Center of Ecological Systems and Technologies (ECOST)
Ministry of Immigrant Absorption of Israel
Union of Immigrant Scientists of Israel

**The 12th Annual Ecological
Immigrant Scientists Conference
from the cycle "Ecological Problems of Israel"**

WATER CRISIS IN ISRAEL AND WAYS OF ITS OVERCOMING

By financial support of
Ministry of Immigrant Absorption of Israel

PROCEEDINGS

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WATER CRISIS IN ISRAEL
AND WAYS OF ITS OVERCOMING

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PROGRAM OF THE CONFERENCE

"WATER CRISIS IN ISRAEL AND WAYS OF ITS OVERCOMING"

Registration	**9.15 – 10.00**
Greeting	**10.00 – 10.30**
Reports:	
Prof. Leonid Krasilschikov, Prof. Nonna Manusov, Dr. Efim Manusov *Water Crisis in Israel and Ways of Its Management*	**10.30 – 11.15**
Dr. Michael Milov, Dr. Israel Edelson *Increase in Fresh Water Amount at the Expense of Freshening and Demineralization, and at the Expense of Rain-Water Collection and Utilization*	**11.15 – 12.00**
Dr. Leonid Blyankman, Dr. Israel Lirisman *Systems of Purification and Repeated Use of Industrial Sewage*	**12.00 – 12.45**
Prof. Lev Boroshok *The State of the Dead Sea as Part of the Israeli Water Crisis and Efficient Ways of the Crisis Management*	**12.45 – 13.15**
Coffee Break	**13.15 – 13.45**
Dr. Yakov Sosnovsky, M.Sc. Beniamin Marash, M.Sc. Yevgeni Ary'ev *Structural Factors of Energy Economy and Rational Utilization of Natural Resources in Israel (in Hebrew)*	**13.45 – 14.30**
Dr. Alexander Tzikerman, M.Sc. Max Shenkerman *Soil and Underground Water Pollution by Industrial and Agricultural Wastes (in Hebrew)*	**14.30 – 15.15**
Communications:	
Dr. Mark Bokman *On Water Reserves in Israel*	**15.15 – 15.30**
Dr. Ilia Linger *Water Purification and Disinfection by Means of the UV Method*	**15.30 – 15.45**
Marina Turkinets *Water in Jewish Tradition*	**15.45 – 16.00**

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DIVISION INTO DISTRICTS OF THE MUNICIPAL TERRITORY CONSIDERING THE MOTOR TRANSPORT ECOLOGY

Valery Anfimov, Elena Goldman

The municipal territory from the point of view of urban ecology is heterogeneous, for there can be distinguished various elements comprising this territory. These elements, exerting an influence on the range of pollution and its transformation, are as follows:

1. Streets, the number of traffic lines, pavements and dividing lines. The urban traffic is based on streets with 2, 3, 6 and 8 lines, boulevards and avenues with different traffic intensity and types of vehicles. This diversity causes different volumes of exhaust and pollution.
2. The traffic-operational properties of the street influencing the speed of motor transport and, subsequently, the waste volume.
3. Longitudinal slopes due to the locality relief, exerting a considerable impact on the waste volume.
4. Intersections and cross-roads promoting formation of queues and traffic jams and causing concentration of waste exhausted by motor vehicles.
5. Grounds and stripes assigned for parking.

At the same time, the municipal territory contains elements exerting influence on transformation of motor transport exhaust. These elements are as follows:

- storey rate of buildings, type and density of residential quarters;
- arrangement of streets with regard to prevailing winds;
- wind speed, relative air humidity and precipitations with regard to the town microclimate;
- squares with plantation and the type of vegetation planted.

To distinguish biotones (territories with different amounts of motor transport waste), coefficients characterizing changes in waste amounts can be used. As an example, provided in Table 1 herewith are coefficients of changes in waste amount (k 1) as related to traffic intensity (the accepted traffic structure is averaged for the given town).

Table 1

Type of the street	*Number of traffic lines*	*Traffic intensity / 24 hours*	*Coefficient of change in waste amount, k1*
Avenue	8	124800	4
Avenue	6	93600	3
Avenue	4	62400	2
District street	2	31200	1
Streets with one-way traffic	3	15600	0.5

In Table 1 hereinabove theoretical intensity of one traffic line (1200 vehicles per hour) is accepted. The motor transport exhaust volume (kg/km) and the coefficient of change in waste amount (k1) in Jerusalem streets (for the average traffic structure as related to specific pollutants) depending on the traffic intensity (vehicles per 24 hours) are provided in Table 2 hereinafter.

Table 2

Intensity / amounts	*PM*	*HC*	*COx*	*NOx*	*Coefficient (k1)*
15600	1.91	16.2	140.82	37.23	0.5
31200	3.82	32.4	281.7	74.5	1.0

where *PM* are solid particles,
HC is the fuel which did not burn out,
COx are the carbon monoxide and carbon dioxide gases,
NOx are nitrogen oxide and nitrogen dioxide.

The traffic-operational indices of the street, such as durability, flatness and roughness, influence the speed of the vehicle and, subsequently, the exhaust volume. The data of the traffic-operational indices and the coefficient of change in waste amount are presented in Table 3 hereinafter.

Table 3

Road covering durability	*Speed, km/h*	*Coefficient of change in waste amount, k2*	*Flatness, cm/km*	*Speed, km/h*	*Coefficient of change in waste amount, k2*
1.0-1.1	100	1.0	50	120	1.0

0.9	80	1.2	100	85-90	1.1
0.8	60	1.4	200	60-70	1.2
0.7	30	1.6	300	50-60	1.3

Upon deterioration of the traffic-operational indices the motor transport exhaust volume increases. The longitudinal slope also influences reduction or increase in the motor transport exhaust volume. The data of the indices related to the change in waste amount depending on longitudinal slopes are presented in Table 4 hereinafter.

Table 4

Descent slant	*Descent coefficient k3*	*Ascent slant*	*Ascent coefficient k3*
0	1.0	0	1.0
2	0.95	2	1.05
4	0.8	4	1.1
6	0.7	6	1.2
8	0.6	8	1.6
10	0.5	10	2.0

Cross-roads and intersections of streets, avenues and boulevards are the most polluted places in the town, as far as the motor transport exhaust is concerned.

Pollution coefficients as related to cross-roads and intersections in towns are presented in Table 5 hereinafter.

Table 5

Type of intersection	*Coefficient of change in pollution volume, k4*
Different levels	1.0
One level, unregulated circular movement	1.6
One level, regulated by traffic light	1.2 – for green traffic light wave 1.9 – with stops at red traffic lights

Using the hereinabove coefficients, we can determine for different sections of the town the volumes of pollution caused by motor transport, distinguish biotones with constant levels of pollution (both for the existing network of streets and for streets under design), and to elaborate a system of measures for pollution level reduction.

PURIFICATION AND REPEATED USE OF SEWAGE WILL REDUCE THE AMOUNT OF FRESH WATER CONSUMPTION

Leonid Blyankman

Israel is a country with developed industry and agriculture. That is why development of reversible systems of water supply will bring about a considerable reduction in water consumption. The degree of sewage purification with the purpose of its repeated use is determined by the technology applied: sometimes it is sufficient to remove suspended substances, in other cases it is also necessary to reduce the water salinity. Let us consider several methods of sewage purification and samples of its repeated use.

Use of ion-interchangeable tar materials

It is known that ion-interchangeable tar materials are widely used for preparation of desalted water to provide feeding of boilers at power stations. Recently they have been successfully used for purification of streaming (cleansing) waters, namely chromic drainage waters, containing heavy metals. According to the technology of the process, the salt content in water is supposed not to exceed 20 mg/l. Cascade cleansing and filtration of water through tar materials, creation of a closed system of water supply meets these requirements. With appearance of cheap tar materials ready to be used, there is no need even for their regeneration. In Israel this method is used at tens of enterprises. Substitution of tar materials is provided once in 3-6 months.

Purification by means of ultra-filtration

Ultra-filtration enables to extract from water suspended substances, colloids and bacteria, at that the saline composition of water actually does not change. Thus, if the water contains valuable components, they sometimes can be repeatedly used. For instance, in a kibbutz flowers are cultivated in a hothouse, and they are watered with solution containing nutritious substances. The surplus water flows to the sewers. Use of ultra-filtration and returning water to the hothouse enabled to reduce water consumption twice as much, and the nutritious substances consumption for 20%.

Application of nano-filtration enables to reduce the amount of organic substances and the salt content in water. Use of this method for the purpose of sewage purification following cleansing of containers in airplanes

spraying pesticides and insecticides enabled to reduce COD from 5000 down to 500 mg/l and salinity from 5000 down to 1200 mg/l, thus providing the possibility of repeated use of water for inner needs.

Application of ultra-filtration and reverse osmosis enabled to develop a reversible system of water supply at the enterprise for production of airplane turbine blades. Sewage waters contain heavy metals, acid anions, detergents. Productivity rate of the purified water installation comprises $5m^3$ per hour. The reversible osmosis concentrate is subjected to evaporation.

Application of direct magnets

Direct magnets are applied to removal of steel colloids reacting to the magnetic field. The pilot tests implemented at the enterprise for blades production indicated that after the colloid iron has been removed, the water can be used in reversible cycle. The necessary parameters of drainage processing have been determined. The enterprise is interested in purification plant construction.

ON WATER RESERVES IN ISRAEL

Mark Bokman

Water problem in Israel is well-known. Yet, according to data of Jewish Encyclopedia, more than 500 mln cubic meters of fresh water are poured into the Mediterranean annually. It is possible to direct this water practically by gravity to the Sea of Galilee which is situated 200 m lower than the sea level. To attain this it is necessary to lay a water duct along the Mediterranean shore from Ashkelon to the border with Lebanon at the distance of some tens of meters from the breaker line. This water duct will collect all water which flows into the Mediterranean along rivers, vadi, Earth's surface and partially underground. It will collect this water at the last minute before the water merges with sea saline water and will transport it to the second duct, from which it will flow by gravity from Haifa to the Sea of Galilee.

The Sea of Galilee cannot accommodate all this water. But close to that place there are ravines which are also situated lower than the sea level. In case these ravines won't be sufficient, it is possible to create water reservoirs in the lower part of Jordan river between the Sea of Galilee and the Dead Sea. Besides, it would be necessary to build water reservoirs along the river beds, as it was proposed by professor L. Krasilschikov, because these reservoirs will damper water torrents during rains, partially retain flooding garbage, feed rivers during the dry season and serve as additional water reservoirs.

As the result, Israel will additionally get up to 500 mln cubic meters of good fresh water per year.

This project has a number of obvious advantages:

1. In comparison with water import, the proposed project frees our country from strategic dependence on countries whose friendly ties with Israel as far from being stable.
2. In comparison with desalinated water, this project will decrease expenditures on capital construction, exploitation costs and water self-cost. It will also produce water of higher quality.
3. There will be much more water than it is necessary for our country. We would be able to sell water to Jordan and even to Syria in exchange for Golan Heights.

To our great regret:

1. Water quality in Israeli rivers doesn’t absolutely correspond to requirements posed to it at present. This water cannot be used for drinking, for household duties and in industry. It is forbidden to enter this water.
2. During many years dirty flows let a lot of dirt in river beds thus making them unfit for clean water transportation.

