

Reduction of Sodium And Potassium By the Magnetizer Technology in Saline Water

We are pleased to present the results of the Magnetizer® Water Treatment Technology in reducing SAR (sodium adsorption ratio).

These tests were conducted only on the fourth day of the Magnetizer's installation in a water irrigation system in a country where water is scarce and valuable.

They were run by an independent lab according to the ISO/IEC 17025 Accreditation Methodology.

A record reduction of the Sodium levels by the Magnetizer®—in harsh environmental conditions—has been achieved by as much as ... 90% (89.95% to be exact):

Standard Limits/Benchmark Parameter for Sodium (unit: Mg/L) – 500

Before the Magnetizer Installation – 637.64

After the Magnetizer Installation – 64.1

They have shown the Magnetizer's positive influence on desalinated irrigation water, with a significant drop in SAR and Potassium, which has qualified this otherwise wasteful water as permissible for irrigation by the authorities.

Our Technology has helped us solve a High Profile Client's biggest water-related problem.

Magnetizer® provides a natural, non-chemical, non-active carbon, safe, healthy, permanent, and low-cost method of neutralizing acid water (stabilizing pH), oxygenating it, lowering its surface tension, suppressing sulfur, inhibiting algae and bacteria, softening it, and more. Thus, it helps eliminate problems associated with hard, residual (waste), or saline water while simultaneously protecting the environment.

Those end-users familiar with Magnetizer® recognize it as one of the most effective ecological solutions to the ever-growing problems associated with hard water.

Magnetizer® is also the world leader in emissions reduction (CO, HC) in boilers, furnaces, ovens, and car/truck engines. The test results of the SAR reduction are as follows:

Water Test Summary – Before Installation and After Installation of Magnetizer

PARAMETERS	STANDARD BENCHMARK LEVELS	UNIT	QUALITY CRITERIA OF WATER FOR AGRICULTURAL PURPOSES	BEFORE INSTALLATION	AFTER INSTALLATION	COMMENTS
TOTAL DISSOLVED SOLIDS	2000	Mg/L	2100	216	220	Within acceptable limits
TOTAL HARDNESS	60 mg/l	Mg/L	-	55	55	Within the limits
SODIUM	500 mg/l	Mg/L	-	637.64	64.1	Permissible limit for irrigation water
POTASSIUM	2 to 3 ppm	Meq/L	-	22.81	2.64	Potassium level is as per EPA benchmark
CHLORIDE	250.00 ppm	Mg/L	16	2	2	Normal levels
SULFATE	250.00 ppm	Mg/L	20	0.33	0.29	Lower reduction in Sulfate after installation
CALCIUM	218 g/l	Mg/L	-	37.16	17.43	Reduction in Calcium level after installation thus making the water soft
MAGNESIUM	5 ppm	Mg/L	-	70.93	5.67	Within the bench mark limits
BORON		Mg/L	2	Not Detected	Not Detected	NA
SODIUM ABSORPTION RATIO (SAR)		-	-	14.145	3.41	Lower the SAR is very suitable for agriculture use
pH.	6.5 to 8.5	-	-	7.7	7.7	Within the benchmark limits
ELECTRICAL CONDUCTIVITY	4000		3,500	343	346	Excellent Electrical Conductivity

Remarks: Water analyzed Before the use of the Magnetizer and After installation of the Magnetizer M-2 T/S - Commercial Hardwater Conditioner meets the specification of the Quality Criteria and the Standard Benchmark Levels of Water for Agricultural purposes.
Potassium, Sulfate, Calcium, Magnesium and SAR levels have reduced after the installation of the magnetizer.
Analytical accuracy within ± 5 percent is considered adequate.

Water Test Summary – Before Installation and After Installation of Magnetizer

Classification of Irrigation Water:

Several different measurements are used to classify the suitability of water for irrigation, including EC_{iw}, the total dissolved solids, the per cent sodium, and SAR. Below are permissible limits for classes of irrigation water:

Permissible limits for classes of irrigation water					
Classes of water	Concentration, total dissolved solids			Concentration	
	Electrical conductivity μmhos^*	Gravimetric ppm	Sodium %	Chloride (Cl) mg/l	Sulfates (SO ₄) me/l
Class 1, Excellent	250	175	20	4	4
Class 2, Good	250-750	175-525	20-40	4-7	4-7
Class 3, Permissible ¹	750-2000	525-1400	40-60	7-12	7-12
Class 4, Doubtful ²	2000-3000	1400-2100	60-80	12-20	12-20
Class 5, Unsuitable ²	3000	2100	80	20	20
[*] Micromhos/cm at 25 degrees C. ¹ : Leaching needed if used ² : Good drainage needed and sensitive plants will have difficulty obtaining stands					

Sodium adsorption ratio (SAR):

Is a measure of the suitability of water for use in agricultural irrigation, as determined by the concentrations of solids dissolved in the water. It is also a measure of the **sodicity** of soil, as determined from analysis of water extracted from the soil.

