DRINKING WATER IN UKRAINE: COMMUNICATION AND EMPOWERMENT FOR LOCAL AND INTERNATIONAL ACTION

This second edition of the case-study is a joint initiative
between MAMA-86 and UNED-UK
It has been completed as a result of a 2 year work of MAMA-86 on
clean drinking water problem in Ukraine.

The report was written and edited by:
Anna Golubovska-Onisimova, MAMA-86
Clare Flenley, UNED-UK
Yelena Panina, MAMA-86

With input of:

Ukrainian experts -
Prof. Tatyana Mitchenko, Ph.D., Laboratory for Ion Exchange and Adsorbtion,
National Technical University of Ukraine, Kyiv;
Natalya Makarova, Candidate of Sciences in Chemistry, Laboratory for Ion Exchange
and Adsorbtion, National Technical University of Ukraine, Kyiv;
Valentina Kvasova, Chief Expert at Ministry of Finance of Ukraine, Kyiv;
Olexandr Stegnij, Candidate of Sciences in History,
Socis-Gallup International, Ukraine, Kyiv;
Oleg Medvedev, Candidate of Sciences in Geology and Mineralogy,
Tatarbunary (Odessa oblast).
Yelena Molozhanova, Candidate of Sciences in Biology,
Ukrainian Institute of Eco-Hygiene and Toxicology, Kyiv;

Translation: Yelena Kushnerenko

We welcome your feedback. Please, bear this in mind as you read the report and send your comments in English, Russian or Ukrainian to:

MAMA-86, Drinking Water Project,
22 Mikhaylivska str., Kyiv-1, 252001, Ukraine,
fax: +380-44-2295514
e-mail: mama86@gluk.apc.org
or
UNED-UK, Eastern European Projects,
3 Whitehall Court, London SW1A 2EL
fax: +44-171-9305893
e-mail: una@mcr1.poptel.org.uk

Content

INTRODUCTION

Ukraine, a country with a territory of 603.7 thousand square kilometers and a population of 50.5 million, is located right in the centre of Europe, and is characterized by various soil and climatic conditions and landscapes, many water reservoirs, rivers, lakes.

The average density of the population is 86 people per square kilometer, and in the southern, industrial regions this figure is about 200 persons per 1 square kilometer.

In the recent years Ukraine has faced an acute problem in providing a good quality water supply to the population, as more than 45% of the population is consuming water which is below the quality standard. The situation at the water and sewage utilities is bleak, as the technical state of facilities is generally very poor, and equipment, management structures are inadequate. The regulatory and legal framework is also not sufficient to ensure its safe effective operation.

A quarter of the waterworks and pipelines have almost reached their expiry date, and 22% of the pipelines are in a state of emergency. The expiry date has passed on every fifth pumping plant. Almost half of the pumping sets have deteriorated, and in 40% of the cases replacement is required. Planned preventive repair takes place in 73% of the cases.

The accident rate at the water pipelines in Ukraine is significantly higher than the European rate. In the sewage system, 26% of the pipelines and 7% of the pumping plants have depreciated. 46% of the pumping units require replacement. Planned preventive repair is carried out in only half of the cases where it is required.

Deterioration in the environmental quality of the washing and drinking water resources, particularly the surface water, makes it more and more complicated to supply the population with drinking water which complies with the current Ukrainian standards, let alone the international standards.

The view of the Dnieper river in the vicinity of the dam at Kyiv hydropower plant

MAMA-86's PREVIOUS ACTIVITIES WITHIN THE DRINKING WATER CAMPAIGN SHORT REVIEW

Introduction: On the Drinking Water Project Launched by MAMA-86 in Ukraine

MAMA-86, a Women's Environmental NGO in Ukraine, has initiated a national project on fresh water quality, bringing together community activists from different parts of the country with representatives of other stakeholder groups and government to facilitate an integrated approach to discussions on drinking water issues. UNED-UK, a UK NGO which promotes the participation of a range of stakeholders in UN activities, has assisted in bringing an international perspective to the Ukrainian project.

The MAMA-86 drinking water project was initiated after consultations with women community leaders from around the country. At a meeting of Ukrainian women's NGOs in April 1997 which discussed the Beijing Platform for Action, the participants considered Health, Environment and Economics the most pressing issues for Ukrainian women. At a later consultation in July 1997, drinking water quality was identified as a key issue for action. From this network four organisations from different regions of Ukraine, including Kyiv, emerged as co-ordinators of a national campaign on drinking water.

The campaign aimed to:

* research the drinking water quality in these regions

* raise public awareness about the issues and provide information about water safety

* bring together experts and representatives from different groups to establish a clearer picture of the situation in Ukraine, and to stimulate cooperation and debate between different sectors

* exchange already existing good practice from Ukraine and overseas in methods of water purification and supply

* lobby and build public pressure for a change in water policy

* use international events such as Pan-European Conferences and workshops, organised by WHO (World Health Organisation), in particular and UN CSD (United Nations Commission on Sustainable Development) to highlight the Ukrainian situation and to promote participation and consultation.

Information and Transparency: MAMA-86's independent water research and sociological study

MAMA-86 has undertaken independent research and analysis into drinking water quality and public perceptions of household water uses.

Achieving cleaner water requires a range of interventions at government, industry, community, consumer and individual level. This requires transparency of information from government and industry, not just on the nature and extent of water pollution, but also on investment programs to reduce pollution and who pays and who benefits from such interventions.

There is no tradition in Ukraine of disclosing information or co-operating with the non-governmental sectors or consumers, and it is difficult for the public to obtain clear information from official sources about water quality. The public needs information about their water quality including what practical steps they can take to improve it, and to protect themselves and their families from health risks associated with inadequate water.

Basic data about who uses most water, who pollutes most water, with what, when and for how long is needed to inform on the introduction of a toxics use reduction strategy to water pollution.

Due to the lack of information MAMA-86 decided to undertake their own independent tests on tap water quality, and have them analysed and verified by Ukrainian L. Medved Institute of Eco-Hygiene and Toxicology, a certified laboratory.

Microbiological, sanitary chemical, and organoleptic studies of drinking water samples from the cities of Kyiv, Odessa, and the towns of Tatarbunary and Artemivsk were carried out at the above laboratory. The results of the chemical analysis were rather frustrating. For instance, heavy metals content in many samples didn't meet the national requirements. Nearly all samples from the above cities and towns contained organochlorine compounds. DDT and its metabolites were detected in excessive concentrations in two samples from Odessa, and in one from Kyiv it was very close to the limit. In the sample from the small river Fontanka in Odessa the herbicide simazin was detected. It is one of the stable herbicides applied in farming. An extremely high level of mineralization ie inorganic compounds, was detected in drinking water samples from Tatarbunary.

As no data were available as to how the public perceives their water supply, MAMA-86 decided to undertake some research into public attitudes and habits regarding drinking water. A questionnaire was drawn up by independent experts and the results were processed by the Institute of Sociology of the National Academy of Sciences of Ukraine. The survey was carried out by local women's and environmental NGOs, partners of MAMA-86. They collected 1,678 completed surveys from members of the public in eleven cities and towns of Ukraine. One of the main conclusions of the survey was that 64% of respondents perceived drinking water quality as a major environmental problem and 21.3% believed that they had to rely on their own devices to improve water quality. 15.6% considered that a large scale public awareness raising drive was necessary.

These two research documents represented the first attempt by local independent organisations to collect their own data on water quality. Within the first week of publication they received enormous public interest, and twenty four press and media features helped to spread the information, raise awareness and stimulate public debate. The research was delivered to local governments and water utilities around Ukraine by the NGOs who helped to collect the data. The data had successfully drawn public attention to the issues, and set the scene for a more open and informed debate between the different sectors, the government and the public.

Seminar on Drinking Water Problems, April 1998

In April 1998 MAMA-86 launched a three-day seminar in Kyiv to set up discussions and networks between water experts and major stakeholder groups from Ukraine. These discussions represented the first opportunity for different stakeholders to meet and share information, and give their perspectives in an integrated multi-sectoral debate on water quality issues in Ukraine. The seminar took into account the international and national processes currently underway to reach new standards of protection for fresh water resources.

Experts from different fields shared their expertise, and the participants, who represented a wide range of stakeholder groups, used these data together with their own experiences, and priorities to come up with their perspectives and recommendations.

The views and recommendations of the participants were listed in the case-study «Drinking Water in Ukraine: Communication and Empowerment for Local and International Action». The first edition was published in April 1998, as the result of this multi-sectoral seminar on drinking water issues. The case-study formed the initial part of an ongoing process aimed at publicising the issues and opinions of different sectors and gathering support and information to facilitate the improvement of drinking water quality in Ukraine.

The principle recommendations of the seminar participants included:

* the need to involve all major groups in planning, implementing and monitoring changes

* action to inform the public and major sectors in the principles of sustainable development, water safety and public health issues

* the need for new legislation, frameworks and standards for water supply, sanitation and monitoring in Ukraine

* introduction of integrated river basin approach to cycle of water supply and sanitation

* better monitoring systems for water quality and disease, which are accessible to the public

* co-ordination by public health bodies of water quality monitoring and supply

* investment in pipelines and purification systems

* policies to use pricing instruments as tools to increase investment in water supply and discourage pollution

* need for international co-operation and networking but also to develop solutions and technology locally, and to encourage «native brains» to be involved

Co-operation with Experts

The co-operation of experts is vital in obtaining information about the state of water supplies and quality, so that the debate can include those who are responsible for water safety. It is currently difficult to achieve any open dialogue with water authorities. Therefore MAMA-86 invited representatives from water supply and regulation authorities from around the country to a seminar to hear the results of MAMA-86's independent research. This research formed the basis for discussion, and many officials who had never previously co-operated with NGOs attended and made their own data available for inspection.