At the same time, I would like to draw your attention to the fact that Moscow river which flows through an industrial megapolis with population of 12 mln people can be used for swimming and fishing. Water in Moscow river is not worse than in the Sea of Galilee, though there is an oil refinery and metallurgical plants as well as chemical and machine-building enterprises and huge household sewage. This proves that even under conditions of developed industry it is possible to maintain natural conditions in water reservoirs and rivers.

Treatment of sewage from enterprises and settlements, development of circulating water supply at enterprises and application of sewage treated from feces for watering grass, trees and agricultural plants will permit to free big volumes of clean fresh water. During last years different systems of sewage treatment including biological ones and those based on ultraviolet filters, nanofilters and reverse osmosis have been developed with the aim of turning any kind of sewage into storm water. Circulating water supply is widely used abroad at industrial enterprises, water treated from feces is widely used for watering flower beds. It should be noted that in Israel activities on sewage purification and development of circulating water supply are also carried out on a larger scale. But they are introduced not so intensively and at random.

In the places where it is technically possible and economically expedient, pipes can be run in the existing river beds through which sewage that doesn't meet requirements to storm water is to be flowing. A new river bed is to be dug parallel to the old river bed and the pipe, and clean water will flow along this new river bed. In future when sewage after treatment will meet the requirements of storm water, they can be directed to the new river bed. The technology proposed doesn't exclude, where it is possible, cleaning of the existing river bed

Water division into clean (rain) water and dirty sewage can decrease quantity of water flowing along new river beds. This insufficiency can be

compensated by a chain of water reservoirs created in each river due to proposal of prof. L. Krasilschikov which will collect water during rainy period and feed rivers during dry seasons, thus compensating for the volume of dirty sewage directed to pipes. Clean water from water reservoirs going through rivers during summer time will also enter the Sea of Galilee. Water reservoirs will feed underground water reservoirs. Water from them can be used for watering. And water parks and recreation zones will be situated along the banks of clean rivers and water reservoirs.

Projects which envisage secondary application of used waste waters are recouped within admissible period of time with the existing cost of water and purification structures. That's why they can be paid by enterprises and settlements which produce them. Created water reservoirs, water parks and recreation zones are also self-recouped. Their development can be paid by the future owners.

Rough preliminary calculations show that for construction of a water duct along the Mediterranean shore, a water duct from Haifa to the Sea of Galilee and new river beds formation along rivers Yarkon, Alexander, Kishon, Lachish, Kziv, Gahaton, etc. about $ 1.3 billion will be necessary. This project can give (with the price of 2 NIS per 1 cu m of water) up to 1 billion NIS per year. Which will permit to recoup expenditures within the acceptable time limits with a guarantee. For financing the project it is possible to create a joint-stock company where Israeli government, private enterprises and people all over the world can become its shareholders. It should be noted that expenditures for development of infrastructure attain 2.6 NIS (less than $0.7) per cubic meter of water a year. While according to data of Minister A. Liberman with desalination capital expenditures are equal to $ 3 per cu m of water a year. Hence, the project proposed is more than 4 times more profitable than desalination in relation to capital expenditures.

Companied engaged in gas and oil prospecting have gathered a lot of money. Positive results of these companies are questionable. In our case water is present. Its quantity is known from yearly reports. In contrast to oil and gas it would never be depleted. Expenditures for creating infrastructure for collecting and transporting water can be easily calculated by specialists. The project is absolutely transparent and reliable. That's why selling of the shares in such a company is without doubt. It is also possible to get credit under shares or Israeli government guarantees. All the above said proves the possibility of collecting and application of rain waters.

It is clear that the project is far from being simple. The present report should be considered only as setting the problem. But there are a lot of highly qualified specialists, such as Manusova, Krasilschikov, etc., specialists in nano-technologies, water resources, purification structures. Specialists from other countries can be also invited for developing the project.

There will be opponents to this project inside Israel. But there will be proponents as well: Greens, builders of protective wall, suppliers of different kinds of filters, Ministry of environment protection, etc.

The realization of this project will permit to save Israel from problems with potable water for many years to come, will turn our Land from a place where instead of milk and honey, the rivers are full of poisonous substances into a country which is ecologically safe and can serve as an example for many other countries.

People won't forget those who participated in realization of this project, and their names will be cut on stones at the entrances to parks and national reserves. They will have the preliminary right for shares in the joint-stock company mentioned.

I consider it useful if the present conference takes a decision "Recommend the corresponding ministries and companies to create a committee for detailed study of this proposal and taking a necessary decision".

CONDITION OF THE DEAD SEA AS CHAIN LINK OF WATER CRISIS IN ISRAEL AND EFFECTIVE WAYS OF OVERCOMING OF THIS CRISIS

Lev Boroshok

Only application of the sea-water desalination the stocks of which in the world are not restricted and will remain same at any cataclysms of a climate for the present exist the planet "Earth", can be the best alternative of all-climatic maintenance of Israel by water resource in the time of repetitive water crises. But it is a question not about notorious desalination an archaic method by the reverse osmosis (RO) which has already gained a residence permit in Israel and continues to expand the presence intensively. And all it not looking that this method possesses essential deficiencies. Such, for example, as high specific expenses of energy, low wear-resistance of membranes and variety of others that leads to the high cost price of made sweet water.

It is known a number of the perfect and economic methods of desalination of great volumes of sea-water. For example, in the capacity of a rational and economic method of desalination it is possible to offer a method of desalination, which use the hydrodynamic principles. The specific power rate of this type of distiller approximately in eight times is less, than in the distillers which working by method RO. Besides, in it there are no rapidly wearing parts. Just the desalination of the sea-water by the low-cost and reliable way remains the only method of the solution of "water crisis". To hope basically for “rainfall run-offs” in the conditions of Israel this same, what to rely on a principle "Авось". Use of hydrodynamic distiller of sea-water will be the all-climatic measure during many years forward, but does not small mend of holes in ragged garments the systems of water resources of Israel.

The deplorable state of the drying up Dead Sea can be adding too to results of water crisis. At least because one of the reasons of drying up of the Dead Sea is that from economic reasons and a lack of fresh water in Israel, the fresh water which was giving to the Dead Sea from lake Kineret through the river Iordan, has been blocked.

About necessity to preserve the drying up Dead Sea speak much in Israel at all levels, but undertake nothing. Here miss such important circumstance, that rational realization of a question of preservation of the Dead Sea will allow to solve two principal tasks. The first of them solves directly

questions of preservation of the Dead Sea. The second principal task solves questions of rational use of its energy potential. And both problems can be solved by means of one technical action. It is a laying of a water main from Red sea to the Dead Sea for feeding water to the Dead Sea. And the hydropower complex will have been built on a branch of the water main going down to the Dead Sea. This hydropower complex will allow to use an energy potential of the Dead Sea.

The induced recharge of the Dead Sea should be fulfilled only by the sweet (desalinated) water. The induced recharge by sea water of the Red or Mediterranean sea can cause the negative phenomena of reaction of the solute salts what will lead to setting of sediments and gassing with a bad smell. Water will become muddy and will lose the medical properties, there will be a sharp unpleasant smell from gas. The Dead Sea will appear in general mutilate, as medical region.

Rational and admissible volumes of feeding of the Dead Sea with water from an external source should be accurately proved. It is counted up, that it is necessary to fill no more than $620 \cdot 10^6$ m^3/year (20 m^3/c) for stabilization of condition of the Dead Sea. The Dead Sea will be already replete after 5 – 10 years if to fill more. Flooding of coastal roads, hotels, and infrastructure constructions will begin.

The installed capacity of a hydroelectric complex of the water main will make up 66 MW at giving through it specified above water volume. This quantity of the electric power should provide all own energy-requirements of the water main, and also will allow to receive a deal of the additional electric power.

It is required 17.7 MW of the installed capacity of power station on transportation of water from the Red sea to the Dead Sea at the optimum constructive scheme of the water main, for technical and economic needs of the water main it is required 1,8 MW. The others 46,5 MW can be used on desalination of the sea water.

The power station with the installed capacity 310 MW is required for desalination all volume of submitted water ($620 \cdot 10^6$ m^3/year) on a method of the reverse osmosis (RO), applied in Israel. Therefore use of this method for feed of the Dead Sea by the freshened water is impossible. Own energy will not suffice for such action.

The energy source with the installed capacity 38,75 MW is required for desalination all volume of submitted water by perfect modern methods, for

example by the hydrodynamic method. Hence, all needs of the water main including desalination of all volume of given water can be ensured by the electric power in this case. And still there will be a remainder of the installed capacity of the hydropower complex at a size of 8,25 MW. This remainder can be used for additional desalination of the sea-water in volume $130 \cdot 10^6$ m^3/year, what will facilitate water crisis in Israel a little. It is very important also, that development of a new progressive method of the desalination will begin in Israel. And it will speed up overcoming of water crisis.

ELECTRODIALYSIS PLANT FOR WATER DEMINERALIZATION

Israel Edelson

Actuality of the Development

Lack of fresh water is an urgent problem in many countries all over the world.

Industrial and cultural development, as well as population growth, lead to increase water famine, exhaustion and pollution of water sources and, as a result, to ecocatastrophes.

Economic significance. In the proposed electrodialysis plant for demineralization of water, electrochemical and electro physical technologies for purification and disinfection of water are used. The plant is simple and reliable, it can operate at the highest level, needs small area and does not require usage of chemical reagents for water purification. The plant can be stationary, mobile or portable, with different level of productivity, for individual or group utilization.

Realization of the proposed project can help solving the problem of fresh water supplies at comparatively low costs, as well as a range of ecological problems in Israel and other countries of the world.

Technical Analysis

Overall Aim and Specific Objectives

Overall aim: development of a basic electrodialysis plant for demineralization of water, which will have the same high technical indices as analogous plants made in the USA, France and Japan, and with capital and current expenses reduced to 20-30%.

Specific Objectives:

- Develop a configuration of plants for water purification and disinfection with different kinds and levels of pollution and usage of a basic electrodialysis plant.
- Arrange conditions for industrial production of plants for purification and disinfection of water and supplying them to the customers.

Background and Rationale

Logical background of the project development:

Achievements in creation of demineralization plants for sewage and artesian water without application of any chemical reagents at the minimum power, operational and capital costs.

Necessity of further reduction of expenses on manufacturing and exploitation of plants for water purification.

The main reason to carry out the proposed project lie in the necessary to:

Develop the basic plant for water demineralization

Intensify technological process at the basic plant with productivity increase up to 20-30% and lessening specific power consumption to 10-15% in comparison with analogous models of other companies

Develop a model configuration of plants for purification and disinfection of water having the basic plant as a base for different kinds and levels of pollution

Arrange the conditions for industrial productions of plants according to the customer's requirements, their supplying and installation.

The essence of the problem from the ecological point of view lies in the fact that in the most cases natural water recourses are not suitable for drinking. Thus, purification and disinfection of water are extremely required. This concerns all surface and underground water recourses in many countries all around the world. Manufacturing water supply systems of urban type in the countryside is expensive and unreal.

Meanwhile, the proposed plants are sample, reliable in work, can operate of the highest level, they do not require large area for installation and chemical reagents, can be stationary or portable, with different level of productivity.

