

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

*ECOST Transactions*

**IMMIGRANT SCIENTISTS AND SPECIALISTS  
FOR ENVIRONMENT PROTECTION**

By financial support of Ministry of Immigrant Absorption of Israel

November 2004  
Jerusalem

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**LAKE HULA – FROM NATURAL CONDITIONS  
THROUGH THE MISTAKEN PROJECT  
TO THE RESTORATION OF THE HISTORIC CONDITIONS**

**Alexander Amstislavsky**

The Hula Valley is nestled between Galilee Hills and Golan Heights. Between 1951 and 1958 major efforts were invested in deepening and straightening the Jordan River's course south of Hula Valley and in forming a network of drainage canals to lower the groundwater and prevent flooding. Drainage of the hula diverted the Jordan River from the north of Lake Hula to the eastern and western edges of the valley and through two main canals downstream.

By 1958 Lake Hula ceased to exist the swampland disappeared. The historic path of Jordan River through the Hula Valley vanished.

Drainage of Lake Hula and the surrounding wetlands reclaimed 6000 hectares of land for agriculture purposes. But serious ecological problems emerged. The valley's indigenous fauna and flora disappeared including 37 endemic species animal. Gradually accelerated the disintegration of nearby farm areas rendering them unsuitable for agriculture.

Declining soil fertility and productivity led to abandonment of agricultural land and to severe damage to the ecosystem.

In parallel exposure of the organic soil to oxygen accelerated the formation of nitrates which then cached into Lake Kinneret and posed a serious threat to its water quality.

Therefore the Hula Valley Administration was established and in April 1994 Jordan River water was once again allowed to flow into reconstructed part of the drained area. Part of the historic Jordan River bed was reconstructed while other sections were cleared of debris and erosion and the banks restored with new plantings and landscape. A dam and water diversion facility were built to regulate the water flow and redirect the Jordan River water into the peat-lands and into the new water body. And the Jordan River has once again resumed its historic course.

## **INTEGRATED SYSTEM “AUTOMOBILE MOTION – ROAD – ENVIRONMENT”**

**Valery Anfimov**

Israel is a small state in the area extent. However, its industry, agriculture, power industry and transport are advanced. The main sources of air pollution in Israel are vehicles, power engineering, chemical industry as well as stone mining and processing in numerous opencasts and plants of the Dead Sea.

The main source of air pollution is transport, especially automobile vehicles (there are more than two million automobiles in the country). The total length of the country's roads is about 6000 km. The municipal road system is advanced, for example, the total street length in Tel Aviv is 720 km, in Jerusalem – 850 km, in Haifa – more than 500 km. The motor-vehicle traffic in cities is impeded by a significant amount of controlled and uncontrolled road junctions, by constant traffic congestions near traffic lights, by pedestrians, etc. The volume of traffic in Israeli roads and streets permanently increases. The number of heavy haulers and automobiles with diesel motors increases as well, and this results in the increase of traffic waste and of the level of air and near-road area pollution. The Israeli climate has a great impact on air pollution, namely high temperatures, small amount of precipitation during summer, intensive precipitation during autumn and winter, great amount of hot “khamsin” winds. Thus, in order to determine the amount of traffic waste and the level of air pollution we shall consider an integral ecological system consisting of three elements having mutual connections: automobiles, streets and roads, and environment.

The elements of this system affect one another. For example, an automobile affects a road, which results in rolling surface wear and pavement destruction. When pavement destruction is increased, the traffic velocity is reduced and the level of traffic waste is increased. On the other hand, the road affects the automobile leading to tyre wear and motor deterioration, which in its turn leads to waste increase and increase of the level of environment pollution. Road building results in environment changes: the relief changes, the existing ecological balance is being destroyed, the wayside is contaminated with products of wear of tyres, rolling surface and motor waste which results in decrease of roadside vegetation and of natural air purification.

Air and area pollution is defined now by stations determining air quality that are installed in several places in the country and by mobile laboratory stations. In order to control the air quality, the Ministry of Environment uses a network of existing stations installed in ports, in plants, near some road junctions and in some other places. The Ministry publishes its reports on presence of CO, CO<sub>2</sub>, NO, NO<sub>x</sub>, PM, SO<sub>3</sub>, O<sub>3</sub> every year. According to the available data, the concentration of the above-mentioned substances increases, and this requires working out a system of measures whose goal will be to decrease the level of pollution.

We shall note that the existing stations can provide air pollution characteristics only in the places where they are mounted. At the same time, there are vast areas with no

stations on them. It is still a question: how the contamination volume may be affected basing on the data from the existing stations since there are no characteristics of contaminated objects. For example, no measurements of contaminated object characteristics are taken in different climatic conditions.

Nowadays, there is no model able to analyse the described above system and its parameters in order to predict air and environment pollution.

In this work, we offer a model of such system designed to determine the volume of traffic waste and to predict of its changes for road use (the system is shown in Fig. 1).

The system consists of three main elements: automobile transport, roads, and environment. The first element of the system is characterized by the following parameters: traffic intensity, structure of traffic, age of automobiles, traffic velocity, traffic congestions, and pneumatic tyre wear.

The second element of the system includes operational parameters of roads, rolling surface wear, slopes. The operational parameters are in their turn characterized by pavement solidity, evenness, and roughness. These parameters have an impact on the volume of road destructions that affects the traffic velocity and quantity of traffic waste.

The third element of the system includes climate and relief. Climate has an impact on traffic velocity. For example, greater precipitation intensity leads to damper road surface, decrease of friction coefficient of vehicles and road, and decrease traffic velocity. Thick and long-continued fog leads to decrease of traffic velocity in consequence of traffic accident prevention. Rise of air temperature results in asphalt carpet softening and in increase of rolling resistance factor, which decreases the velocity. In conclusion, the more road parts having positive slope, the less fuel expenditure and the greater the velocity, and vice versa – negative slopes reduce the speed and tend to increase the volume of waste.

The center of this system is the volume of traffic waste that depends as well on the fuel type and includes: carbon monoxide, carbonic acid, nitrous oxide, nitric oxide, unburned fuel, combustion particulate pollutant (CO, CO<sub>2</sub>, NO, NO<sub>x</sub>, CH, PM).

Some relations for definition of the parameters of the system are listed below.

1. The amount of traffic waste depends on traffic intensity that is measured directly within 10-15 hours at the assumed road section. The road service organizations measure traffic intensity every year. Besides, traffic intensity is determined by requests of city administrations or developer companies. Using data on traffic intensity change within 5-10 years, we can build a prediction model on traffic intensity like the following one:

$$N_j = N_1 (1+q)^{T_j-1} \quad (1)$$

$$N_j = N_1 + qT_j \quad (2)$$

where:  $N_j$  is traffic density in year  $j$ ,

$q$  is increase of traffic intensity,

$T_j$  – years.

2. The structure of traffic is determined for the following groups of automobiles: passenger cars (C), tenders and commercial trucks up to 7.5 tons (T), lorries of 7.5-14 tons and 14.1-20 tons (L), taxis (Ta), buses (B), and motorcycles (M) and tractors (Tr). As an example, Table 1 contains data on processing data on traffic intensity and structure in seven streets of Jerusalem and Haifa.

**Table 1. Intensity and structure of traffic in Jerusalem and Haifa.**

Structure of traffic in the cities, (%)	C	T	L	Ta	B	M	Tr
Jerusalem	78.1	6.4	3.9	7.3	3.2	0.95	0.14
Haifa	63-93	1-11	1-11	4-24	2-4	–	–

Using the data on traffic structure change within several years, we can predict the change in traffic structure for 10 years with accuracy of up to 5%.

3. Groups of automobiles must be distinguished in traffic structure according to their age (service life) as well as according to presence of absorber catalytic agents refining exhaust.

The analysis held in Haifa polytechnic institute (Technion) indicates that there are 50% automobiles equipped with catalytic agents (year of production: 1992) and 50% automobiles not equipped with catalytic agents including 27% automobiles produced in 1989-1992; 12% – in 1985-1988; 11% automobiles are operated for more than 25 years.

4. The velocity of vehicles affects the amount of waste. The more the automobile speed, the less waste is littered per one kilometer of a road. The traffic velocity depends on the length of back slope and on road surface quality. Table 2 contains data on lorry velocity change depending on pavement deformation.

**Table 2. Change of speed of lorries depending on a pavement deformation.**

<i>Degree of pavement destruction, %</i>	<i>Speed of lorries, km/h</i>	<i>Average speed, km/h</i>
up to 10	80	80
10-20	50-60	55
20-40	30-50	40
40-60	20-30	25
60-80	less than 20	less than 20

Back slopes on roads influence fuel consumption as well as the volume of traffic waste. As an example, Table 3 contains data on alterations of re-calculation factors for fuel consumption and waste of passenger cars not equipped with catalytic agents depending on road slope.

**Table 3. Re-calculation factors for automobiles not equipped with catalytic agents and for the ones equipped with them (data from Technion).**

<i>Slopes, %</i>	<i>For automobiles equipped with catalytic agents / For automobiles not equipped with catalytic agents</i>			
	<i>fuel consumption</i>	<i>CO</i>	<i>HC</i>	<i>NO<sub>x</sub></i>
-10	0.3/0.6	0.1/0.5	0.1/3.3	0.01/0.4
-5	0.5/0.75	0.6/0.7	0.5/2.25	0.3/0.6
0	1.0/1.0	1.0/1.0	1.0/1.15	1.0/1.0
+5	1.6/2.0	1.25/1.3	1.0/3.0	2.0/3.5
+10	2.5/3.0	1.6/3.0	1.5/5.5	4.5/18

Pavement evenness also has substantial influence on the traffic velocity. The less even the pavement, the less traffic speed and the more amount of waste per one kilometer of road (Table 4).

**Table 4. Interrelation between evenness of pavement and traffic speed.**

<i>Evenness, cm/km</i>	<i>Average value of evenness, cm/km</i>	<i>Speed limits, km/h</i>	<i>Average speed, km/h</i>
0-100	50	75-90	82.5
100-200	150	65-75	70
200-300	250	57-65	61
300-400	350	54-57	56
400-500	450	50-54	52
500-600	550	47-50	49

Having data on road evenness measurement ( $S$ ) we can determine allowable velocity ( $V$ ) using bumpometers, according to the following formula:

$$V = 850 / \sqrt{S} \quad (3)$$

5. The volume of traffic waste in the areas of traffic congestions is determined taking into account data provided by police and traffic department. There are two types of traffic congestions in the streets and roads of Israel: accidental (near the places of traffic accidents, road repair work, car breakdowns, where large-size loads are transported, near security barriers) and permanent (near traffic lights at controllable and uncontrollable road junctions). In order to determine volume of traffic waste we need to know traffic intensity and structure, starting and ending time of a traffic congestion, length of congestions, number of automobiles in congestions, interval between automobiles. Automobiles found in traffic congestions may not move at all or move very slow, with an average velocity of up

to 5 km/h. Considerable amounts of traffic waste are formed in the areas of traffic congestions, and they are abnormal in the roads.

6. More than 500 thousand tyres are worn out in the roads of Israel every year. The volume of waste from pneumatic tyre wear is determined according to traffic intensity and structure and the amount of tyre wear.

7. The volume of waste from road pavement deterioration at the roads with intensive traffic is determined taking into account annual average thickness of deterioration layer. Pavement deterioration within 7 years according to the change of traffic intensity and structure ( $h_t$ ) may be calculated by the formula:

$$h_t = at + \frac{bN_1 (Kq)^{t-1}}{1000 (Kq - 1)} \quad (4)$$

where  $N_1$  is traffic volume during the first year;

$K$  is factor taking into account changes in traffic structure;

$q$  is annual average increase of traffic intensity;

For bituminous concrete pavement,  $a$  and  $b$  are accepted in limites:

$$0.4 \leq a \leq 0.6, \text{ mm}$$

$$0.25 \leq b \leq 0.55, \text{ mm / mill.ton}$$

Table 5 contains factor of pavement deterioration depending on the influence of automobiles having different axial load (according to the available data).

**Table 5.**

<i>Axial load, kn</i>	<i>Wear factor</i>
60	1
80	1.6
100	2.9

The volume of pavement wear may be calculated by the formula:

$$V = B \times L \times h_t \times K, \text{ m}^3 / \text{year} \quad (5)$$

where  $B$  is pavement width,  $L$  is road length,  $K$  is factor of a non-uniformity of pavement deterioration.

8. Climatic conditions influence the traffic velocity. In Israel, intensive precipitation is falling during the “rain period”. The number of rainy days and duration of precipitations may be determined according to the climate data.

It is a known fact that fogs limit visibility distance; this leads to decrease of traffic velocity and increase of volume of traffic waste per one kilometer of a road. Table 6 contains data on the influence of meteorological factors on the traffic conditions.

**Table 6. Intensity of meteorological factors having various degrees of danger depending on traffic velocity.**

Factors	Degree of danger	100 km/h	80 km/h	60 km/h
Precipitations, mm/min	of low danger	–	–	<0.2
	dangerous	<0.2	<0.2	0.2-1.2
	extra dangerous	>0.2	>0.2	>1.2
Fog (visibility, m)	of low danger	>250	>200	>100
	dangerous	150-250	100-200	70-100
	extra dangerous	<150	<100	<70

There are similar data for the cases of strong wind and dust storm.

Data on actual duration of rolling surface condition ( $T_q$ ) are necessary to determine actual traffic velocity, fuel consumption and objects undergoing pollution.

$$T_q = t_q + t_T + t_b + t_n \quad (6)$$

where  $t_q$  is duration of precipitations resulting in decrease of traffic velocity, in days;

$t_T$  is duration of fogs decreasing visibility distance, in days;

$t_b$  is duration of windy days decreasing the traffic velocity;

$t_n$  is duration of days with dusty hot winds (khamsins).

Nowadays, data on the volume of traffic waste depending on engine operating regimes, traffic velocity, slopes may be found in literature. Using these data in the proposed model, we can determine the volume of traffic waste in different places; and then, on the basis of received data, we will draw maps of waste volume of every street and road. Later on, these maps may be used for working out activities on decrease of waste volume.

As an example, we have calculated the volume of traffic waste along one of the streets in Jerusalem. We have assumed the following average velocities for different automobile groups: 50 km/h for passenger cars, 30 km/h for lorries and commercial vehicles, 50 km/h for taxis, and 50 km/h for buses. The results are given in Table 7.

**Table 7. Volume of traffic waste (kg/km) for traffic volume of 59754 automobiles per day.**

Type of automobiles	Solid fragments	Nitric oxide	Unburned fuel	Carbon oxide
passenger cars	–	43.75	27.9	377.3
commercial	1.63	16.28	6.51	8.14
lorries	0.72	7.52	2.78	3.55
taxis	0.37	1.84	0.25	1.28
buses	0.87	31.11	2.22	5.80

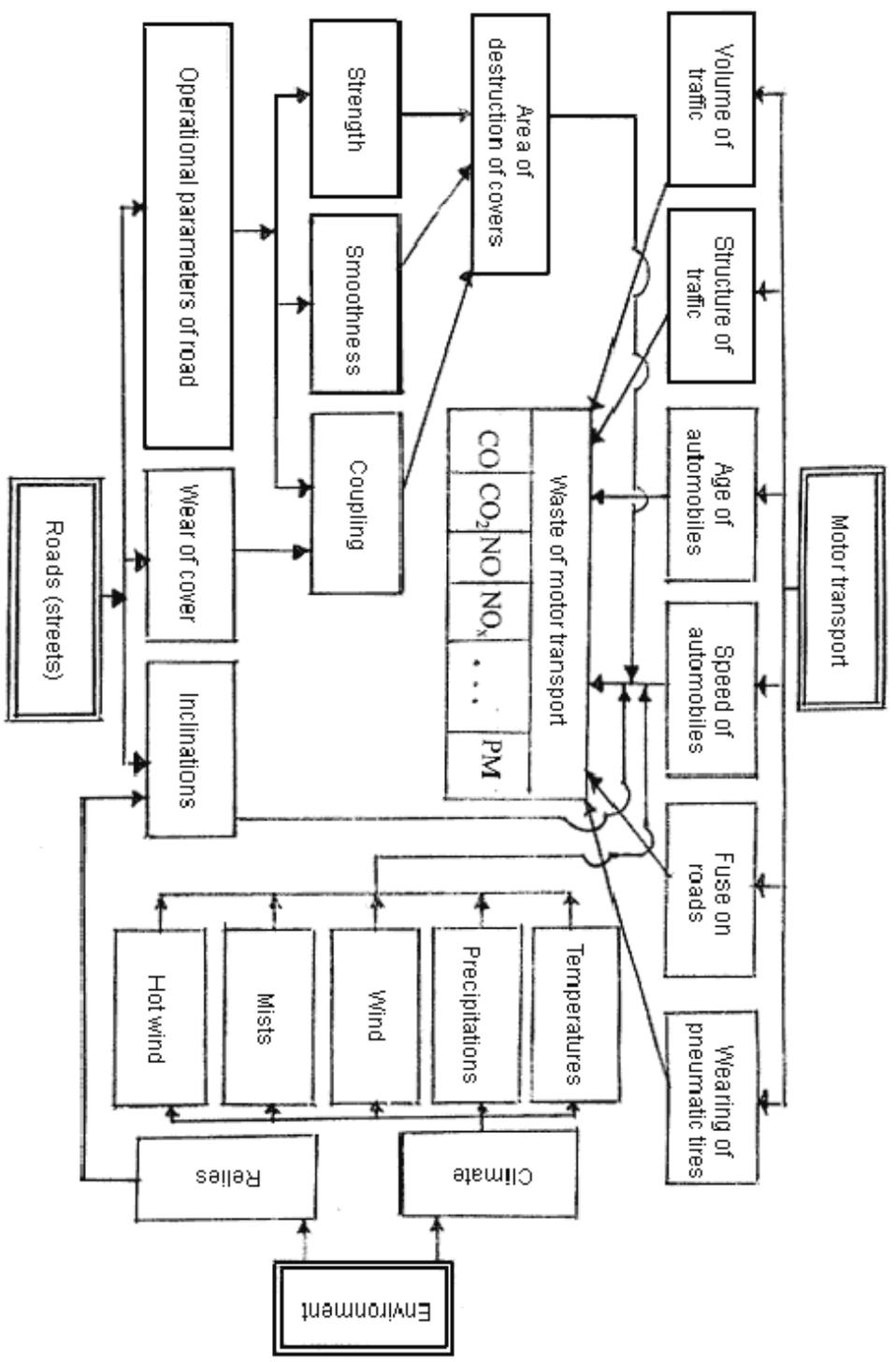
Total volume of waste per one day	3.59	100.5	39.66	396.07
Total volume of waste per one year (300 days)	1077	30150	11898	118821

The data provided evidently indicate necessity to work out measures in order to decrease the volume of traffic waste. These measures should include:

- designing of roads and streets taking into account the volume of waste;
- designing of by-pass roads for freight transportation;
- organization of traffic in order to reduce traffic congestions near traffic lights;
- road operation improving transport operating parameters;
- decrease of traffic waste volume at the expense of catalytic agents usage;
- designing safety devices;
- changing vehicle quality;
- development of law system in the field of transport ecology.

The consequences of introduction of measures on environment ecological condition improvement include general economy because of:

- improvement of the general state of health of the country inhabitants;
- reduction of diseases of the upper air passages;
- decrease of the level of lethal outcomes;
- increase of labor productivity;
- growth of the number of tourists visiting ecologically clean places;
- growth of productivity of agricultural crops.



**Fig. 1. Computer model of an ecosystem of mission control of a motor transport.**

# OCME – THE NEW PRINCIPLE MEMBRANE TECHNOLOGY OF THE WATER AND WASTEWATER TREATMENT

Leonid Blyankman, Boris Podolski

## Membrane technology: benefits and disadvantages

Nowadays desalination of sea-water, preparation of water for boilers, improvement of potable water quality, separation of heavy metals, oils, detergents, suspensions, organic substances and other impurities from industrial wastewaters for the creation water supply systems of a closed-circuit type are impossible without membrane technology.