These included Senior Medical Officers and Microbiologists from the Ukrainian Ministry for Health, the Deputy Chief Engineer of Odessa's Water Utility, representatives from Sanitary-Epidemiology Stations, which are water quality regulators, and scientists from water purification plants. Other official participants included: the Head of the Department of Water Resources at the City Environmental Management in Kyiv, the Green Party member of Ukrainian Parliament (Verkhovna Rada), and the Deputy Chief of External Relationship Management at the Ministry for Environmental and Nuclear Safety. He described the negotiations for the draft WHO Protocol on fresh water, in which Ukraine was playing a key role.

Other stakeholders with an interest in water quality were also represented, including business and industry, academics and researchers, journalists, NGOs and women's groups. These included scientists from the Research Institute of Eco-Hygiene and Toxicology, manufacturers of water filters, environmental campaigners, and the community based NGOs from around the country who are water consumers as well, and who worked with MAMA-86 on collecting the data.

Networking the Major Stakeholders

It was the first time for many NGOs present that they had access to the authorities, and the first attempt on the part of the authorities to share their knowledge and opinions with members of the public. The networking proved fruitful:

NGOs and business people from Kyiv had their first opportunity to make contact with their local government representatives:

* local activists from the Tatarbunary region who had been campaigning for years against a destructive irrigation system, met the engineers responsible for the system for the first time. Some conflict resolution methods were required to make this encounter positive for both sides, but in the end, it was agreed that the meeting was fruitful

* government officials responsible for the NEHAP and the WHO Water Protocol both agreed to NGOs' demands by committing to a public consultation on these documents.

Multi-sectoral meetings such as this were considered as highly constructive by the majority of the participants. Since October 1998, a major Public Consultation on the Ukrainian NEHAP has been carried out, with the support of the Parliamentary Committee responsible for adopting the NEHAP. The Consultation was co-ordinated by MAMA-86 who formed a coalition with other Ukrainian NGOs to organise a nationwide Consultative Process, with some support from UNED UK. A report on the NEHAP Consultation Process is available from MAMA-86.

International Networking and Action

The international activities of the UN CSD and WHO currently offer opportunities for lobbying and participation on drinking water issues at a local, national and international levels. MAMA-86 are collaborating with UNED-UK, their long-term UK partner organisation, to ensure that Ukrainian NGOs have the information they need to use these opportunities. UNED-UK has acted as co-ordinator of NGO input to the 1999 WHO Health and Environment process. As a result of this collaboration, a skillshare for major groups representatives was organised within the seminar framework in April 1998 in Kyiv. Six UK experts contributed to discussions with their Ukrainian counterparts on issues of public health and disease control, pollution reduction, water resource management and supply, legislative structures and local participation and implementation. The UK representatives outlined some strategies to improve drinking water quality, and to mobilize community participation in activities to improve health and environment.

Participation in the UN CSD and the WHO processes can give opportunities for lobbying national and local governments. Information about these events and how to participate was provided at the seminar, and the seminar report was disseminated afterwards as a lobbying and awareness raising tool. Presentation of the project and the case-study was planned and carried out at the UN during the 6th session of the CSD in late April 1998, with a follow-up at the European Ministerial Conference in London in June 1999 initiated by WHO.

Stakeholders' Perspectives: the participants made the following priorities for water improvement in Urkaine:

To improve the drinking water quality it is above all necessary:

* to implement water conservation technologies
* to locate the source of pollutants
* to monitor and control waste discharge
* to monitor and decrease water losses in the whole system
* to constantly monitor the state of water in its natural sources
* to inform people on the issues of water consumption

* to distinguish between the notions of «drinking water» and «household water»
* to study international experience and introduce new technologies
* to improve water supply network and purification plants
* to provide economic incentives for every stage of distribution
* to introduce licenses and tenders for water activities

Resources:

* Introduce economic tools and pricing structures such as:
* fees for water use
* fees for pollution
* define property issues for water management
* privatize ownership of water treatment facilities, and take this partly out of state control
* investments in the infrastructure and improved technologies

Possible partners in planning and implementation:

* all sectors of the society, including water consumers
* international organisations
* investing institutions

MAMA-86 and Network's Clean Drinking Water Campaign Follow Up

The follow up to the Clean Drinking Water Campaign in Ukraine is headed by MAMA-86 with the participation of environmental NGOs from Odessa, Tatarbunary (Odessa oblast), Artemivsk (Donetsk oblast) and Sevastopol (Crimea). The latter has recently joined the Campaign.

MAMA-86 is coordinating the activities of the campaign partners to assure a good level of knowledge on the issue for all partners involved, to support the local groups in carrying out their activities, to bring about the linking of activities at local, national and international levels, and to facilitate the process of cooperation among the local groups, etc.

Among the main goals of the Campaign are:

* to build public awareness about the problems of drinking water and opportunities for change

* to inform and educate the public on the connections between the drinking water quality and their health

* to create a broad public debate about the need for clean drinking water and the need for public participation in the decision making

* to engage officials, scientists, businesses and NGOs in debate referring to the economic advantages of improving the water system

* to build a public platform to lobby the National and local government for action on improving drinking water quality and supply

The Planned activities of the Campaign

To achieve these goals a wide spectrum of concrete objectives have to be tackled. The climax point of the Campaign should be a public hearing organised by MAMA-86 in Kyiv in 2000, followed by public hearings in the regions (Sevastopol, Tatarbunary, Odessa, Artemivsk). The public event is to put the legislators, implementors and experts on the podium to answer the questions of the citizens. The recommendations and views of the public presented at the public hearings, and related press conferences are to be presented to the authorities.

A large media campaign in preparation for the public hearing is needed to build up a broad public awareness in the Kyiv region. This will include radio, television, newspapers, women's magazines, door-to-door leaflets and brochures, Eco-telephone and metro-billboards to tell the public about the hearing, and about the problems and opportunities of clean drinking water. This formula will be followed later by the other project participants in their regions.

Workshops at International Conferences

Around the public hearing there will be several important international fora where MAMA-86 would like to present its work and recommendations. These are the WHO Conference on Health and Environment in London in summer 1999, the International Water Summit to be held in the Netherlands in summer of 2000.

Ase at the 6th CSD session at the UN 1998, MAMA-86 would like to organise workshops and present their case-study at these international fora together with representatives from the regional partner organisations. MAMA-86 is co-organiser of a workshop at Healthy Planet Forum in London on «The Role of NGOs and the Public in the Implementation of the Water Protocol», and is drafting paper which will be attached to NGO Declaration. MAMA-86 wants to present the Ukrainian case as an example of the water problems in the post-soviet countries and the importance of NGO involvement in contributing to solutions.

The Activities Carried Out by MAMA-86

Analysing State Programs on Water

As part of the Campaign, MAMA-86 planned to monitor the Government's progress in implementing the Ukrainian State Programs on Water. MAMA-86 engaged a consultant to analyse the Ukrainian state water-related programs and to summarize this into accessible language for the project partners and the general public. The project partners need to understand the content and quality of the state programs and how these can be used to promote changes at their local and regional level. All the project partners need to achieve a high level of understanding of the issue at stake if they are to become respected partners in discussion and negotiation with governments, water engineers and business people.

The research was done by an expert of the Ukrainian Medved Institute of Ecohygiene and Toxicology, Candidate of Sciences (in biology), Yelena Gr. Molozhanova, who has expertise in risk assessment of anthropogenic pollution of the territories in Ukraine, Russia, Moldova, Kazakhstan and in the West.

(See ANNEX I)

Developing a Community Based Secondary Purification Water Project in Tatarbunary (Odessa oblast)

One of the strategic outcomes of the discussion launched in April 1998 for the ongoing activities within the water campaign was the possibility of the establishment, by citizens, of a secondary treatment plant for drinking water. MAMA-86 decided to undertake some research into the advantages and disadvantages of a citizen-run small-scale water purification system for special target groups (kindergartens, clinics, hospitals, etc.) The necessity of developing a clear economic model for such an undertaking is also very urgent in this country. If the experiment is a success, MAMA-

86 could assist in setting up other pilot projects for community based secondary purification of drinking water.

The regional group in Tatarbunary was extremely eager to start working on this. And it is quite reasonable, as the drinking water quality in their area is very poor.

The main source of water for Tatarbunary are underground wells and artesian drillholes, and the small river Fontanka which flows right through the town. The water in these sources exceeds the Ukrainian standard for mineralisation, and the level of nitrates is very high. There is no centralised piped water supply in the area, and drinking water is transported in tanks rather than through pipes in most cases, though some residents consume water piped in from small reservoirs that have been filled from artesian wells. This supply is not even always chlorinated.

The waste water treatment plants have completely broken down and now contamination of drinking water is constantly occuring. The local authorities claim that the region is not included into the Ukraine State Plan on improving drinking water.

Prevalent health problems in the region are diseases among children and pregnant women, which are particularly high, including metabolic diseases, nephritis, polyarthritis, scoliosis, and pregnancy related illnesses.