The problem from the technical point of view lies in the fact, that the plants have to process water solutions with admixtures of various physical, chemical and biological agents of different dispersion.

The Problem

The principal achievement is creation of demineralization plants for sea and artesian water without application of any chemical reagents at the minimum power, operating and prime costs.

The method is surprisingly simple, cheap in operation and perfectly pure with respect to ecology. The plants are characterized with stable output parameters (TDS), lower sensitivity to mechanical contamination and bacteria, lower contamination to free chlorine.

Technology combines four major effective procedures in one efficient system. It combines electrodialysis, electrolysis, electro osmosis and electro membrane in one design configuration.

Plants provide with water treatment:

- from water hardness of 99.9%;
- from heavy metals and ferrum of 99.5%;
- from organic admixtures of 98%;
- from nitrates, nitrides and ammonia of 100%;
- from sulfhuretted hydrogen of 90%.

The application field of the plants is wide, including a purification in any power stations, in the plants for demineralization of artesian water, for cattle-breeding, fruit and vegetable farms, purification of water from nitrates, nitrides arsenic, mercury, boron etc.

The Solutions

The problem of the customer is to reduce capital and current expenses on production of purified water.

The problem is solved by increasing the productivity of the plant up to 20-30% and reducing its specific power consumption to 10% with the rise of its initial cost no more than 1%.

Technology. The special spacers are put into the plant module between rotational demineralizing and concentrated chambers. These spacers provide laminar mode of water movement through the module (with Re = 300-400) with macro disturbances in the stream of running wave (like on the dolphin hide). At the same time, liquid friction is reduced and mass transfer in the liquid flow is increased. The channel of a spacer is made as a

Archimedean spiral 12 m long, 10 mm wide, 1.0 mm high and radial partitions of a quarter of the height.

In the existing electrodialysis apparatuses membrane caskets are used, e.g., american Mark 1, Mark 2, in which the direction of water flow is constantly changing to the reverse at right angles. Loss of pressure in this case is 2 kg/cm^2. In our plant loss of pressure is no more than 0.7 kg/cm^2.

With permanent voltage current density in the solution increases significantly. Recalculation to the number of ion exchange shows the increase form 0.3-0.4 to 0.6-0.7.

The effect of mass transfer increase is especially significant while processing viscous hydrates, for example, when whey is demineralized and where classic frame does not work.

Applications

Purification and mineralization of water from artesian wells up to the quality of drinking water.

Purification and disinfection of waste water and its further use in agriculture.

Purification and demineralization of salt water from underground sources (up to 10 g/l), production of water with the set parameters (salinity, pH, salinity of different kinds of salts, etc) using for selective watering of crops (tomatoes, cotton, drupaceous, etc).

Demineralization of whey in dairy factories.

Purification of water from nitrates, arsenic, mercury, boron and other admixtures.

ECOLOGICAL ENLIGHTENMENT IN NETIVOT

Alexander Furman

This year ECOST started educational activities among immigrants. The forms of educational activities are internal studies in regional clubs, seminars, outside studies.

Netivot population is 25.000 residents (among them an audience of about 3.500 comprising the Russin-speaking community).

Ecological environment of Netivot: the town is situated in the transitional desert-subtropical zone, and is characterized by considerable erosion of loess soils. There are two small forest lots (coniferous and eucalyptus), a large number of river-beds drying up in summer. The largest river-bed is Grar.

The relief type is that of a flat plain.

Various subjects related to ecology were elaborated at the Netivot regional ECOST department, including practical activities, such as substitution of several cultivated garden species.

(Succulent and coniferous species were planted with the purpose of water economy; to slow down soil erosion and ravine formation bushes were planted).

The Netivot residents engaged in ECOST studies are acquainted with flora species used for greenery planting in the town and with flora species of the surrounding forests, with the scheme of the rock strata disposition and the underground water bedding, with methodology of folk medical treatment.

Under specific conditions of Netivot ecological enlightenment is extremely important for improvement of the local ecological situation.

ON THE CHOICE OF THE CONCRETE MIXER WORKING REGIME WHEN UTILIZING "SORBEX" SORBENT

Yuli Ilyevsky, Ludmila Kireycheva

Our center ECOST offers geo-chemical barriers using the granules of artificial sorbent of SORBEX type as protection means for water sources (see report "Protection of Israeli underground water resources by means of artificial geo-chemical barriers" by N.Manusov and L.Kireycheva in this book).

This report is devoted to sorbent utilization, which is a mandatory part of this sorbent application. We offer to insert the exhaust sorbent into the concrete mass to be used in curbstone production. The concrete mass is processed in a drum-type mixing device (MD) before anything is formed from it. MD may work in one of three regimes (Fig. 1): centrifugal, cataracting, and cascading. The choice of one of these regimes is determined by the value of n revolutions per minute, that is, correspondingly: n_{cen}; n_{cat}, and n_{cas}.

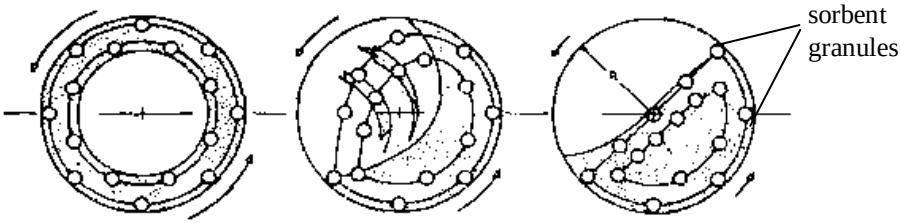

Fig. 1. Centrifuging, cataracting, and cascading motion regimes of sorbent granules in a drum-type concrete mixers.

Reasoning from the balance of forces affecting every sorbent granule, we receive the following expression for the centrifugal regime (CR):

$$n_{CR} = 29.9/\sqrt{R} \qquad (1)$$

where R is MD radius.

The formula (1) is received on the stipulation that MD radius is given in meters, and acceleration of gravity is $g = 9.81 m^2/sec$.

It is the theoretically minimal number of revolutions of MD in order to achieve CR. For a really achievable CR (RCR) we will have the following expression:

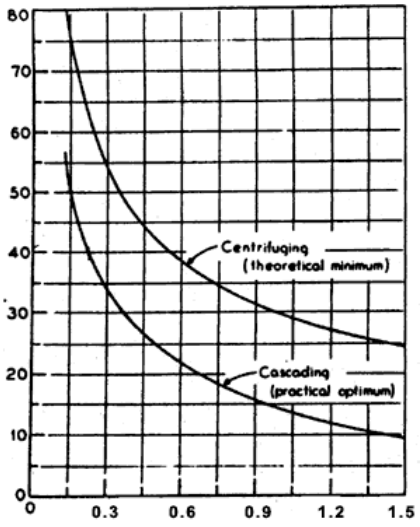

Fig. 2. Plot of critical centrifuging RPM and optimum cascading RPM drum radius of a concrete mixer.

$$n_{RCR} = 20.44/\sqrt{R} - 6.67\sqrt{R} \quad (2)$$

As may be seen from Fig. 1, different working regimes lie in the interval from n_{RCR} (when $n < n_{\mathrm{RCR}}$ no mixing will be done) to n_{RCasR}, that is real cascading regime, since when $n > n_{\mathrm{RCasR}}$ the sorbent granules may split up and the sorbed contaminations will exude. Making the graphical representation of the relations $n_{\mathrm{RCR}} = f_1(R)$ and $n_{\mathrm{RCasR}} = f_2(R)$, where R is MD radius in meters, we will receive the curves shown in Fig. 2. Since these curves may be identified as hyperbolas, the experimentally received curves (Fig. 2) might be extrapolated for MD having practically any radius.

WATER RESOURCES OF ISRAEL, THEIR STATE AND PERSPECTIVES OF THEIR FURTHER UTILIZATION

Leonid Krasilschikov

In Israel a program of emergency means has been elaborated to guarantee provision of the country with sweet water. The program proposes to aggravate the control procedures related to water consumption and to introduce exploitation of additional desalinating complexes. The governmental program did not include measures assigned to save the natural resources, to promote a more efficient use of underground and rain waters, to elaborate measures and to develop equipment for water economy and preservation of its quality under transportation. There were not regarded up-to-date methods of using artificial rain, obtaining production amounts of water from air, etc.

The natural water resources of Israel, their condition and perspectives of further use have been thoroughly considered in professional literature (1, 2). On the basis of these publications, proposed and substantiated herewith are certain measures to be implemented for preservation and rational use of natural water resources.

The water resources of Israel are mainly formed at the expense of atmospheric precipitations which comprise an average annual quantity of about 10 billion m^3. The precipitations are spent to provide surface fluxes, vaporization and infiltration.

The surface fluxes of rain waters are hardly used, and their overwhelming part runs down to the sea. According to the data processed by the authorities providing hydrological services, the average quantity of water fluxes running down to the Mediterranean Sea reaches 500 million m^3. It is noted that in the course of the last 5-6 years this quantity decreased to about 300 million m^3 (2).

Vaporization is practically not measured. To provide an approximate estimation of actual vaporization, we elaborated a calculation technique (7). The approximate value of actual annual average vaporization obtained by mean of this technique comprises 3 billion m^3.

Infiltration of rain waters according to the data of the authorities providing hydrological services (3, 6) is estimated as reaching 1700 million m^3, of which about 780 million m^3 penetrate into underground waters of the coastal and the mountain aquifers (2).

The problems of using surface fluxes of rain waters were studied in Israel by many researchers. A number of reservoirs were constructed. Analysis of functioning of these reservoirs indicates their low efficiency. Since 1992 we have been proposing a methodology providing implementation of measures for management, complex and rational use of surface fluxes of rain waters under condition of favorable natural environment preservation and protection of water resources from exhaustion and pollution (4).

These measures are based on analysis of regularity of formation and relief of surface fluxes of rain waters and their change by means of engineering constructions. The engineering constructions are recommended to be allocated in the form of a "cascade" in upper sections of mountainous and pre-mountainous zones, where in numerous small tributaries of mountain rivers the rain flux is formed and where the negligible water masses are slow and easily managed. The engineering constructions constitute low dams of the overflowing type (2-3 m high). Above the dam reservoirs are formed, in which rain waters will be accumulated. The constructions will create favorable conditions for infiltration of rain waters and increase in influx to underground water resources and improvement of their quality (4, 7).

The problems of underground water layers in Israel

It is proposed to study the processes of hydro-geological development in the underground water layers by means of conditional hydro-geological maps in sections of specific sub-horizons (6).There are no such maps in Israel. These maps will clarify the efficiency of exploitation of the existing underground water system, their exhaustion and pollution in different parts of the layer. It is proposed to develop a set of hydro-geological maps, each one of them reflecting properties of sub-horizons as related to that or another specific index, its area, section, littoral composition, hydrodynamic features, parameters of water abundance, chemical composition of underground waters, water pollution, etc. Analysis of hydro-geological maps of each sub-horizon will enable to identify sources of its pollution by various pollutants and to elaborate measures preventing or diminishing the processes of pollution of the sub-horizon studied or of the adjoining ones.

