US EPA standards relating to water quality.	Code limited to Meet health and safety based on existing technology of Water production : • Type of technology of water production which limited to thermal process in cogeneration plant (MSF, MED). • Water Transmission System (Pipelines) requirement. • Code not consider other water technology such as RO.	Technology meets the code and Standard	to apply new code
ECRA standard (Seawater Desalination Code)	2014	Drinking Water (end user)	Presidency of Meteorology and Environment PME	WHO Drinking Water Guidelines 2004.	Health and Safety		

Drinking Water Quality Requested Amendment:

KSA SW Desal Code

0-130

World Health Organization

0-1000

Total Dissolved Solids (mg/l)

Recommendation

0-300

United States Environmental Protection Agency

0-500

Drinking Water Quality Requested Amendment:

The effect of the presence of Sodium in drinking water:

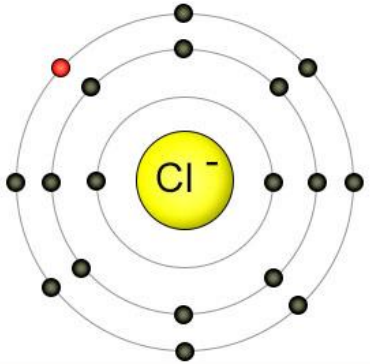
- 200 ppm is well below that which could affect blood pressure.
- Along with chloride, sodium is a potential indicator of salination.
- The taste threshold concentration of sodium in water depends on the associated anion and the temperature of the solution.
- At room temperature, the average taste threshold for sodium is about 200 mg/L.

Max = 200 ppm

Drinking Water Quality Requested Amendment:

The effect of the presence of Chloride in drinking water:

- It is primarily a problem for taste but can also exacerbate corrosion of metal pipes and fittings.
- Taste thresholds for the chloride anion depend on the associated cation and are in the range of 200–300 mg/L for sodium, potassium and calcium chloride.
- Concentrations in excess of 250 mg/L are increasingly likely to be detected by taste.



Max = 250 ppm

Drinking Water Quality Requested Amendment:

KSA SW Desal Code

0.2-0.5

World Health Organization

5

Residual Chlorine (mg/l)

Recommendation

0.1-0.5

United States Environmental Protection Agency

NA

Drinking Water Quality Requested Amendment:

The effect of the presence of Residual Chlorine in drinking water:

There is limited evidence in humans that the unintentional by-products of disinfection of drinking-water using chlorine may pose a low risk to exposed individuals, but it remains uncertain whether the associations seen in epidemiological studies are causal.

Cl_2

Drinking Water Quality Requested Amendment:

KSA SW Desal Code

20-40

World Health Organization

NA

°C

Recommendation

MAX 40

United States Environmental Protection Agency

NA

Drinking Water Quality Requested Amendment:

pH

KSA SW Desal Code

8.1–8.6

World Health Organization

6.5–9.5

Recommendation

7.0–8.8

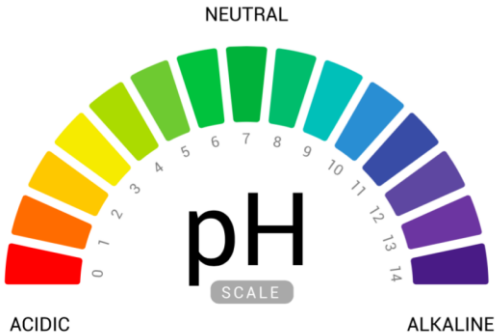
United States Environmental Protection Agency

6.5–8.5

Drinking Water Quality Requested Amendment:

The effect of drinking water's pH:

It impacts corrosion at low pH and chlorination efficiency at high pH levels. The range of the 8.1 to 8.6 reflects an acceptable range for both chlorination and reducing corrosion.