Considering all the above reasons, MAMA-86 provided the local group with a reverse-osmosis water treatment device UVPM-01 («EcoSoft»), which was delivered and installed by the producers in May 1999. The device produces purified drinking water of high quality. The organoleptic, microbiological and chemical analysis of the water samples after purification has been done. The results of the chemical analysis of the water before and after secondary purification are presented in Annex II.

Most of the purified water will go to the children of a local kindergarten. The administration of the kindergarten is looking forward to having clean drinking water to aid the children's nutrition.

The survey carried out during the pilot project showed that many citizens interviewed would want to pay for installing a secondary treatment device in their communities. The experience of the group in Tatarbunary and the comparative study of the benefits and disadvantages of such end-of-pipe technologies, including their different costs and market prices, will give us an opportunity to consider how such temporary solutions accord with the final aim, which is to supply all citizens with clean drinking water at an affordable price. Thus, recommendations on how, if at all, such solutions could be implemented by local groups, are expected to be produced as a result of the Campaign.

A Public Survey in Kyiv and our Partners' Cities & Towns

As we found with the public opinion survey carried as part of our pilot project in 1998, public surveys can be very useful as a tool to press for policy change. No government can ignore a survey which shows, for instance, that the majority of its citizens are highly worried about the quality of drinking water and their water supply, and see it as a priority for government intervention. Our survey in 1998 even showed that people are ready to pay some additional money to consume guaranteed safe drinking water. To be politically useful a survey has to be carried out and analysed in a scientifically correct manner.

In May, 1999 MAMA-86 carried out a survey in Kyiv, Odessa, Tatarbunary, Artemivsk and Sevastopol in cooperation with Socis-Gallup International, Ukraine (Social and Marketing Research Centre). The questionnaire was designed by MAMA-86 with the input of regional partners and experts working with the organisation and completed by the head of the project Olexandr Stegnij, Socis-Gallup International. A representative sample of 2 100 people in the above cities and towns of Ukraine were interviewed and a statistical assessment and analysis was produced by sociologists. The four regional partners were closely involved in the process.

(See ANNEX III)

Tap and artesian water monitoring in Kyiv

From March 29th to May 29th 1999, MAMA-86 commissioned experts to monitor the drinking water in Kyiv. This was done by the Laboratory for Ion Exchange and Adsorption at the Chemical Engineering Department of the Ukrainian National Technical University (KPI).

The total number of tap water samples taken in different districts of Kyiv is 90. In addition 25 water samples were taken from artesian wells in different points of Kyiv.

The total number of analyses produced is 1,968.

Given the results, the experts from the above Laboratory state that tap water regularly exceed the legal limit for aluminum, iron and, organic substances. Turbidity and colour don't meet the threshold values either. In April these deviations were not regular, being registered only in four districts in Kyiv. But starting from late April till the end of May a constant increase of these indices in all districts was detected.

In some districts the content of ammonia and in some others of manganese exceeds the standard.

It was also detected that the content of manganese in the water of the two artesian wells constantly exceeds the maximum limit. The content of hydrogen sulphide also contsantly exceeds the limit in two wells. In addition, in one well, iron, manganese and turbidity indices exceed the standard occasionally. (See ANNEX IV)

MAMA-86 and Sevastopol City Communicable Diseases Hospital

The administration of The City Communicable Diseases Hospital in Sevastopol (Crimea) has applied to MAMA-86 for assistance in the rehabilitation and improvement of the hospital's drinking water, wastewater and heating systems.

The hospital gets its water from Sevastopol Vodokanal, the state utility. Its water supply and distribution system is in a deplorable state. Reportedly, the water quality does not meet national standards (e.g. in terms of suspended solids and aggressiveness).

The hospital is dependent on the city heating system for hot water for heating, and for daily use. The reliability of the city heating system is relatively low (water temperatures fluctuate from 200^0 to 600^0 C).

Wastewater collection facilities (toilets and internal sewer pipes) are in very poor condition. At present, manual disinfection of wastewater is being practised by the

hospital. There is a grave concern that the disposal of untreated or insufficiently treated hospital wastewater into the Black Sea may cause serious pollution, hence greater health problems.

The Drinking Water Coordinator in Sevastopol drew the attention of MAMA-86 to the deteriorating state of the Hospital and depicted the general situation as very critical.

MAMA-86's long-term partners from WECF (the Netherlands) introduced experts from Aquanet Co. into the problem at the initial stage. The latter visited the Hospital at MAMA-86's request and developed Terms of Reference for improving the situation, which was very helpful at the first stage.

As a secondary stage, MAMA-86 has started the implementation of a local project in Sevastopol in cooperation with Tebodin Ukraine LLC for Technical Services.

A lake in the city district of Kyiv (Obolon)

ANNEX I

ANALYSIS OF THE GOVERNMENTAL PROGRAMMES AIMED AT THE IMPROVEMENT OF THE WATER AND SEWAGE SECTOR IN UKRAINE

by Yelena Gr.Molozhanova, Candidate of Sciences in Biology, the Chief of the Soil Hygiene Department at Ukrainian L.Medved Institute of Eco-Hygiene and Toxicology, Associate of the International Academy for Environmental Safety of Nature and Man, Member of International Association for Mathematical Environmental Science.

Water is one of the major sources of human life support and has been exposed to anthropogenic pressure for many centuries. As a result, at the boundary between second and third millenium every country in the world faces great difficulties related to safe drinking water provision to the citizens.

Water quality is believed to depend on water content at the source of water supply, methods of drinking water treatment, and the conditions of the systems that transport water and sewage. It is worth noting that the nature and landscape of Ukraine have always been favourable for habitation. Surface and underground water resources were sufficient for the country's needs, except for the southern regions, where people consumed imported water.

However, in the last decades drinking water quality has dramatically deteriorated. This process assumes an evermore catastrophic character.

Hundreds of organic compounds, heavy metals, etc. are being identified in drinking water as a result of industrial, agricultural and municipal contamination of the environment.

The drinking water treatment methods in use to deal with chemical and bacteriological pollution can provide only partially safe drinking water. So, the need for sound technology for the treatment of drinking water taken from surface water sources is growing. For instance, wide application of chlorine in water treatment processes may cause formation of mutagenic and carcinogenic chlorine organics. During some seasons of the year, the chloroform content exceeds the safety limit figures (Maximum Permissible Concentration - MPC) by 3-5 times. The use of conventional coagulants such as aluminum sulphate and alternative coagulants that contain this element as well, causes aluminum ions which enter the drinking water. It is especially true for the periods of spring flood or active eutrophication in reservoirs when the aluminum content may increase by two or more times. This has a negative impact on drinking water safety as aluminum has neurogenic health effects.

There are several factors contributing to the unfavorable situation with drinking water in Ukraine:

- pollution of surface water reservoirs and underground water sources by anthropogenic contaminants including persistent chlorine organic pesticides, symmetric atrazins, PCBs, oil products, phenols, heavy metals, etc.

- bacteriologic contamination of the surface water by the following pathogenic organisms: salmonella, enteroviruses, etc.

- technological treatment of contaminated water cannot provide adequate safety for drinking water, and drinking water does not comply with the standards due to the high anthropogenic load on water reservoirs and the insufficient capacity of treatment facilities.

An analysis of the current situation enables us to define the following solutions to the problem of obtaining safe potable water:

- minimization of contamination in surface and underground water sources through state monitoring and control of their quality;

- improvements in water treatment;

- renewal of water and sewage pipelines;

- development and implementation of the national legal and regulatory framework including a Law On Drinking Water, stricter related sanitary regulations and limits, drinking water standards, and standards for water in the drinking water supply, etc.

- raising public awareness and changing the culture of the water use.

While evaluating the solutions listed above, we may select the most complicated and, at the same time, most regulated issue, which is water transport by water and sewage pipeline systems.

In recent years government departments have produced national and departmental programmes and draft programmes. Based on an analysis of the condition of the water and sewage sector in Ukraine, they propose measures to develop this sector for the period till 2005.

Let us list some of them:

1. The National Programme on Provision of Safe Drinking Water to Ukrainian Citizens.

2. The Programme on the Development of the Water and Sewage Sector in accordance with the Decree of the Cabinet of Ministers, of November 16, 1997, No.1269.

3. The State Programme on the Development of Water Supply and Sewage Systems in Communities in Ukraine (1995).

4. The Programme of the State Communal Services of Ukraine: On Overcoming the Crisis in Water and Sewage Sector of Ukraine and Legal Acts on the Issues of Technological, Technical and Financial Provision of Its Activities (1996).

First of all it seems reasonable to give a general overview of all the above Programmes. The above Programmes assess the current state of water supply systems as unfavourable even approaching catastrophe.

A Centralized water supply is available as follows: to 100% of the population in the 445 cities and towns of Ukraine; to 91% of the population in 911 urban villages; and to

only 19.5% of the population in 28,564 villages. Piped centralized sewage systems are available to 93.7% of the population in the cities and towns, to 57% of the population in urban villages, and to only 3.1% of the population in villages.

More than 1,000 communities in the southern region of Ukraine and the Crimea are supplied with delivered water, as there is no piped system.

The total capacity of all water pipelines makes 27,210 thousand cubic meters a day. This figure is dramatically different for cities, towns and urban villages, which can receive up to 23,478 thousand cubic meters a day; whereas in rural area the capacity is 6-7 times less.

The poor state of water pipelines in Ukrainian communities causes concern. Their total length is 152.5 thousand km. 21% of pipelines are worn out; 7.7% are in a state of emergency.