The problems of Lake Kinneret

The inadmissible lowering of the lake water-level was referred to, and measures were stipulated to diminish water extraction. But no possible

future changes in the water balance, which can cause drastic changes in its quality and quantity, were taken into account. Our special studies (8) indicated that Kinneret and the Golan heights constitute an integral ecological system. 96% to 99% of the surface water flux from numerous rivulets and streams feeding Kinneret come (both directly and through the Jordan river-bed) from the slopes of the Golan heights. At present, the industrial and agricultural drainage on the Golan heights is insignificant, its effect on the Kinneret water quality is unessential, and it is under sanitary control. The fate of Lake Kinneret and, subsequently, of the all-national Israeli Conduit, depends on the Jordan river flux and the ecological condition of the Golan heights territory. Growth of population on the Golan plateau, industrial and agricultural development will cause acute water quality deterioration in Kinneret, impossibility of using it for water supply, and a deep water crisis throughout the entire Middle East. Thus, any solution concerning the Golan plateau must be based on scientifically grounded analysis and prognosis of the environment within the integral ecosystem "Lake Kinneret – Golan plateau".

The problems of water economy in Israel

The governmental program proposes to aggravate the control procedures related to water consumption. These measures undoubtedly will be useful. But for substantial water economy it is indispensable to develop methodologies and appliances enabling to provide efficient water economy. A considerable number of such proposals were delivered to the Ministry of National Infrastructures in 2001-2002. They were accepted by the Consultative Committee engaged in the issues related to the relevant problems, and a special protocol was issued with recommendations to consider these proposals and promote their further implementation. Nonetheless, this was not accomplished. It is herewith recommended to announce a tender for development of methodologies and appliances enabling to provide efficient water economy, and to establish a special laboratory for selection of the most efficient proposals, their promotion and providing the specialists with assistance in developing production samples. Arranged introduction of such appliances throughout the country will enable to obtain an economy of water reaching tens and hundreds of millions of cubic meters.

Measures for prevention of repeated pollution of water supplied by transportation means

Supply of cheap drinking water meeting the modern requirements of quality becomes an ever growing difficult problem, since the quality of the water supplied can be sufficiently changed on the entire way to the consumer, and it is necessary to study, control and manage its quality all the way along the process of its transfer from the source to the consumer.

As applied to the Israeli conditions, we distinguish, in general, 5 stages of water supply to the population, though in specific territories, where water supply is based on combined use of several sources with different chemical and isotope composition, and their distances from the consumers are different, the number of stages subsequently can be more that that basically determined, regarding the sources of drinking water supply, plants for water extraction, large-scale consumers with their own stations for water distribution (municipal authority, kibbutz, settlement etc.), tracks of water fluxes, consumers. The first three stages are provided with water quality control. But, before reaching the consumer, the water passes through pipelines. In most cases the pipelines of populated areas are obsolete, and they pollute the water.

Reconstruction of the water transportation system is a complicated and quite expensive project, which hardly can be implemented in the near, and even in the remote, perspective. That is why the main responsibility for additional purification of water is that of the consumers themselves. It is proposed to establish a special quality control service as related to the water supplied directly to the consumer, providing recommendation of concrete filters for additional water purification.

Measures for use of desalinated water

Taking into consideration that Israel is entering the period of water supply based on considerable amounts of desalinated water, a special committee headed by Prof. Adin considered the requirements to be demanded in this respect. The committee stated that desalinated water reduces concentration of all substances contained in it, which will bring about ultimate removal of a series of substances accepted as healthy compounds of water. Taking into account that since almost 40-45% of the water supplied to the consumer in the nearest future will be desalinated, there is a necessity to enrich it with missing substances. Besides, there appears an acute problem of discharging

considerable amounts of salts and pollutants filtered in the process of desalination to the sea.

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PROJECT OF HIGHLY EFFICIENT COMPACT SYSTEM FOR SEWAGE PURIFICATION FROM ORGANIC COMPONENTS WITH 100% RETURN OF WATER BACK TO THE TECHNOLOGICAL PROCESS

Israel Lirisman

The system is assigned to purify sewage resulted by washing motor transport vehicles, military and civil mobile equipment. The system has been tested at washing complexes of leading companies.

Purification of sewage is implemented by means of combined technologies including mechanical, electrochemical and physical-chemical purification. The obtained quality of purified water enables to use it the system of recurring water supply for washing or, alternatively, the waste water can be disposed to ponds reservoirs.

The system contains a sedimentation tank for water collection, a purification block and pumping groups of water supply for purification and recurring utilization.

The purification block contains an electric reactor, a flotation unit, a contact lighter, a tank of purified water and a facility for automatic washing of the contact lighter.

The system can be located next to the place where the vehicles are washed, both indoors and outdoors. The elements of the system have a compact construction, small size, and the purification process is implemented without using re-agents. Within the framework of the herewith proposed project there will be elaborated components as follows: technical assignment for recurring water supply at the sites of washing motor transport vehicles and mobile equipment; technical assignments for working out of documentation related to purification blocks with output productivity 0.3 m^3 per hour and 1 m^3 per hour.

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BIOSPHERE REVERSIBILITY AS THE MAJOR FACTOR OF STRUCTURAL SUSTAINABILITY OF THE SYSTEM "HUMAN BEING – NATURE"

Efim Manusov, Nonna Manusova, Oleg Figovsky, Vladimir Alekseyenko, Ludmila Kireycheva

Biosphere and Ecosystems

The notion of biosphere appeared in science accidentally. In 1875 the Austrian geologist Edward Zuss used this term for the first time dealing with Earth strata. But only in 1926 two lectures of V.I. Vernadsky were published where the basic theses of the biosphere concept as accepted today were set forth. Biosphere was treated by Vernadsky as earth-crusts undergone influences exerted by the animate nature in the course of the entire geological history.

In the first place, the biosphere as a peculiar earth-crust is characterized by a considerable quantity of water. In the second place, a powerful energetic stream comes from the Sun. Finally, biosphere is characterized by surfaces of partition between liquid, solid and gaseous substances.

Since the source of energy on the Earth is the Sun, the animate organisms are located on the upper strata layers, the *lithosphere* and the *hydrosphere*. The better the Earth layer transfers the sunbeams, the deeper is its population with animate organisms. But biosphere does not end where the light does not reach. Due to the gravity force, the energetic stream spreads further.

Biosphere is a global ecosystem, thus all components must be balanced in it, from the energy stream, substratum, atmosphere, water up to biotic totality, which is the managing system as related to abiotic totality. In the biotic system the consuming components comprise the managing subsystem, since consumption of primary products and, in the final analysis, stability of the entire system depends on them.

Almost a century of preparations towards noo-sphere realization in any area on the Earth constitute an evidence substantiating the fact that till now the declared method of seeking for the area corresponding to the given population has no algorithm to be practically realized. Moreover, according to Ashby such algorithm is unrealizable, since the managing subsystem and the object managed are evolving individually. But such algorithm is realizable due to the Manusovs-Figovsky regulation. This regulation is used

when one natural system is managed by another one. In this case a detailed analysis of the managed subsystem is undertaken, and the destructive element of the ecosystem is exposed. Such principle of management is determined as control by means of block-up of the hindering process.

Inside the biosphere, ecosystems of the lower order must be territorially balanced. In other words, the Earth must have a definite amount of tundra areas, forests, deserts, etc. as biomes. Moreover, in the tundra biome optimal tundra properties, in the biome of coniferous forests corresponding coniferous properties etc. must be preserved. And so down to the smallest bio-geo-cenosis units.

But the ecosystem comprises a permanently changing integrative unit including all the organisms within the given section and interacting with the physical environment so as to promote the energy stream to create a certain trophic structure, diversity of species and circulation of substances within the system.

Ecosystem is the basic functional unit of the animate nature including both the organisms and the abiotic environment, while these two components influence each other, and they are indispensable to provide the animate nature in the form it exists on the Earth. The bilateral character of this complex was reflected in the doctrine of bio-geo-cenosis.

The organisms reach insignificant depths of lithosphere. The bulk of them is concentrated on the upper ground stratum of several tens of centimeters, and it is quite seldom that an organism reaches the depth of meters or tens of meters (plant roots, earthworms). Through clefts in the earth-crusts, wells, mines and bore-holes animals and bacteria can sink much deeper, down to 2.5-3 km.

From the lithosphere surface animate organisms can penetrate to the lower *atmospheric* strata reaching several centimeters to a few meters down. As to flora species, sometimes they can raise their green crowns up to tens of meters.

The hydrosphere, unlike atmosphere and lithosphere, is filled with life throughout its entire depth. Anywhere, where the instruments gaining information could reach, the researches found animate organisms. This leads to conclusion that liquid is a more important limiting factor in distribution of organism than light. Thus, the most torrid deserts are formally located outside the biosphere. But actually they can be treated as para-biospheric areas, since nevertheless there are animate organisms there.

Structurally and functionally, ecosystems comprising the biosphere realize all forms of activities inherent in organisms of the given biotic milieu, their interaction with the physical environment and with each other. But organisms live for themselves, not for functioning as components in the ecosystem. The ecosystem properties are formed due to the activity of its fauna and flora. Only taking into account this activity we can understand its structure and functions, as well as the fact that the ecosystem as a whole reacts to environmental changes.

As it is generally known, the notion of ecosystem substituted those of biocenosis and bio-geo-cenosis in 1935 (the term ecosystem was introduced by the British botanist A. Tensley) and became distributed regardless its disadvantages (impossibility of sensible classification, lack of balance, fundamental uncertainty in the non-balanced status and necessity of using rough linearization for description of ecosystems).

There exist several hypotheses of ecosystem formation. The most convincing among them seems to be that of Gaia hypothesis, as follows.

According to Gaia hypothesis, *organisms, especially microorganisms, together with the physical environment form a complex regulation system maintaining conditions for favorable life on the Earth* (Lovelock, 1982). It is known that the abiotic environment (physical factors) influences the activity of organisms, which in their turn exert a regulating impact on the abiotic environment. The organisms exert a permanent influence upon the physical and chemical nature of inert substances, returning new compounds and sources of energy to the environment, as, for instance, plants that took roots in sandy dunes comprising a soil sharply differing from the primary substratum. There is a great number of examples of this kind. The organisms even regulate the composition of our atmosphere.

Here are extracts from the article of the American scientist James Lovelock who set forth his hypothesis (it is known as "Gaia hypothesis") as early as in 1969 and developed it in his book "Gaia, or a new vision of life on the Earth":

"In 1979 I came to the conclusion that the atmosphere is not just an environment for life, but an integral part of life itself… Further calculations indicated that the atmospheres of two "Earth-like" but lifeless planets, Venus and Mars, substantially differ from the Earth. The Earth atmosphere is abnormally unstable, and without this instability the Earth would have been lifeless and sterile just like Mars or Venus… And if we

consider the earth-crust, the oceans and the atmosphere in this respect, it becomes clear that the Earth constitutes a striking exception: it is a kind of a biologic structure where all its components, including the animate nature, interact so as to provide this unstable stability, which is indispensable maintain life… I'd define this unique entity, the planet capable of regulating its own atmosphere and biochemistry, by using the term the ancient Greeks referred to the Earth: Gaia".