Among the membranes, spiral wound membranes have found most frequent practical application for their high capacity, compactness, and relatively low cost and easy operation. Substantially, the membrane plant is a membrane element enclosed in a pressure vessel and a pump for fluid delivery.

Water filtration via a membrane element is performed by the principle of cross flow membrane filtration, so that a flow entering the membrane element is divided into two flows: permeate flow and concentrate flow.

However, alongside with indisputable benefits, the spiral wound membrane has a major drawback - sensitivity to various kinds of impurities, which causes their capacity reduction, deterioration of the fluid purification effect, reduction of membranes life and even their failures.

The main cause of impurities deposition on the membrane surface is that impurities concentration within the membrane module increases by several times as compared with the water entering the module and low turbulence of the flow.

Therefore, from the moment the membranes were placed in commercial operation, that is, for about twenty years, methods have been sought for their fouling prevention, cleaning membrane surface, creation of membranes tolerant to fouling etc. Hundreds of patents have been issued intended to solve these problems. As a rule, methods disclosed therein are not universal, and often the cost of plants for fouling prevention or cleaning the membranes exceeds the cost of the basic plant. And the application of chemical membrane cleaning causes the generation of highly fouled and often toxic waste waters, and besides it allows to wash up a membrane only in part.

## The new principle membrane filtration and its benefits

The authors have patented a new principle of fluid filtration through a membrane (OCME) **which provides pulsation of a flow with a simultaneous change direction of its motion at definite intervals to increase turbulence** and prevent particles deposition on the membrane surface. Besides, it prevents formation of a boundary concentrate layer, which reduces membrane capacity. There is also suggested a device to realize this principle.

The method is intended to eliminate the major drawback of spiral wound membranes – excessive sensibility to impurities, which will permit to use

successfully their indisputable advantages over other kinds of membrane modules and start their large-scale application. These advantages, as was mentioned above, lie in high capacity, high separation grade, comparatively low cost, compactness, and easy operation. By the way, the invention may be used for all types of filtration devices wherein the filtration is carried out by cross flow principle.

OCME method is first of all necessary for membranes working under severe conditions when their capacity reduces drastically and therefore frequent washings are applied- once a month, once a week and sometimes even every day. At frequent washings the life of membranes decreases from two- four years to two-three months. The application of new principle filtration (OCME) will make it possible to keep membrane capacity and permeate quality on the initial level, that is, from the moment of installing new membranes, and increase the membrane life, reduce reagents consumption and drastically reduce the number of washings and volume of wastewater, increase permeate issue and reduce the quantity of concentrate, reduce capacity of pumps and energy consumption.

OCME system is suitable both for plants of a small capacity- from several tens of liters to several cubic meters per hour, and for large plants – from tens to hundreds of cubic meters per hour.

### **State of the project**

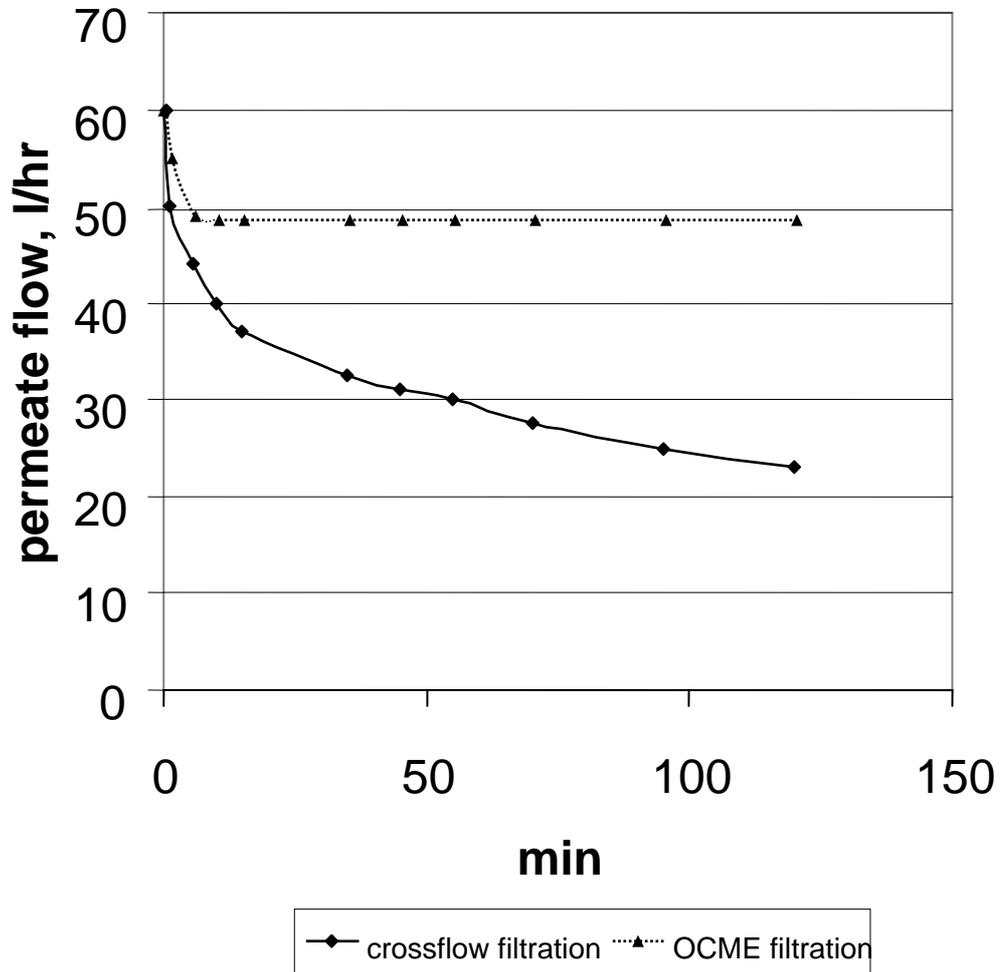
Laboratory research has been carried out and completed. On the basis of obtained results there is being designed a first industrial OCME plant. The manufacturing and placing the plant in operation is planned to be accomplished in the nearest future.

### **Results of laboratory research**

The plant for carrying out laboratory research has been manufactured as a model of industrial plants. Conditions for water filtration through the membrane: pressure, flow velocities, relations between the volumes of permeate and concentrate corresponded to those in industrial conditions. Into the flow of water entering the membrane there was introduced a substance quickly depositing on the membrane, which caused drastic reduction in its capacity and increased pressure. Thus there were created extreme conditions of membrane fouling. The research results are presented as graph.

In the drawing there are presented the results of filtration of artificially fouled water by the conventional (cross flow filtration) and new principle (OCME). While at conventional filtration through a membrane there occurs an essential reduction in product (filtrate) issue, in applying the OCME principle no reduction in membrane capacity occurs, all other factors being the same. The initial momentary reduction in membrane capacity in both variants is connected with replacing pure water in the module in starting position by excessively fouled one. The tentative price of an OSME device for membrane plants of 4 –10 m<sup>3</sup> per hour amounts to about 10% of the cost of basic plant. The payback period of an OCME device is from half a year to one year.

## Flux versus filtration method



# QUESTIONS OF THE DEAD SEA ECOLOGY

Lev Boroshok

## Abstract

The necessity of preservation of the Dead Sea that intensively shallows during the last years and faces the threat of full disappearance is considered in this article. Necessity of preservation of the Dead Sea, the riches of global value is discussed widely for quite 20 years. However, no specific steps were taken in this direction until now. Really, such grandiose and expensive action as construction of a main for replenishing with water of the Dead Sea cannot be approved and accepted to realization only under the only one offer. It is necessary to analyse a number of alternative ideas that will enable to choose the best positions of each idea and to create the optimum variant. The submitted work is prepared with this purpose also.

## Introduction

Only serious actions can prevent disappearance of the Dead Sea. The basic from them is replenishing with water of a drying up reservoir from an external source. Such source can be the Mediterranean Sea or the Gulf of Aqaba of the Red Sea [2]. Replenishing with water will allow stopping reduction the level of the Dead Sea surface (the first stage of works on preservation of this sea), to increase a water level in the Dead Sea up to optimum size (the second stage), and then constantly to support a level achieved at the second stage (the third stage).

The water main from an external source of water to the Dead Sea should be lead. The project of the main should provide construction of the hydraulic engineering and the hydropower complexes.

The designing and the construction of the main, and also its operation are enough expensive actions. Questions of financing the designing and the construction of all edifices should be submitted on the international level. Such way of the decision the questions of financing the large ecological actions, having the international value, widely practices in the world practice. The Dead Sea is riches of the world significance. Therefore the world community and the international banks are obliged to help to carry out this action.

The question of operation of the main is solved so, that expenses of means for the main operation can be avoided in general and even to receive essential profit. It is possible to take advantage for this purpose of unique lay of land of Israel - difference of heights from a level of a World Ocean (0 meters) up to a minus 417 meters of the level of the Dead Sea. It will allow to construct the hydropower complex on a going down part of the main. The received electric power will completely ensure the functioning of the main not only, but also the essential part of it can be used for transfer to external consumers on a commercial basis that will yield a profit.

## **The ecological analysis of the main project**

Such global action as construction of the main for replenishing with water the Dead Sea from a World Ocean demands the careful ecological analysis in order to eliminate a negative influence on environment and on object with which action is carried out.

It must be carried out the ecological analysis with purpose of determination the optimal structure of water, which will use for replenishing, the volumes of replenishing on the every stage of work on preservation of the Dead Sea. It is necessary also to carry out ecological analysis of the processes of the water-intake from the external source into the main, the transportation of water via the main, the discharge of delivered water into the Dead Sea.

*The optimal structure of water for replenishing of the Dead Sea.* The Dead Sea was replenished with fresh water of the river Jordan and the lake Kineret in all years of the existence. Accordingly the replenishing with the freshened water of a World Ocean is the best variant of restoration of the Dead Sea. This variant provides carrying out of the replenishing without the slightest infringements of an ecological condition of the Dead Sea on water structure. The problem will be to provide low cost of the desalination.

It is impossible to receive cheap fresh water on widespread membranous installations, in which the principle of the reverse osmosis is used. This principle of branch of salts from water is applied already tens years. In it are used physical diffusion processes. The water is forced through the walls of the cellulose acetate or the synthesized membranes by applying pressure at about  $25 \text{ kg/cm}^2$ .

Lack of this way is that application of film membranes for a filtration at a molecular level demands carrying out before desalination a complex and expensive operation "Pretreatment". Thin film membranes are quickly worn out at work on high pressures. High power consumption, low wear resistance, and necessity of application of additional complex operations result in high specific cost of the freshened water.

It is needed the development of a new less power-intensive and cheap principles desalination of the seawater. It'll be practicable a realization of replenishing with fresh water of the Dead Sea only in this case. Facilitating circumstance here is that replenishing can be carried out with technical fresh water. Less rigid requirements on such parameters, as residual quantity of the salts dissolved of water and a degree of a filtration of solid particles are showed to such water. Besides, there is not necessity to make disinfection of water from organic pollutant by preparation of water for replenishing the Dead Sea.

Application of diaphragmless electrotechnical methods of desalination is perspective for reception of cheap technical fresh water. Therefore it is necessary to increase and to precipitate the research works in this direction, that will render the positive influence on the decision of the question of the Dead Sea preservation.

*Required volumes of replenishing with water the Dead Sea.* The volume of water, which is required to be taken from an external source and to submit to the Dead Sea

within one year at the first stage of work (stops it's shallow), is depended on volume of water, which evaporates from the Dead Sea surface under the action of sun heating, and also from compensating factors as atmospheric precipitation on the Dead Sea surface and water flow to the Dead Sea from the side of the coast and the river Jordan.

It has been calculated, that annually losses of water with consideration of the compensating factors and a water leakage from main make in average  $180 \cdot 10^6 \cdot m^3/\text{year} = 20,5 \cdot m^3/\text{hour}$ . The following stages of works on restoration of the Dead Sea will demand to increase the volumes of replenishing.

*Water-intake.* Negative influence on the underwater environment of the sea, from which the water-intake is made, can render the hydro dynamical processes arising at movement of the taken away liquid. Therefore it is necessary to define speed of the water streams arising at the water-intake.

The sea space, filled with a liquid, is the object of studying in the given calculation. The parameters of change a speed of movement of streams in the fixed points of sea space and change of these elemental motions at transition from one point of space to another are studied by this.

The water-intake from the sea can be examined as movement of water through concentric segments of sphere aside of a water-intake located in the center of sector of sphere, which simultaneously is the beginning of coordinates. The radial straight lines, which are taking place through the beginning of coordinates, will be the lines of a current. Besides, concentric sphere segments of radius  $R$  with the center in the beginning of coordinates will be the lines of equal potential.

The results of calculations of water torrent speed  $V_1$ , which are made by water-intake device, in the function of volume of intake liquide  $Q_n$ , are adduced in the Table 1.

**Table 1.**

$R, m$	$Q_n, m^3/\text{year}$			
	$45 \cdot 10^6$	$90 \cdot 10^6$	$135 \cdot 10^6$	$180 \cdot 10^6$
	$V_1, m/s$			
1	0,190	0,4	0,6	0,8
2	0,050	0,1	0,15	0,2
3	0,020	0,04	0,06	0,08
4	0,012	0,025	0,037	0,05
5	0,008	0,016	0,024	0,032

Some background movement of water with a speed 0,05...0,10 m/s in the coastal sea environment of east coast of the Mediterranean Sea and the Gulf of Aqaba takes place constantly. It is known, that these streams are ecologically harmless to the sea environment. It is possible to accept, that the speed of the stream created by the

water-intaking device allowable, is a speed  $V_l = 0,05$  m/s. Accordingly, the zone of values  $Q$  and  $R$ , at which a water-intake will cause increase of the streams speed at size of 0,05 m/s and less, is allocated in the resulted table.

The received data testify, that for exception of negative influence of process of a seawater intake on the underwater environment of the sea, the intaking device should be removed from ground formations, which can be damaged (for example, coral reeves), not less, than on 3 m. Such requirement can be satisfied easily.

The water intake in volume, for example, 20500 m<sup>3</sup>/hour can cause amplification of current aside the intaking device on distance of 20 m from him on  $2 \cdot 10^{-3}$  m/s. Such insignificant increase in speed of current does not render any negative influence on the sea environment from which will to be carried out a water intake.

*Transportation of water via the main to the Dead Sea.* Water should move on closed water-pipe which area of section provides movement of water with average speed no more than 1 m/s.

*Discharge of water from the main into the Dead Sea.* The discharge of water from the main to the Dead Sea is very responsible process in the ecological attitude and in the technological chain of the Dead Sea preservation. It is necessary determine by elaboration of project to what final result it should be strive. It may be put the additional special task of stopping or of lowering the fall of dissolved salts in the sediment, lowering the strength of salts solution in the water, gradual dissolving of the bed saline deposits and anothers. But there are the questions for future. It can be formulate in the first case of the work the next ecological recommendations.

It is impossible to make discharge of water directly at coast, as submitted water (fresh or sea) will dissolve the deposition of salt which have collected in a plenty at coast of the Dead Sea. It will cause irreversible changes in ground of coast. It is necessary to submit water to the Dead Sea on water-pipe on distance 7...8 kms from coast and in several places on length of the Dead Sea.

It is necessary to give the water to the border of division the water and the salt layer. It is ecologically expedient to submit the freshened water on natural water-pipe on which it came to the Dead Sea in all years of the existence. This is the mouth of the river Jordan.

### **Economic parameters of the main**

The main hydropower complex will be the basic source of the energy. The energy  $W_y$ , which can be received on the hydropower complex of the Dead Sea for one year on flow of the liquid through the main  $Q_y$  and efficiency of the hydropower units 0,86 is adduced in the Table 2.

**Table 2.**

$Q_y \cdot 10^6, m^3/year$	90	135	180	225	270	315	360
$W_{ey} \cdot 10^6, kW/year$	80	120	160	200	240	280	320

The economic indices of the main objects depend on a rational choice of their parameters and operating modes.

It has been established by means of calculations, that rational operating mode at the first stage of replenishing with water the Dead Sea (the stop of the shallowing) is  $V=1$  m/s. The water pipe is in two branch-pipe at volume of water flow  $Q=180 \cdot 10^6$  m<sup>3</sup>/year with the area of cross-section 2,84 m<sup>2</sup> each is required to receiving the speed of stream  $v=1$  m/s. Diameter  $D$  of each branch-pipe at such water-pipe will make 1,9 m at round section.

The distribution of receiving electric power on a fulfillment all own needs of the main, and also quantity of electric power, which may be realized to a external consumers, is adduced in the Table 3.

**Table 3. Distribution of receiving electric power, %.**

Scooping and transportation the water	Receiving the technical fresh water	Execution the technological operations and the household works	Transmission of power to external consumers on commercial principles
The main from the Mediterranean Sea to the Dead Sea (L=90 km)			
12	18	9	61
The main from the Gulf of Aqaba to the southern part of the Dead Sea (L=220 km)			
34	18	9	39

It follows from the Table 3, that it will be spent for transportation of water from Mediterranean sea 12% of received electric power or 34% of the received electric power for transportation of water from the Red Sea.

The desalination of seawater on economic two-stage installations will require about 18% of the received electric power. All other electrified technological operations, monitoring systems and managements, and the electrified economic works will require about 9% of received electric power. The others of 61% or 39% of the received electric power can be realized to external consumers on a commercial basis or are used in additional desalters for reception of fresh water for needs of Israel and the next Arabian countries that is incorporated in the name “The main of peace”. It also will ensure the profit from the main operation.

### **Prospect of development of new direction of Israel ecology**

Constructions of the hydropower complex of the Dead Sea can be the beginning of a new perspective direction of economy and ecology of Israel.

It is known from the published statistical data, that the population of Israel has grown on 60 % for last 20 years, and the current consumption has increased in three times. It is natural growth of a level of saturation of the population and the industry with power-intensive electric equipment. And all gain of manufacture of the electric power has taken place to the account of construction and increase at capacities of thermal power stations. Hence, the volume of harmful emissions in an atmosphere

had trebled also. Expenses for protection of biosphere should increase in as much time.

It is spent over three billions dollars for import of liquid fuel for power stations. It makes an essential share of deficiency of the country trading balance. It will be required to treble capacity of thermal power stations again with all negative consequences for economy and ecology in the next 20 years if will not be changed the developed tendency of growth of a current consumption will be changed only to the account of the construction the thermal power stations.

It is required investments about 20 billion dollars on a gain of capacities of power stations. Cost of the electric power inevitably will increase and there will be a rise in price of all kinds of production and services. All this testifies that sharp necessity of development of alternative ways of manufacture the electric power has ripened in Israel. Such direction can be started from use of a unique opportunity of construction of hydroelectric power stations on the main of water delivery to the Dead Sea. It will give economic profit and simultaneously will lower the loading on ecology of Israel.

## AN ECOLOGICAL TWO-CYCLE DIESEL ENGINE

**Vladimir Cherenkov**

The developed design of an ecological two-cycle Diesel engine is distinguished from the kinematic scheme that is dominant today in internal combustion engines by the fact that it utilizes a helical transformation method of reciprocating motion to the rotary motion of the power shaft. The helical method of the mentioned transformation has been known for many decades, and has been referred to in hundreds of patents.

But only on the modern development level of technology and of information science has a real possibility appeared to create an extraordinarily promising scheme that allows by rational design means by taking into account the medium level of production technology to develop a preliminary project, and then a technical project of the mentioned engine.

The preliminary studies of the subassemblies and overall calculations have shown the feasibility of the chosen direction. The main result has been the possibility to increase the efficiency by 2 to 2.5 times due to a two-stage expansion and repeated utilization in the engine of the waste gases, due to using a part of the cooling air as a working fluid, and also due to the exclusion of the sources of mechanical losses, and likewise due to a densification of the cycles of work, and due to many secondary design solutions.