Another object of concern is the state of street and housing block pipeline systems. The total length of pipeline systems in street and housing blocks amounts to 70 thousand km. This includes 35% of worn-out pipelines and pipelines in an emergency state.

In rural areas the total length of water supply pipelines, including street and housing networks amounts to 57 thousand km, of which 20% are worn-out and almost 10% are in a state of emergency.

All these lead to a waste of treated drinking water and to reduced quality of tap water. Analysis of the situation proves that 230 cities and towns and urban villages are supplied with drinking water that does not comply with the standards on several physical and chemical indicators.

As the manmade pressures on water resources are extensive, 8 out of 10 of the southern oblasts (Nikolayev, Kherson, Dnipropetrovsk, Donetsk, Odessa oblasts etc.) and the Autonomous Crimean Republic, do not receive enough water.

The situation with drinking water in rural areas causes concern. Only 20% of the citizens there use tap water, 80% of them use well water. There are 1.8 million hand-pumped wells in Ukraine. The majority of the wells are in a poor sanitary and hygienic state resulting from the wide application of pesticides in rural area, and their entry into drinking water in concentrations that exceed the health limit by 10 times and more. Even in those cases where the limit is not exceeded for any one chemical, the cocktail effect of many toxic substances in one sample may pose hazards to health.

Provision of drinking water to military settlements is a serious problem. The hydraulic facilities in use cannot sufficiently meet the demand for safe drinking water.

The country faces problems related to the throughput capacity of the water treatment plants in cities, towns and villages, which is 15,663 thousand cubic meters a day.

In urban areas up to 20% of main pipelines are worn out and in a critical state, in rural areas this figure is twice as high. The same deplorable situation is observed in street pipeline systems. Their total length in urban area reaches 15.7 thousand km, and in rural areas 2.1 thousand km, of which 22.1% are worn-out and 38.1% are in an emergency state.

As a result of the inefficient operation of the water treatment plants, poorly treated waste water is discharged in 136 cities and towns and 50 urban villages at a volume of

5 million cubic meters a day. Untreated waste water is discharged at a rate of 400 thousand cubic meters a day. The sewage systems in the cities, towns and urban villages of Zaporizhzhya, Zhytomir, Dnipropetrovsk, Kirovograd, Lugansk and Odessa oblasts raise particular concern.

One of the major problems remains the disposal of sewage sludge which has accumulated in the silt-settling tanks and has reached a volume of 500 million tonnes. Annually approximately 40 million tonnes are added to this. In the view of environmental science, hygiene and the economics of natural resources, this is harmful as it takes up large areas of ground, and accumulated sludge is a source of additional pollution to open reservoirs and underground water. It also threatens the environmental conditions of the inhabitants in the areas adjacent to the silt-settling sites.

The above information on the state of the water and sewage sector in Ukraine leaves no doubt that improvements are needed. The programmes mentioned above consider the solutions.

It seems appropriate here to dwell on the following State Programmes.

The Draft Programme on Water Supply and Sewage Systems in Communities in Ukraine was produced in 1995 in compliance with the Decree of the Verkhovna Rada, of September 20, 1994, No.168 94-BP: On the Epidemiological Situation Related to Cholera Spreading; proposals of the Government of the Crimean Autonomous Republic; regional, cities' of Kyiv and Sevastopol authorities, several ministries and departments. The proposals for the improvement of water and sewage pipelines incorporate:

- building and reconstruction of facilities and pipelines for water supply, sewage systems in cities and urban villages, appropriate facilities in military settlements;

- expansion of the building of group water and sewage pipelines in rural area;

- development of the local water treatment facilities at hospitals for contagious diseases departments.

Furthermore, **the Programme** includes the following live issues: replacement and reconstruction of operating installations for water treatment in communities where drinking water does not meet standard values (Zhytomir, Lugansk, Odessa, Kharkov, Chernovtsy oblasts, etc.), introduction of additional waterworks in the regions suffering from water shortages, mainly southern regions (Crimea, Zaporizhzhya, Odessa and other oblasts).

Implementing **the Program** offers the opportunity:

- to improve the provision safe drinking water to the public in compliance with the standards;

- to reduce the volume of discharges of untreated wastewater to water reservoirs thereby reducing pollution from anthropogenic substances both in open and underground water sources;

- to resolve the problem of reduction and disposal of sewage sludge already accumulated and being accumulated every year at the water and sewage facilities;

- to reduce the waste of water;

- to eliminate the lack of sewage capacities in cities, towns and urban villages, to replace water sewage systems that are in critical state, to increase the efficiency of

water and sewage facilities, thereby easing the problem of water supply and drainage for military and industry and settlements;

- to build and put into operation treatment facilities in hospitals and departments for contagious diseases.

The Draft Programme proposed as early as 1995, if introduced, would enable solutions to several of the problems aimed at improving drinking water quality for the Ukrainian public. However, the lack of budget funds in Ukraine prevented the implementation of **the Programme** so far.

The next Programme: **Overcoming the Crisis in the Water and Sewage Sector of Ukraine** (1996), lists measures for improving the legal and regulatory framework of the water and sewage sector operation in Ukraine for the period 1997-2000. This includes the development of several draft laws and regulations that cover the relations between producers and consumers of tap water on a national, regional and oblast scale. This is aimed at the assessment of the quality of water in the centralized supply. The Programme includes proposals for the reconstruction and repair of water and sewage pipelines and facilities in Ukraine till 2005. It includes a specific list of priority facilities. The measures proposed by the Programme incorporate the development of a set of technologies and equipment which will improve the treatment of surface water and the conditioning of underground water, as well as flocculants to treat natural and waste water. It envisages the development, manufacture and sale of water treatment apparatus and modular-structured sets of equipment for small capacity water and sewage utilities.

The issues proposed by the **Draft Programme** are live and aimed at resolving specific problems to overcome the crisis in the water and sewage sector in Ukraine. The lack of funds to implement the above objectives in 1997 caused a number of crisis situations in 1999. For instance, the problem of poor water quality in Kyiv this spring during the great flood.

The accelerated expansion of the pump-room network to use underground water cannot solve the problem of providing drinking water to the 3 million citizens of the city, and this can be considered only as a local measure.

The above **Programmes** consider the costing of the proposed activities, and the figures presented in the **two Programmes** more or less tally with one another. They estimate the cost at one thousand million hryvnya. Hopefully, the Ukrainian government will find and allocate the funds to introduce the **Decree of the Cabinet of Ministers (No.1269): On the Programme on Development of Water and Sewage Sector** and other programmes aimed at improving the safety of the public's drinking water in Ukraine. Besides the governmental budget, the following financial resources are supposed to be used: money from extrabudgetary funds for environmental protection, investments, loans from the World Bank and the European Bank for Reconstruction and Development. These are to improve the water supply and drainage in Odessa, Lviv, Dnipropetrovsk, Zaporizhzhya as a first step.

ANNEX II

UkrSEPRO Certification System
Derzhstandard Ukrainy
Laboratory for Ion Exchange and Adsorption
at the Chemical Engineering Department of the Ukrainian National Technical University (KPI)
Certificate of Accreditation № UA 6.001.H.748 of October 31, 1997.

Address: build.4, 37 Peremogy Av.
Kyiv-56, 252056
tel./fax 241-86-22
tel. 441-19-25

Approved by
The Chief of Water Laboratory
T.Ye.Mitchenko

PROTOCOL
of certification tests
№32- ФХ of May 27, 1999

Applicant: Women's NGO «MAMA-86», Kyiv

Subject of the tests: Water samples from the town of Tatarbunary (of the original water and the water treated by the reverse osmosis device UVPM-01). Samples № 11/1/ ФХ-99, № 12/1/ ФХ-99.

Sampling report: The sampling of the treated water took place on May 21, 1999.

Objective of the tests: to monitor samples for compliance with the GOST 2874-82 «Drinking Water», DSANPIN #136/1940 «Drinking Water/ Hygienic requirements for the quality of water from centralized water supply systems».

Date of the tests: May 24, 1999 - May 27, 1999.

Results of the tests: Table 1.

Table 1

Indicator, unit	Indicator				Normative documents for testing methods
	Normative document and tolerance		Fact		
	GOST 2874-82	DSANPIN #136/1940	Original water	Treated water	
PH	6-9	6.5-8.5	8.2	6.6	GOST 2874-82
Colour, gradient	20	20	25	0	GOST 3351-74
Turbidity, mg/dm^3	1.5	0.5 (1.5)	1.6	0	GOST 3351-74
Total hardness, mg-eq/dm^3	7	1.5-7	3.04	0.1	GOST 4151-72
Potassium, mg/l	not regulated	Not regulated	10.3	3.4	Certified method
Sodium, mg/l	not regulated	Not regulated	820	274	Certified method
Total alkalinity, mg-eq/dm^3	not regulated	0.5-6.5	12.96	3.46	Certified method
Total Iron, mg/dm^3	0.3	0.3	0.22	0.01	GOST 4011-72
Manganese, mg/dm^3	0.1	0.1	0.01	<0.01	GOST 4974-72
Sulphates, mg/l	500	250(500)	822	276	GOST 4389-72
Chlorides, mg/l	35	250(350)	321	112	GOST 4245-72
Silicates (converted to SiO_2) mg/l	not regulated	Not regulated	10.1	3.8	GOST 10671.1-74
Dry residue mg/dm^3	1000	100-1000	2112	708	GOST 18164-72
Oxidability (chemical absorption of oxygen), mgO_2/dm^3	not regulated	4.0	2.2	0.68	GOST 4595-89

THE CONCLUSIONS: According to the tested indicators, the quality of water taken in the town of Tatarbunary upon treatment at the reverse osmosis device UVPM-01 complies with the standard GOST 2874-82 «Drinking Water», DSANPIN #136/1940 «Drinking Water/ Hygienic requirements for the quality of water from centralized washing and drinking water supply systems».