Until 1977 these concepts of Lovelock-Margulis had not been accepted in the scientific milieu, but then the situation changed, and for the time being, following two international conferences devoted to these ideas, they have been intensively promoted by scientists worldwide. The arguments set forth by Professor Gorshkov and his entire ideology actually renders the concept of Gaia up to the smallest details, such as comparison of the "Earth stability" with Venus and Mars, though, strictly speaking, scientific argumentation here is somewhat different: if the original Lovelock hypothesis emphasizes self-regulation of the atmospheric chemical composition, Gorshkov is concerned with forest-planting as the main regulating factor of the Earth homeostasis. In his recent article "On the Agenda is the strategy of mankind survival" published in "Herald of the Russian Academy of Sciences" at the end of 2006, Gorshkov consistently presents his views related to ecology, and these views happen to be quite reasonable. Actually, the article constitutes a list of what Gorshkov refers to as "delusions and wrong priorities in issues related to ecology". One of such "delusions" was already attacked by Gorshkov before, when he asserted that the main danger for the Earth balance is not discharge of hotbed gases, but destruction of forests as pumps creating the atmosphere. Now he bring down his attack upon the modern ecological science on a larger scale.

According to Gorshkov, influence of the Earth biotic structure on the climate happens to be principally sufficient in maintaining the main atmosphere and biosphere parameters within the limits providing the possibility of life on the Earth. Pondering over this statement leads to understanding that according to Gorshkov life on the Earth takes an active part in maintaining its own existence. In other words, the animate nature, the biosphere is not a passive observant of processes taking place in the atmosphere (and lithosphere) of the planet, but an active partner in these processes.

Today there is no doubt as to the fact of development of the ecosystem as a whole.

Succession of communities following each other in the given area brings about changes in the physical environment influenced by the community, i.e. regulated and controlled by the community. Substitution of species in ecosystems is a result of populations striving to modify the environment and to create conditions favorable to other populations. This goes on until the balance is achieved between biotic and abiotic components. In a sense development of ecosystems resembles that of an individual organism and, at the same time, that of the biosphere as whole.

Succession in sense of energy resources is characterized by fundamental increase in energetic streams directed to the system maintenance.

Thus, development of the ecosystem, or *ecologic succession*, is a succession of communities changing each other in the given territory. Under absence of external destructive processes, succession constitutes a directed process taking place as a result of changes in the physical environment. It can be determined due to indices as follows:

Development of the community constitutes a regulated process connected with changes in time as related to the community structure. This process can be predicted and even regulated.

Succession takes place as a result of changes in the physical environment under the influence exerted by the community, i.e. it can be regulated by the community, though the physical environment determines the character of succession, the tempo of changes, and the limits of development.

The culmination of succession is a stabilized ecosystem, in which maximum biomass is accumulated per unit of energy stream, and maximum number of symbiotic interrelations between organisms is observed.

Succession of communities changing each other in the concrete area is referred to as a series, while only a limited number of species of the primary stages remain valid at the ripe stage of the ecosystem.

If development of the ecosystem begins in the area which was formerly occupied with some kind of population (for instance, a deserted field, or a hewed-out space), the succession process constitutes a secondary formation. Generally the succession process of the secondary formation is faster than that of the primary formation, since the formerly occupied territory is already populated with organisms indispensable for interaction

with the environment, and it is more favorable for population development that a “sterile” zone.

A terminal, stable population of the developing series is the climax population. In the climax population, unlike in those of developing and other unstable stages, the annual pure organic production is minimal or ultimately absent. For each climatic zone it is convenient to distinguish its peculiar climatic climax and a number of soil climaxes. Climatic climax is a theoretical population constituting the final target of the ecosystem development in the given region, preserving balance with climatic conditions of the environment. This theoretical population is realized where the physical conditions of the environment are not extreme enough to change the impact of the prevailing climate. In areas where relief, soil, reservoirs, fires, bogged up localities and other factors hinder climatic climax development, succession ends in formation of a soil climax. Thus, depending on the relief and the soil peculiarities, different populations are developing on adjoining sea terraces with the same basic bed-rock. Since the main ecosystem modifying factor is the biotic population, the more extreme are the physical conditions of the environment, the more probable is termination of the ecosystem development before having reached its balance with the environmental climatic conditions.

Quite frequently the human being influences the ecosystem development preventing it from reaching the climax condition. When the population which does not constitute climatic or soil climax in the given area is supported by human beings or domestic animals, it is referred to as *anthropogenic sub-climax*. For instance, excessive pasture can cause a desert population where due to the regional climatic conditions steppe could have been preserved. Desert populations in this case constitute disclimax and steppe presents the anthropogenic subclimax.

Anthropogenic support of subclimaxes, as seen in the sample above, can be that of preventing zoo-cenosis exerting a negative impact on vegetation from interfering in the region, due to the Gaia hypothesis as related to the atmosphere of the area. In regions with extreme temperatures the upper stratum is in the situation of withering, which causes at the first stage to allometric growth of roots and diminution of tree crowns, as far the main atmosphere formation factor, the forest-planting is considered. In this case destructive zoo-cenosis, as, for instance, beef-dairy horned small cattle, causes desert intensification, and, in the area with extreme temperature of water resources, accelerated destruction of the area. But if under the same

climatic conditions there are underground water resources in the area, the allometric growth of roots will cause an intensified absorption, growth and total normalization at the expense of “hydro-lift” of plants nutrition, as well as normalization of atmospheric conditions.

Similar to the effect of forest-planting, such areas from the point of view of the management theory becomes an object of management, which predetermines the possibility of its recurring to previous succession conditions, i.e. provides reversibility of the biosphere based on such systems.

Using the strategy of biosphere reversibility, restrictions inherent in any strategy of transformations must be taken in consideration, namely:

a) The unit of (restored) resource can be obtained only within a certain time section detached by speed of the system functioning. Within this time section no boundaries of limitations determined by all ecology theorems can be violated.
b) As a rule it is impossible to skip over a phase in successive development of the natural system with participation of animate elements.
c) Transformation activities must not cause violation of balance in the natural systems by introducing surplus milieu components, i.e. if there is a necessity in such new milieu components, sufficient compensation must be provided in the form of relatively untransformed natural systems, as, for instance, optimal woodlands.
d) The secondary ecological balance which gradually came to the fore, as a rule is more stable than that of the initial one, but the potential “reserve of transformations” (i.e. of future transformations) is being reduced.
e) Discrepancy between the “targets” of natural systemic regulation and the targets of economy can cause destruction in the natural milieu (i.e. the forces of nature and those of considerable economic transformations in the course of their “rivalry” first “extinguish” each other, and then the natural component is being destroyed).

Biosphere reversibility, considering the above remarks, is the basis of man’s interference in the biosphere ecology with the aim of maintaining structural sustainability predetermines their reversibility, which has been confirmed by the history of mankind. At that, in open systems no less

important is the role of anthropogenic interference, which can both promote structural sustainability and be a destructive factor as related to the initial system. It must be noted that the analogous conformity of biosphere to open systems, including socio-economic systems, predetermines their reversibility, which has been confirmed by the history of mankind. At that, in open systems no less important is the role of anthropogenic interference, which can both promote structural sustainability and be a destructive factor as related to the initial system.

PROTECTION OF ISRAELI UNDERGROUND WATER RESOURCES BY MEANS OF ARTIFICIAL GEO-CHEMICAL BARRIERS

Nonna Manusov, Ludmila Kireycheva

Creation of optimal geochemical landscape constitutes a new powerful factor of nature transformation.

Prof. Alexander Perelman,
one of the founders of geo-chemistry

Abstract

The term “geochemical barriers” was set forth by Prof. A. Perelman in 1961 [1]. Developing his barriers doctrine, Perelman himself and other scientists [2] suggested to use artificial geochemical barriers (AGB).

It is obvious that under conditions of our subregion only AGB of sorption type обеспечивают надежную защиту (safe protection) of underground aquifers.

Key words: **aquifers**, **solid waste**, **sorption barriers**.

1. Technogenic Sorption Barriers

There is no version of socio-economic development that provides ultimate extermination of solid industrial waste (SIW). In any case, solid particles of the municipal (domestic) waste (RDW), and, subsequently, solid waste dumps are unavoidable. This means that the vital necessity of protecting underground water resources from the injurious impact of these dumps keeps in force [3,4].

The problem of protection of underground water resources from sluicing water caused by watering agricultural crops, as well as from downpour water flows, keeps in force too.

Besides, another important aspect of the problems above is protection of underground water resources and of agricultural products from pesticides and ions of heavy metals in the soil and in the water used for irrigation.

The ultimate universal method for solving the above problems is establishment of various sorption barriers with one universal sorbent. For the time being, activated coal is used worldwide, and for purification of the

soil surface from oil products organic sorbents (such as rice husk, straw etc.) and non-woven fabric are accepted.

Disadvantages of activated coal are production expenses ($2000-3000 per ton) and complicacy of its regeneration.

The activated coal tends to premature exhaustion because of formation of organic flakes on its surface, requiring ablution and regeneration, which renders to be impractical under conditions of sorbent intrusion into the soil. Besides, the surface of the activated coal creates ideal conditions for development and growth of bacteria, which can cause a considerable increase in concentration of micro-flora in wash water.

Proposed herewith is use of special sorbetnts-meliorants of the SORBEX and SAPROLEN types, their advantages being as follows [5]:

1. Universal character of their use for systems as specified above.
2. Long duration of their functioning after having been inserted into the soil or onto protecting installations (3 to 5 years, depending on the specific quantity of pollution).
3. High capacity of cation exchange (250 mg/equ per 100 g), high specific surface (160 m^2/g), fertilizing effect, availability and low cost of the initial raw material.
4. Low price of the sorbent (about $100-200 per ton).
5. Possibility of utilization of the waste sorbent used in protecting installations for road construction and maintenance.
6. Increase in productivity of agricultural crops and improvement of agricultural products quality.

Table 1 below indicates that the sorbent provides the fertilizing effect at the expense of K_2O and microelements. This is especially important for specific sorbents-meliorants, which are used not only for protection of water resources, but also for detoxification of soil and agricultural products (Table 2).

Table 1. Raw materials composition in one of the synthetic sorbents.

Heavy metals	*Initial components*		
	ceolite	*sapropel*	*aluminum sulphate*
Cu	21	11	–
Ni	24	24	10
Pb	4.8	12	16
Zn	60	28	20

Cd	traces	–	–
Cr	54	12	not determined
Hg	traces	traces	–
Co	6.9	0.9	–
Mo	0.3	12	–
MnO	500	300	150
K_2O	1450	1280	–

Table 2. Reduction of heavy metals content in crops due to the versions of sorbent-meliorant insertion, as related to control tests.

Version	*Insertion dozes, kg/m²*	*Percent of reduction as related to control tests*				
		Cu	*Zn*	*Ni*	*Pb*	*Cd*
1	0.5	87.2	62.7	30.2	23.0	+25
2	1.0	81.8	58.8	49.1	92.3	+20
3	1.5	86.5	77.1	58.1	92.03	+5
4	2.0	86.1	77.1	55.8	46.3	0

The data obtained enable to assert that for detoxification of polluted hothouse soil 1-1.5 kg of sorbent per 1 m^2 is sufficiently enough. High efficiency can be achieved to obtain ecologically pure products on polluted soils, as well as to increase their sorption capacity (or to erect artificial buffer levels) for prophylactic purposes on territories with increased danger of pollution.