Although SAR is only one factor in determining the suitability of water for irrigation, in general, the higher the sodium adsorption ratio, the less suitable the water is for irrigation. Irrigation using water with high sodium adsorption ratio may require soil amendments to prevent long-term damage to the soil.

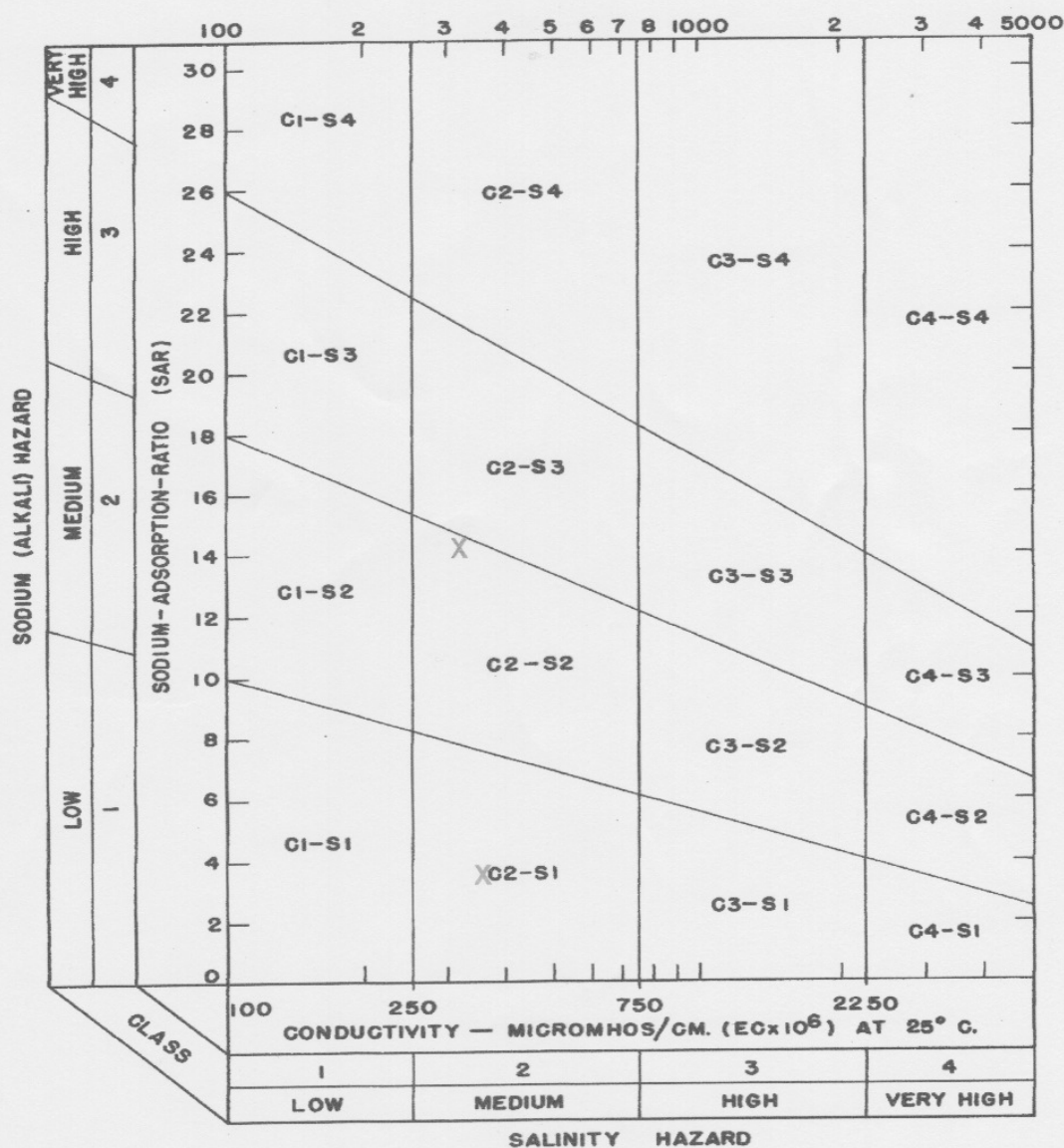
If irrigation water with a high SAR is applied to a soil for years, the sodium in the water can displace the calcium and magnesium in the soil. This will cause a decrease in the ability of the soil to form stable aggregates and a loss of soil structure and tilth. This will also lead to a decrease in infiltration and permeability of the soil to water leading to problems with crop production.