Notes:

1. The record of the tests covers only the tested samples.

2. No part of the record of the tests may be reproduced without the prior permission of the testing laboratory.

Responsible executive staff: Signature N.M.Kharkovchuk

Water Purification Installation

Oleg Medvedev and Irina Vykhrystyuk,
(MAMA-86's Network, Tatarbunary)

The problem of an alternative water supply for the town of Tatarbunary has existed since 1954 and still today has not been resolved. For the majority of the population's potable water supply, artesian and water wells are utilized, with imported, rain, and melted snow water proportionally less. And the exact number of wells, consumers and depth of underlying pipelines are not known since artesian wells belong to various organizations and departments.

Two of the basic problems of the town's water quality are the following: firstly, practically all of the water supply sources do not meet the maximum permissible concentration (MPC) regulations for potable water supplies. The water's «natural» chemical conditions exceed the MPC in some respects, such as mineralization, the salt quantity, the amount of chloride, etc. For example, the water has a changing chemical structure with mineralization varying from 1.2-5.2g/l in artesian wells, and 0.8-20g/l in water wells. Secondly, there is a progressing contamination of the water supply sources, such as water wells and pipes. 30% of the town's population utilize the urban water system, which extends about 9 kilometers. The water pipes in the urban system are of asbestos-cement, 7 kilometers long, and at a depth of 1.8-2 meters. And the pipes were installed more than 30 years ago, a period of which exceeds the life span by 10 years. With the economic situation, the only possible way to ensure the town's water quality problem is solved, is the purification of water on the existing water system.

To do this, a study of the given problem was conducted under the women's environmental organization MAMA-86's program «Potable Water in Ukraine». A water purification system is necessary to ensure the improvement of the drinking water situation. An optimum water purifying variant was found as results of the conducted study and analysis of the purified water «market». A water purification installation establishes a water system with a qualitative accumulation capacity for distribution or sale.

A location in the town's center, that meets the «Sanitary-Hygienic Regulations on Handling and Repackaging Potable Water-Odessa 97» was selected. The water purification system UVPM-0.1 MNPP «Ecosoft» of reverse osmosis was installed and now purifies the water. Random testing of the water has shown that the water's chemical structure now meets the Ukrainian requirements on MPC. And the water purification installation helps to solve the quality drinking water problem and ensure the health of the people of the town.

(Translated by Gina Spratt, PC activist)

Hole of the main drinking water reservoir at the Tatarbunary pumping station in deterioratyion

Tatarbunary: tanks with drinking water at the emergency storage

ANNEX III

Results of the Sociological Study of Public Opinion on Drinking Water Quality and Supply

Produced by Olexandr Stegnij, the Head of Department of Social and Political Research, Candidate of Sciences in History, SOCIS Gallup International, Ukraine

TECHNIQUE OF THE STUDY

The analytical report of the sociological study is based on the results of a public opinion poll conducted by the SOCIS Center of Social and Marketing Research, a full-fledged member of Gallup International together with the Kyiv non-governmental environmental organisation MAMA-86 in May 1999.

The said opinion poll was held in five cities and towns: Kyiv (800 respondents), Odessa (600), Sevastopol (400), Artemivsk (200) and Tatarbunary (100). The population sample is representative of the grown-up population of the listed localities for the following features: sex, age and educational background.

The sampling is multistaged with quota selection at the last stage. The selection was organised so that it covers residents of all districts in the cities. This geographical sampling is important as it avoids any possible shift in results which could be caused by the influence of a specific water supply in a specific district. It helps obtain the generalized attitude of cities' inhabitants to their drinking water and water supply.

The study was carried out by the method of standard interview at the place of permanent residence of the respondents.

The number of respondents from each locality varies according to the density of its population, but is adequate for correct sociological polling. All participants of the study were grouped into four age groups to achieve demographic representation: young, up to 25 years (426 respondents or 20% of the total number of respondents), the most socially active, 26 to 40 (679 persons or 32%), older group, 41 to 54 (480 or 23% of the total) and pensioners (515 or 25% of the total).

THE CULTURE OF WATER CONSUMPTION

The overwhelming majority of the participants (78%) use tap water for drinking purposes and to cook food. At the same time, sources of drinking water for every day use considerably differ with regard of the place of residence. In particular, almost half of the Kyiv respondents use artesian wells.

One of 70 pump rooms with artesian water operating in Kyiv

According to the data, a significant proportion of our citizens (41%) continue to use raw, or unboiled water for drinking. The proportion of those who consume unboiled water is higher among those with lower lelvels of education, but anyway the value remains fairly high among specialists with higher education.

The matter of concern is the fact that among consumers using unboiled water only 14% additionally treat it with filters, while the remaining 27% of the total amount of respondents drink it untreated on a daily basis.

The results of the study demonstrate that uninterrupted tap water supply is a live problem for residents of many cities and towns of Ukraine. The most favourable situation with water supply is observed in Kyiv and partially in Sevastopol, at the same time, the most complicated situation appears to be in Artemivsk and Tatarbunary.*

TAP WATER QUALITY

A clear majority of the opinion poll participants, regardless of the place of residence, are not satisfied with the quality of their tap water. They named the following causes for their concern: firstly: unpleasant taste/flavour (68%) and odour (55%). The Tatarbunary respondents emphasized primarily the unpleasant colour (61%) and turbidity (52%) of the tap water.

The overwhelming majority of the respondents (71%) are prone to believe that their tap water is inadequately treated. Furthermore, over one third believe that the quality has deteriorated in the last three years. Positive changes were percieved by only 6% of tap water consumers.

* MAMA-86 notes: As usual, the further from the centre, the more acute problems people have to face.

Tatarbunary: residents of the area take artesian water

ATTITUDE TO WATER FILTERING

There are various ways to improve drinking water quality. The respondents prefer, first of all, to use filters (44%) and to additionally treat water at the place of residence through specific established associations of water consumers with payment of membership fees (30%).

It is worth noting that among environmentalists and biologists who participated in the poll the majority prefer to use additional water treatment organised by the above associations, rather than to rely on household water treatment devices (48% to 26%).

Although this group is small for making a statistical analysis, this figure does identify certain trends in the preferred solutions for improing drinking water quality in this professional sector.

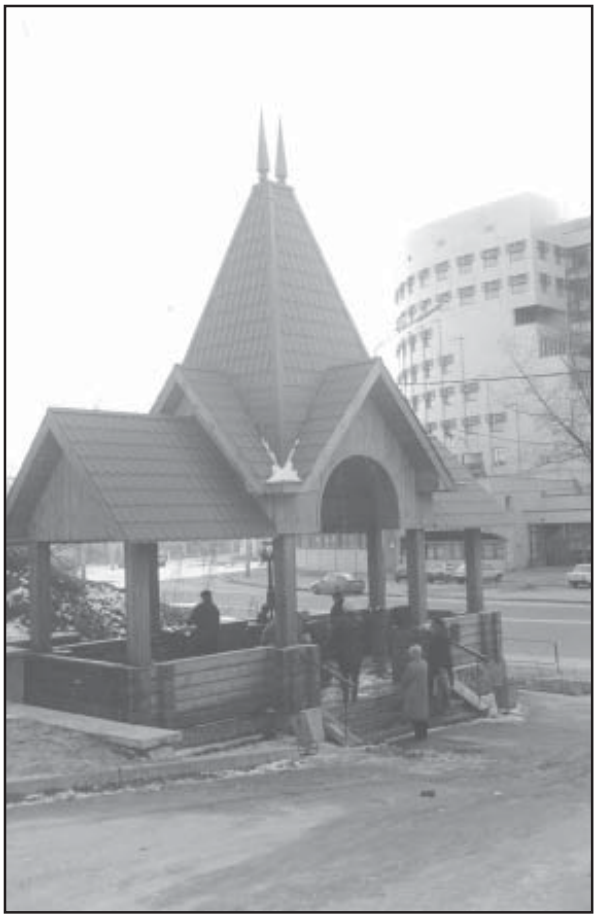
The preference of the majority of the respondents is to use filters to treat water. However, many of them do not actually do this. The majority of them (65%) have never used filters to additionally treat water, one fifth stopped using them and only 14% at the moment of the study were actual users of the water treatment devices.

The overwhelming majority of the filter users are satisfied with their quality. Product labelling which gives information on the country of origin and the life expiry date of the device, contributes to the level of the user's satisfaction. In particular, those who use filters of foreign origin and have been using them for one or two years are the most satisfied respondents. It is worth noting that a fairly high proportion of respondents could not define their attitude towards the quality and effectiveness of filters.

The two reasons most frequently cited for preventing respondents from purchasing filters are: financial difficulties (52%) and a lack of necessary information. The lack of necessary information was, first of all identified by the citizens of Tatarbunary at (90%)!

Household filter «Ecosoft» by Ukrainian producer

Odessa: secondary treated potable water on sale



One of the pumprooms in Kyiv

WATER CONSUMPTION AND HUMAN HEALTH

Over a half of the individuals polled said they felt that the water they consumed adversely affected their health. The overwhelming majority of these respondents (59%) are prone to believe that the quality of water they consume has caused changes in the functions of their inner digestive organs, which was the most common disease suffered by respondents. A quarter claimed negative changes in skin condition, and a fifth claimed negative changes in the cardio-vascular system. Some respondents also named kidney and urination dysfunction, negative changes in hair, nail, and teeth condition as well as intensification of rheumatism.