This engine has no limitations with regard to type dimensions and is sensitive to any improvements of the gas dynamic process, and the multi-fuel properties except for all liquid hydrocarbon fuels assume the utilization also of all gaseous fuels, not excluding hydrogen in the improvement of their fuel systems.

The suggested engine has an output power, that is, a power per propelling agents (such as wheels, caterpillars, and so on) that is equal to its efficiency. That means, that to obtain the required result, a nominal power is sufficient that is decreased by half. If one takes into account that each kilogram of the fuel that is combusted in the combustion chambers of all internal combustion engines requires oxygen that is contained in 15 cubic meters of air, then it is easy to calculate, how many exhaust gases “enrich” our air basin each second.

The decreased nominal power of all internal combustion engines with a twofold increase of their efficiency entails savings in two directions - decreased oil consumption, a decreased capacity of the accumulators (starting by air), reduced noise levels (the exhaust gases have only half of the energy). Besides what has been mentioned, the simplified design entails production-related and operational advantages. This can bring about a reduced energy intensity of the corresponding productions and infrastructures.

It has become possible to obtain such high parameters as a result of using a number of design solutions that have made their proofs in practice and due to their consistent mutual agreement with several new solutions that have allowed creating a rational system that is capable of opening a new direction in the production of engines. Such solutions are: starting by air, two-stage injection and compression,

two-stage expansion, double-flow ejection air cooling, repeated utilization of exhaust gases at the second expansion stage, the utilization of part of the cooling air as a working fluid, the elongation of the diffusion stage of fuel after-combustion, the gaseous fixation of the mobile masses at the extreme points, as well as the dynamic balancing, and likewise of a number of secondary design solutions.

At present, the materials of the project have been submitted to the Patent Office in Jerusalem.

# **WATER/WASTEWATER TREATMENT/DESALINATION/DEMINERALIZATION SYSTEM**

**Israel Edelson**

There are presented comprehensive yet cost-effective solutions for the water treatment/desalination/demineralization and for the purification and regeneration of industrial and municipal wastewater. System is a multi-stage, highly customizable water treatment system that prepares brackish and saline water for drinking-water and wastewater for either recycling or sewage.

The first of its stages involves preliminary treatment from rough particles, fats, dye-stuffs, organic products and similar contamination using filters and chemical oxidation (ozonization). The next process utilizes a highly effective coagulants and filters to allow the ash remains to remove out of solution. This is followed by a process of mechanical filtration that mechanically removes non-soluble particles. The final stage removes metal ions, including heavy-metal, and other solutes from solution by a process of electro dialysis. All these stages an integrated system that is compliant with both American and European environmental regulations and can be used in a variety of saline, brackish water and industrial wastewater disposal applications.

## **Advantages of the System**

### ***Broad application***

System is intended for removing various contaminants and for restoring the water properties and energy potential. System is most effective for regeneration of water that was polluted with any salts and heavy metals in addition to various organic contaminants, detergents, phenols, etc.

It can be utilized:

- Purification and mineralization of water from artesian wells up to quality of drinking water.
- Water desalination for using in thermal electric power stations and heating plants.
- Purification and disinfection of wastewater and its further use in agriculture.
- Purification and demineralization of saline water from underground sources (up to 17 g/l), production of water with the set parameters (salinity, pH, sodium absorption ratio, etc.) using for selective watering of crops (tomatoes, cotton, drupaceous, etc.).
- Demineralization of whey in dairy factories.
- Purification of drinking water from nitrates, arsenic, mercury, boron and other admixtures.
- At the end of a manufacturing process, for purifying wastewater prior to discharging it into the local sewage system.
- At the beginning of the industrial process, for various pretreatment methods of water.

- For regeneration and recirculation of water in an industrial production cycle.

***No neutralizing chemicals are used in the process***

pH correction without the addition of strong acids and bases addresses many of the attendant concerns with the transportation, use costs, and storage of strong, potentially hazardous and dangerous chemicals.

***Environmentally appropriate disposal***

Used active materials are disposed of via an environmentally friendly process in which waste materials, including heavy metal pollutants, are reduced to harmless silicates.

***Rate of treatment is continuous and is equal to the flow rate***

Treatment on the liquid is performed continuously, instead of gathering into a finite tank for batch processing. As the flow rate fluctuates, the system adjusts for it accordingly.

***Requires minimal floor space***

System is compact, can be assembled on one base or kept as separate modules, and is convenient to operate and maintain. A system of 30 cub. m per hour capacity locates in one 20' container.

***Complete package***

System comes complete with all parts that are necessary for its operation, inclusive the active modules, equipment, monitoring system, power supply and other accessories. At the request of the customer, this package can be expanded and supplemented.

***Easy hook-up***

System does not require special facilities or a foundation for installation and hook up. It can be easily installed in an existing operating environment of technological manufacturing complexes with only minor modifications. No redesign or reconfiguration of the existing process or its components is necessary.

***Simple operation***

The construction of the System is simple, and it can be operated by factory personnel with short training. Additionally, the time required for replacement of active materials is minimal due to the system's unique design.

***Constructed of rust-free components***

All of the components that are exposed to the process water are made of non-corrosive materials such as polypropylene, PVC, and stain-less steal. These materials are resistant to reactive chemicals, which translates into longer-lasting, more reliable performance.

***Customizable solution***

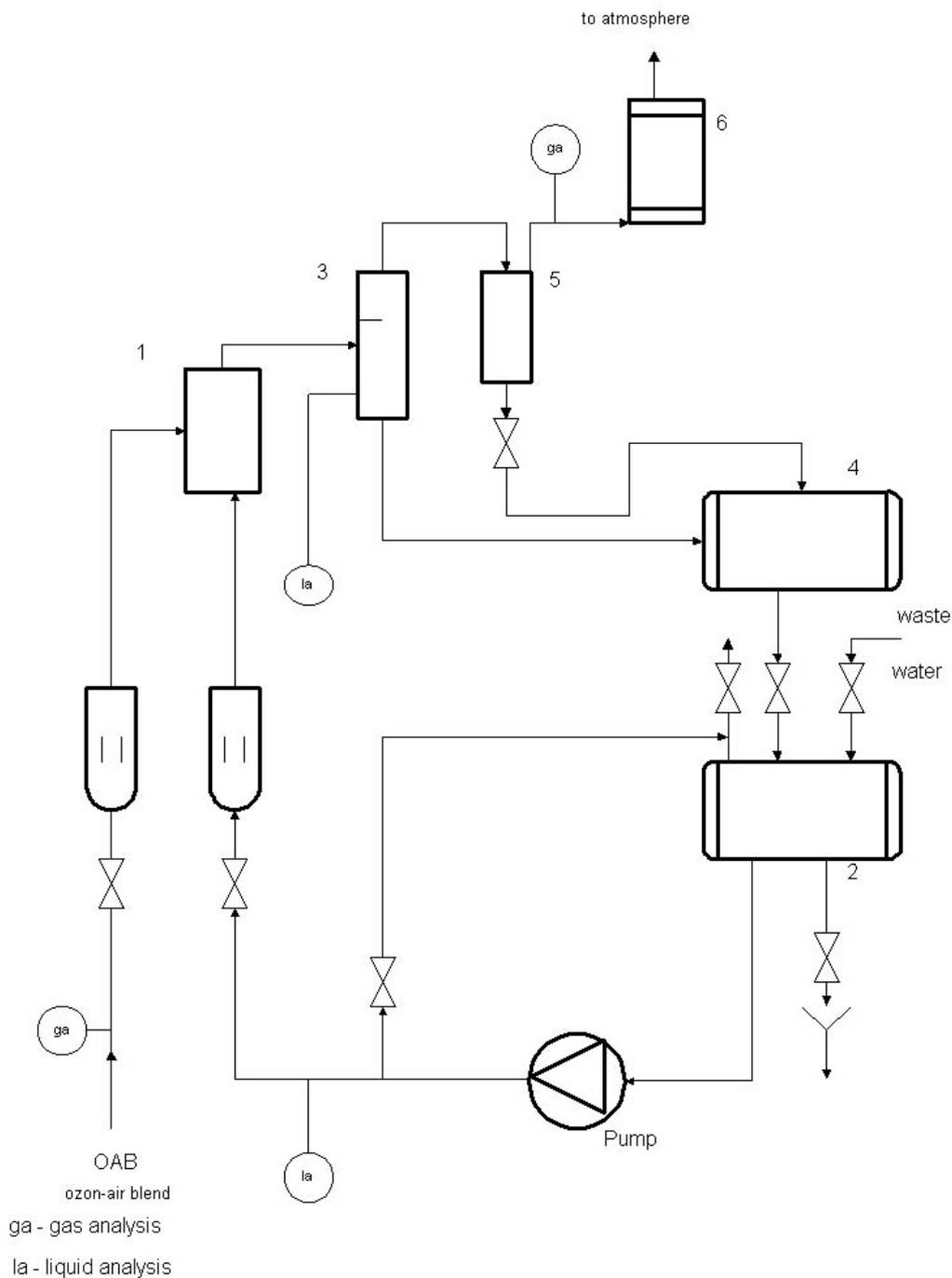
Because it is completely modular, the System can be re-assembled and customized according to the customer's operating conditions and production.

## Wastewater treatment by ozonization

### *Description of technological scheme (Fig. 1)*

Wastewater is fed to tank 2, from which by pump to hydrodynamic mixer of ozone and wastewater (HDM)1. The ozone-air blend is fed that way from an ozonizer. The gas-liquid blend from HDM is fed to de-aeration apparatus 3, from which the liquid is sent to tank 4, and gas passing through a separator 5, is come to the reactor of catalyst treatment 6.

It will be noted that the wastewater efficiency by HDM using exceeds the same in bubble systems. Specific consumption of ozone is diminished hundred as less and treatment efficiency exceeds to 25-35%.



**Fig. 1. Scheme of treatment by ozonization.**

## Wastewater treatment by electro dialysis

### Description of technological scheme (Fig. 2)

Saline water is fed to electro dialysis plant EDP by line W to tanks TW and TB. Water volume control is effected by ON-OFF valves K9 and K10. Water circulation is effected by two pipelines: D+C and B+A by use of centrifugal pumps PB and PW. The pump PB sucks saline water from tank TB and feeds it to input of EDP to B-brine and A-anolyte chambers, the pump PW feeds water from tank TW to D-diluent and C-catholyte chambers. Four streams outflow from the EDP after water processing: D1 - diluent (desalinating water), B1 - brine (concentrate), A1 - anolyte (acid solution), C1 - catholyte (alkaline solution).

D1 - diluent returns, fully or partly, to tank TW for repeated desalination.

D2 - diluent feeds to outlet from EDP.

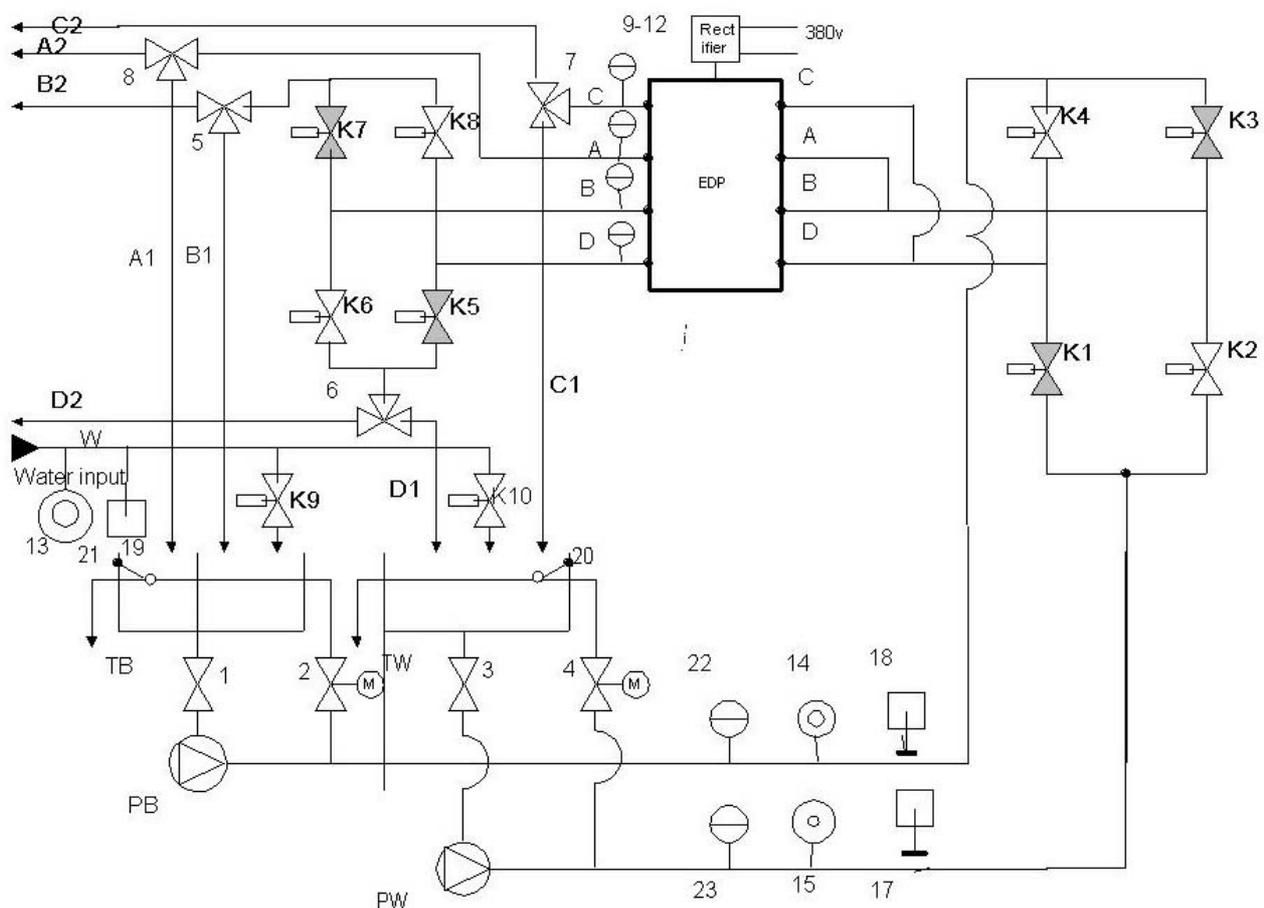
The following parameters affect on quality and quantity of desalinated water:

- voltage or consumed power of electric current;
- rate of flow through the EDP;
- number of cycles of processing water pass through the EDP.

Ratio of circulating and outlet flows is controlled by valves 5 and 6.

Rate of flow is controlled by valves 2 and 4.

Reverse of hydraulic flows is effected by switch of solenoid valves K1 - K8.



**Fig. 2. Scheme of electro dialysis plant.**

Explication to technological scheme of EDP:

EDP - electro dialysis plant.

1 - 4 - two-running valve.

PW - diluent pump.

5 - 8 - three-running valve.

PB - brine pump.

9 - 12 - indicator and switch manometer.

TW - tank of diluent.

22 - 23 - indicator manometer.

TB - tank of brine.

13 - 15 - flowmeter.

K1 - K10 - solenoid valve.

17 - 19 - conductometer.

20 - 21 - level-gauge piezometer.

## **BUILDING MATERIALS AND ECOLOGY**

**Victor Gendin, Yuli Ilyevsky**

The use of raw materials and industrial processes that do not worsen people's health and do not pollute the environment is necessary when fulfillment of ecological requirements comes into play when technological questions of building are solved. The highest requirements concern the materials and technologies used during building dwelling houses and office and production buildings where people will be found all the time. Yet, according to the normative documents currently in force, some requirements except radiological ones may be weakened for single objects and/or their parts. Materials that did not undergo ecological testing may be used, for example, for house footings, lower layers of pavement, drain coverings, bearing foundations, etc.

In Israel, the main building material is concrete – an artificial conglomeration consisting of cement, water filler and chemical filler materials as well. The general volume of concrete being placed per year is 6-8 million cubic meters.

The main suppliers of cements are Israeli plants. The plant in Neshet is the leader in cement production providing a high level of air blowout treatment (more than 99%) and having proper equipment to eliminate ingress of cement dust. Other cement plants and limestone burn plants solve these tasks less effectively.

Coarse and fine fillers (mostly solid carbonates) are processed in the open pits of practically any grain-size composition. Dust collecting and laying-up present certain difficulty in open pits. In this way, watering and rolling dust fractions may hardly be called effective decisions. Among the ways of dust utilization that are used in foreign plants we shall mention the technologies of cement diluting and using cements in asphalt concrete.

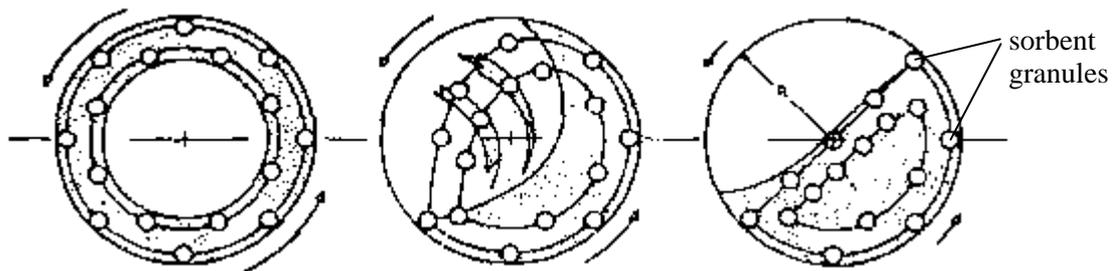
Basing on the quantity of cement mixtures being produced per year we have calculated that in order to satisfy the requirements of Israeli building sites in fillers, approximately 5 km<sup>2</sup> must be taken out from land utilization every year for open pit development. Essentially smaller areas are needed for open pits of Jerusalem stone, granite, marble and other non-metallic building materials. More effective use of rocks being dumped during pre-building area preparation might reduce the need for areas being taken out of land utilization.

# 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  $n_{cas}$ .

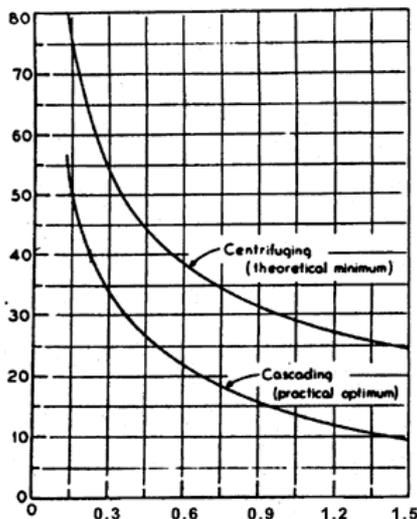


**Fig. 1. Centrifuging, cataracting, and cascading motion regimes of sorbent granules in a drum-type concrete mixers.**

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

$$n_{CR} = 29.9/\sqrt{R} \tag{1}$$

where  $R$  is MD radius.



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

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

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:

$$n_{RCR} = 20.44/\sqrt{R} - 6.67\sqrt{R} \tag{2}$$

As may be seen from Fig. 1, different working regimes lie in the interval from  $n_{RCR}$  (when  $n < n_{RCR}$  no mixing will be done) to  $n_{RCasR}$ , that is real cascading regime, since when  $n > n_{RCasR}$  the sorbent granules may split up and the sorbed contaminations will exude. Making the

graphical representation of the relations  $n_{\text{RCR}} = f_1(R)$  and  $n_{\text{RCasR}} = f_2(R)$ , 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.