The mechanism of the proposed sorbents functioning when inserted into the soil and their interaction with the soil solution is characterized by various physico-chemical features: chemo-sorption (absorption accompanied by formation of almost insoluble compounds of heavy metals), mechanical absorption (volume absorption of large molecules) and ion-exchange processes (substitution of ions of heavy metals for non-toxic ones in the soil-absorbing complex).

The high absorbing capacity of the sorbents is due to the regulated value of the cation exchange capacity, their fine structure (i.e. high specific surface), as well as the stabilizing effect on the hydrogen index pH depending on the character of pollution and on the existing reaction with the purpose of preventing desorption of the most dangerous pollutants.

2. Determination of the Adsorption Capacity of SORBEX

The tests were implemented in laboratory conditions as applied to sorption pumps with mixed solution of water-soluble zinc, copper and lead salts. The results of the analysis are presented in the Table 3 below.

Table 3. Content of heavy metals in water samples under filtration through powdery and granular SORBEX sorbent.

Metal	Initial content in the solution, mg/l	After filtration through powdery sorbent, mg/l	After filtration through granular sorbent, mg/l	The sorption coefficient of the powdery sorbent	The sorption coefficient of the granular sorbent
copper	380	0.05	0.08	0.99	0.98
zinc	1190	1.73	3.3	0.99	0.98
lead	164	0.01	0.9	0.99	0.98

According the test results, the sorption capacity *At* is calculated as obtained from the formula as follows:

$$At = (Co\text{-}Ct)W/m,$$

Where *Co* is the initial concentration of heavy metals in the solution; *Ct* is the corresponding concentration at the given moment *t*; *W* is the volume of the filtrated water; *m* is the sorbent hinge.

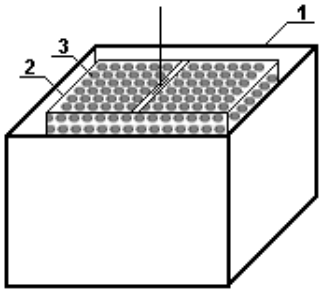
The sorption capacity in the case of powdery sorbent was 2.28 mg/g for copper, 6.9 mg/g for zinc, 0.96 for lead. The summary sorption capacity was 10.14 mg/g. Depending on each ion concentration, the sorption capacity may change.

To determine the indices of sorption dynamics, and to obtain the sorption isotherm, the presence of at least one ion in the solution is indispensable. If several ions are present in the solution (as in our experiment), the sorption dynamics is determined by its chemical analysis and chemical thermodynamics.

3. Constructions of technogenic sorption barriers

We assume that the most efficient means of protecting dumps are anti-filtration screen walls erected according the “wall in soil” technology (Fig. 1).

The essence of the technological process of screen walls erection lies in processing of a trench under the protective thixotropic (usually, a loamy one) mortar, with further submersion of a grid container with sorbent. The sorbent (usually granular) is supposed to absorb (detain) flows of injurious pollution inside and on the periphery of the dump, caused by rains, dew, high temperature etc.



1 – trench; 2 – net container; 3 – sorbent granules

Fig. 1. Protection geo-chemical system "Wall in soil"

The advantage of the technology is that works can be implemented without digging foundation ditches, under narrow circumstances (as, for instance, urban areas), and practically in any kind of soil.

The best results are obtained when bringing the barrier right down to the aquiclude (the perfect construction). The depth of the trench is determined in accordance with the state of the soil in the point of its contact with the aquiclude. The incut into staunch aquicludes presented by clays, heavy loams etc. is usually accepted as 1 m.

The width of the barriers must be determined taking into consideration the filtration strength of the sorbent.

The minimum thickness of the walls, as preconditioned by the equipment used, is 0.5 m.

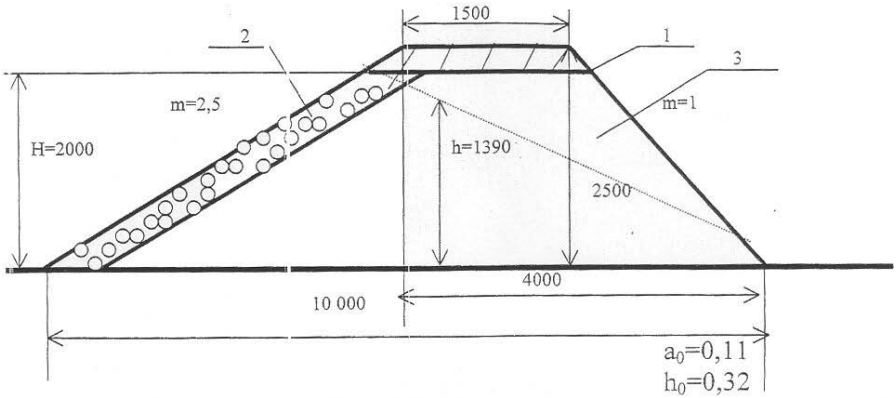
The slot in the soil can be arranged both as a continuous trench and as a successive coupling of separate sections.

The grid containers are filled with the sorbent chosen in accordance with its sorption characteristics, taking into account economically sound considerations.

The grid containers (1-3 m long) are filled with special granular sorbent providing sorption of a wide range of injurious substances discharged by the dump. Normally, the trench is blocked by protecting shields leaning against flows of the trench external edge and the border of the dump substrate, which is separated along the perimeter by a skirting. The sorbent without overload functions for about 2-3 years, then it is discharged, grinded and used for production of border stones along motorways.

Use of protecting barriers of the type described above, is restrained because of difficulties related to efficient control of absorption capacities exhaustion. ECOST (Israel), VIGM (Russia) and INSTEB (Russia) developed a system of such control, applied to be registered as patent "Mechanized system for installing and extracting of the "wall-in-soil" or "wall-curtain" protecting system from the trench".

The universal character of the "Sorbex" sorbetn-meliorant (see Table 2) enables to use it successfully on surrounding fields and other agricultural sights, such as canals and dried-up river-beds, near dumps and channels transporting municipal waste to the collective sewage disposal plants. For this purpose, so-called filtration "dams" (FD) can be used with the same sorbent-meliorant (see Fig. 2, which will be also supplied with the above system for control of the sorbent protecting properties.



1 – layer of condensed clay (0.5 m);
2 – layer of large swipes (0.5 m);
3 – granular sorbent (granule diameter 0.8-2 cm).

Fig. 2. A sample of the filter dam construction

4. Optimization of the sorption barriers functioning

As shown above, the most commonly used sorption barrier must be that protecting dumps of the trench type ("wall-in-soil", or "wall-curtain". But the restraining factor hampering introduction of these constructions is uncertainty as to the term of their protecting effect, since this term depends on the content and the concentration of pollution in the distant dump, as well as on the weather-climatic conditions.

In order to avoid skipping of injurious compounds to the soil and to the underground water resources, it is necessary to envisage that the term of the protecting installation exploitation until its replacement (τ_e) exceeds that term of the sorbent layer protecting effect (τ_p).

On the other hand, $(\tau_e) << (\tau_p)$ is unprofitable. Thus, it was necessary to develop a method of the sorbent control in the processes of its exploitation.

The studies undertaken in the Moscow Institute for Melioration and Hydro-Technology revealed that the best indices of the sorbent functioning are those of relative change of its electric conductivity from the beginning of its exploitation up to $\tau_e \rightarrow \tau_p$ for above an order, while the change is that corresponding to the exponential curve.

We developed a probing sensor. 6 to 9 such sensors will be installed under loading of the container, for further measurement of electric conductivity in each point. Under value $\delta > 500$ cm/m in two or more points, the frequency of measurement is doubled, and under $\delta \geq 700$ cm/m the container with the sorbent is drawn out and substituted by a new one.

On using filtration dam, the probing sensor is not installed, but 3 of them are inserted periodically into the piled-up layer of the sorbent upon the dam.

The border values of electric conductivity are lower in this case (about 500 cm/m), in order to prevent skipping of considerable quantities of pollution passing with waste water through the filtration dam.

5. Conclusion

Under conditions of prevailing underground water resources and high sensitivity of the landscape, any sight of solid waste accumulation must be equipped with a geochemical sorption barrier, for instance, of a trench type ("wall-in-soil'). The granular artificial sorbent-meliorant compositions "Sorbex" and "Saprolen" placed in special containers are recommended in this case.

These containers are located along the perimeters of dumps, car parks and other sights of concentration of injurious substances, which may cause pollution of underground water resources.

For purification of waste water flows carrying large amounts of pesticides and ions of heavy metals, filtration dams with the sorbent on their frontal surfaces are installed.

To diminish the amount of these pollutants in waste water flows and in agricultural products, as well as their content in soils (soil detoxification), 1.5 kg/m^2 of the same sorbent is inserted into the soil.

Thus, the protecting sorption barriers constitute an indispensable supplement to any, perfect as it may be, system of rigid waste utilization, waste water purification, and even gas kicks, since soil detoxification causes absorption of pollutants penetrating into the soil from the air together with rain and dew. The latter requires soil detoxification not only of agricultural grounds, but also of spaces with high concentration of air pollution, taking into consideration the wind rose, the climatic peculiarities, etc.

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A REALIZATION OF THE CONDITIONS OF SUSTAINABLE DEVELOPMENT IN REGIONS WITH UNDERGROUND WATER RESOURCES

Nonna Manusov, Efim Manusov

Nowadays, the conditions of sustainable development (CSD) represent an idea, instead of system elaboration. To realize the CSD it is necessary to reach a point gradually, that all the prior points of calculations are stable and do not need iteration between the points.

The commission of ecology and sustainable development was working in UN from 1983 till 1987 under the direction of Prim – Minister of Norwegian Brutland. As the result the report "Our common future" which included the new term "a sustainable development" in to scientific terminology for the first time was appeared. From the beginning it was belonged just to the ecology and was used in the meaning of the saving of the environment during social – economical development. Now the Department of UN that was deal with sustainable development worked out the indicators of sustainable development and entered on a list the indicators of social –economical development and organization structure of society. There were only 4 groups of indicators, the general number of those were 132 (ecological – 55, economical – 26, social – 41, organizational – 10).

It is obviously that generally a mission is coming difficult to realize it and methodically indefinite because that the indicators are not put in order not inside the groups not according to the CSD.

It was the reason that we had to use the system approach to the problem and to define the most suitable regions and sub regions for realization CSD. Moreover we issued not from the speculated listing of indicators as the department of UN suggested but from the model of social – economical complex. The most suitable model for us was that one that was worked out by N.N.Moiseev, the famous Russian mathematic, academic of Russian Academy of science, and a member of Brutland commission.

The choice of stable suitable regions and gradual approach to the CSD

In the Middle East, in some sub regions of Russia, Northern America e.t.c there are sub regions in which underground sources of fresh water in appearance of aquifers dominate. Quality of water in the underground sources can be used as universal indicator of pollution that is allowing for

pollution of industrial and municipal flows, dumps of firm wastes and atmosphere.