Sources of Information on Medical Aspects related to Water Consumption.

The major source of information about health effects of poor water quality for respondents is the mass media. About a third of the respondents named interpersonal communication, and a fifth named medical personnel. A minimum number of the participants of the study named public organisations and teachers (5% and 2%, respectively).

The poll revealed rather low public awareness of action from governmental institutions and non-governmental organisations to improve water quality. The overwhelming majority of respondents have not come accross information on this kind of thing.

Against a background of generally low public awareness, the respondents most frequently encountered information on drinking water quality produced by the sanitary and epidemiological stations (43%) and the Ministry of Health (31%).

It is worth noting that information from non-governmental organisations is more widely disseminated to respondents than information from the Ministry for Environment & Nuclear Safety and other governmental institutions. The opinion poll revealed that over a half of the respondents in Tatarbunary (highest value among all respondents) encountered information on drinking water quality prepared by non-governmental organisations. In comparison, this indicator in Kyiv, Odessa and Artemivsk varied from 12-15%.

It is interesting to emphasize that among professionals in the field of health and environment 62% said they do not have enough information on water related health effects.

There is evidence of generally low public awareness about drinking water quality and its health effects, and this is borne out by the study, in which 68% of the participants stated that they lack such information and only 18% said they had enough.

AS TO IMPROVEMENTS IN WATER SUPPLY

Practically all respondents believe that the system of water supply requires improvements. To resolve water supply problems and to improve drinking water quality in their locality the respondents preferred actions funded by the government (65%). Moreover, a large number of respondents count on the efforts of local self-government and business representatives (40.29%).

If the respondents happened to have any extra money, 70% said they would spent it on goods of prime necessity, namely food and clothing. On the second place, 38% said they would spend it on medicines and medical services, and another 38% said they would spend it on communal service payments.

There were more people willing to purchase a filter for additional water treatment than there were willing to purchase electrical household appliances (28% to 20%).

PUBLIC AWARENESS ON THE EFFORTS OF NON-GOVERNMENTAL ORGANISATIONS

According to the obtained data almost three quarters of the respondents have heard nothing about non-governmental organisations (NGOs) established after the collapse of the USSR. Only a quarter of the interviewed persons answered positively. The most aware are respondents of higher education background (37%) and citizens of provincial Tatarbunary and Sevastopol rather than citizens of the capital and Odessa. It is probable to assume that the latter demonstrate higher awareness primarily due to specific actions undertaken by environmental NGOs which have led to some social resonance in these towns.

The overwhelming majority of the individuals questioned could not name any environmental NGO in Ukraine (69%). The following fact attracts our attention: the public opinion does not clearly understand the difference between a political party and an NGO. This is the only way to explain why the people named the Green Party of Ukraine, in answer to this question. The Green Party is a parliamentary party, not an environmental NGO.

The Green Party of Ukraine and Greenpeace were most often named by the respondents in Kyiv, while Bakhmat, an NGO in Artemivsk, was known in its local region, and Vidrodzhennya, NGO in Tatarbunary, was known in its region. MAMA-86 was mentioned in every city and town except Sevastopol, the Environmental Protection Service was mentioned also in every researched locality except Tatarbunary. However, we think that this Service is a department of Ministry for Environment in every region.

As in the previous case, the educational level of the individual influences their awareness related to environmental NGOs. In particular, awareness is increasing from 18% in the respondents without higher education to 48% in students of higher educational institutions. It is worth noting that a quarter of all students mentioned Greenpeace, and specialists with diplomas remembered the Green Party of Ukraine (28%).

In their attitude to whether NGOs are able to do something to improve the quality of drinking water, the participants of the study divided into three equal groups: optimists, pessimists and those who did not know.

The optimistic group included young people under 25, students in the health sector, and citizens of Kyiv and Sevastopol. However, pensioners, persons without a higher education background, workers and inhabitants of Tatarbunary and Odessa could be considered pessimists.

Twice as many respondents who are aware of NGOs expect them to acheive positive changes. This clearly proves the important role that public awareness raising activities can achieve to direct public involvement into the third sector actions.

ANNEX IV

ASSESMENT OF THE TAP AND ARTESIAN DRINKING WATER QUALITY IN SOME DISTRICTS OF KYIV IN THE SPRING HIGH-FLOOD PERIOD 1999

(Produced by the Laboratory for Ion Exchange and Adsorption of the Chemical Engineering Department of the Ukrainian National Technical University (KPI)

According to the contract No.05/05-99 with the Women's NGO «MAMA-86» the Laboratory for Ion Exchange and Adsorption of the Chemical Engineering Department of the Ukrainian National Technical University, the tests of the drinking water quality were conducted at the various sources of water supply in Kyiv from March 29 till May 29, 1999. The programme of activities incorporates analysis and assessment of the quality of water from the municipal water supply system and artesian wells.

To assess quality of the tap drinking water, sampling took place once a week in the following districts of Kyiv:

- Zhovtnevy (37 Pobedy Av.)
- Shevchenkovsky (27 Lukyanovska St.)
- Podolsky (25 Sahaydachny St.)
- Minsky (6 Tymoshenko St.)
- Pechersky (22 Mikhaylivska St.)
- Dneprovsky (38/14 Stroiteley St.)
- Starokyivsky (21/8 Malopodvalna St.)
- Moskovsky (112 Antonovich St.)
- Zaliznychny (7 Nekhody St.)
- Leningradsky (11 Koltsov St.)

In total there were 10 sampling points (areas).

Within 2 months 9 samples were taken at every point.

In total 90 samples of the tap water were taken.

To assess the quality of the artesian drinking water, sampling took place once every two weeks in the following wells in Kyiv:

- Klovsky spusk
- Darnitsa underground station
- Goloseyevo park

- Stadionnaya St.
- Pobedy Sq.

In total there were 5 sampling points (areas).

Within 2 months 5 samples were taken in every point.

In total 25 samples of the artesian water were taken.

The sampling was executed by the Laboratory staff in compliance with GOST 24481-80. The content of the water samples was identified according to GOST 2874-82 or certified methods.

The following indicators were analysed in every sample:

- colour
- turbidity
- total hardness
- total alkalinity
- pH
- total iron
- aliminum
- oxidability
- manganese
- nitrates
- nitrites
- copper
- TDS

Twice a month every sample was analyzed for the following indicators:

- lead
- zink
- mercury
- cadmium
- arsenic
- total organic carbon

Besides, every sample of the water taken at Zhovtnevy district (37 Pobedy Av.) was additionally analysed for:

- ammonia
- aggregate residual active chlorine

and of the samples taken from the artesian wells:

- hydrogen sulphide

The total number of analyses made was 1968.

Assessment of the Kyiv drinking water quality was carried out by comparing the levels found with the acting national standard GOST 2874-82 «Drinking water. Hygienic requirements for water quality in the centralized washing and drinking water supply» passed by the Ukrainian Ministry of Health, Reg.No. 136/1940 of April 15, 1997 and the Guidelines on Drinking Water Monitoring of the WHO and the EU Directives on Drinking Water Quality (Table 1).

Table 1. Drinking water quality limits

No	Name	Unit of measurement	Standard					
			GOST 2874-82	SANPIN No.136/ 1940	WHO	EU	Russia draft GOST on water TsSV	
							1 stage	2 stage
1	2	3	4	5	6	7	8	9
Organoleptic indicators								
1	Appearance	-	-	-	-	-	-	-
2	Smell	Mark	2	2	Must be pleasant	2-3 (0)	<2	Must be pleasant
3	Taste and flavor	Mark	2	2		2-3 (0)	<2	
4	Colour	degree	20	20 (35)	15	20 (1) according to Pt/Co scale	20	15
5	Turbidity	EMF	1.5	0.5 (1.5)	2.0	10 (1) mg/l SiO_2	2.6	1.0
Toxicological indicators								
1	Aluminum	mg/l	0.5	0.2 (0.5)	0.2	0.2 (0.5)	0.5	0.2
2	Barium	mg/l		0.1	0.7	(0.1)	0.1	0.1
3	Beryllium	mg/l	0.0002		-	-	0.0002	0.0002
4	Boron	mg/l			0.3	0.3	0.5	0.3
5	Molybden-um	mg/l	0.25		0.07	-	0.25	0.07
6	Arsenic	mg/l	0.05	0.01	0.01	0.01	0.05	0.01
7	Nickel	mg/l		0.1	0.02	0.02	0.1	0.02
8	Mercury	mg/l		*	0.001	0.01	0.0005	0.0005
9	Lead	mg/l	0.03	0.01	0.01	0.01	0.03	0.01
10	Selenium	mg/l	0.001	0.01	0.01	0.01	0.01	0.01
11	Strontium	mg/l	7.0		-	-	7.0	7.0
12	Fluorine and fluorides	mg/l	0.7-1.5	0.7-1.5	1.5	1.5	1.5-0.7	1.5-0.7
13	Chromium (+6)	mg/l		*	0.05	0.05	0.05	0.05
14	Cyanides	mg/l		*	0.07	0.05	0.035	0.035
15	Cadmium	mg/l		*	0.003	0.005	0.001	0.001
16	Lindan	mg/l		Pesticides 0.0001	0.002	Pesticides 0.0001	0.002	0
17	DDT	mg/l			0.002		0.002	0
18	2,4-D	mg/l			0.03		0.03	0
19	Atrazin	mg/l			0.002			
20	Simazin	mg/l			0.002			