## ECOLOGICAL BASIS OF DEMOGRAPHIC SUSTAINABLE GROWTH

Tatyana Kantorovits, Yulia Shleyfman, Efim Manusov

*A king is not saved by the multitude made of a host;  
A mighty man is not delivered by great strength.*

*Psalms 33:16*

Ecology is a science studying the “dwelling place” of the human society (HS) and the interaction of HS with the environment (EN), i.e. interaction between the bio-geo-system (BGS) and HS as social-political systems. It is obvious that the anthropogenic power influencing BGS will result in impact on the environment and, subsequently, will bring about irreversible changes and even ecological collapse caused by possible EN reaction to these influences (see Manusov N. et al, “Correlation between the Society Sustainable Development and the Democracy Development, The 7<sup>th</sup> Interdisciplinary Ecological Association Conference of IEA, 2001, San-Francisco, USA).

Nonetheless, by now the negative impact of En on HS, which can bring about collapse for the reason of the above interaction, has not been considered. In the Middle East region, it is Judaic onthology that provided protection of HS from the negative natural impact. For instance, the Judaic dietary laws (Kashrut) provided survival of the Jewish population.

Let us consider here only two principal regulations of Kashrut: the prohibition of pork and the procedure of the ritual meat processing. The two regulations are directly related to ecology of the Middle East sub-region (MES) situated between the Mediterranean Sea from the West and the Jordan river from the East, the Golan heights from the North and the Red Sea from the South. Thank to the underground aquifers, favorable conditions for cattle breeding have been developed in the sub-region. Availability of meat products under torrid climate conditions requires technologies for its preservation without appropriate refrigerating appliances. Actually, that is what Kashrut was. There was a special way of cattle slaughtering, providing momentary death of the animal and removal of blood as much as possible. The cattle to be slaughtered was chosen very carefully, with strict precautions (without injuries, developmental defects, diseases), with healthy lungs (without grumes and bladders). When processing the carcass meat, blood vessels are removed, since the residue blood promotes putrefaction. Further on, the meat is macerated and salted, which enables to preserve it for some time, enough for using it, before it undergoes putrefaction.

Recently the American virologists, studying the reasons of the pandemic disease, which took in 1920 above 40 million lives – much more than the number of victims of the 1<sup>st</sup> World War – found out that the disease was brought to Europe from Kansas, US, by the American expeditionary corps. The reason proper of the disease was the bird virus, which got to pigs’ organisms together with the bird’s faeces, undergoing mutation and becoming virulent for men, i.e. pork food in this case

becomes mortally dangerous. Extrapolating the Kansas “bird rookeries” to annual migration bird colonies of the Middle East region (more than 560 million species in season – L.Dinevich. Scientific Israel – Technological Advantages. Vol.6, No.1-2, 2004. pp. 31-47), it is easy to explain from the viewpoint of natural and ecological sciences the strict prohibition of pork.

Another example of prohibited food is shellfish of the coastal Mediterranean waters. It is here that molluscoids cause a severe infectious hepatitis. Such ecological-medical grounding from the point of view of modern scientific knowledge can also be found as related to other Judaic ontologic laws (JOL).

Replying to those quasi-religious persons, who will treat such dualism as profanation of Judaism, we should observe that this report is but a scientific grounding of the provision set forth by the outstanding Jewish thinker Moses ben Nachman (RAMBAN, or Nachmanides) who lived 8 centuries ago. Since King David (see epigraph) 30 centuries passed, but the principle of systemic HS and biosphere interaction, denying involvement of strength, as declared in 1987 (see the Bruntland Commission Report) remains a declaration for the time being (Report of World Commission on Environment and Development “Our Common Future”. Oxford, 1987).

The authors of this article are now working out and trying to apply the latest achievement of science and technology in order to create sustainable conditions for development of Jerusalem and Israel.

## **ECOLOGICALLY CLEAN WAREHOUSES**

**Evgeny Levin**

Warehouses are usually situated near resident areas. The warehouses supplied by automated equipment don't worsen the ecological situation in a region.

Field of application: for responsible storage of food and industrial goods belonging to different firms (trading, intermediary, industrial firms).

An automatic warehouse is made of "carrying" racks; roof and walls are fastened to them. High automatic warehouse has racks, attending on automated stacker-cranes and transport-distributive system. The use of line code on pallets with loads makes it possible to be refused to an operator, indexing of each loading package.

The technological process and registration of operations is controlled by an automated control system. Warehouses can be cooled, heated or refrigerated.

The use of "carrying" racks increases the service life of the warehouse building by 2-3 times decreases the building price.

I took part in creation of four generations of automated transport storage systems (ATSS) situated in warehouses used for storage of the piece goods and packaged goods.

The first generation of ATSS was designed to transport and store piece goods with the weight of up to 100 kg without pallets. There were two modifications of this equipment (having combing and gravitated racks)

The second generation of ATSS allowed storing piece goods with the weight of 500-1000 kg on the pallets in warehouses having the height of 6 meters. There were three modifications of this equipment.

The third generation of ATSS was designed to store piece goods and packaged goods on pallets in new high-rise stores. Computers controlled these stores in "on-line" and "off-line" regimes.

The fourth generation of ATSS was designed to store packaged goods coming to the store in lots. There were shelves of passing-by type. Separate devices electrically connected with each other performed three-dimensional distribution and storage of the goods.

I received 10 invention certificates for the described technical decisions.

The use of automated stores in Israel will allow to improve ecological situation, to reduce land consuming and the need for unqualified manpower and to improve the control over stored goods as well.

# STUDY OF THE EFFECTIVENESS OF SOME STRUCTURAL CHANGES IN A VORTEX GAS ATOMIZER

Michael Levitsky

## Abstract

A vortex gas atomizer is developed for liquid atomisation. Its operational principle and design are expounded, and the results are presented of studying the influence of its structural and operational parameters on the dispersion quality. The tests show that the developed gas atomizer provides for a decrease of more than a half in the average diameter of the spray drops under significantly lower supply pressures in comparison with conventional gas-blast atomizers. Results of fire tests in a steam boiler burner of the Eshkol (Israel) and ANWIL (Poland) power plants are presented for a new design of a vortex gas atomizer. During the tests in the boiler burner the  $\text{NO}_x$  content in the combustion products turned out to be almost three times less compared with conventional gas-blast atomizers under the same operation conditions.

## Introduction

The concept of liquid atomisation by gas atomizers was implemented in practical atomising devices more than thirty years ago and was the subject of numerous studies (Mi *et al* 1989, Unal 1989, Lefebvre 1992 and 1995, Miller *et al* 1996, Liu 1997, Shtemler *et al* 2000). The use of gas atomizers enables the liquid dispersion parameters to be significantly improved, thereby raising the effectiveness of the fuel combustion process.

The spray properties of most relevance to the formation of pollutant emissions are mean drop size and spray angle. The mean drop size is dependent on the atomizer's design features (including the path of the liquid supply into the gas stream), operating conditions (gas and liquid inlet pressures, ratio of the gas/liquid flow rates) as well as the physical properties of the liquid and the gas (Lefebvre 1992). Various designs of gas-blast atomizers are widely used for liquid atomisation, for instance, a conical liquid sheet sandwiched between two air streams (Kyushu 1986), air swirl devices (Tadahisa 1974), atomising gas nozzles (Shtemler *et al* 2000, Levitsky *et al* 2001).

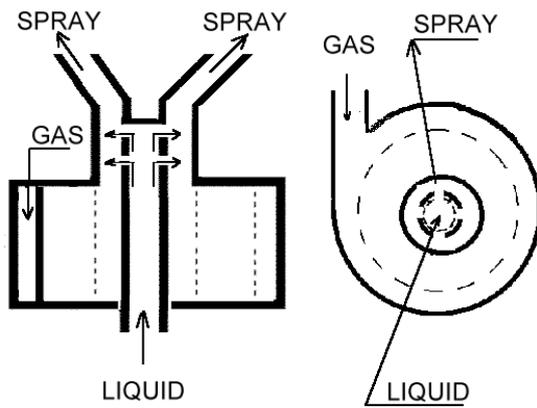
The ratio of gas/liquid flow rates affects the dispersion quality significantly. Reducing this value by raising the liquid flow rate by 60% with the airflow rate unchanged increases the drop diameter (*SMD*) by 15-20% (Lefebvre 1992). Thus, the gas/liquid flow ratio should be increased in order to reduce the drop size. However, the operation cost rises considerably together with the gas/liquid flow ratio. Conventional gas-blast atomizers provide for practically quite satisfactory ratios of flow rate, while the gas and liquid supply pressures sufficient for fine dispersion can be significantly reduced. Indeed, the conventional gas-blast atomizers used at electric power plants provide for relatively fine dispersion ( $SMD = 120\text{-}130 \mu\text{m}$ ) with a flow rate ratio of atomising steam to fuel equal to 0.3, the fuel supply pressure of 0.7-0.9 MPa and the gas (steam) supply pressure

0.8-1.2 MPa. However, to provide for fine atomisation a high relative velocity between gas and liquid is required, which can be reached at significantly low supply pressures. For instance, at the gas supply pressure of 0.3 MPa and the gas-liquid mixture outflow into the ambient atmosphere the sonic velocity of the gas is reached. Note that low liquid supply pressures yield small liquid speeds, which also raises atomisation quality because of the relative velocity rise. Furthermore, reduction of both liquid and gas supply pressures brings the operation costs down and enables the erosion of the atomizer's working surfaces to be precluded, thus lengthening its service life. A next problem is obtaining required values for the spray angle of the two-phase mixture in a boiler furnace which depend on the boiler furnace design, its volume and pressure in it, on the kind of fuel, on the ratio between the fuel and oxidizer flow rates, etc.

Thus, obtaining finer atomisation under lower gas and liquid supply pressures as compared to conventional gas atomizers at the same time providing for required values of the spray angle and the ratio of the gas/liquid flow rates is a vital and urgent practical problem awaiting adequate technical solution. For this purpose, an entire gas-atomizer family has been developed including the atomising gas nozzles developed previously (cf. Shtemler *et al* 2000, Levitsky *et al* 2001) and the vortex gas atomizers considered in the present work. The key idea of these devices is to reduce the drop size in the spray while at the same time raising the relative velocity, optimising the liquid supply into the gas stream and decreasing the supply pressures of the gas and liquid in the region of their interaction. This paper presents the operational principle and design of the vortex gas atomizer, as well as the results of its cold tests at different geometrical and operational parameters for air-water system and fire tests in the boiler.

The developed vortex gas atomizer is based on the listed-below peculiarities of the flow structure in vortex chambers. Based on the conservation laws of angular momentum, mass and energy, engineering descriptions are widely used for one-phase hydrodynamics within vortex chambers (Abramovich 1948, Taylor 1948, Dityakin *et al* 1977, Goldshtik 1981). According to these studies, the tangential gas velocity rises in inverse proportion to the distance from the chamber axis, while the pressure drops to the ambient atmosphere value with the distance. As a result the necessary pressure head for injecting the liquid into the atomizer chamber is minimal, while turbulence is maximal, and that enables a high dispersion quality to be attained for the liquid at low pressure values and with considerably smaller air flow rates. Since the atomisation quality rises with relative velocity between gas and liquid, the radial injection of low-velocity liquid jets into the gas stream at the boundary where the tangential velocity is maximum should provide for the finest atomisation at chosen operating parameters. Note that the proposed design of the atomizer enables low values to be reached of the operating parameters – gas and liquid supply pressures and the ratio of atomising-gas to liquid flow rates.

## Operational principle and design of the vortex gas atomizer

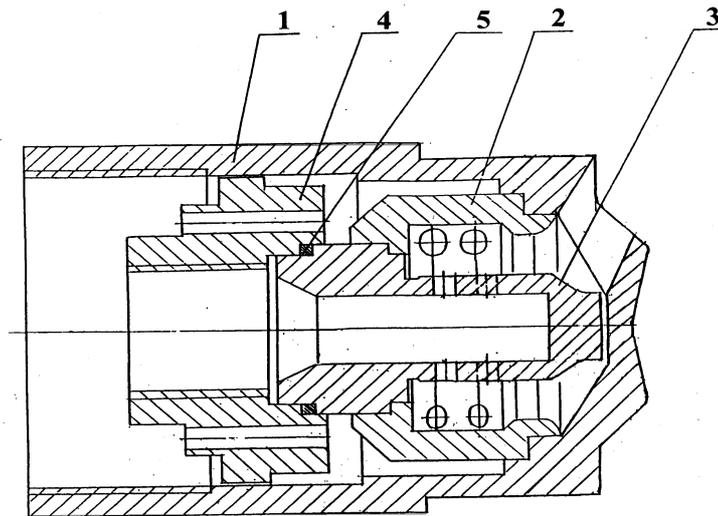


**Fig. 1. Scheme of vortex gas**

mixture (Fig. 1). In compliance with the above-listed peculiarities of the vortex chamber flow, the liquid should be injected into the gas stream at the radius value close to the radius of the central gas-cavity zone calculated for an ideal vortex chamber, that is close to the radius of the outer radius of the liquid delivery duct. This corresponds to the most effective atomisation of the liquid.

Experimental studies were conducted on a vortex gas atomizer with the following parameters: diameter of tangential ducts 3.5 mm; number of tangential ducts 12, arranged in three rows 4 ducts in each row; diameter of the vortex chamber 26 mm; inner diameter of the liquid delivery duct 9 mm; outer diameter of the liquid delivery duct 12 mm; diameter of the discharge nozzle at the outlet of the vortex chamber 20 mm; diameters of the orifices for the liquid injection from the liquid delivery duct 1.5 and 2.3 mm; number of orifices for liquid injection – 8, arranged in two rows 4 orifices in each with the rows displaced relative to each other by 90°; the angle of the conical body 70°.

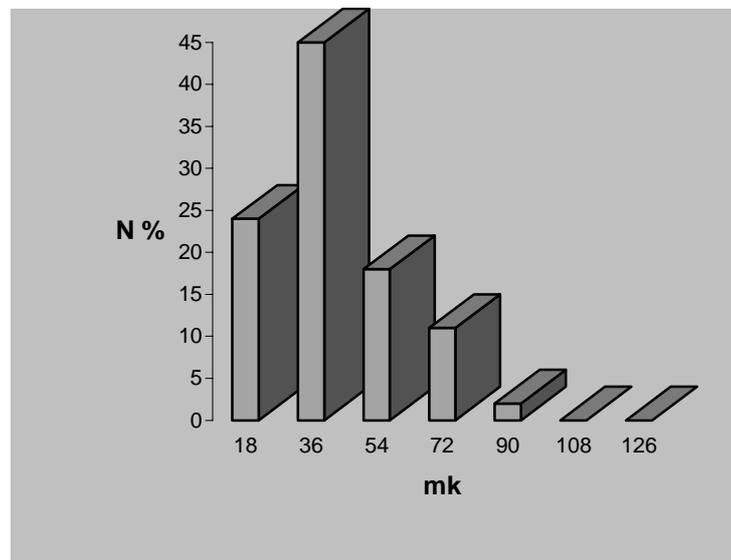
Although at heat power plants the conventional atomizers working on residual oil have spray angles within the range of 70°-120°, it is not easy to obtain fuel spray angles larger than 90° by vortex chambers, since in centrifugal devices the spray angle is determined by the ratio of tangential to axial velocity at the outlet cross-section of the discharge nozzle. Furthermore, after the gas-liquid interaction the tangential velocity of the two-phase mixture and the value of the spray angle drop considerably compared with vortex chambers using pure gas. At the developed vortex gas atomizer the given spray angle is attained by installing a diffuser and a central conical body (with the angles equal to the spray angle) behind the discharge nozzle of the vortex chamber. The two-phase mixture stream thus moves inside a conical clearance and receives the required direction. The modified design of an atomizer was shown on Fig. 2.



**Fig. 2. Vortex gas atomizer of the modified design.**

### **Experimental studies**

The liquid atomisation quality at each cross-section of the spray was estimated by measuring the liquid-particle sizes at several ( $n$ ) stations across the spray. The initial distance between the nozzle and probe was 30 cm, and then the probe was moved into the spray flare by consecutive steps of 7-10 mm to the total penetration of ~40 mm. In the considered range of the probe locations along the spray, the values of SMD are weakly changed, and below the characteristic values of SMD are presented corresponding to the distance of 30 cm between the nozzle and the probe.



**Fig. 3. The histogram of spray drop-size distribution by size ( $SMD = 67 \mu m$ ). Air supply pressure 0.6 MPa, Water supply pressure 0.9 MPa, Water flow rate 1.24 t/h.**

At the first step, the SMD measurements were carried out for the same values of water supply pressure as in the case of conventional gas-blast atomizers, but at approximately half the supply pressure of the atomising gas (water supply pressure 0.9 MPa, air supply pressures 0.5 and 0.6 MPa). The calculated ratio of air/water

supply pressures was ~0.12-0.15 (with water flow rate 1240 kg/hr, diameter of the orifices for the liquid injection 1.5 mm), while  $SMD = 74 \mu m$  and  $67 \mu m$  respectively. The histogram of spray drop distribution by sizes (Fig. 3) is shown for the air pressure of 0.6 MPa.

The spray angle was equal to the angle of the diffuser. At each position of the probe  $n$  ( $n$  is the station number) the time of measurement was also registered, which indirectly characterizes the particles density at each station. The results of the measurements are presented in Table 1. Thus the reduction by half of the atomising gas supply pressure leads to the reduction by half of the spray drop sizes compared to those provided by conventional atomizers.

**Table 1. The Sauter Mean Diameter (SMD) of the spray drops, the times of its measurement at  $n=4$  stations at the liquid supply pressure 0.9 MPa and water flow rate 1240kg/hr and the gas supply pressures 0.5 and 0.6 MPa.**

	Gas supply pressure, MPa	n = 1	n = 2	n = 3	n = 4	Average SMD, $\mu m$
<i>SMD, <math>\mu m</math></i>	0.5	70	72	73	83	74
	0.6	63	57	66	80	67
Duration, sec	0.5	56	75	66	–	
	0.6	43	52	52	66	

The influence of the way of the liquid supply into the gas stream was investigated by using a modified design of the atomizer where instead of radial direction the liquid is introduced in the tangential direction opposite to the rotation of the air. Measurements of the average drop size were made under air supply pressure 0.6 MPa, water flow rate 1240 kg/hr and the diameter of orifices for the liquid supply 1.5 mm. The tests showed deterioration in the dispersion quality, the average drop diameter rose to  $97 \mu m$ , with the water supply pressure going up to 1.2 MPa.

The flow rate coefficient  $\mu$  for the water inlet orifices (equal to the ratio of the real flow rate to that theoretically determined by the Bernoulli equation at the given pressure drop) was 0.4 and 0.43 at air pressures of 0.5 and 0.6 MPa, respectively. It should be noted that during atomizer operation the liquid supply pressure must be sufficient to provide for the minimal magnitude of the liquid outflow velocity from the liquid delivery ducts needed for the interaction with the air stream inside the swirl chamber. In the practical absence of a pressure drop on the ducts the liquid moves parallel to the swirling gas stream. Interaction between the liquid and the air takes place only in the outlet ports of the body, which worsens the liquid atomisation quality. Atomizer tests under these conditions showed that the value of SMD rises to 100-110  $\mu k$ . This was confirmed by the tests of a design version of the atomizer, in which the liquid was not fed into the nozzle chamber through radial ducts, but through a central duct coaxial with the swirl chamber. The duct diameter was 7.5 mm. Opposite this nozzle a cylindrical rod was installed in the body,

against the end of which the water stream exiting the nozzle impacted. Under the impact against the wall the stream flattens and turns into a thin disk, with which the rotating air stream interacts. The tests of this atomizer version were conducted under water supply pressure of  $0.5 \text{ MPa}$  and air supply pressure of  $0.95 \text{ MPa}$ . The water supply pressure was determined by the condition of providing for a flow rate close to the nominal flow rate of the experimental atomizer ( $m_{\text{air}} = 3.45 \text{ t/h}$ ). Since the part of the liquid that was close to the periphery of the cylindrical rod interacted with the air only in the outlet space of the atomizer, the atomisation quality also worsened. The magnitude of SMD was  $97\text{-}108 \text{ }\mu\text{k}$ .