Water Test Summary – Before Installation and After Installation of Magnetizer

The diagram below is a classification of irrigation water based on electrical conductivity (EC) and sodium absorption ratio (SAR).

Based on the water analysis test report, calculation of EC and SAR, the following:

- **Water Before Installation of Magnetizer – categorized as Medium C2 – S2**
- **Water After Installation of Magnetizer – categorized as Low C2 – S1**



Water Before Installation of Magnetizer -X (SAR 14.145 & EC 343)

Water After Installation of Magnetizer -X (SAR 3.41 & EC 346)

Water Test Summary – Before Installation and After Installation of Magnetizer

Classification of Conductivity and Sodium:

Conductivity:

Low salinity water (C1) can be used for irrigation with most crops on most soils with little likelihood that soil salinity will develop. Some leaching is required but this occurs under normal irrigation practices except in soils of extremely low permeability.

Medium salinity water (C2) can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown without special practices for salinity control.

High salinity water (C3) can not be used on soils with restricted drainage, special management for salinity control may be required and only plants with good salt tolerance should be planted.

Very high salinity water (C4) is not suitable for irrigation under ordinary conditions. In special conditions where the Soils must be permeable, adequate drainage, excessive application of irrigation water to provide considerable leaching and very high salt tolerant plants must be planted.

Sodium:

The classification of irrigation water with respect to SAR is based primarily on the effect of exchangeable sodium on the physical condition of the soil. Plants sensitive to sodium may suffer injury as a result of sodium accumulation in plant tissues when exchangeable sodium values are lower than those effective in causing deterioration of the physical condition of the soil.

Low sodium water (S1) can be used for irrigation on almost all soils with little danger of development of harmful levels of exchangeable sodium.

Medium sodium water (S2) will present an appreciable sodium hazard in fine textured soils having high cation exchange capacity especially under low leaching conditions.

High sodium water (S3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management, good drainage, high leaching and organic additions.

Very high sodium water (S4) is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity, where the solution of calcium from the soil or use of other amendments may make the water feasible.

S o d i u m H a z a r d :

Irrigation water which contains large amounts of sodium is of special concern due to sodium's effects on the soil that poses a sodium hazard.

Sodium hazard is usually expressed in terms of SAR or the sodium adsorption ratio. SAR is calculated from the ratio of sodium to calcium and magnesium. The latter two ions are important since they tend to counter the effects of sodium. For waters containing significant amounts of bicarbonate, the adjusted sodium adsorption ratio (SARadj) is sometimes used.

Continued use of water having a high SAR leads to a breakdown in the physical structure of the soil. Sodium is adsorbed and becomes attached to soil particles. The soil then becomes hard and compact when dry and increasingly impervious to water penetration.

Soluble sodium percent (SSP) is also used to evaluate sodium hazard. SSP is defined as the ration of sodium in epm (equivalents per million) to the total cation epm multiplied by 100. Water with a SSP greater than 60 percent may result in sodium accumulations that will cause a breakdown in the soil's physical properties.

S o d i u m C l a s s i f i c a t i o n :

Water hardness classification – (ASAE – American Society of Agricultural Engineers)

Water classification	mg/L or ppm	grains/gallon
Soft	0—60	0—3.5
Moderate	60—120	3.5—7.0
Hard	120—180	7.0—10.5
Very hard	Over 180	Over 10.5

Calcium :

Hardness can be quantified by instrumental analysis. The total water hardness, including both Ca^{2+} and Mg^{2+} ions, is reported in parts per million (ppm) or mass/volume (mg/L) of calcium carbonate (CaCO_3) in the water. Although water hardness usually measures only the total concentrations of calcium and magnesium (the two most prevalent divalent metal ions), iron, aluminium, and manganese can also be present at elevated levels in some locations. The presence of iron characteristically confers a brownish (rust-like) colour to the calcification, instead of white (the color of most of the other compounds).

