Desalination of Water and Soil

Salinity levels are one of the major challenges of the agricultural sector. Using magnetic systems addresses these issues successfully, as confirmed by numerous experimental results worldwide in totally different environments.

Soviet scientists have conducted countless tests and concluded that magnetized water is absorbed into the soil at 0.1 g /cm faster than non-magnetized. Rate of filtration doubles and every 100 g of soil, irrigated by magnetic water, loses more than 10 g of salt.

When a 5% aqueous solution of industrial iron sulphate underwent magnetic treatment, it produced meliorant, which extracted 20 g (per 100 g) more salt from soil than ordinary water. Subsequently, these findings were confirmed repeatedly in the field and in laboratory conditions.

Tests were carried out on soil with the following parameters:

CO_3^{2-}	0.019	Ca^{2+}	0.082
HCO_3^-	0.066	Mg^{2+}	0.006
Cl^-	0.572	$Na^+ + K^+$	1.072
SO_4^{2-}	1.663		

Dry residue 3.46 mg /l. Magnetic treatment of water with parameters (mg/l): HCO3 - 1.94; Cl - 0.79; Ca2 + - 1.16l Mg2 + - 0.76. Dry residue was 372 mg/l. Results indicated that at optimal settings of a magnetic system, treated water can be 5 times more effective in desalination than ordinary water.

A group of experts held a comparative experiment to test the effectiveness of the use of hydrochloric acid and magnetic water soil desalination provided an interrupted water supply to soil (1973). The experiment was carried out in laboratory and field conditions. Whole sections of soil were used in both cases. In the field experiment that was conducted on a plot of land from 25 to 100 m2, cross section of 0.8 m2

and depth of 2 m. A magnetic system was used to treat water with a flow rate of 1.5-2 m / sec.

Mineralization of the water ranged from 0.7 to 7.5 g/l.
Soil for irrigation contained chloride and sulfate salts. The highest point in the solubility of salts of this soil did not exceed 2.5%. A one meter thick layer contained up to 225 ton of salt per hectare. Whereas a layer of a 2 meter in thickness -340 tons.

Also soil had a lot of gypsum, up to 5.5% and 15- 20% at a depth of 20 cm and 120-140 cm, respectively. Sample soil contained large amounts of calcium carbonate. Total mass of absorbed substances (Ca, Mg, N, and K) equaled to 19-22 mg per 100 g of soil. Absorption of sodium exceeded the mentioned above amount by 20-25%.

In regards to chemical reagents, soil was treated with 0.5% and 1% hydrochloric acid solution taken in the amount equal to the shortage of moisture. Intake of hydrochloric acid was 8.6, 17.2, 25 and 34.4 tons per hectare.

Laboratory experiments showed that magnetic treatment of water accelerates the initial filtration rate by 20-30%. This pattern can improve the aggregate composition of the upper layers, which have a reduction of fine fractions (less than 0.005 mm) due to coagulation. A procedure of flushing soil with magnetic water causes an increase in mobile phosphate forms and increases volume of nitrification in the upper layers of the soil (see Table 3).

Table 3. Changes in the composition of nutrients of plants after

#	Indicators		
		0-20	20-40
1	Soil		
	N	0.50	0.27
	P_2O_5	6.60	4.00
	K_2O	75.30	57.80
2	After ushing with normal water		
	N	-	0.10
	P_2O_5	7.00	3.00
	K_2O	55.40	45.20
3	After ushing with magnetic water		
	N	3.70	0.60
	P_2O_5	8.20	4.50
	K_2O	53.60	41.60

treatment of soil with magnetized water (mg per 100 g of soil)

By watering a two meter monolithic layer of soil with high salinity, it was found that magnetic water flushes out salts by 18-32% more effectively than a solution of hydrochloric acid.

Results were obtained in field trials:

#	Глубина, м	Соль залегает в почве						Обессоливание			
		До промывки		После промывки				Обычная вода		Магнитная вода	
				Обычн.вода		Магнитная					
		%	т/Га	%	т/Га	%	т/Га	%	т/Га	%	т/Га
1	0-0.3	2.9	126	2.3	100	1.6	70	26	100	56	216
2	0.3-1.0	2.4	242	1.9	192	1.4	142	50	100	100	200
3	1.0-1.5	1.7	123	1.4	102	1.3	94	21	100	29	138
	Общая глубина										
4	0-1.0		368		292		212	76	100	156	205
5	0-1.5		451		394		306	97	100	185	192

It is also important to note that stubborn sodium sulfate would flush out more effectively in the early stages - more than 70%. Also magnetic treatment supports mineralization of water by up to 7-14 g/l.

Extensive field tests were conducted by Agro-physical Institute with collaboration of the Institute of Design of Water Systems and "Tajikistan-stroi". Tests were conducted in Zafarobadski area (Golodnaya Step, Tajikistan, USSR) in an area of 10 hectares of soil with most salinity. Tests took place after successful laboratory experiments. Square test plots were separated by drainage tracks. Soil samples were taken from each hectare at a depth of 0.3m, 1m and 1.5m before and after irrigation. Number of soil flushes was determined by a standard that included 12,000 m3 / ha (three stages of 4,000 m3/ha) on soil with 2.5% salt content. Total time period of soil flushing was 1.5 months.

Magnetic water is able to flush out salts 2 times more effectively than ordinary water (see Table 3). Found striking is the fact that ordinary water hardly flushes out any salts. This is particularly indicated by a content of HCO3 (see Table 5). The oxygen content of magnetic water is 10% higher than in ordinary water.