With the outer diameter of the liquid supply duct ( $14 \text{ mm}$  instead of  $12 \text{ mm}$ ) exceeding that of the central gas-cavity zone, with the other geometrical parameters unchanged and at the same air pressure ( $0.5 \text{ MPa}$ ), the resistance to the water inlet rose, while the dispersion quality remained the same ( $SMD = 71 \text{ }\mu\text{m}$ ). Thus, the water flow rate was  $1180 \text{ kg/hr}$  at the supply pressure of  $0.45 \text{ MPa}$ , instead of  $1240 \text{ kg/hr}$  at the supply pressure of  $0.35 \text{ MPa}$ .

Research was carried out on the influence of the character of the two-phase medium outlet from the nozzle chamber. Instead of the stream exiting through ports in the body ends, the ports were located on the lateral surface of the body. This enables the length of the outlet diffuser and the area of the ports to be increased without increasing the outer diameter of the body, the magnitude of which is limited by the geometry of the burner used. However, stream outlet through the lateral surface showed that such an arrangement for the stream outlet strengthens the influence of centrifugal forces, causing non-uniform distribution of the working medium over the cross-section of the stream and increasing the diameter of the droplets; at the same time the magnitude of the spray angle grows by  $7^\circ$  to  $10^\circ$  relative to the geometrical angle.

Tests of the atomizer with an annular outlet stream (without ribs at exit) revealed the lack of correspondence between the preset geometrical angle of the outlet diffuser and the physical spray angle. Thus, with the geometrical angle of  $80^\circ$  the spray angle was  $65^\circ$ , i.e. its magnitude was considerably less. Such deviation of the spray angle from the magnitude predetermined by the geometry of the outlet diffuser can be explained as follows. As the two-phase stream exits the atomizer shaped as an annular flow, rarefaction is created in the inner space of the spray cone because of the high outflow velocity. The ambient pressure acting on the outer surface of the stream compresses it and thereby decreases the physical spray angle. To provide for correspondence between the geometrically predetermined spray angle and its real magnitude, it is necessary to preclude rarefaction inside the spray cone. In order to confirm this hypothesis tests were conducted on an atomizer with a single rib at the exit from the body intended to break up the annular stream and to supply the ambient pressure to the rarefaction space. Correspondence of the spray angle to the preset magnitude was observed in these tests.

## Testing of vortex gas atomizers in steam boiler burners

This gas atomizer was designed for a boiler oil flow rate of 3-3.3 t/h with a working medium spray angle of  $107^\circ$  (equal to the value for conventional gas-blast atomizers) for using at Eshkol power plant (Israel) and a boiler oil flow rate 2.7 t/h, spray angle  $85^\circ$  for using at ANWIL power plant (Poland). The ribs dividing the outlet stream into 4 sectors are made integral with the body, which ensures the constancy of the atomizer's outlet cross-section area and the rigidity of the structure.

To carry out the fire tests in the steam boiler burner of the Eshkol power plant (Israel) all the 16 burners of the boiler were equipped with vortex gas atomizers of the proposed design. The composition of the combustion products was measured at boiler loads varied from 95 MW to 220 MW.

After 11 months of tests for the modified vortex gas atomizer installed in the boiler burners the  $\text{NO}_x$  content was reduced by 2.5-3 times, with some increase in the unburned particle content as compared to conventional gas-blast atomizers. Table 2 presents the test conditions with the results of measuring the unburned particle and  $\text{NO}_x$  content adjusted to 3% oxygen content.

**Table 2. The results of measuring the content of the unburned particle and  $\text{NO}_x$  for various conditions of the fire tests.**

Boiler load <i>MW</i>	Fuel flow rate <i>t/h</i>	Fuel supply pressure <i>MPa</i>	Fuel Temperature <i>C°</i>	Unburned particles <i>mg/dNm<sup>3</sup></i>	$\text{NO}_x$ <i>mg/dNm<sup>3</sup></i>
95	22.5	1.0	108	69-71	350-380
150	33.5	0.85	108	86-100	370-380
210	45.5	1.0	108	66-82	530-595

It should be noted that the boiler load was reduced both by lowering the fuel supply pressure and by switching off part of the burners.

According to mean statistical data, during the 11 months of operation modified design of vortex gas atomizer the amount of  $\text{NO}_x$  and unburned particles was  $550 \text{ mg/dNm}^3$  and  $71 \text{ mg/dNm}^3$  respectively (Boiler Gas Outlet Test 2001). After this time tests the boiler walls were found significantly less soiled than in the case of the conventional gas-blast atomizers.

At the boiler ANWIL power plant all 8 atomizers were replaced on a new vortex gas atomizer. The quality of the unburned particles was reduced with  $250 \text{ mg/dNm}^3$  to  $96 - 99 \text{ mg/dNm}^3$ .

## Conclusions

1. The proposed vortex gas atomizer design provides for an average diameter of atomized drops less than half that attained with conventional gas-blast atomizers, at considerably lower supply pressures.

2. Lowering the air supply pressure while keeping the velocities of the air high at the inlet to the vortex chamber does not affect the dispersion quality significantly.
3. When the liquid is let in through the tangential ducts instead of the radial ones, the average diameter of the drops grows by 30%.
4. With the outlet ports located on the lateral surface of the atomizer body the atomisation quality deteriorates, while the spray angle increases by  $7^\circ$  to  $10^\circ$  relative to the geometrical angle.
5. With an annular outlet stream the spray angle is  $\approx 15^\circ$  less than the geometrical angle. To provide for correspondence between the geometrical and physical spray angles it is necessary to supply the ambient pressure to the inner space of the spray cone.
6. In the atomizer tests as part of the boiler burner at Eshkol the  $\text{NO}_x$  content in the combustion products was reduced by almost three times. The boiler walls were found significantly less soiled than in conventional gas-blast atomizers. This provides the possible explanation for the increased content of unburned particles in the outflow of the developed vortex gas atomizers compared with conventional gas-blast atomizers.
7. At ANWIL power plant using the new design vortex gas atomizer was reduced content of the unburned particles in exhaust gases with  $250 \text{ mg/dNm}^3$  to  $96\text{-}99 \text{ mg/dNm}^3$ .

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## **THE ENVIRONMENT PRESERVATION AND THE COMMUNITY PARTICIPATION**

**Ilya Linger**

The Israel Law of environment protection at 1984 suppose the possibility of participation for the general public. It is the volunteer movement “Neemaney Nikayon” (“Cleanliness Upholders”).

Everyone town-dweller interested in this movement participation could take the special course and to receive certificate giving possibility to carry on cleanliness checking and draw up the document against the disturber of the Law. These documents (reports) are considered by the Ministry of Ecology and the Ministry use some sanction to disturber.

About 200 thousand people lives in Ashdod and 72 thousand from them are repatriates former USSR. The permanently working group of volunteers is in each district of our town. This group registers all disturbances of environment protection and gives these data to municipality (at the kind of report) and to Ministry of Ecology. The average 10 reports are registered monthly. The number of volunteers is more than 200.

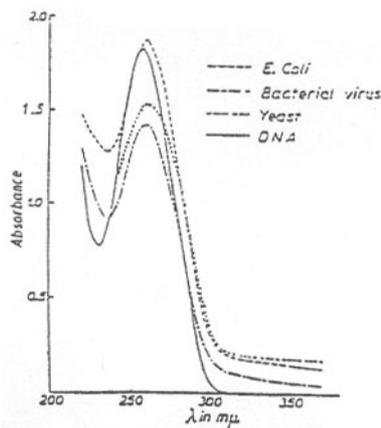
Beside that 20 well speaking Hebrew volunteers participate on duty for the information and breaking service of the town (so called “moked 106”). These volunteers receive from 2 to 10 messages daily. The information received from volunteers usually used for planning of town cleaning and disturbers making answer.

There some projects are made out and at realization: defense of animals; ecological clubs organization for children and others.

# CONTROL OF WATER PURIFICATION AND DISINFECTION IN SEWER PROCESS

Efim Manusov

The problems of control related to sewer processes are very complicated due to the following reasons: first, it is impossible to use regular continuous methods of analysis of water quality parameters in sewer processes for they are continuous themselves. Second, the lack of controllability in many sewer devices.



Hence we have three main problems which have to be solved in order to create a control system of sewer water treatment process (SWTP). First of all we should select that minimal set of water quality parameters which is necessary for estimation of a given SWTP. Then we need to develop such methods of measuring for these parameters that would allow us to use the instrumentation. And, finally, we need to modify the SWTP in order to provide the required controllability.

All these problems were solved in development of a sewer process for a simultaneous purification and disinfection of water. The process was implemented with usage of combined complex devices (CCD) comprising a germicidal filter and UV-reactor connected consecutively in a special way. Such CCD increases the germicidal efficiency at least in 2.5-3.0 times comparing with the separate elements it comprises. It provides a good controllability, as well.

The turbidity and colourness of the water are the main factors that affect the microflora inhibition effect and UV-irradiation. Without their discrete measuring one can not implement an efficient control system of SWTP with a usage of CCD. In order to measure the turbidity a nephelometric method is presently used while for colourness measuring a visual comparison of the colour of the tested water with a platina-cobalt solution of various concentration is used. The microflora density is presently measured only by complicated bioassays.

It is known that the microorganisms when exposed to UV-irradiation, adsorb a certain part of this irradiation and it, actually, provides the existence of the disinfection process. The value of UV-irradiation dosage absorbed depends on the UV-light wavelength and the type of microorganisms. Thus, in a monochromatic radiation through a stratum of microorganisms, the intensity of the radiation in the special cell length  $L$  will depend according to Beer's Law, on the  $L$  value and absorption coefficient  $K_a$  while the latter is defined by the total microflora intensity in the cell, the types of microorganisms comprising the microflora and, mostly probable, by the number of every type of microorganisms. The difficulty lies in the light scattering by the cell substance.

In order to reduce the light scattering influence a new method is proposed. This method presumed a comparative photometric measuring of the monochromatic light transmitted through two cuvettes, one of them containing water with

microorganisms and another one containing filtered disinfected water. The both cuvettes have identical opalescent plates in the output of the transition beams. The required properties of the opalescence are uniform, moderate and constant opalescence over a wide range of light wavelengths. By using different opalescent plates the absorption spectra of microorganisms were measured and they ranged from 220 nm to 1300 nm. It was found that the value of UV-radiation wavelength which provides the maximal light absorbance for *E. Coli*, bacterial viruses, yeast, etc., is approximately 261 nm, i.e. the value lies between the germicidal effectiveness wavelengths for low and medium pressure UV-lamps.

The control system must include a flowing transmitted cell and automatic driving pump and spectrophotometer must be equipped by special device, generated quantity of which would be a control signal for automatic drive of pump. For water of low turbidity (less than 0.7 NTU), it is possible to use control system which is reacting on disturbance of microorganism density of water in hygienic set. However, in this case it is difficult to calibrate the spectrophotometric special device, that there are different species of microorganism have a different UV radiation absorption. On practice, the control systems have a discrete or relay control law, that is the disinfection and purify system the threshold of microorganism density must be kept definite only by working condition.

Feedback loop of control system can also be used for calculation of generalization coefficient  $K$ , which refers to microorganism species in germicidal water. It allows to create the computer-aided control system, which allows to optimize the microbial inactivation process. The method of numerical calculation of inverse tasks is used for coefficient  $K$  calculation.

## SEPARATION TECHNIQUE EFFECTIVENESS ESTIMATE VIA UV-RADIATION

**Efim Manusov**

The usage of UV-irradiation for water disinfection purposes is widely known [1,2]. This method has a disadvantage of gradual extinction that is natural for any kind of beams. This decrease can be estimated by the spectral extinction coefficient

$$K_E(\lambda) = K_a(\lambda) + K_s(\lambda) \quad (1)$$

where  $K_a$  – spectral absorption coefficient,  $K_s$  – spectral scattering coefficient,  $\lambda$  – wave length in UV-irradiation range.

In order to use the extinction of UV-irradiation to control the concentration of suspended particles in transparent liquids, e.g. water, one should go from the spectral characteristics put in the expression (1) to certain values of these coefficients in a selected wavelength. Here one can base on the general assumption of the increase of the ratio of the absorption component ( $K_a$ ) using Rayley's approach to scattering irradiation in water (Einstein's formula). Then one needs to perform special experiments for the separation of UV-absorbency and scattering effect, e.g. the opalescent plate method with a usage of translucent materials [3,4].

There is a simpler method for such a research which uses the analysis of cross-correlation bioassayed and spectrophotometric absorbency results, obtained at wavelength of approximately 254 nm [5]. Now the expression (1) obtains definite values and it is necessary to find the influence of suspended particles concentration in the water on the absorption value which is characterized as a ratio of  $K_a / K_s$ . Practically, the concentration of suspended particles is characterized by turbidity value.

The abovementioned cross-correlation of bioassayed and spectrophotometric absorbency allows to determine the presence of a practically linear dependence of the scatter component from turbidity value in a range of approximately 0.7-14.0 NTU with a proportionality coefficient equal to 0.43. In this turbidity range which is rather wide, the contribution of the absorption dose of UV-radiation is certainly dominant and therefore we can use a known expression

$$I = I_0 \exp(-K_a l) \quad (2)$$

where  $I_0$  – initial radiation intensity of UV-source,  $I$  – radiation intensity at the distance  $l$  from the UV-source.

Having measured the extinction of UV-radiation intensity in a spectrophotometric way in the water with a turbidity range of 1.0-15.0 NTU and after determining the absorption coefficient  $K_a$ , we can use it for an evaluation of the effectiveness of separation techniques for particles of different nature, including colloids and biological flocks. The measuring can be performed by a periodical test of the controlled environment in transparent cells after separation sets using a special semiautomatic device for filling these cells without distorting the hermeticity of any flowing system or vessel [3,4].

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## **APPLICATION OF LINEAR PROGRAMMING METHODS TO DOMESTIC WASTE MANAGEMENT**

**Nonna Manusov, Efim Manusov**

Among mathematical methods used for planning and management in economic systems, the most popular method is the linear programming method of Russian academician L.V.Kantorovich and American scientist J.Danshis. This is because in many economic problems, both in function undergoing conditional extremization and in functions limiting the accessible region, variables are changed linearly.

For the problem stated further two problems would be most appropriate: transport problem (TP) and optimal load planning problem for units of the same type (OLPP) that is mathematically similar to TP.

It is easy to show that the complex of programs for solving TP (optimal “attachment” of producers and users) and OLPP (intensity maximization when expenses are minimized) fully corresponds to the problem of optimal management of the process of municipal waste collection with the use of street containers (SC), further waste collection and removal with special transport dust-carts.

The transport and maintenance expenses will be minimized approximately by one fourth. SC will not be overflowed and what is more micro-dumps will not be found near SC. It means that no centers of insanitariness will be found in towns using the system of domestic solid waste collection in SC and its further collection and removal to the large out-of-town dumps.

# 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 sorbents-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<sup>2</sup>/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<sub>2</sub>O 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.**

<i>Heavy metals</i>	<i>Initial components</i>		
	<i>ceolite</i>	<i>sapropel</i>	<i>aluminum sulphate</i>
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 <sub>2</sub> O	1450	1280	–

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

<i>Version</i>	<i>Insertion dozes, kg/m<sup>2</sup></i>	<i>Percent of reduction as related to control tests</i>				
		<i>Cu</i>	<i>Zn</i>	<i>Ni</i>	<i>Pb</i>	<i>Cd</i>
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<sup>2</sup> 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

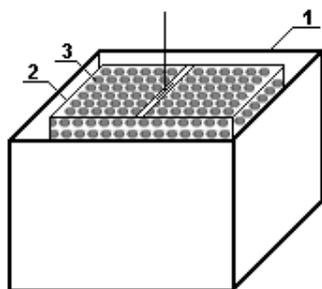
According the test results, the sorption capacity  $A_t$  is calculated as obtained from the formula as follows:

$$A_t = (C_o - C_t)W/m,$$

Where  $C_o$  is the initial concentration of heavy metals in the solution;  $C_t$  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.



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

**Fig. 1. Protection  
geo-chemical system  
“Wall in soil”**

### 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.

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.

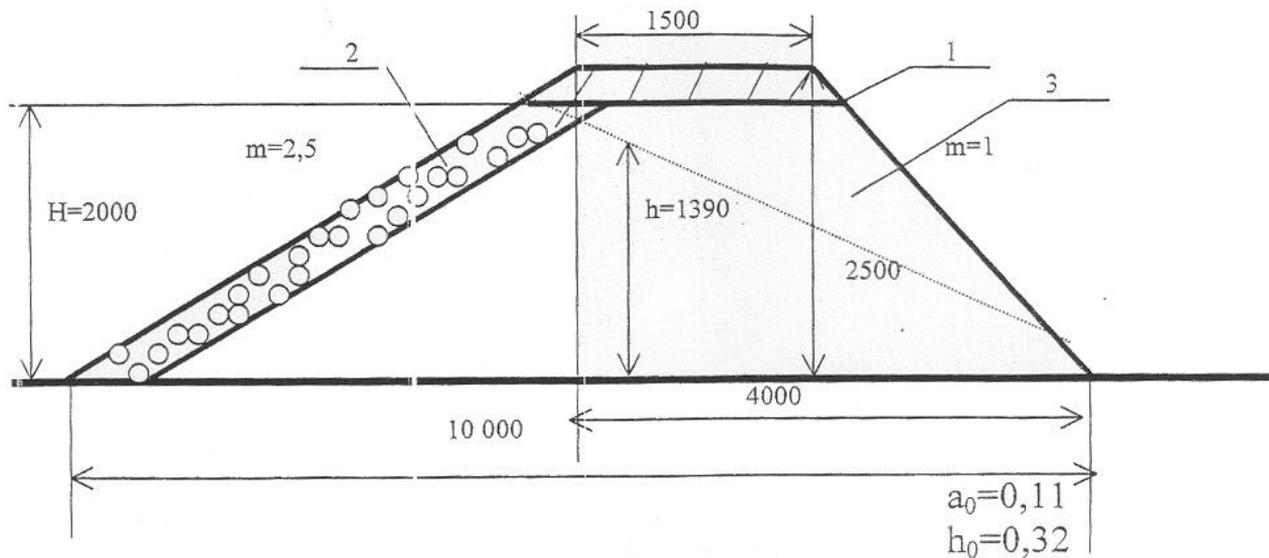
The grid containers are filled with the sorbent chosen in accordance with its sorption characteristics, taking into account economically sound considerations.

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 ( $\tau_e$ ) exceeds that term of the sorbent layer protecting effect ( $\tau_p$ ).

On the other hand, ( $\tau_e \ll \tau_p$ ) 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<sup>2</sup> 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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## **MARKETABILITY OF SUSTAINABLE DEVELOPMENT CONDITIONS IN MIDDLE EAST SUBREGIONS**

**Nonna Manusova, Maria Asherovskaya, Efim Manusov,  
Ludmila Kireycheva, Marina Tarnopolskaya**

Nowadays, sustainable development conditions (SDC) are only an idea, not a system elaboration. SDC may be fulfilled by phasic approach to them, each preliminary estimation phase being stabilizing one, not requiring any iteration between the phases.

### **1. On sustainable development and on Earth populated habitat modeling**

In 1983 the United Nations appointed an international commission on ecology and sustainable development chaired by Norwegian Prime-Minister Brundtland. Upon completion of its work in 1987, the commission published its report "Our Common Future" that introduced a new scientific term "sustainable development". First, it had to do only with ecology meaning environment preservation in the process of socio-economic development. As for today, the UN Department for Sustainable Development have worked out sustainable development indicators including socio-economic development indicators and society organization indicators, all in all 132 indicators divided into 4 groups (55 ecological indicators, 26 economical ones, 41 social ones, 10 organizational ones) [1,2].

It is obvious that this problem in general is hardly fulfilled and methodically undefined because the indicators are not ranked neither inside the groups, nor regarding SDC.