Because it is the precise mixture of minerals dissolved in the water, together with the water's pH and temperature, that determines the behavior of the hardness, a single-number scale does not adequately describe hardness. Descriptions of hardness correspond roughly with ranges of mineral concentrations:

Soft:	0–60 mg/L
Moderately hard:	61–120 mg/L
Hard:	121–180 mg/L
Very hard:	≥ 181 mg/L

The level of total hardness in water can be evaluated with commercial testing kits, which measure the concentrations of calcium and magnesium. Several scales are used to describe the hardness of water in different contexts.

Potassium :

Potassium plays a central role in plant growth, and it often limits it. Potassium from dead plant and animal material is often bound to clay minerals in soils, before it dissolves in water. Consequently, it is readily taken up by plants again.

Potassium is weakly hazardous in water, but it does spread pretty rapidly, because of its relatively high mobility and low transformation potential. Potassium toxicity is usually caused by other components in a compound, for example cyanide in potassium cyanide.

Water Quality Guidelines :

Below is a table of guidelines that are practical and have been used successfully in general irrigated agriculture for evaluation of the common constituents in surface water,

Water Test Summary – Before Installation and After Installation of Magnetizer

groundwater, drainage water, sewage effluent and wastewater. They are based on certain assumptions which are given immediately following the table. These assumptions must be clearly understood but should not become rigid prerequisites.

GUIDELINES FOR INTERPRETATIONS OF WATER QUALITY FOR IRRIGATION							
Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
Salinity (affects crop water availability)							
	EC _w			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	TDS			mg/l	< 450	450 – 2000	> 2000
Infiltration(affects infiltration rate of water into the soil)							
SAR	= 0 – 3	and EC _w	=		> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6		=		> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12		=		> 1.9	1.9 – 0.5	< 0.5
	= 12 – 20		=		> 2.9	2.9 – 1.3	< 1.3
	= 20 – 40		=		> 5.0	5.0 – 2.9	< 2.9
Specific Ion Toxicity (affects sensitive crops)							
	Sodium (Na)						
	surface irrigation / drip irrigation			SAR	< 3	3 – 9	> 9
	Chloride (Cl)						
	surface irrigation / drip irrigation			me/l	< 4	4 – 10	> 10
	Boron (B)			mg/l	< 0.7	0.7 – 3.0	> 3.0
Miscellaneous Effects (affects susceptible crops)							
	Nitrogen (NO ₃ - N)			mg/l	< 5	5 – 30	> 30
	pH				Normal Range 6.5 – 8.4		

TEST REPORT

MICROBIOLOGICAL ANALYSIS OF LAKE WATER

Report No.	: Q2DX11-10282/10	Date	: 13/10/2011
Client Name	: [REDACTED]	Sampling Method	: APHA
Project Name	: Internal Quality Checking	Receiving Date / Time	: 11/10/2011 - 08:30 Hrs
Address & Location	: [REDACTED]	Test Dates	: 11/10/2011 - 13/10/2011
Contact Name	: [REDACTED]	Location	: [REDACTED]
Telephone & Fax No.	: [REDACTED]	Sampling Location	: Lake
Sample ID	: Lake water	Sample Container	: Residual chlorine neutralised
Laboratory Request No.	: Q2DX11-10282 (Q2/AD11-11190)	Sample Container	: Sterile bottle
Sample No	: S2DX11-10282 (S2/AD11-11190)	Received By	: [REDACTED] Rep.
Sampling Date / Time	: Not given	Tested By	: SAR
Sampled By	: Client's Rep.	Sample Receipt Temp.	: 4°C

Parameters	Methods	Units	Results
Total Coliforms *	APHA 9221 B	MPN/100ml	1.7 x 10 ²

Remarks : This test was conducted in [REDACTED] branch.

Test Method Variation : None.

GTL certifies that above tests were carried out in accordance with

1) Standard method for the examination of water and waste water 2005, APHA - AWWA - WEF 21st edition.

* This test is within ISO/IEC 17025 Accreditation scope of [REDACTED] branch.

- Result relates only to the item tested
- Report shall not be reproduced (Except in full) without written approval of the laboratory.

Form: MB/RP-01
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ROSANA M.
DEPARTMENT-IN-CHARGE
(CHEMICAL)

For [REDACTED] LABORATORY