Drinking Water Quality Requested Amendment:

Turbidity (NTU)

KSA SW Desal Code

0 – 1

World Health Organization

4

Recommendation

MAX 1

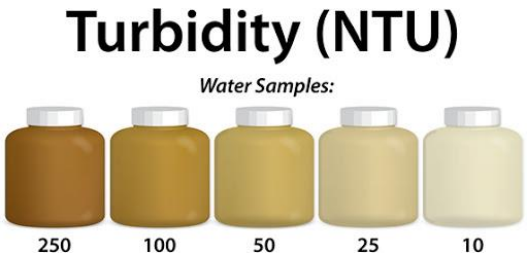
United States Environmental Protection Agency

1

Drinking Water Quality Requested Amendment:

The effect of Turbidity in water:

- It indicates a change in water quality as well as in coagulation filtration efficiency.
- To ensure the effectiveness of disinfection and parasite removal, well-run large supplies should be able to achieve < 0.3 NTU under normal circumstances.
- Turbidity can have a negative impact on consumer acceptability of water as a result of visible cloudiness. Turbidity is not visible by the naked eye in final water at NTU < 4.



Drinking Water Quality Requested Amendment:

Sulfate (mg/l)

KSA SW Desal Code

0 – 2

World Health Organization

250

Recommendation

0 – 150

United States Environmental Protection Agency

250

Drinking Water Quality Requested Amendment:

The effect of the presence of Sulfate in drinking water:

- Sulfate Taste varies with the associated cation's nature; taste thresholds have been found in a range from 250 mg/L for sodium sulfate to 1000 mg/L for calcium sulfate.

- It May affect gastro-intestinal gut motility at concentrations over 500 mg/L in naïve individuals, but this is not considered an adverse health effect.

Sodium sulfate

Calcium sulfate

Drinking Water Quality Requested Amendment:

Iron, Fe (mg/l)

KSA SW Desal Code

0-0.05

World Health Organization

0.2

Recommendation

MAX 0.05

United States Environmental Protection Agency

0.3

Drinking Water Quality Requested Amendment:

The effect of the presence of Iron in drinking water:

- There is usually no noticeable taste at iron concentrations below 300 µg/L, although turbidity and color may develop.
- At levels above 300 µg/L, iron stains laundry and plumbing fixtures.
- The Guidelines propose a health-based value of 2000 µg/L which is higher than the acceptability threshold.
- Accumulation of iron oxides can cause episodes of discoloration when deposits on pipe wall.

Drinking Water Quality Requested Amendment:

KSA SW Desal Code

0-0.05

Recommendation

MAX 0.05

Copper, Cu (mg/l)

World Health Organization

2

United States Environmental Protection Agency

1

Drinking Water Quality Requested Amendment:

The effect of the presence of Copper in drinking water:

- Copper is widespread as a consequence of copper plumbing with intermittently very high levels that can cause acute gastric irritation, which is a concentration effect.
- It causes problems with staining sanitary ware and at high concentrations with taste.
- It is recommended to retain the value of 2 mg/l of Cu or less.

Drinking Water Quality Requested Amendment:

	Calcium Hardness (mg/l as CaCO3)	
KSA SW Desal Code		World Health Organization
40-50		NA
Recommendation		United States Environmental Protection Agency
36-50		NA

Drinking Water Quality Requested Amendment:

	Total Alkalinity (mg/l as CaCO3)	
KSA SW Desal Code		World Health Organization
40-50		NA
Recommendation		United States Environmental Protection Agency
36-50		NA

Drinking Water Quality Requested Amendment:

KSA SW Desal Code

0.1-0.3

World Health Organization

0.1-0.3

Langlier Saturation Index

Recommendation

0-0.8

United States Environmental Protection Agency

NA

Drinking Water Quality Requested Amendment:

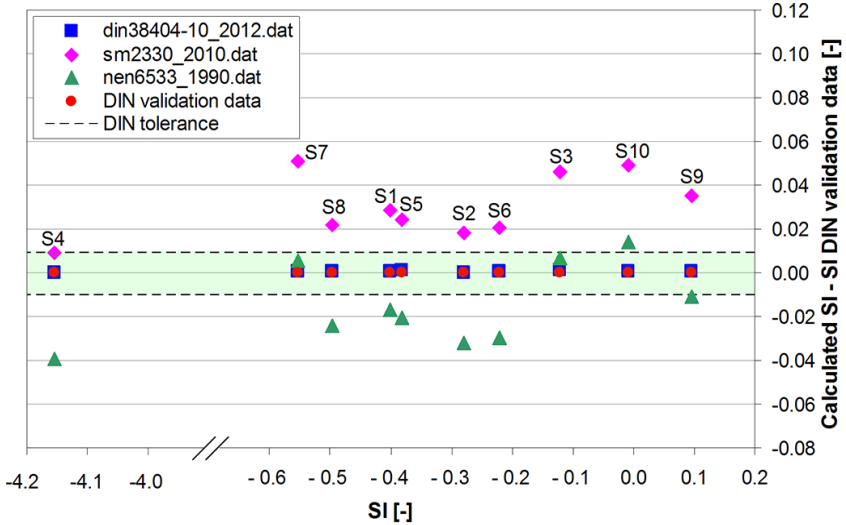
Remineralization of treated water:

- As for LSI, the addition of calcium and magnesium salts should be considered a means of conditioning and mineralizing desalinated and other reverse osmosis treated water.

- World Health Organization has recommended a need to condition the treated water to reduce corrosivity to metal components and cement mortar construction materials and improve taste acceptability. Where possible, the water should be re-mineralized with calcium and magnesium salts.

LSI, Different Standards:

There are many Saturation Indices which are more complicated and accurate than LSI (Langlier Saturation Index, 1936). Each standard has its own Saturation Index values. Therefore, there was a study done by a union of universities to test and compare the values of the individual standards. The result of the study showed that the German Standard was the most accurate, among others.



Source: Assessment of calculation methods for calcium carbonate saturation in drinking water for DIN 38404-10 compliance

Advantages & Positive Reflection on the Industry:

A new proposal limits of codes will reflect a reduction on the overall Life Cycle Cost of RO Desalination in the following terms:

- A reduction on Plant overall CAPEX around 1 – 2 % is expected.
- A reduction on Specific Power Consumption around 3% is expected
- More flexible Operational scenarios in reference to LSI parameter, in comparison to current practice.

Advantages & Positive Reflection on the Industry:

In terms of numbers; With reference to RO Desal Projects outlook, totaling 4.87 million m3/day:

Plant	COD	Capacity, m^3/day
Jubail B	2022	570,000
Alhassa	2023	300,000
Ras Alkair 2	2023	600,000
Ras Alkair 3	2024	400,000
Jubail 4	2025	300,000
Ras Mohaisan	2022	300,000
Rabigh 4	2022	600,000
Tabouk 1	2023	400,000
Rabigh 5	2024	400,000
Rayis 4	2025	300,000
Shuqaiq 4	2023	400,000
Jazan 1	2023	300,000

If we apply new product water specifications, it will reflect on a reduction of Specific Power Consumption (in comparison to current) by:

+4.0 Million MWhr over the projects term in 25 years, corresponding to saving of **+3.0 Million tons of CO2.**

Conclusion:

Expanding the range of Product Water Quality Parameters from SWRO next generation Desalination Plants, to a new range in KSA Desal Code. While maintaining and satisfying both Drinkable Water standards and Pipeline requirements. It will reflect on optimizing KSA Desal Industry in terms of projects Life Cycle Cost.

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THANK YOU

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Saudi Desal Code, Comparison Table:

Parameters	Units	Existing Saudi Desal Code	New Saudi Desal Code
Total Dissolved Solids	mg/L	0 – 130	Max 300
Residual Chlorine	mg/L	0.2 – 0.5	0.1 – 0.5
Temperature	°C	20 – 40	Max 40
pH	-	8.1 – 8.6	7.0 – 8.8
Turbidity	-	0 – 1	Max 1
Sulfate	mg/L	0 – 2	Max 150
Iron	mg/L	0 – 0.05	Max 0.05
Copper	mg/L	0 – 0.05	Max 0.05
Calcium Hardness	mg/L	40 – 50	36 – 50
Total Alkalinity	mg/L	40 – 50	36 – 50
LSI	-	0.1 – 0.3	0.0 – 0.8