This is why we had to apply system approach to this problem and define the subregions that are most appropriate for SDC fulfillment. Besides, we didn't use speculative enumeration of indicators, as the UN Department for SD proposes. Instead, we proceeded from a socio-ecological complex model. We supposed that the most expedient model was the one developed by a famous Russian mathematician, academician N.N.Moiseev who was a member of Brundtland commission.

### **2. Choice of sustainability-suitable subregions and phasic approach to SDC**

There are subregions in the Middle East, in some subregions of Russia, in North America, etc. where the underground sources of fresh water (aquifers) predominate. The water quality in these underground sources may be used as a universal pollution indicator taking into consideration contaminations from industrial and municipal drains, solid waste dumps and atmosphere [3].

Therefore, the first phase of our phasic approach to sustainable development conditions must be a system of geochemical protection of underground water resources. Plants with artificial sorbent and with natural sorbent (mesoporous coals) are used for this purpose. The former is used for solid waste dumps, for street containers with domestic solid waste, for agricultural drain water; the latter – for municipal and highway storm overflows.

The second phase of our preliminary work on SDC achievement must be calculation algorithmization and choice of water-preserving variants of development. Since all calculations concerned with technology of treatment of contaminations contained in drain water, in solid waste, and in gas blowouts have a priori indeterminacy of initial information, then we cannot deal with optimal technologies and have to work with a group of rational or sub-optimal technologies that can be evaluated by the minimax costs criterion (Vald's criterion) and minimax risk criterion (Savige's criterion) [4].

The third phase of the preliminary work on SDC achievement is to build the system of local, group, municipal drain water treatment systems, systems of solid waste elimination or utilization as well as global activities on reduction of the contamination level in the atmosphere.

The fourth preliminary phase is analysis of water condition in aquifers. When there is practically no water pollution in aquifers, we can go on to achievement of other ecological indicators having to do, for example, with soil, flora and fauna, and then – to achievement of the indicators from other group starting with the group of economic indicators.

Unfortunately, these calculations usually make sense for autocratic states. We think, though, that the necessity of social and organizational indicators is quite questionable taking into consideration the following statement of C.G.Jung: “It is impossible to invent (underlined by the authors) such a common outer form of life, however fair and right it could seem, that would not be unfair for this or that type of people”.

### **3. Conclusion**

The sustainable development conditions may be achieved only in the case of extraordinary external conditions that are characterized by one or two vital figures, for example the water stress value, or in the case of pronounced ecological peculiarities of an areal, for example underground water source predomination.

In these cases one to three indices may be selected that would characterize the possibility of the areal realization.

We have set the necessity of making phasic calculations for the current condition preliminary stabilization.

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# A UNIVERSAL SENSOR FOR EARTHQUAKE PREDICTION

**Boris Mavashev**

## **Abstract**

The global warming during the last decades of the 20<sup>th</sup> century and at the beginning of the 21st century accompanied by weather cataclysms and seismic activity in various areas testifies to a connection between atmospheric and seismic-tectonic processes. Catastrophic earthquakes in Armenia (Spitak, 1988), Japan (Koba, 1999), Russia (Neftegorsk), 1996, Altai, 2003), Turkey, Greece, 1999, 2003, Iran (Bam, 2003), and many others have carried away thousands of lives, and inflicted huge material and ecological damage. Therefore the elaboration of an authentic and universal method for short-term earthquake prediction has turned out to be an urgent problem of the present time.

A universal method for earthquake prediction is proposed based for the combined utilization of geo-chemical (Radon-based) and meteorological precursors. The method is used for limited territories such as Israel, and on a global scale.

Several documented successful predictions exist of seismic activity in Europe during the summer of 2003 and of an earthquake in Israel on 11 February 2004. They were announced beforehand on the Internet to some scientific institutions in Europe and Israel and published in the mass media. These successful predictions allow with certainty to affirm a positive solution of the global problem, the early warning about subterranean disasters. These predictions were made on the basis of results obtained by many years of research on meteorological precursors of earthquakes – abnormal variations in air temperature and wind direction.

In contrast to the Radon-based earthquake precursors that are most informative near the epicenters, the meteorological earthquake precursors occur also at locations far enough from the epicenter. Hence, to predict earthquakes it is expedient to utilize the meteorological and the radon-based precursors together. These precursors are mutually complementary and they open up new possibilities for exactly predicting the location (coordinates), power (magnitude), and time of underground shocks.

## **Method (1)**

The studies on Radon-based earthquake precursors apply principal methods of Radon measurements in underground water and soil gases.

These methods are based on the physical properties of "alpha"-particles to ionize gas, to provoke scintillation in chambers, and to leave tracks in photo emulsions. Recently, silicon photo-diode detectors and gamma spectrometers have been widely used for Radon measurements. These measurement devices are produced in Russia, Japan, the USA, Germany, and France.

In studies of meteorological earthquake precursors, it is easy to measure the abnormal variations in the air temperature and variations in the wind direction by means of improved sensors for the wind regime (wind vanes) and for the air temperature. Establishing a connection between seismic and atmospheric processes led to the discovery of radon-based and meteorological earthquake precursors. This

discovery allows developing a highly accurate universal short-term sensor for the prediction of subterranean disasters. To solve this task, the following arrangement is necessary. At least 3 observation points must be set up in a triangle over the zone of seismic activity to continuously measure the meteorological parameters and the Radon concentration level in the underground medium. The approximate location of the observation points is represented in Fig. 1. As can be seen, the prediction stations are to be set up along the beach-line of the Dead Sea- Jordan rift and also near the beach of the Mediterranean where the seismic activity is manifested. As is known, this territory is located in the zone of the Syrian-African active fault of the earth crust. Numerous devastating earthquakes (in 1837, 1927 etc.) occurred in this region with many casualties and returning strong aftershocks (1996, 2004).

A universal sensor for earthquake prediction contains a Radon-based and a meteorological sensor that are used together. The principal block diagram of the sensor and of the operating system is shown on Fig. 2,3. This arrangement includes 3 basic components: the field prediction stations, the central prediction station, and the communication devices.

The field stations are quipped with control instrumentation. The instruments are designed to conduct continuous measurements of the Radon level and of the meteorological parameters, (air temperature and wind direction). These field stations are set up near the known earthquake epicenters and near the sources of underground water and of soil gases. For the input and output of the information received from the measurement devices, a microprocessor is used with a modem. It provides information for the operation of the instruments, in order to record and transmit the data to the central station.

The central station consists of a computer with software for processing and analyzing the input information and drawing up an operative report on the seismic situation. The central station also calculates the magnitude, the coordinates, and the time of possible earthquakes.

The communication devices generate a Working System and Alert to Officials and to the Public Switch Telephone Network. Their main task is to make preparations for a variety of extreme emergency situations, in order to duly notify the appropriate services about disasters and to ensure support for the population.

## **Discussion**

A contemporary approach is concerned with the modern understanding of new global tectonics, and with the theory of planetary compression as a “geophysical engine”. In line with this approach, the solid shell of the earth crust consists of a small number of blocks (plates) moving relatively to each other in a horizontal direction. As a result of such a movement enormous stresses emerge on the seam of the plates. By a certain time, these stresses in the epicenter become so great as to exceed the strength limit, and then an earthquake occurs.

According to the diffusion-dilatational model, the preparation stage of an earthquake is accompanied by an increase in volume and a dome-shaped bending of the earth crust in the epicenter zone. The increasing elastic deformations and

drastically increasing inside temperature of rocks in the epicenter zone is conducive to an avalanche-like creation of fissures. Their nature and development over time in the surface layer would be the same as in the epicenter. This brings about a variation in the pressure level of underground water. Hence, Radon and other gases are emitted. The inflow of geothermal heat towards the surface is increased. Due to the increased absorption of solar radiation by the earth's surface, the albedo is decreased. As a result, the surface layer is heated in a certain area of the earth. This substantially affects the circulation processes in the atmosphere. Concomitant with this is the outflow of southerly cyclones, hurricanes, floods, and droughts. The air temperature is drastically increased. After an earthquake, the usual regime of atmospheric circulation processes and of the weather is restored.

Probably, one reason for explaining the global warming of the climate is connected with the increased seismic activity of the earth.

### **Conclusions**

The method proposed here foresees the combined utilization of Radon-based and meteorological precursors to exactly predict the location, magnitude, and time of earthquakes. The chosen precursors are mutually complementary and are distinguished by the reliability and reproducibility of the prediction features. These features satisfy all those main prediction criteria that have been defined by the International Seismological Association (IASPEI).

The considered theoretical foundations of this method are in conformity with the prediction models built up by means of the averaged data obtained in various seismic activity regions.

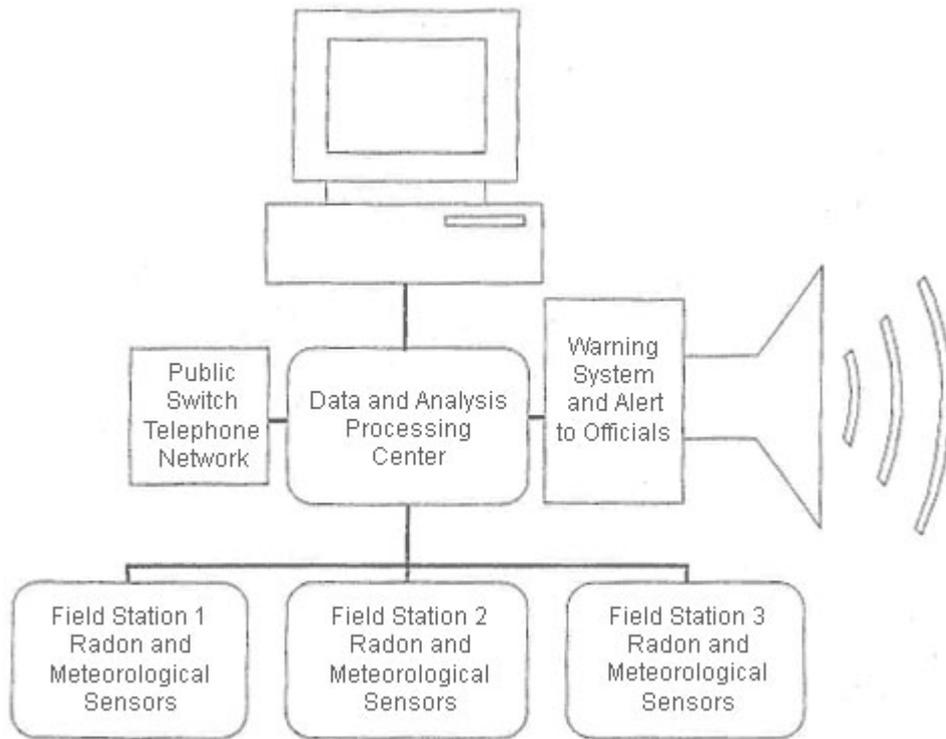
The connections established between seismic and atmospheric processes, the discovered new meteorological precursors allow not only successfully predicting the earthquakes. In addition, from new scientific positions they also allow to consider the problems of the emergence and formation of weather cataclysms such as hurricanes, typhoons, floods, and droughts.

The successful predictions of seismic activity in Europe and of the earthquake in Israel provide encouragement. Thus we receive confidence that the interaction of geophysicists, electronics engineers, and geologists would allow in the near future to solve the complex problem of precisely predicting underground disasters. This will reduce to a minimum the number of casualties among the population and the material damage in dangerous seismic regions.

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**Fig. 3. System operation.**

## NEW PLANTS FOR TREATMENT OF WATER CONTAINING IONS OF HEAVY METALS

**Michael Milov**

The “W-2-W” (water to water) company now specializes in production of devices for industrial wastewater treatment by the electrolysis method.

The devices are generally electrolyzers of a new original construction where oxidizing and reduction processes take place under the action of electric current. Salts are removed from hydroxide solutions in special sedimentation columns where entrapped metals are retained and utilized. The refined water is returned to production.

The devices don't use any reagents except electrical energy. Energy expenses depend on the structure of wastewater and the device productivity.

Table 1 contains a list and characteristics of metals having been tested on the devices to be extracted from drain water.

**Table 1. Effectiveness characteristics of the devices of “W-2-W” type.**

<i>Materials</i>	<i>Concentration in solution</i>	<i>Achieved concentrations</i>
Cr	130 mg/l	0.02 mg/l
Cu	85 mg/l	0.8 mg/l
Ni	19.6 mg/l	0.056 mg/l
Zn	30 mg/l	<0.025 mg/l
Sn	10.26 mg/l	<0.05 mg/l
As	0.176 mg/l	<0.05 mg/l
Al	88.25 mg/l	0.7 mg/l
CN	170.0 mg/l	0.1 mg/l
Ag	8.7 mg/l	0.05 mg/l
B	1.78 mg/l	0.05 mg/l
Mn	17.0 mg/l	0.1 mg/l
Pb	17000 mg/l	0.51 mg/l

By request of customer, the company may supply the devices with buffer shielding blocks to be loaded with ionite resin as well as with protective metal filters.

Special “sacks for sediments” (developed by “W-2-W” company) are mounted in several factories. Entrapped sediment should be unloaded periodically into these “sacks”. In these “sacks”, the sediment is condensed; its volume is decreased before removal from the factory.

As a rule, the prior step before signing the equipment delivery agreement with the company is to deliver a water sample (1 m<sup>3</sup>) to undergo technological analyses in laboratory and at test desks. Thus, parameters and operation characteristics of the future device are defined more precisely.

All devices are designed and adjusted to the actual water quality of the customer's water.

The company specialists train personnel, follow on, and provide customer service for the bought equipment. All these questions are discussed before signing the delivery agreement.

The devices work semi-automatically; their maintenance means periodical unload of mud accumulated in the columns into a “sack” and cleaning or replacement of electrodes.

Service life on one “sack” in a factory equipped with two devices having total productivity of up to  $2 \text{ m}^3$  per hour is approximately one year.

Sediment with humidity of up to 99.5% is unloaded into a “sack”; sediment with humidity of up to 60% is removed to a dump. Water returns to the factory to be used again.

Electrodes are cleaned once in three weeks; they are replaced approximately once in two months.

The area occupied by one device having productivity of up to  $2.0 \text{ m}^3$  per hour is:

- the device including all necessary pump installations and means of hydraulic and electrical control (including power sources):  $1.3 \times 0.8 \times 1.7 \text{ m}^3$ ;
- two sedimentation columns: length 1.3 m; height 3.0 m;
- one “sack” for sediment unload and accumulation:  $1.25 \times 1.1 \times 2.5 \text{ m}^3$ .

All elements of the device may be placed either in adjacent or separate rooms.

All questions concerned with placement and general arrangement as well as with connection to the functioning networks and buildings of a customer are discussed and agreed before signing the agreement.

Now, we also consider additional questions concerned with automation of the processes of sediment unload into a “sack”.

A new sample of reactor undergoes now factory testing. This reactor will continue optimal electrolysis process even when the quality of initial water is changed.

Ideological and structural characteristics of this reactor now undergo patent examination.

A new series of sedimentation columns will soon be developed. These columns will have several advantages as compared with the existing ones: they will have better operational parameters; their dimensions will be smaller; they will have a simpler control circuit.

Among the most urgent tasks to be solved in the near future:

1. Familiarization and practical application of electrochemical analysis techniques, which will shorten time and raise precision.
2. Multivariate analysis method, in order to set a mathematical dependence between water quality parameters and parameters affecting its treatment, that is to express by a formula the process for every metal and electrodes taking part in water treatment.

The equipment produced by our company is operated in Israel and in Italy.

# DEVELOPMENT OF A TERMINOLOGICAL ILLUSTRATED REFERENCE DICTIONARY OF FACIAL TOOTHED JOINTS AND GEARINGS

**Garri Raikhman**

## **Facial Toothed Joints and Gearings (FTJ&G)**

Within the last several years, FTJ&G have formed an independent type of transmission and actuating gear mechanisms. This type of gear mechanisms develops quite fast owing to their characteristics that are integral part of these mechanisms. FTJ&G are being applied in more and more fields, especially in mechanisms of control systems of helicopters, airplanes and rockets; in harmonic gear-drives of radars; in order to turn the solar boards of satellite antennas; in industrial robots and *in engineering ecology in order to solve ecological problems*.

We have developed a general structure of how the terms of specific notions are formed on the basis of their parental concept. This structure gives us the possibility to fundamentally describe the main types of FTJ&G (see Table 1).

We have developed a pioneer reference dictionary of FTJ&G in accordance with world and national standards of gearings. Basics of the theory of FTJ&G terminology and classification serve as a basis for our dictionary as well as methods and ways of shaping upon facial teeth (FT) gear treatment. The terms of specific notions are formed on the basis of the parental and nominal bearer, the uniting word “facial”. In our classification, the gears, toothed joints and gearings are divided into three basic classes: *surface* one, *flat* one, and *flat-surface* one. These classes also cover FTJ&G including the ones having non-round gears. The dictionary is built on the thematic principle. The main terms are grouped in sections and subsections. All terms have to have continuous numbering. In order for a dictionary reader to find a needed term, the dictionary will contain indexes in Russian, in English and in German (situated in the end). The majority of terms have illustrations: drawings, schemes, diagrams, tables, formulas, and legends.

**Table 1. Basic terms, definitions.**

Term	Definition
<b><i>BASIC CONCEPTS</i></b>	
1. Tooth	Lug on the link for connection or motion transmission by interaction with corresponding lugs of another link.
2. Gear	Toothed link with a closed system of teeth providing continuous or intermittent motion of another toothed link or relative immobility of links.
3. Wave toothed gearing	Toothed gearing with movement of the engagement zone in the form of a wave.
4. Toothed joint	Joining of a pair of gears or of two parts with evenly distributed slots and lugs mounted on their working axes.
<b><i>FACIAL TOOTHED JOINTS AND GEARINGS. BASIC CONCEPTS</i></b>	
5. Facial tooth	Tooth placed on the facial surface.
6. Facial gear	Gear with facial reference plane.
7. Facial toothed gearing	Toothed gearing by means of facial gears, or one of them is a cylindrical, bevel, toroid or another gear.
8. Facial wave toothed gearing	Wave toothed gearing in the axial direction.
9. Facial reference plane of facial gear	Reference surface of the facial gear constituting surface of the coaxial circle perpendicular to the gear axis.