#	Anions	Water	
		Normal	Magnetized
1	Cl	30	50-80
2	SO_4^{2-}	15	30
3	HCO_3	0	30

The problem of soil desalination is related to another important issue - the use of saline water for irrigation. Currently brackish water is not suitable for irrigation for 2 reasons:

1. Plants accumulate salts, which in turn disrupts its metabolism.
2. Harsh salts accumulate in soil, making it impermeable to nutrients.

However, years of experience have shown that magnetic treatment can make salty water fit for agricultural irrigation. A set of experiments mainly in Azov and Black Seas gave positive results. Institute of Water and Irrigation in Azerbaijan held a series of experiments using magnetic treatment of salt water from Caspian Sea (salinity 14g/l). This resulted

in multiple harvests of sorghum and corn by 45% and 30% more yield than regular irrigation.
A method of using brackish water and soil desalination in agriculture.

Magnetic treatment of brackish water with devices by 'Magnetic Technologies' has the following effect:

- Prevents formation of encrustations in the pores of soil and plant capillaries.
- Breaks down and prevents formation of new salt crystals in irrigated soil by magnetic water.
- Increases nutrients accessibility to plants uptake.

Brackish water has a high salt content usually referred to as 1000-7000ppm as but less than that of seawater. It often obtained by mixing fresh and sea water, for example in river deltas and from ground water. Also brackish water can form as a result of human activity, i.e. creation of dams, shrimp farms, irrigation lakes etc. where small amounts of salt content remains and builds up after evaporation or irrigation extraction.

Brackish water is harmful for growing all terrestrial plants. Technically, brackish water contains from 0.5 to 30 grams of salt per liter. Most often expressed in units of 0.5 to 30 g per thousand (ppt or %). Thus water salinity is a very inaccurate parameter.

Degree of water salinity

Fresh water: <100 ppm
Urban water supply: up to 500 ppm
Irrigation water: up to 2000 ppm
Brackish water, soft: 1,000 - 7,000 ppm
Brackish water, moderate: 7,000 - 15,000 ppm
Brackish water, hard: 15,000 - 35,000 ppm
Seawater: 30,000 - 50,000 ppm (typically 35,000 ppm)
Dead Sea: 330,000 ppm
World water reserves

It was established that 97.5% of the world's water reserve is salt water and remaining 2.5% is fresh. About 70% of freshwater is locked in the glaciers of Antarctica and Greenland, and less than 1% is available for human consumption (0.007% of the world's water): lakes, rivers and

shallow underground sources. This 0.007% of world's reserves is replenished by rain and snowfall.

Everyday water is used for different purposes. Agriculture consumes on average over 60% of fresh water supplies; in Asia - 86%, North and Central America - 49%, in Europe -38%. Rice production requires large quantities of water, about 5,000 liters of water to grow 1 kg of rice (7,650 m3/ha.). However wheat still requires 4000 m3/ha and it takes 4,000 liters of water to produce 1 liter of biomass (ethanol).
According to rough estimates, about 10% of fresh water is used by households and only a small part of it is used for drinking.
It is also important to note that about 25% of fresh water is lost before it reaches end user due to leaks. Within agriculture approximately 40% fails to reach the plant for numerous reasons. Including mismanagement of irrigation systems in conjunction with leaks and inefficient storage facilities.

The use of Magnetic technologies

Magnetic treatment enables to use brackish water with a salt content of up to 6500 ppm for agriculture. It also enables the recycling of agricultural water for domestic purposes as grey water for toilets and gardens

Application of magnetic treatment for desalination of soil and its decontamination

Process of soil desalination

This issue can be efficiently resolved by magnetic treatment, which results in breaking down and dissolution of salt crystals contained both in water and soil.
This effect is supported by many experiments and practical applications of devices by 'Magnetic Technologies' across the globe.

Over 20 years of practical implementation of magnetic technologies in agriculture has led to the development of various types of devices. These vary in their specifications depending on the parameters of irrigation water, flow capacity and soil composition. Magnetized water is 2 times

more effective than ordinary water when it comes to flushing out harmful salts from soil and retains its effectiveness in cases of mineralization of water by up to 7000-8000 ppm. It can even cope with such compounds as sodium sulfate.

Irrigation of plants using brackish water has the following implications:

1. Salt crystals accumulate in and upon the soil, making it unsuitable for agriculture, being un-penetrable by irrigation and rain water

2. Salt crystals accumulate in and upon the plant slowing down its metabolism, suffocating it from water absorption.

Magnetic water treatment in field trials using devices of 'Magnetic Technologies' made it possible to use Caspian Sea water (14,000 ppm) for irrigation.

Effect of magnetic treatment on deep underground sources of brackish water.

Experiments show that magnetic water can gradually desalinate deep sources of brackish water, making it suitable for irrigation in the future.

Conclusion
Magnetically treated brackish water has many advantages over non-magnetically treated water because of its ability to break down crystals of salt and other
adverse materials found in agriculture environments, thereby cleaning the soil and allowing plants to effectively absorb nutrients, while not accumulating harmful substances.

The most successful results from practice were:

- 45% increase in total crop of sorghum.
- 30% increase in total crop of maize compared to ordinary irrigation water.

It has been proven that magnetic water absorbs into soil faster, more effectively and has ability to cleanse it from various harmful compounds.

The use of magnetic devices:

- Has no side effects side effects and is harmless to plants.
- Decontaminates soil and water used for irrigation.
- Warranty period of each device is at least 10 to 15 years, during which a lot of saline cultivated areas can be restored.