(Table 1 continued)

1	2	3	4	5	6	7	8	9
21	Benzene	mg/l			0.01	-	0.01	0
22	Benzo-a-pyrene	mg/l		*	0.0007		0.000005	0
23	Phenols	mg/l		Chlorophen-ols 0.0003	-	0.0005 (Phenol index)	0.25 (Phenol index)	0.25 (Phenol index)
24	Chlorinated ethylene: 1,1 dichloroethylene, trichloroethylene, tetrachloroethylene	mg/l		*	- - -	- 0.7 0.4		
Indicators affecting organoleptic water properties								
1	Hydrogen indicator	pH	6.0-9.0	6.5-8.5	-	6.5-9.5	6.0-9.0	6.5-8.5
2	Hardness, total	mg-eq/l	7.0	1.5-7.0 (10.0)	-	-	7.0	1.5-7.0
3	Oil products, total	mg/l		*	-	-	0.1	0.1
4	PAV	mg/l		*	-	0.2	0.5	0.2
5	TDS	mg/l	1000	100-1000 (1500)	1000	1500 (-)	1000	500
6	Iron	mg/l	0.3	0.3	0.3	0.2 (0.05)	0.3	0.05
7	Manganese	mg/l	0.1	0.1	0.1	0.05(0.02)	0.1	0.02
8	Copper	mg/l	1.0	1.0	1.0	-(3.0)	1.0	0.1
9	Sulfates	mg/l	500	250(500)	250	250 (25)	500	250
10	Chlorides	mg/l	350	250(350)	250	-(25)	350	250
11	Zinc	mg/l	5.0	*	3.0	(0.1-5.0)	5.0	3.0
12	Nitrates	mg/l	45.0	45.0	50.0	30.0 (25.0)	45.0	25.0
13	Nitrites	mg/l		*	3.0	0.1	3.0	0.1
14	Potassium	mg/l				150		
15	Calcium	mg/l				100		
16	Magnum	mg/l		10-80		50		
17	Alkalinity, total	mg-eq/l		0.5-6.5				
Chemical substances incoming and formed in the process of water treatment								
1	Chlorine residual, free	mg/l	0.3-0.5	0.3-0.5	0.6-1.0	-	0.3-0.5	0.6-1.0

(Table 1 continued)

1	2	3	4	5	6	7	8	9
2	Trihalomethanes: Bromoform Dibromochloromethane Bromdichlormethane Chloroform Carbon tetrachloride	mg/l		Total 0.1 0,01 0,06 0,002	 0.1 0.1 0.06 0.2	 - - 0.015 0.04	 0.2 0.006	 0.2 0.002
3	Ozone residual	mg/l	0.1-0.3	0.1-0.3	-	-	0.3	0.3
4	Formaldehyde	mg/l			0.9		0.05	0.05
5	Polyacrylamide	mg/l	2.0		1.0	Acrylamide - 0.25	2.0	2.0
6	Activated silicic acid (according to Si)	mg/l	3.5		-	-	10.0	10.0
7	Polyphosphates (according to PO_4^3)	mg/l			-	-	3.5	3.5
8	Silver	mg/l			not limited (allowable to 0.1 mg/l)			
Integral indicators								
1	Oxidation	mgO_2/l		4.0				
2	Total organic carbon	mgC/l		3.0				
Nuclear safety indicators								
1	Strontium-90	Bq/l		According to Dose Register-97 4.0				8.0
2	Cesium-137	Bq/l		According to Dose Register-97 2.0				8.0
3	Gross Volumetric Activity of a-emitters	Bq/l		0.1				
4	Gross Volumetric Activity of ß-emitters	Bq/l		1.0				

* Water should not contain contaminants in concentrations which may be identified by the standard test methods

The results of the tests demonstrate that there were no excessive levels of heavy metals including lead, zink, mercury, cadmium, or arsenic, and no excessive levels of copper in any sample of either tap or artesian water in Kyiv. During the whole period of testing the following indicators also complied with Maximum Permissable Concentration (MPC): pH, total hardness, total alkalinity, nitrates, nitrites, TDS, free residual chlorine.

At the same time, some contaminants in the tap water in Kyiv exceeded standard content on a regular basis. These were aliminum, iron, organic substances (oxidability and total organic carbon) as well as colour and turbidity. It is worth noting that they were normally higher than the standards and were identified mostly in Zhovtnevy, Moskovsky, Zaliznychny, Shevchenkivsky districts. The figures were growing gradually, starting with the last days of April and by the end of May they had grown in every district of the city. Only in Minsky district was this indicator within the MPC. Out of the

total of all 9 samples, the contaminants which exceeded the limits are shown below in Table 2:

Table 2

District in Kyiv	Indicators									
	Aluminium		Iron		Oxidability	Total organic carbon (of 5 samples)	Colour		Turbidity	
	GOST (0.5mg/l)	DSANPIN, WHO & EU (0.2mg/l)	GOST, DSANPIN, WHO (0.3 mg/l)	EU (0.2mg/l)	DSANPIN (4 mgO_2/l)	DSANPIN (3mgC/l)	GOST, DSANPIN (20 grad.)	WHO & EU (15 grad.)	GOST	DSANPIN (0.5 mg/l)
Leningradsky		3				4	2	7		7
Dneprovsky	5	9	1	3	7	5	9	9	3	6
Zhovtnevy	4	9	5	6	6	5	8	9	5	5
Zaliznychny	1	9		2	7	5	9	9		3
Minsky		1			1	4		6		3
Moskovsky	1	9			8	5	7	9		3
Pechersky	2	9			6	5	7	8		1
Podolsky	3	9		3	6	5	7	9		4
Starokyivsky	2	9	1	3	4	5	7	9	1	5
Shevchenkovsky	3	9		4	6	5	8	9	1	6
Total in Kyiv (of 90 samples)	21	76	7	21	51	48	64	84	10	43
In Total, %	23	84	8	23	57	96	71	93	11	48

Besides that, the ammonia indicator was identified as higher than the MPC (analyses were conducted only in Zhovtnevy district). Excessive levels of manganese were found in Zaliznychny, Podilsky and Starokyivsky districts, however, not on a regular basis.

The manganese level was exceeded systematically in the wells at the Darnitsa underground station and Goloseievo park. The hydrogen sulphide level was exceeded at the Pobedy Sq., and Klovsky spusk. The iron, turbidity and manganese indicators were in excess of the standards at the well in Stadionnaya St. Table 3 shows the number of exceeded levels for specific contaminants in 5 water samples.

Table 3

Wells in Kyiv	Indicators					
	Manganese	Iron		Hydrogen sulphate	Turbidity	
	GOST, DSANPIN, WHO &b EU (0.1 mg/l)	GOST, DSANPIN, WHO (0.3 mg/l)	EU (0.2 mg/l)	WHO & EU (0.05 mg/l)	GOST (1.5 mg/l)	DSANPIN (0.05 mg/l)
Darnitsa underground station	5			1		1
Stadionnaya St.	1	2	2		2	4
Pobedy Sq.			1	5		3
Goloseyevo park	2			2		2
Klovsky spusk			1	4		4
In Total in Kyiv	8	2	4	12	2	14
In Total, %	32	8	16	48	8	56

We also observed that the iron content was increasing during the whole period of the observation in all points of the sampling. In most cases the value of this indicator reached 0.15-0.2 mg/l by mid April in comparison with 0.05-0.1 mg/l at the beginning of April.

See Table 4 for data on impacts of some hazardous substances in drinking water on the human body.

Table 4

Group the substance belongs to	Substances	Health effects
Inorganic components	Aluminum	Neurotoxic effects
	Manganese	Damage to the nervous system Adverse effects on liver, heart
	Nitrates, nitrites	Methemoglobinemia, stomach cancer
Organic toxicants	Carbon tetrachloride	Cancer, mutagenic impacts
	Trihalomethanes (chloroform, bromoform)	Mutagenic impacts, partially cancer
	1,2-dichloroethane	Cancer
	Chlorinated ethylene	Mutagenic effects, cancer
	Aromatic hydrocarbons:	Damage to the liver and kidneys Cancer
	Benzene	
	Benzo(a)pyrene	
	Pentachlorophenol	
	Pesticides:	Damage to the liver and kidneys, nervous, immune, cardiovascular systems
	Lindan	
	DDT	Cancer, damage to the nervous system and liver
	Hexachlorobenzene	Cancer
	Atrazin	Tumors of mammary gland
	2,4 D	Damage to the liver, kidneys
	Simazin	Cancer
Chemical substances affecting organoleptic properties of water	Iron	Allergy, blood diseases
	Sulphates	Diarrhea, increase in hypoacid state of stomach
	Chlorides	Hypertension, hypertension disease
	Chlorinated phenols	Cancer
	Hydrogen sulphate	General and narcotic impacts, damage to the nervous system and inner organs

ANNEX V

Problematic Economic Aspects of the Water Supply in Ukraine at the end of the XXth century.

Valentina Dm.Kvasova, The Chief Expert,
Ministry of Finance of Ukraine.

Given the current economic crisis in Ukraine, the water supply problems are partially neglected, especially by the local authorities. Therefore, for the majority of measures mandated by Ukrainian Laws and Decrees of the Cabinet of Ministers, there is no mechanism for implementation at all. That is why the municipal authorities pay inadequate attention on them.