10. Facial pitch plane of facial gear	Pitch surface of the facial gear constituting surface of the coaxial circle perpendicular to the gear axis, which has a mutual tangent in each point of its contact with the coaxial circle of another facial gear of the facial gearing passing through its teeth lines, and the relative motion speed vector of facial gears is directed along this tangent, under parallel rotation axes equaling zero.
11. Facial axoid plane	Axoid surface constituting rotation surface formed by momentary axis of the relative movement parallel to the rotation axis of one of the gears.
12. Facial toothed joint	Toothed joints, in which lugs of two tooth-shaped details or of a pair of gears are facial. <u>Note.</u> The teeth may be distributed along the whole circumference or situated in separate sectors, both evenly or unevenly. A sector may have one or more gears.
13. Facial gearing	Gearing with parallel axes, the gear axoids of which are circular cylinders, and the pitch reference surfaces - a facial plane.
<b>TYPES OF FACIAL TOOTHED GEARINGS</b>	
14. Cylindrical facial toothed gearing	Facial toothed gearing, one its links constituting a cylindrical gear.
15. Hypoid cylindrical facial toothed gearing	Cylindrical facial toothed gearing with crossing gear axes.
16. Bevel facial toothed gearing	Facial toothed gearing, one its links constituting a bevel gear.
17. Worm facial toothed gearing	Facial toothed gearing, the links of which are a facial worm and a cylindrical gear with arch gears.
18. Spiroid facialtoothed gearing	Facial toothed gearing, the links of which are a cylindrical spiroid worm and a facial spiroid gear.
19. Facial toothed gearing with non-round gears	Toothed gearing with facial non-round gears.
20. Spiroid facial toothed gearing with non-round gears	Facial toothed gearing, the links of which are a non-round cylindrical worm and a facial surface spiroid non-round gear.
21. Spiroid facial toothed gearing with one non-round gear	Facial toothed gearing, the links of which are a round cylindrical worm and a facial spiroid non-round gear.
<b>TYPES OF FACIAL GEARINGS</b>	
22. Facial cylindrical gearing	Gearing with intersecting axes, the axoid gears of which are conical, and the pitch and reference surfaces are cylindrical and coaxial facial plane.
23. Facial bevel gearing	Gearing with intersecting axes, the axoid, pitch and reference gear surfaces of which are facial-facial plane, conical-conical plane.
24. Facial harmonic drive	Harmonic drive with facial wave toothed gearing.
25. Hypoid facial cylindrical gearing	Facial cylindrical gearing with crossing axes, the axoid gears of which are single-space hyperboloid rotations, and the pitch and reference surfaces are cylindrical coaxial facial plane.
26. Facial worm gearing	Worm gearing with crossing axes, the axoid gears of which are single-space hyperboloid rotations, the pitch and reference surfaces of the facial worm constitute a facial plane, and the cylindrical gear with arch teeth - a cylindrical surface.
27. Facial cylindrical spiroid gearing	Cylindrical spiroid gearing with crossing axes, the axoid gears of which are single-space hyperboloid rotations, and the pitch and reference surfaces of the spiroid worm constitute cylindrical surface and that of the facial spiroid gear constitute a facial plane.
28. Facial gearing with non-round gears	Gearing with parallel axes, the gear axoids of which are non-round cylinders, and the pitch and reference surfaces constitute facial plane limited by a curve with a variable radius.
29. Facial cylindrical spiroid gearing with non-round gears	Cylindrical spiroid gearing with crossing axes, the gear axoids of which are single-space (non-round hyperboloids), and the pitch and reference surfaces of the non-round cylindrical spiroid worm is a non-round cylinder, and that of the facial surface spiroid non-round gear – a facial helical surface.
30. Facial cylindrical spiroid gearing with one non-round gear	Cylindrical spiroid gearing with crossing axes, the spiroid worm axoids of which are single-space (round hyperboloid) rotations, the facial spiroid non-round gear is a single-space (non-round) hyperboloid, and the pitch and reference surfaces are: that of the worm one – a round cylinder, that of the gear – facial plane limited by a curve with variable radius.

# **ECOLOGICALLY CLEAN BIOTECHNOLOGIES IN AGRICULTURE ON THE BASIS OF NON-RADIOACTIVE ELECTROMAGNETIC PROCESSES**

**Vladimir Slavin**

## **Abstract**

The present article is devoted to the analysis of being available experimental and theoretical data on effects of millimetre electromagnetic radiation on seeds, animal sperm, microalgae. In the article the effectiveness of the action of millimeter emission on the seed germination and seedling growth was examined, on increase in mobility spermatozoa and on duration of their existence, on increase in a target biomass of microseaweed and pigments.

## **1. Bases of wave agricultural biotechnologies**

Technological revolution the 21<sup>st</sup> century in agriculture is characterized by application of high technologies to which number it is necessary to attribute, first of all, genetic engineering. Also the technology of creation of soil weight is applied to struggle against reduction useful agricultural lands in Israel by artificial way within several days.

In plant-growing for reduction of great volumes of used artificial mineral fertilizers search of effective growth factors of plants is carried out.

The executed researches in the field of radiophysics allow to suggest to consider an alternative way of increase of efficiency of agricultural crops on the basis of influence of artificial radiophysical processes of radiation on biological objects in view of ecological requirements of maximum permissible norms of parameters of radiation..

Experimental and theoretical works on a microwave irradiation of various biological objects (microorganisms, seeds, microseaweed, yeast) have shown a bacterium presence of steady specific biological effect: change of a metabolism of a cell and a microorganism occurs at an irradiation millimeter radiation of the smallest intensity.

The stimulating effect induced by a single low-intensity millimeter irradiation on photosynthesizing organisms may be ascribed to the development of self-enhancing mechanisms, with these mechanisms being triggered by the initial self-catalyzed reactions in the lipid phase of cells.

Building of these structures is accompanied by changes in the character of DNA bindings to membrane, changes in the complexes formation with proteins, lipids, microelements. This determines changes in protein's conformation influence the ion - transport and activate ATF-syntheses of energy transforming membranes.

Further ATF-syntheses and ATF accumulation provide for cells division process stimulation.

Through the entrance ultra - pure deep sea water mixed together with uterine material is put into growing reservoir. After that there is a fulfilling stages process, such as: heating, mixing and so on.

To accelerate the growing process, we fulfill a new technological operation: irradiation of microalgae with an electromagnetic energy of extremely high frequency (from 30 GHz to 200 GHz). Besides, with the help of control regulation of power, frequency, radiation pulse duration is made. Energy from generator through the highway conductor enters to the transmitting antenna for irradiation of biomass, inside the reservoir.

Thus, the ecological pure biotechnologies are based on an irradiation of biological objects of various kinds (seeds of agricultural crops, incubatory eggs, microseaweed, sperm of animals) by electromagnetic non- radioactive radiation of low intensity. As a result of informational interaction of a microwave field and a cell there is a sharp change of a condition of ionic channels of a membrane of a cell, then a change of a metabolism of a cell and all the biological object. Such display of biological effect has allowed to develop new technologies and the equipment of a microwave field for an irradiation of biological systems in a number of biotechnological processes (in plant-growing, animal industries, fish culture, in cultivation of microseaweed). Scientific bases of the specified biotechnologies are theoretical and experimental researches that are executed in Russia, Ukraine and Israel within 30 years. Serial elements and blocks of microelectronics, radio engineering and mechanics are design bases of the developed devices. The marketing estimation of the developed equipment has shown high profitableness of investments into the projects, a fast recouplement of investments (for the buyer of the equipment) and the big capacity of the world market of selling and profitableness of release of the equipment (for the manufacturer of the equipment).

## **2. Examples of wave agricultural biotechnologies**

### ***2.1. Instrument for the presowing irradiation and for an increase in the period of storage of seeds***

For the increase of seed germination and protection of plants against wreckers now chemical pickling of seeds and chemical processing of ground are being made. For a basic change of the condition of the ecology of the ground and the air environment the way and the device of non-polluting preseeding processing of seeds is developed. In the device covered seeds are irradiated with not radioactive electromagnetic radiation of a squared range of small intensity (about 1-10 mW/cm<sup>2</sup>). The duration of irradiations depends on a kind of seeds, term of their storage and a bacteriological condition of the ground.

The experiments carried out have shown that after seeding the irradiated seeds ascend 15-20% faster and at maturing evolved plants from the irradiated seeds are 10-15% less sick or perish from wreckers. The weight of the received grains (on 1000 control grains) is also higher than 12-18%.

The device consists of typical elements of electronics and standard units of the mechanics; it is simple and convenient in operation. The device is served by 1-2

operators. The estimated cost of the device is 7,000 dollars. The term of operation is 8-10 years. The recoument of the device is 11-14 months of work.

### ***2.2. Instrument for making the animal sperm more active***

THIS DEVICE INCREASED THE SEMENS MOBILITY ABOUT 35% AND VITALITY PROLONGED ABOUT 23%.

The device consists of standard elements of the mechanics and electronics, and also of some original units. The tests on the device with sperm of bulls and male pigs were carried out in Ukraine and in Israel. The tests have shown that at an irradiation not radioactive radiation of weak intensity the mobility of sperm grows 1.8-2.1 times, the time of sperm existence is increased 1.5-1.7 times. As a whole it raises efficiency of artificial insemination from 18% up to 37%. The device has the following technical and economic parameters: power consumption – 5-15 W/h; weight of the device – 4-7 kg; number of operators – 1-2.

The proposed price of the device is \$800-1,300. The time of recovery of outlay of the device is 7-9 months.

### ***2.3. Instrument for stimulation of eggs incubation***

Nowadays, chemical preparations of superficially – active action are applied to disinfecting incubatory eggs. In a number of incubators unitary irradiations of daily chickens ultra-violet or radioactive radiation are made for reduction bacterial contamination a mucous membrane of a mouth of daily chickens. The offered device alone carries out these two functions alone. For the increase in an output of commodity meat and the reduction of the number of perishing daily chickens the device irradiates with low power incubatory eggs during the various incubation's periods on different frequencies, and also at the certain hours of the first day of the life of the chickens. It provides 2.5-6.0% reduction of the number of choked chickens and 2.8-5.5% increase in the survival rate of daily chickens. Besides, the installation allows to increase a period of storage of eggs before incubation's process from 10 to 70 a day. Also the current consumption at the maintenance of daily chickens is reduced 1.5-1.8 times. The installation will consist of typical elements of mechanics and electronics, is simple and convenient in operation.

The tentative wholesale price of instrument for industrial incubator – \$4,000-6,000. The tentative profit FROM THE SECOND YEAR is equal \$27,000-29,000.

The payback period of the instrument for the user with the incubation monthly on 100,000 eggs is 6-7 months. The period of the return of credit with 15% percentages is 7-10 months after the beginning of series output of the instrument (from the calculation of 3000 instruments per annum).

### ***2.4. Device to bioreactor (fermenter) for an increase in the biomass of microalgae and their pigments***

According to the laboratory experiments, the microwaves irradiation of phototrophic microseaweed (microalgae) causes the increase of a biomass of microseaweed up to 250-400%. During August-December 2003 half-location tests for the working biotechnological plant for cultivation of microseaweed and

reception of a pigment were performed. The data of experiments show the following:

1. The irradiation of microseaweed on phases of cultivation, carrying out the stress causes 185% increase of the biomass of microseaweed.
2. The irradiation of microseaweed on phases of carrying out the stress, receptions of pigment causes 390% increase of the biomass of a pigment.

This additional device consists of serially let out units and circuits of the mechanics and electronics. The device is simple and convenient in operation.

***Estimation for the producer of the additional device:***

The prospective general profit of the manufacture of the device of 4 types within 5 years in estimations minmin – maxmax is 165.7-430.87 million dollars.

The economic effectiveness of production and sale of the device is determined by values of prime cost, wholesale and price of dealers and by the quantity of produced instruments. Tentatively prime cost of the device for the bioreactors of small volumes is equal to \$35,000-90,000 and for bioreactors of big volumes is equal \$50,000-180,000

***Estimation for the user of the additional device:***

Application of the device and the optimization of the regimes of microalgae irradiation allows an increase in the expenditures for 17.9%, 30.6% and 41.5% (for an increase in the output of biomass. Thus the growth of the profit (with the minimum cost 1 kg of the output product of the biotechnological process of equal to \$11900) respectively to 4.165 times, 5.622 times and 12.745 times is received.

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## METHODS OF ETCH WASTEWATER TREATMENT

**Rozalia Slobodov**

When alloyed steel is being processed by pressure, calx is formed. This calx may be removed by etch. Our experiments have shown that when the mixture of sulphuric acid (H<sub>2</sub>SO<sub>4</sub>; 10%), hydrochloric acid (HCl; 5%) and nitric acid (HNO<sub>3</sub>; 4%) is used to remove calx from chromium steel, the best result is achieved during 15 minutes' treatment at temperature of 70°C.

Approximately the same result will be achieved during 30-40 minutes' treatment if the etch mixture is received from surplus of sulphuric acid and technical salts (NaCl, NaNO<sub>3</sub>) and is heated to 70-90°C.

Etches usually have quite complex composition:



Using the solubility data for the systems:



as well as the data for the systems:



we may assume that all salts are dissoluble in more or less the same way, except NaCl.

The best method to treat the etch wastewater having quite complicated structure (see above) is the multi-component extraction method that can single out separate components from etch mixtures [1].

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# ENERGY SAVING – THE MOST IMPORTANT FACTOR OF EFFICIENT NATURE MANAGEMENT IN ISRAEL

Yakov Sosnovsky

## Abstract

The state is considered and recommendations are given with respect to primary measures on creation of favorable conditions for energy saving and rational nature management in our country, first in nonproductive sphere.

## Energy consumption and environment

Scientific researches proved that *energy saving is a new resource of power* which is essentially cheaper than its production [1, p.12] and this difference is growing as fossilized fuel resources exhaust and ecological standards become tighter. So now there exist a complex “problem of 4 “E””: power engineering – ecology – economy – energy saving” with leading role of the last link.

Unlike the majority of developed countries which have achieved significant energy saving (30-50% and more for 5-10 years) and corresponding improvement of the ecological situation in economic growth conditions after the power crisis of the 70-es, in Israel the economic growth is followed by an increasing technogenic load on the territory. For the last 20 years discharges of fuel burning up have significantly increased: for CO<sub>2</sub> – 2.6, CO – 1.43, NO<sub>x</sub> – 4.1, HC – 1.9 times. Besides, the heat emission makes up about 800 million GJ per year in spite of large annual expenses (in year 2002 – 2.3 billion NIS) for biosphere and air protection. [2]

In greater Tel Aviv in 2002 the average annual level of particular matter is twice that of the European Community’s official target for 2005 [3].

With the population growth for this period by a factor of 1.6 the fleet of motor vehicles increased more than thrice, electric power production - more than thrice and production of all kinds of energy – by a factor of 2.4. Maintenance of this tendency will have led to the growth of electric power demand by a factor of three by 2020 (there are estimates proceeding from the developed growth rate of electric power consumption and assuming that such level can be achieved just in 10 years), which will result in the corresponding growth of a technogenic load not to mention the necessity of investments in the power engineering amounting to at least 20 billion dollars.

## Energy saving potential estimation

In perspective, according to the available estimations, energy saving will allow to provide 2/3 of the world demand in the power growth and will be the most important factor of rational nature management [4]. This proportion is true for the Russian Power-Generating Strategy: only 1/3 of the planned GDP will be achieved through FER consumption growth and the remaining part – at the expense of energy saving [5].

International comparisons indicate the availability considerable reserves of energy saving in our country. For comparison, Israel index versus that of Italy in year 1999

was: GDP – 0.83, energy intensity – 1.248, electric power intensity -1.478, CO<sub>2</sub> intensity – 1.522 [6]. An average Israel family in year 2002 consumed more electrical power as compared to Japan 3.2 times, Canada 40%, Great Britain 9%.

The world experience shows that energy saving is achieved on the basis of investments reorientation from the primary increase of fuel and power complex capacities to the measures for more effective fuel and power consumption in all branches and on all economy levels at the expense of: scientific and technical measures including usage of non-conventional and renewable energy sources (they provide 40-50% of the total saving), as well as organizing and technical measures including those associated with a progressive change of the economy structure (they also provide 40-50% of the total saving).

As compared with other countries Israel is characterized by an extraordinarily dynamic growth of power consumption in the nonproductive sphere. 2/3 of energy consumption growth in 20-years period falls on the nonproductive sphere where final power consumption (FEC) per capita average year rate growth was 6-15 times more than in industry and transport sectors. On this sphere fall now about 40% of final energy consumption and 60% of electric power consumption, and thus it is the zone of the greatest concentration of saving reserves. There are preconditions for further growth of specific consumption in the nonproductive sphere with welfare increase, flat space extension, saturation of everyday life with heating, ventilation and conditioning devices.

It will not be out of place to note that such situation is typical of the water consumption as well. In this period the water consumption increase by 4/5 falls on consumption growth in the household, where per capita consumption rose by 81,9%, while as a whole it reduced by 23%. Respectively the share of the household increased from 22 to 32,9%.

Thus the priority attention should be paid to measures for efficiency increase in energy and water consumption just in these spheres.

By our extended estimates including the most significant directions of scientific - and technical and organizing factors (development of renewable and non-conventional sources of energy; essential increase of public transport share in passenger and cargo carriages; increase of natural gas share in electricity production up to 40-60% and generating facilities modernization in the power engineering; large-scale use of an a.c. adjustable electric drive in all spheres of electric drive application; improvement of buildings heat shielding up to European standards level; replacement of obsolete power intensive equipment, first of refrigerators, air conditioners, incandescent lamps) the potential of energy saving in the country for the medium-term prospects makes at 30% and more of the existing consumption level.

Numerous facts of fuel and energy resources (FER) wasteful and non-rational consumption, particularly in everyday life and services sphere are an evidence of lack of consumers' material interest and responsibility in energy saving. Priority low-expense measures on their elimination, primarily in non-productive sectors

allow save up to 8 - 10% of the present FER consumption as the world experience confirms.

### **Energy saving mechanism**

Realization of this potential is possible with the priority state policy of energy saving and rational nature management being carried out and existence of its legal, economic and ideological provision.

In 1989 Knesset adopted the Law of energy resources (instead of the law of 1980) under which energy saving management in the country was placed on the MNI and it was granted a number of rights in this field [7].

In spite of the measures taken by the MNI [8] they have not managed to change the tendency of FER consumption dynamic growth.

The main reason is an imperfectness of existing legislative, economic and ideological mechanism of energy consumption management. The state policy mechanism is not developed. There exists a poor economic motivation of energy saving for separate consumers, lasting contradictions of interests among different sections of the society and economic structures. The housing and communal sector and small business are the least covered by analysis and modern methods of energy saving management. City councils are not practically involved in the work on energy saving.

*Propagation* of the energy saving and rational nature management as it is understood in advanced countries including its ecological aspects does not practically exist in our country. It is possible to judge this principle importance by the USA data: 78,1 of all FER saving in housing and communal sector and 21,1% of total saving in the country in the period of 1974-1982 fall on the factor "change of the consumer's behavior". [4, p.171]

To make the energy saving and rational nature management an actually priority direction of the state policy, being the most important factor of the rational nature management and economic growth, it is necessary, with regard to the world experience and features of Israel, to realize the following measures on creation of favorable legal, economic, ideological conditions for all participants of the process of energy production, distribution and consumption.

1. To work out and adopt new wording of the Law of energy resources of 1989 (or to work out a new Law of energy saving resources and environment protection) and the legislation adopted for its development.

It would account for the necessity to establish the energy saving priority in solution of any problems of the country economic development and a common orientation of the activity in this area. In these documents there should be also determined/specified the main questions in the energy saving and efficient nature management sphere: fundamental principles of the state policy; objects and subjects of the relations legal regulation; order and terms of program development; education and bringing up; researches; an economic mechanism (measures financing, creation of off-budget funds and directions of their application; mutual economic responsibility of consumers and suppliers, incentive to energy saving;

economic sanctions for a wasteful FER consumption); standardization and normalization, etc. (See for example the corresponding laws of the Ukraine[4, pp.475-480], Russia [9] and others.

2. To develop and to set to realization of the State long-term Program of energy saving and efficient nature management combining efforts and means of various branches, enterprises and organizations for solution of the problem and to put into effect stipulations of the legislation indicated in clause 1 above.

In the program structure it is expedient to pick out the stage of priority low-cost measures (on elimination of irrational and wasteful consumption of energy and water, optimization of the available equipment usage, introduction of means of account, control and regulation, etc.).

Establishment and state support of the network of specialized energy saving companies, based on “the performance – contract” principle, should occupy an important place in the structure of measures. In the USA since 1988 Federal agencies have used energy saving performance contracts to leverage more than \$800 million in private-sector investment to improve their facilities and help meet Federal energy, water and emissions reduction goals [10], [11]. In conditions of Israel the activity of such companies is especially expedient for the enterprises of small individual business and households.

A subprogram of propagation of energy saving combined with state programs of consumers’ training to an economical and ecological type of behavior shall be an obligatory part of the Program.

Working out of the above legislation and the Program in the full volume will require involving considerable personnel and financial resources and will take rather long time. As the first step the concept of the Program to the above item 2 is suggested to be worked.

This document shall include the comprehensive grounding of the program necessity. There should be determined:

- economical potential of the energy saving;
- main directions and stages of the work;
- sources of measures financing and their efficiency stage by stage.

Its fulfilment will require study of variations of fuel and energy demand and corresponding levels of fuel burning emissions at different versions of the country economy development and consumption growth rate for the long-term prospects.