That is why the first stage of phased approaching to the conditions of the sustainable development has to be a system of geochemical protection of underground water resource. The installations with synthetic sorbet for dumps of firm wastes, urban containers with domestic firm wastes, overflow waters of agricultural areas and the installations with natural sorbet (mesoporous coals), for urban downpour flows and downpour flows of motorways are used for it.

The second stage of works foregoing to realization of CSD have be works of algorithm of calculation and choice of development's water saving options. As in all calculations connected with technology of processing of pollutions, that are in the flow waters, firm wastes and gas drops, there is indefinite of initial information and instead of optimal technologies we have to deal with a group of rational or sub optimal technologies, for the evaluation of which we use a criterion of minimax costs (Weld's criterion) and criterion of minimax risk (Savage's criterion).

The third stage of works forgoing to creation of the conditions of CSD is realization of the system of local, group, urban systems of sewage treatment, and the systems of liquidation a utilization of firm wastes and also the level of pollutions in atmosphere.

The fourth stage is an analysis of a condition of water in aquifers. In practical absence of pollution water in aquifers can proceed to realization of other ecological indicators, that touch with soil, flora and fauna and then to realization of indicators of other groups, that begin from economical indicator's group. Unfortunately all these calculations usually have a meaning for autocratic states. What is about social and organization indictors so their necessity is very questionable, if to take on account the next words of K.G. Jung: "And unable to invent that general external shape of life as it were not correct and right which shouldn't be unjust for one or another type of people".

Conclusion

The conditions of the sustainable development can be realized just in case those extraordinary external conditions that are characterized by one or two vitally important conditions, as for example, a magnitude of water stress, or

for regions with brightly expressed ecological particular qualities, such as the domination of ground water sources.

In such cases one or three indexes, characterizes the possibility of realization of a region can be revealed.

ON RAINWATER USAGE IN ASHDOD

Michael Milov, Alexey Popadin

One of the sources of water supply is rainwater usage. In Ashdod, there are a number of reasons to use rainwater as an additional source of water supply.

1. According to data provided by a meteorological station of Ben-Gurion airport, that has an observation station near Ayalon highway, precipitation level of a 50% provision year is 514 mm, and that of a 95% provision year is 283 mm, which is evidence of large amount of fresh water (up to 5 million m_3 per year) that is drawn off to the sea only from built-up territory of the city.
2. The city is situated in a plain coastal area and has good amenities; its territory is planed taking into account possible rainwater overflow to lowered places or to the sea.
3. Around Ashdod, soils with quite high water permeability are deposited that may be used for storage and natural purification of rain flows.
4. Now, because rainwater carrying large amounts of contaminations from road surfaces is drawn off into the sea without treatment, the coastal strip and Lachish river are being polluted, which is inadmissible by ecological conditions.
5. In some places, effluents of rain sewage are put into network of fecal sewage, which is inadmissible because these flows are not designed for modern biological treatment plants. In these cases, reconstruction is needed.

Ashdod is situated over one of the two main aquifers – Coastal Aquifer, therefore the main task now is not to create and exploit special repository for rainwater, but to organize treatment of rain flows using special plants described in one of the articles of this book (see Tarnopolsky Marina, et al.).

GROWING OF THE WOODY PLANTS OF ISRAEL FLORA WITHOUT WATERING IN THE GARDEN OF THE MUSEUM OF NATURAL HISTORY IN JERUSALEM

Tatyana Shimmel

Arboretum of the Museum of Natural History in Jerusalem is placed on the territory of 2 dunams (2 acres). The principal planting of the arboretum was realized in 50-ties of the XX century. It represents the fine collection of trees, bushes and semi-shrubs of several woody vegetative associations of natural flora of Israel. In the garden of the Museum are presented the trees of the next woody associations: **the Mediterranean /Common/ Oak Forest** – the most familiar and important type of local arboreal vegetation (includes: *Quercus calliprinos, Pistacia palaestina, Laurus nobilis, Arbutus andrachne, Crataegus aronia,* and *Ceratonia siliqua*); **the Tavor Oak Forest** (*Quercus ithaburensis, Styrax officinalis, Pistacia atlantica*); **Aleppo Pine Forest** (*Pinus halepensis*); **Carob and Mastic Pistacia Scrub Forest** (*Ceratonia siliqua, Pistacia lentiscus*); elements of **Hydrophytic Vegetation** (*Nerium oleander, Tamarix tetrandra*); and other woody plants – trees, shrubs and vines from the named and other woody associations and they are:*Acer obtusifolium, Amygdalus communis, Cercis siliquastrum, Fraxinus syriaca, Hedera helix, Lonicera etrusca, Myrtus communis, Parkinsonia aculeata, Phyllyrea latifolia var. media, Pyrus syriaca*.

It is worth to take into consideration that during last 20 years minimum the vegetation of the Museum's garden survived practically without watering. This fact is optimistic for the gardeners of Jerusalem.

THE NEGATIVE INFLUENCE OF VARIOUS ECOLOGICAL FACTORS ON THE ISRAEL POPULATION MORBIDITY RATE

Rozalia Slobodova

One of the main problems among the Israel environment protection problems is the air pollution. To live normal active life, human beings need pure air first of all. A range of various pollutants causing respiratory diseases development may be described. These pollutants may have sometimes combined influence.

It is known that in Israel the morbidity rate due to combined influence of those factors amounts to about 1000 persons per year. However sometimes the interrelation between certain diseases morbidity rate and certain pollutants should be revealed. In that case the hypotheses theorem, or the Bayece Formula (2), may be used. Performing certain rather simple calculations one can find that the probability of a disease induced by the *i*-th factor is the highest. This analysis allows to estimate the synergetic influence of the pollutants mixture and to determine the dominant reason of the decease morbidity.

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STRUCTURAL FACTORS OF RATIONAL NATURE MANAGEMENT IN ISRAEL (WATER AND ENERGY)

Yakov Sosnovsky, Yevgeni Ar'ev, Beniamin Marash

Energy and *water* are the most priority global problems of mankind in 21 century. Their close interrelation is conventional.

In our country, in conditions of a hostile encirclement, dynamical population and economy growth, these resources consumption management has some substantial features.

During all period of the state existence only limited *water* resources were used, their annual volume being essentially changed depending on precipitation amount.

The decision of the problem till now was provided with essential *increase* of water use *efficiency* in the agriculture, the main water consumer. The sector output growth was achieved by irrigated areas reduction and practically stable water consumption volume.

By repeated GDP growth and population increase in 2.5 times, the common annual water consumption in the country has grown only on 1/3, and the index on 1 inhabitant has decreased almost twice.

The country requirement for *power resources* until recently was covered practically completely due to hydrocarbon fuel import. Its cost, even in conditions of the last years sharp growth of the world prices, does not make a significant share in the annual state budget. In decision of the complex problem "power engineering – economy – ecology – energy saving" the priority is kept behind the first component, instead of the main world tendency to energy efficiency, especially after world energy crisis of 70-ies.

Economic growth in our country is provided mainly by power economy expansion: primary energy consumption has grown in 4.5 times, electric power one in 8.4 times; and indices upon 1 inhabitant in 1.8 and 3.4 times accordingly. It had serious negative consequences for the country ecology, economy, power safety.

A common line in the resources consumption is essential increase of household, trade and public services share. These sectors are now zones of the greatest resources saving potential by use of the modern effective equipment, and also consumers behavior change.

Structural factors of resources saving conservation potential. Sharp *water* deficiency forces some countries to import some agricultural products, especially connected to significant water consumption.

Roughly 1/3 of the sector production in Israel goes on export, and together with it a part of scarce water resources are loosed (comparable with its consumption by industrial sector).

It is planned up to year 2013 to obtain all potable water volume (800 million cubes) by means of sea water desalination,. that will demand additional generating capacities input more than 400 MWt. The solar electric installations efficiency does not exceed 30%, and the rest of energy is allocated as heat. Methods of direct use of the last in thermal processes are developed.

Potable water exclusively use in housekeeping is functionally superfluous. There are many developments on *turnaround water* use for many such functions and also for irrigation. For their realization it is necessary essentially increase of R&D financing in structure of the environment preservation expenses. In 2006 for these purposes it has been spent 6.5 billions NIS (incl. 1.2 billion NIS for water treating.), the share of R&D has made only 0.03% of the total sum.

The main share in total final *energy* consumption is of the *transport* sector one (more than 30%). In passengers transportations the main energy saving potential is connected to public transport outpace development. By our estimation, "change" of every 10% of personal transport passengers on public one allows to lower energy consumption on 15%, thus the additional requirement for buses fleet will make only 1%. Despite of growth in 6 times by 1990 of the most effective high-speed railway transportation, its share in total passengers transportation volume still remains insignificant.

The situation with our country *electrification* accelerated rate and high level requires for profound all-round analysis.

Now electric power manufacture share is roughly a half of the primary energy consumption (in year 1980 – 31%). In conditions of mainly hydrocarbon fuel use for electric power manufacture (that will be kept also on intermediate term prospect), the power economy development on this model results in significant losses of primary energy on transformation and own power stations needs. So, in Israel in year 2006 a share of the electric power in the total final energy consumption was 30.6% and above

mentioned loses were 38% (for comparison: in Italy corresponding indices were 18.4 and 20.4%).

The electric power universal application is promoted by existing tariff policy. As against pricing on the water resources, directed on encouragement of their maximal savings, tariffs for the electric power do not take into account socially necessary expenses of different energy carriers, and do not stimulate energy saving, and also of alternative energy sources application.

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WATER IN JEWISH TRADITION

Marina Turkinets

In *Tanah*, there are more than 600 places where the word "water" is mentioned, and among them the "rain" is mentioned about 40 times. There are many words and phrases on the subject of "water". This fact indicates the importance of Water in Judaism.

While in other cultures the role of the Source of the Life is performed by the Sun, the Moon, animals and trees, in the Jewish tradition it is Water. Here is a brief list of the main events which are connected with water:

- From the description of the beginning of the Creation we learn that the Earth was a kind of water, since it is written in Genesis that *"the Spirit of G-d was hovering over the face of the waters"*.
- The Second Day of Creation was dedicated to the separation of the waters;
- Images of wells full of water are both material keepers of plain water and at the same time – symbols for blessing;
- The ability to search for, to discover and to use wells (Abraham, Isaac, Jacob, Miriam, Moses);
- The salvation of Moses from the river in Egypt;
- Seasons changings, which are connected with praying about rain or dew;
- Laws of Jewish holidays and different kinds of customs connected to water (process of dish *koshering* by boiling water for Passover; the spiritual cleaning in face of the "natural" water reservoir during the second day of *Rosh HaShana – Tashlikh;* water libations in the Temple during *Succot – Simkhat Beit Hashoeva*; ritual ablution of *kohanim* in the Temple;
- Mikve for men, women and dishes;
- Necessity of keeping the water in closed vessels;
- The ritual ablution of the hands before and after bread, after visiting toilet and cemetery, etc.;
- The waters of the Red Sea that saved the Jews and killed the Egiptians;
- The Flood as the punishment of the mankind;
- Drought as a punishment;
- The rain as the prize in appropriate time an das a punishment when sent in wrong time;
- And the Torah itself is referred as Water.

We have listed just a few of the most wide-known cases from *Tanah* where "water" is mentioned. Thus, being one of the most important components of the Creation, water is an important tool in connection between G-d and World. However, since the Earth was given into men's hands, the full responsibility in this connection lies on human beings and then Water becomes an explicit token for us to understand whether our doings are right or wrong.