### **Tasks of the energy and economic analysis development**

The effective instrument for choice of energy saving priority directions is a deepened energy and economic analysis of FER saving reserves.

In our country, in particular, the reserves associated with *heat shielding of buildings* are underestimated. 50-70% of the year the air temperature deviates from the comfort one by 8-12 degrees. Walls thickness is determined by their bearing capacity and for most of buildings it is not more than 0,2 m; the heat transfer factor of exterior wall is more than 2,4 W/m K, whereas in most of European countries it

varies within 0,3-0,5 W/m<sup>2</sup> K [12]. From 20 to 60% of the total consumed heat are lost through exterior walls depending on the building height and construction. Three-layer constructions with the insulation used allow reduce these losses more than twice. Heat specific losses through window openings are 4-6 times higher than through walls. Double glazing or multiple glass units allow their 1.5-2 times reduction [1, p.12, p.95]. As we estimate it, modernization of protective enclosures for the whole housing fund available could allow up to 7-10% saving of the current FER consumption in the country.

The application scales of technologies of *renewable and non-conventional sources of energy* are determined by the level of their industrial production mastering what is concentratedly embodied in the cost of the power unit production. At the present moment, as the comparison with the cost of 1kW-h of mineral fuel-based electric power shows, the cost of that one produced at wind electric plants is considerably lower; the cost of that one generated of biomass is at the same level; the cost of that one generated at solar thermal stations is ¼-th higher and the cost of the photovoltaic electric is thrice higher [13].

In some countries a greater part of the generated electric power falls on the wind energy (in Denmark – 18%) [14]. In Israel the wind power has not found a practical application yet.

This is relevant to *reclamation* and *biomass* usage. In the country there annually arise about 600 kg of solid domestic, trade and street waste (in the amount of about 4 mln t now, in future this amount will grow), of which 30-40% make various organic matters which can be converted into biomass. The biomass plays an important role in the power balance of industrially developed countries: from 4% in the USA and 6% in Denmark to 16% in Sweden [1, p.136]. In Israel there are only reclaimed about 1 mln t waste including about 300 thou t of organic waste, 170 thou t of street waste and wood. As we estimate it, maximum usage of solid domestic waste, heat value of which is close to the low calorific value coal, can save up to 3% of FER consumed at present in the country. In Denmark a thermal power station has been built where straw and chips are used as a fuel and in the future garbage will be used [15].

Full usage of organic waste of stock raising and poultry farming with obtaining biogas can provide in addition up to 1% saving, however the dispersion of power sources over the country makes realization of this potential difficult.

It seems also well-timed to give a comprehensive grounding of the electrification optimal level in our country that is higher as compared to many countries not possessing their own sources of mineral fuel, for example, in Italy it was 14.7, while in Israel – 17.0 [6].

The current state of the official data base of energy consumption does not meet the tasks of a thorough energy and economic analysis, development of systems of standards, norms, prices and tariffs providing incentives to energy saving.

In statistical yearbooks there are unavailable many elementary data of fuel and power consumption in some important spheres: thus in fuel-and power balance

tables there is no sector “transport” at all; there are no data of fuel distribution by sectors except electric power engineering and oil processing; since 2002 into the balance there have not been included data of used renewable resources, including solar power ones.

There are available detailed data of electric power distribution by economy sectors but in this case the detailing is only given by subindustries including those the portion of which make just percentage shares of the total consumption; at the same time such large consumers as “Construction, commerce and services” (в 2002 г. 16%), “Private and public consumption” (43.6%) are united into one group without detailing. That is why these data cannot be used for seeking reserves and one has to resort to other sources and circumstantial estimates.

There are required more exact data of electric power distribution by types of its conversion into other energy kinds – light, mechanic, technological, as well as of power consumption by PC, television-and radio apparatus, by separate service functions, etc. This can require conductance of special investigations including separate sample observations.

As the example of many countries shows there are required generalized normatives of power consumption for different-purpose buildings what will allow work out power consumption standards providing incentives to systems of prices and tariffs.

Existing data of direct power consumption by economy sectors are expedient to be added with full power consumption estimates with regard to the power consumed as a part of other branches services. For example, direct power consumption in agriculture make 1.1% of the total consumption, with account for the power consumption for water supply this share grows up to 4 % [16]. The calculation of full power consumption by economy sectors requires drawing up of the interbranch balance of energy resources. In France there have been calculated indices of total input per unit of work/services for different types of transport (including fuel consumption, land value over which the road runs, the traumatism level, ecological indications) that provides more justified choice of promising decision preferable versions [17].

The aforementioned shows the expediency of investigations enlargement in the field of the power and economic analysis and the data base of energy saving and rational nature management and the corresponding redistribution of research and development works financing.

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# POSSIBILITIES OF ECOLOGICAL IDENTIFICATION OF SOCIAL PROCESSES

Larisa Yanovsky, Anatoly Gorelov, Efim Manusov

*The researches of complex systems should deal with simple patterns; hence all embracing research is impossible.*

W. Ashby

*States with low environmental demands are beyond the states with low environmental demands.*

“Grasham laws”.

## Abstract

The concept “ecology” has been first used by E.Heckel in 1866 and applies first of all to the systemic concepts that describe the interaction, the environment and inhabitants populating the place.

Apparently, this kind of interaction depends on social processes that take place in population. Those processes could be identified in local levels of justice.

## Introduction

### *Identifying / selecting the model*

Apparently, during the model identifying process, according to “Ashby principle”, minimal number of components in model will prevent duplication in description of the described object that could distort the research project. Since that we have decided to choose the basic model of prof. N.N.Moyseev in detail version Fig. 1a.

It has been long time agreed that being determines consciousness, though artists have known long before the others that consciousness is reproduced in arts differently.

It has not been a secret as well among criminalists, when they took evidence from different witnesses.

During the first quarter of the 20<sup>th</sup> century psychologists found put that there is no external event that could project similarly in consciousness of different psychological types “while determining the concepts one should first differentiate psychological types.”

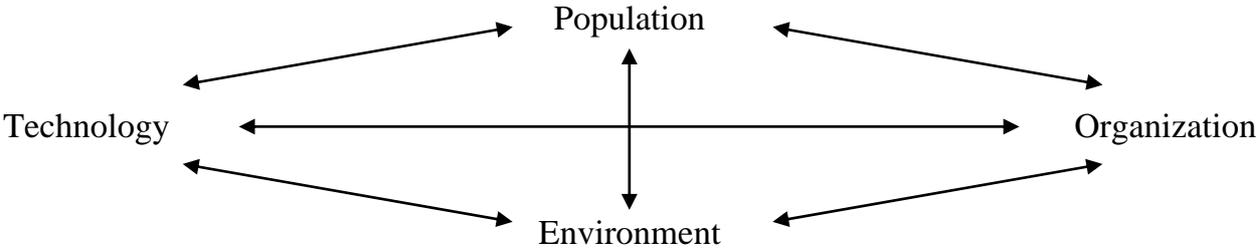
But, if consciousness is individual and psychology defined category than the socio-ecologic complex scheme (Fig. 1b) shouldn't include the reverse links that project the influence of technology and system on the population of a certain place.

The existing Socio-Economic Complex (SEC) has objectively one kind – gain around feedback on the environment (E component) that project any variations in compounding complexes. Every component of the SEC has a great capacity lag and consequently the capacity lag of population component (PC) throughout the

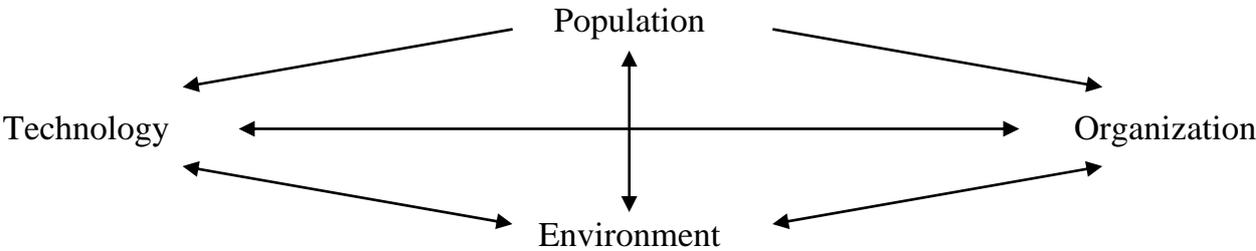
Technology component (TC), Organizational component (OC) or Environmental Component to PC that could become destructive process of the environment.

Though this doesn't happen due to intrinsic stability. This environmental feature enables in extreme situations (like earthquakes) to consider the environmental situation as quazistable in time.

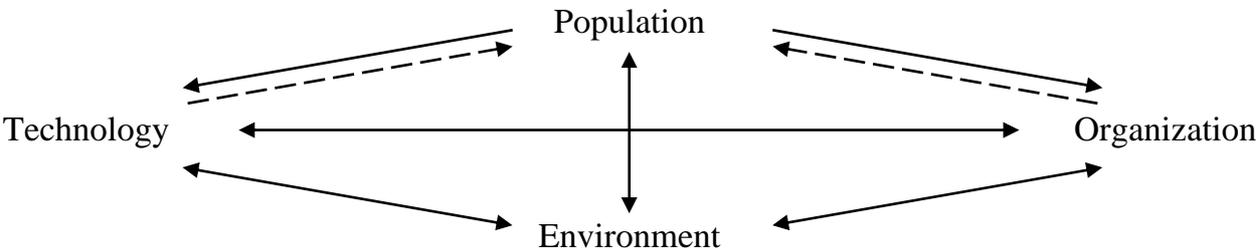
In order to widen the controllability complex we could conduct control design and to determine the calculated feedback from TC and OC to PC. Then the scheme would look like Fig. 1c.



**Fig. 1a.**



**Fig. 1b.**



**Fig. 1c.**

**Sustainable development and ecological justice**

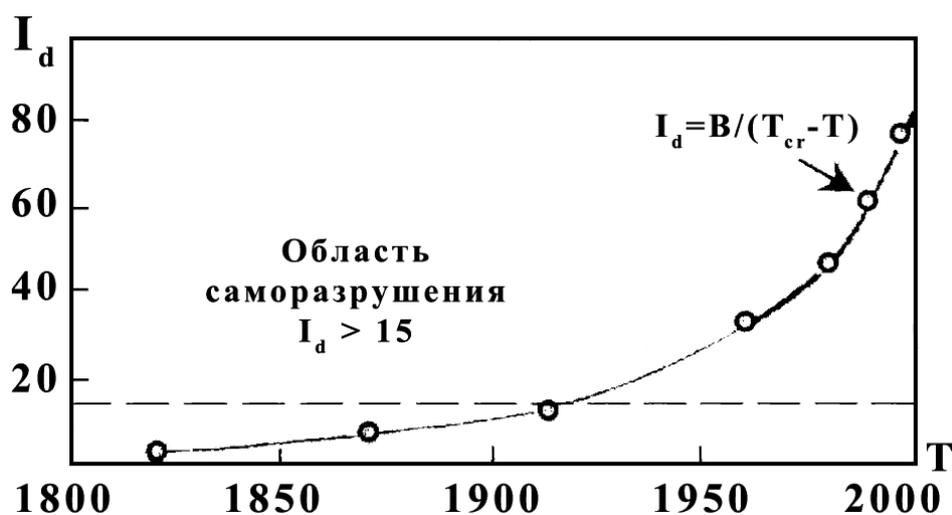
Recently, these two concepts have become basic not just in ecology but in globalism as well, quire of the interaction between three major spheres of human activity – ecology, sociology and economics that put together indicators of sustainable development (6) including 134 indicators, divided to four groups: social, economic and institutional. The inevitable leading group indicators of sub-groups cited below (see Table 1).

**Table 1. Key themes suggested by CSD testing country priorities.**

Education	Freshwater/groundwater
Employment	Agriculture/secure food supply
Health/water supply/sanitation	Urban
Housing	Coastal Zone

Welfare and quality of life	Marine environment/coral reef protection
Cultural heritage	Fisheries
Poverty/income distribution	Biodiversity/biotechnology
Crime	Sustainable forest management
Population	Air pollution and ozone depletion
Social and ethical values	Global climate change/sea level rise
Role of women	Sustainable use of natural resources
Access to land and resources	Sustainable tourism
Community structure	Restricted carrying capacity
Equity/social exclusion	Land use change
Economic dependency/indebtedness/ODA	Integrated decision-making
Energy	Capacity building
Consumption and production patterns	Science and technology
Waste management	Public awareness and information
Transportation	International conventions and cooperation
Mining	Governance/role of civic society
Economic structure and development	Institutional and legislative frameworks
Trade	Disaster preparedness
Productivity	Public participation

In globalism one major indicator of socio-economic disharmony is proposed, and it is determined as correlation of an income between 20% of the richest and 20% of the poorest population. Here, the choice of 20% of the population is arbitrary. And, the expected conclusion that the growth of disharmony index could cause destruction is absent (Fig. 2).



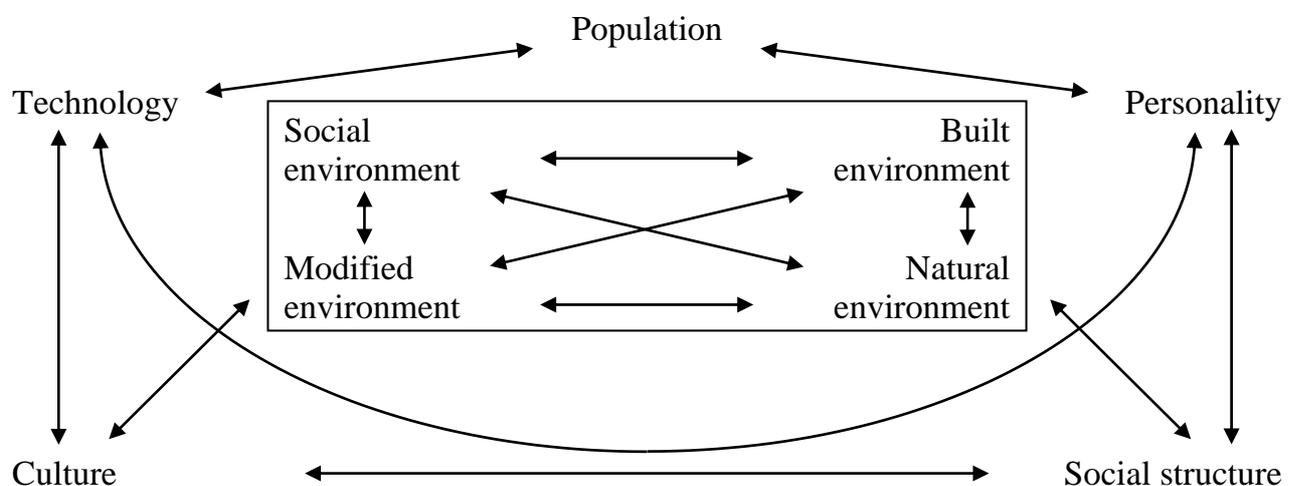
**Fig. 2. Objective law of modern world self-destruction process.**

This objective law reflects interactions in the world community:  $I_d = B / (T_{cr} - T)$ . Here  $B = 1850$ ,  $T_{cr} = 2022$ . In the year  $2022 \pm 5$  the  $I_d$  parameter is equal to infinity.

Ecological justice is another matter. Here the analogy of environmental indicators is seen as ecologic complex. It is obvious, that the analogy of these indicators is reached on behalf various expenses for different complexes, for example the poorest population lives in industrial areas, that require more financial and intellectual expenses than the suburbs, where lives the well-off population. It is more obvious then, that the ecologic justice is the highest standard of social justice. Moreover, different location have negative influence on one another. Consequently, reaching ecological justice determines the social justice in the frames of socio-ecological complex.

### Conclusions

1. Ecologic justice is a universal and integral indicator of social justice. Using ecological justice indicator in research is evidence of higher level of sustainable development. This indicator is an outcome of higher development than any other sub-group. It is an independent indicator (independent of the socio-economic structure).
2. Ecologic justice is a universal and integral indicator of social justice also because it prevents centers of fluctuations.
3. Ecologic justice provides uni-directional development of social processes in complex. The realization of ecological justice provides additional negaentropical influence, highly prevailing the ethno-cultural level of the population. (Fig. 3)



**Fig. 3. An ecologic complex (EC) scheme.**

4. Realization of the social justice makes thus the ecological complexes invariant to ethnocultural level of population (rules of invariance of complexes Yanovsky-Gorelov).
5. The invariance value enables to integrate these complexes to a larger system.

# OPTIMAL CLEAN ENERGY SYSTEM

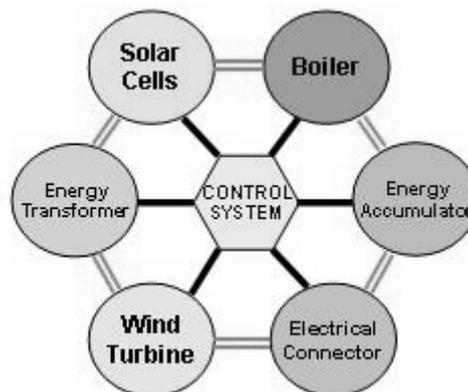
Ilya Zlatkis

**Main goal of the project:** To create an optimal construction of an ecologically clean autonomous power system, using solar and wind energy.

## Features:

1. This system use only renewable clean energy: solar energy by photovoltaic cells, hot water boiler and wind energy by wind turbines in common construction.
2. The system unites in an optimal construction high efficiency components, also working out at this project, and well integrated through electronic control.
3. The project provides for several types of energy systems with different power production capabilities: 2.5 KW, 5 KW and 10 KW.
4. The system can be used as a module for a local power grid.
5. The system provides high effective transforming one form of energy to another.
6. The system contains an control block, based on a microprocessor with following functions:
  - Treating of information about climate factors
  - Loading optimal regulation.
  - Accumulator mode control.
  - Automatic selection of operation modes with power grids:
    - isolated mode
    - energy consumption
    - energy production mode.

## THE CONTROL SYSTEM STRUCTURE:

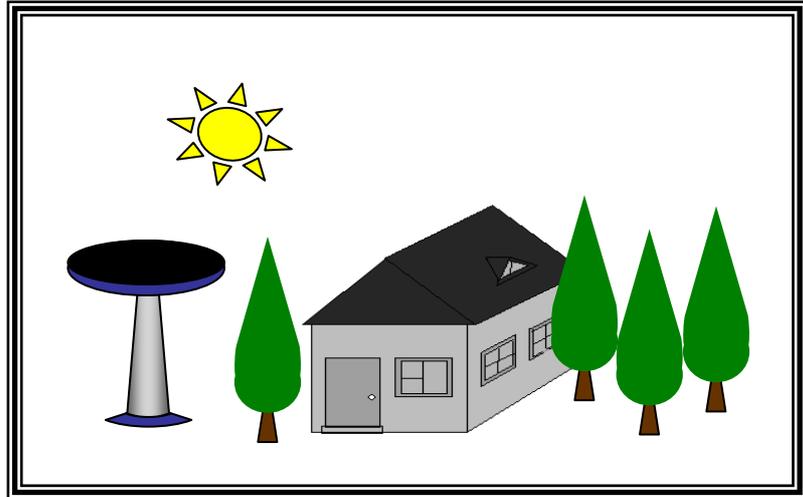


## Applications:

- Energetic system for location having no central grid, as for boats, military installations or communication stations, irrigation controllers etc.
- Energetic system for homes, that provide increasing independence from central power.

- Electric system for energy supplying in Shabbat.
- The system may be widely adopted to individual and collective uses.

Relative size of the  
energy system module:



**Main advantages:**

1. Decrease of energy cast.
2. Increase of energy reliability.
3. Improvement of home interior ecologic conditions.
4. Increase of energy supply security.
5. Decrease of exploitation expenses.
6. High level of environment control,
7. Decrease of peak load for power grid.
8. Increase of system energy supply steady.

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