POLLUTION OF SOILS AND UNDERGROUND WATERS BY INDUSTRIAL AND AGRICULTURAL WASTE

Alexander Tzikerman, Max Shenkerman

The negative influence of human activity on the environment is characterized by production of considerable amounts of polluting substances, sewage and other factors causing climatic changes, pollution of soil, atmosphere and natural water resources.

In the last century mankind began to apprehend the gravity of ecological problems to overcome, and the fragility of the very existence of life on the Earth. Warming up of the global climate, appearance of holes in the ozone layers above the poles, wide distribution of toxicants and pollution of water, air, soil and foodstuffs by harmful chemical substances, extinction of many fauna and flora species, reduction of biological diversity as a result of the growing population all over the planet – all this has become a dangerous reality.

Pollution of natural environment by gaseous, liquid and rigid substances and production waste causing degradation of the environment and damaging health remains the most acute ecological problem constituting a problem of high social and economic priority. Appearance of new technologies and continuous increase in industrial production of chemicals and expansion of their assortment inevitably lead to ecologic load caused by this development.

Especially negative is the impact exerted by so-called eco-toxicants, the most poisonous chemical pollutants of the environment capable of being preserved for a long time and exerting a long-term toxic impact on human beings and animals. It should be noted that for the last 30-50 years highly toxic waste materials have not been processed or destructed by means of traditional methods of their utilization, thus the only method of "struggling" against them has been that of their burial in specially allocated sites, such as Ramat-Hovav (17 km away from Beer-Sheva) or Krasny Bor (in St. Petersburg suburb). Such long-term preservation of waste materials in the ground, alongside the extremely low technological level of their preservation and maintenance, beyond any doubt presents a situation which does not meet the minimal requirements determined by modern standards. Taking this into account, as well as the irreversible damage caused by these burials, of paramount importance is maintenance of appropriate monitoring, processing and utilization of waste. For the time being, as far as processing

of waste is concerned, the most perspective the technologies are those of eco-toxicant plasmo-chemical processing, but there is no possibility to provide a detailed consideration of the advantages of these technologies within the herewith publication.

Any chemical pollution is an alien component in the ecosystem. It is accepted to subdivide the kinds of chemical pollution into four levels of danger:

I – extremely dangerous pollution,

II – highly dangerous pollution,

III – pollution of moderate danger,

IV – pollution of minor danger.

The eco-toxicants referred to as extremely dangerous to the environment and to man's health, the non-organic toxicants are heavy metals and the organic toxicants are petroleum and its products, poly-chlorine and poly-cyclic aromatic hydrocarbons. Especially dangerous for man are dioxins and dioxin-like toxicants, referred to as super-eco-toxicants for their toxic properties and chemical durability.

The group of heavy metals, with the exception of precious and rare metals, is that with density exceeding 8 thousand kg/m^3 (*lead, copper, zinc, nickel, cadmium, cobalt, antimony, bismuth, mercury, tin, vanadium, semimetal arsenic, etc.*). Many of them are widely spread in the environment and can cause various diseases.

Mercury is widely used in industries related to electrical engineering and production of instruments, in enterprises with chlorine components as alloying additives, heat carriers, catalysts of plastic synthesis, in laboratory and medical practice, in agriculture. The main sources of environment pollution by mercury are pyro-metallurgical processes of obtaining metals, organic fuel combustion, effluent water, production of non-ferrous metals, painting materials, fungicides etc. The most dangerous mercury combination is that of methyl-mercury.

Another significant eco-toxicant is lead, which is widely used in production of cables as a component of various alloys, in screens protecting from gamma-radiation, in production of electric accumulators, paints and pigments, in chemical mechanical engineering, pyrotechnics, printing

industry, agriculture. Another source of lead penetration into the organism is that of the leaden dishes.

According to the data maintained by the Austrian Institute of Food Products, the most dangerous eco-toxicant in the group of heavy metals is neither mercury nor lead, but cadmium, which comprises a dispersed dash element in many minerals. But anthropogenic pollution of the environment caused by cadmium is several times as much as that related to its natural concentration. Cadmium is widely used in nuclear power engineering industry, in galvanization technology, in production of accumulators (nickel-cadmium batteries). It is also used as a stabilizer of polyvinyl-chlorine, as a pigment in glass and in plastic, as an electrode material, as a component in various alloys. The main sources of the environment pollution by cadmium are production of non-ferrous metals, burning of solid waste, coal, industrial effluent waters of mining and metallurgical enterprises, production of mineral fertilizers, dye-stuff, etc.

The most significant factors of environmental pollution by eco-toxicants are as follows:

- impact of rocket missiles and spaceships (in regions where parts of rocket-bearers landed, a large amount of toxic material is being accumulated, causing pollution of soil, surface and underground water resources);
- impact of civil aircraft vessels (negative effect on the ozone layer, pollution of the atmosphere by substances formed in the process of fuel combustion);
- impact of transportation vehicles: pollution by toxic substances of waste gases, emission of "non-traditional" substances, such as carcinogenic (benzol, formaldehyde, benzopyranyl, acetaldehyde etc.) and those causing various diseases (toluene, xylols, 1,3-butadiene, heavy metals etc.), drain of effluent waters from stationary sources, formation of rigid waste;
- tens of billions of tons of production and consumption rigid waste, containing ecologically dangerous toxic components, which are subdivided into degrees of their danger as follows:
    - the 1st degree: waste of galvanic production, mercury, chlorine-organic substances, 6-valent chrome, etc.
    - the 2nd degree: indigo remnants, oil products, arsenic, sulfuric acid, etc.
    - the 3rd degree: petroleum slag, copper, lead, zinc, etc.

- objects of agricultural production (bases of chemical components, runway-landing strips, stores of mineral fertilizers, manure stores, cattle-breeding complexes, etc., where abnormal contents of nitrates and other eco-toxicants, including prohibited and unfit pesticides, are discovered;
- mining, coal-mining and timber industries (rigid waste, ore-mining waste heaps, chemical components of timber processing);
- oil-extracting industry (petroleum slag);
- cluttering up territories in suburbs and inhabited localities, by-road areas and parking lots with industrial waste, waste of construction sites and garbage;
- thermal power stations based on rigid fuel (toxic ashen slag);
- municipal dumps, lots of rigid domestic garbage (eco-toxicants caused as a result off rotting and burning);
- accumulation of production and consumption waste extracted by the railway transport network;
- sediments from water-supply and sewer stations of water purification.

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6. **Boroshok Lev**, D.Sc., Professor. Specialization: agricultural wastes conversion, automatic control of poison chemicals expenditure in agriculture. Scientific works: papers – over 150, patents – over 35.

7. **Edelson Israel**, Ph.D. Specialization: control systems and technological process optimization. In Israel takes part in projects for wastewater treatment and disinfection processes optimization and automation. Scientific works: papers – over 40, patents – 8.

8. **Figovsky Oleg**, D.Sc., Professor, academician of European Academy of Sciences, foreign member of RAASN and REA, Chairman of the UNESCO chair "Green Chemistry", Editor-in-chief of journals "SITA" (Israel) and "Open Corrosion Journal" (UK), Director R&D of Nanotech Industries, Inc. (USA) and INRC Polymate (Israel – Canada).

9. **Furman Alexander**, M.Sc. Specialization: geography and biology. Taught in a special biological school in Moscow, Russia. In Israel, works as an instructor on geographical, biological, and ecological issues. Also worked in the area of planting of greenery in Israel. Scientific works: papers – 4.

10. **Goldman Elena**, B.Sc. Specialization: urban roads engineering and ecology. Works at "Tedem" as a Head of the group of roads engineering. Works on her Master's degree in Motor Transport Ecology Management in the Cities of Israel.

11. **Ilievsky Yuli**, Ph.D. Specialization: industrial wastes utilization in building material industry. Scientific works: papers and inventions – over 50.

12. **Kireycheva Ludmila**, D.Sc., Professor. All-Russian Research Institute of Hydraulic Engineering and Land Reclamation. An expert in the field of irrigation, soil salinity, drainage, modeling of water-salt transportation in soil under irrigation, soil cleaning from pollutants. Publications: 3 monographs, over 120 scientific papers.

13. **Krasilschikov Leonid**, D.Sc., Professor. Specialization: hydrogeology and civil geology. In Israel – Chairman of "Scientists of the South" Association. Works in the field of hydrogeological and civil geological research in carrying out building of hydrotechnical and irrigation systems; output of ground water for supply and irrigation systems, taking into account water protection from wastes and contamination; hydrogeological and civil geological conditions being changed by human activity and problems of environment protection. Has over 65 books and scientific works.

14. **Linger Ilya**, M.Sc. Field of expertise: processes and equipment of chemical and water technologies; UV-processes of wastewater treatment; electrofilters for gases. Has over 30 scientific articles and 5 patents.

15. **Lirisman Israel**, Ph.D. Field of expertise: wastewater treatment. Has several scientific works.

16. **Manusov Nonna**, D.Sc., Professor. Specialization: automation of processes of wastewater treatment, analytical systems of optimum regional ecological development. In Israel took part in development of several projects for local wastewater treatment structures, taking into account specific Israeli technological processes. Scientific works: monographs – 6, papers – over 160, patents – 25. Author of 14 scientific reports at Israeli and International Ecological Conferences and Congresses.

17. **Manusov Efim**, Ph.D. Specialization: investigation and elaboration of technological and ecological processes and devices, algorithmization of ecological sustainable regional development strategy. In Israel takes part in projects of unreagent disinfection and purification developed of sustainable economic growth. Scientific works: monographs – 5, papers – over 100, patents – 20. Author of 20 scientific reports at Israeli and International Ecological Conferences and Congresses. Associated Member of several ecological societies, honor inventor in Russia.

18. **Marash Beniamin**, M.Sc. Specialization: economics of engineering ecological systems. Scientific works: papers – over 10.

19. **Milov Michael**, Ph.D. Specialization: different water and wastewater treatment plants projects and introduction. Scientific works: papers – over 30, inventions – 4.

20. **Popadin Alexey**, M.Sc. Specialization: control of different technological processes. Scientific works: papers and inventions – over 20.

21. **Sandigursky Michael**, M.Sc. Scientific consultant of several companies on matters of ecology. Specialization: applied ecology. Scientific works: papers – over 30.

22. **Shenkerman Max**, retired officer of Army of Israel.

23. **Shimmel Tatyana**, Ph.D., the Museum of Natural History in Jerusalem, Israel. Has several scientific works

24. **Slobodov Rozalia**, M.Sc. Specialization: wastewater treatment processes. Scientific works: papers – over 20.

25. **Sosnovsky Yakov**, Ph.D. Specialization: energy consumption management. Scientific works: papers – over 20.

26. **Turkinets Marina**, a Jewish historian, a doctorant of the Ben-Gurion University, author of many articles about history of Russian Jews. She took part in various conferences and seminars. The chairman of the committee "The Jewish Memorial".

27. **Tzikerman Alexander**, Ph.D. Specialization: technologies and installations for utilization of solid and toxic waste. Scientific works: papers – about 170, inventions – over 100.