In order to ensure operation of the water supply and sewage pipeline sector, to improve water supply and water drainage, the Cabinet of Ministers passed the «Programme for the Development of the Water and Sewage Pipeline Sector in Ukraine» on July 17, 1997 by the Decree No.1269. The Decree states that the Rada of Ministers of the Crimean Autonomous Republic, the municipal authorities of Sevastopol and Kyiv, and other regional and centralized bodies of executive power are instructed to submit to the Cabinet of Ministers proposals on required changes and amendments to the legislation of Ukraine, in accordance with the Programme approved by the Decree. However, this Decree is being poorly implemented, and as there is no state reporting procedure for this Decree, it is hard to monitor its progress at the national and local level.

If the local authorities are making an effort to take care of the health situation in their city, they allocate money from their local budget and make specific steps to improve drinking water consumption. For instance, Kyiv State Administration, in response to the poor condition of the water supply in the city of Kyiv, had 70 pump rooms built in Kyiv at the expense of the local budget. 11 of them were built in Minsky district, and 7 were built in both Moskovsky and Leningradsky. There are plans to bring 32 more pump rooms into operation in 13 districts of the city. These will be: 3 in Darnitsky; 3 in Dniprovsky; 3 in Zhovtnevy; 3 in Zaliznytchny; 2 in Leninsky; 4 in Minsky; 2 in Moskovsky; 2 in Podilsky; 1 in Radiansky; 1 in Starokyivsky; 2 in Kharkivsky; and 4 in Shevchenkivsky.

According to the above Programme, the water and sewage pipeline system lacks funds for servicing the water supply and sewer systems, suffers from poor technical conditions in water facilities, where equipment and management structures are inadequate. Additionally, the regulatory and legal frameworks do not ensure safe effective operation of the facilities. Altogether, the introduction of this programme, its primary actions for 1998-2001, requires 2,486 million hryvnya, in the prices of May 1, 1996 ($ US 1,243 million according to the exchange rate on January 1, 1999).

It is proposed to utilize the following sources of finance besides budgetary funds:

- allocations for depreciation according to legislation;

- extra budgetary funds for environmental protection;

- communal loans that can accumulate funds to improve safe operation of the water and sewage sector;

- loans of the World Bank and European Bank for Reconstruction and Development that are involved in improvement of the water supply and sewerage in the cities of Odessa, Dnipropetrovsk, Zaporizhzhya, etc.;

- funds from fines and tariffs for amounts of wastewater discharged into the municipal sewage systems above a certain limit;

- money of the special fund for financing activities aimed at reducing the inefficient use of water, material and energy resources.

According to a rough calculations of funds, 42% of the total funds for this programme would be spent on capital investment. This would cost around 1,032 million hrv. ($ US 516 million, according to the exchange rate of January 1, 1999). However, the progress in implementing the programmes for the development of the water and sewage sector, and the program for improving drinking water quality, are insufficient due to lack of funds. Moreover, local authorities make poor use of the powers delegated to them by the Ukrainian Laws: On Local Self-Government in Ukraine, On Sanitary and Epidemic Safety of the Population, etc.

Furthermore, the complicated financial state of the water and sewage utilities, is another factor which requires improvement, but which is not being improved this year.

Sales from the water supply in 1998 totalled 976.8 million hrv. ($ US 488 million), but expenditures for the production of the water supply totalled 1,930.573 million hrv. ($ US 546,786 thousand), so the negative balance amounted to 116.8 million hrv. or ($ US 58,400 million according to the exchange rate of January 1, 1999)

The major causes of this situation are non-payment of water charges by some of the population, as well as utilities and other consumers, and also debts owed to the water production facilities by various institutions that owe grants, subsidies, and compensations for losses at utilities caused by non-payment privileges granted to some consumers.

The poor financial state of the water utilities is proved by the losses made by production. Water supply makes a 10.7% loss, and water drainage makes a 5% loss.

In 1998 a government subsidy of 59.5 million hrv.($ US 29.75 million, according to the exchange rate of January 1, 1999) was received. This included 91.0% of the amount approved in the budget and 42.6% of the amount payments required from utilities. A subsidy of 31.9 million hrv. ($ US 15.95 million, according to the exchange rate of January 1, 1999) was made to the sewerage system, including 87.4% of the amount approved in the budget and 39.2% of the amount payments required from utilities.

It is necessary to emphasize that in practice the hryvnya to dollar rate had fallen by 1.5 times by the winter 1998 and since April 1999 it has been 1:4. Moreover hidden inflation decreases the incoming funds to the water production sector by more than 2 times as the compared to the date of the decision on the subsidy.

Payment for water supplied to the public cost 0.23 hrv. according to the tariff in 1998. That was equal to 50% of the service cost. Only 43% of the state subsidy which was supposed to cover the difference between the cost of water production and the

cost of the tariffs was received. Not more than 11% was received in the following oblasts: Dnipropetrovsk, Kyiv, Sumy, Kherson, Chernigiv.

Drinking water production fell in Ukraine in every one of the 21 oblasts. Production amounted to only 94.6% of the previous year's production.

In 1999, according to the minutes of the meeting of the Cabinet of Ministers of Ukraine on May 28, the budget for this year is formed on the basis of the tariffs for drinking water supplies. So, the budget stipulates no state subsidy to cover for losses caused by the governmental regulation of the tariffs paid by the population for their water supply. The financial state of the utilities will become more complicated due to this change.

In 1998, in order to ensure the reliable and safe operation of the buildings, facilities and engineering pipelines of the water utilities, the State Civil Engineering Committee adopted «The Rules of Inspection and Assessment of the Technical State and Operation of the External Pipelines and Facilities for Water Supply and Sewage».

These rules are aimed at improving the operation of the water utilities regardless of their ownership. The same order approved «The Regulations on Safe Reliable Operation of the External Pipelines and Facilities For Water Supply and Sewage». Provision 5 of the Regulations stipulates that financial resources for the repair of the pipelines and facilities of the water supply and sewage may be taken from gross expenses, depreciation allocations, and the income of the owner of the water and sewage pipelines and facilities as well as the investors' funds.

Provision 5.2 says that payments to contractors such as repair and building companies are funded according to the established Laws.

Local authorities take many other actions to improve the water supply in Ukrainian cities, towns and villages. However, all of them face a common problem - lack of funds. There is a need to improve the government's funding of the water supply in the cities, towns and villages of Ukraine. The government also needs to improve its understanding of the complicated situation.

Attraction of foreign investments may also have real impacts in the cities, towns and villages of Ukraine and may be a single reliable source to fund the water supply. A strategic step to attract investments into water consumption could be a transfer of the regional water utilities to a new mixed ownership, involving the public as shareholders, as a way of attracting public funds. A new approach to the establishment of shareholders' associations is needed.

Partial privatization of the water pipelines by the population is possible and may bring results. A number of measures in cities, towns and villages of Ukraine should be developed to make the public pay on time for water consumed. Significant improvements in services to citizens, including water supply, may be achieved through the introduction of water meters, and improvements in the system of payments for services, which can be linked to the quality. Of course a reduction in the waste of water would also improve services. A list of fines levied on water producers and providers for low quality services is to be approved. New types of contracts between water producers and providers, whereby sanctions for poor service or delayed payment could be levied, are to be approved.

In order to ensure the implementation of the Ukrainian Law On the Sanitary and Epidemiological Safety of the Population, the Ministry for Health passed the state sanitary

rules and standards: Drinking Water: Hygienic Requirements to Water Quality in the Centralized Household and Drinking Water Supply Systems by the order No.383, of 23 December 1996. This document incorporates systematic basic hygienic requirements for washing and drinking water from centralized water pipelines. It also incorporates the procedures for state sanitary and epidemiological monitoring of water in the centralized water supply system under normal and epidemic conditions, and responsibility for compliance with these state sanitary rules and standards.

According to the Ukrainian Law On Sanitary and Epidemiological Safety of the Population, regulatory institutions, and local and oblast authorities bear the responsibility for both the volume and quality of drinking water, and they are responsible for compliance with the DSANPIN (State Sanitary Regulations and Norms).

ANNEX VI

THE ISSUES SURROUNDING SECONDARY TAP WATER TREATMENT IN UKRAINE AND SOLUTIONS TO THE PROBLEMS

Prof., Ph.D. Tatyana Eu.Mitchenko;
Candidate of Sciences,
Natalya V. Makarova
National Technical University of Ukraine (KPI)
Laboratory for Ion Exchange and Adsorption

This study reviews the effectiveness of traditional secondary water treatment, such as tap filters, and presents studies on the effectiveness of a new treatment technology, «Ecosoft».

Household tap water treatment devices are widely applied in the world and this is one method to guarantee a safe drinking water supply. Recently, as the quality of centrally distributed water has deteriorated significantly, demand for devices, installations and systems for secondary water treatment has been growing.

Devices for tap water secondary treatment on offer to consumers differ in their efficiency, design features, principles of operation, treatment methods, etc. In particular, they differ in the method of treatment as follows:

* filtering (those which trap contaminants and substances present in the water in the form of small, dispersed suspended matter, e.g. some compounds of iron and aluminum);

* adsorbtion (remove organic compounds, chlorine and some toxic substances)

* ion-exchanging (able to remove some heavy metals, iron, nitrates ions as well as hardness, etc.)

* electrochemical (provide for water disinfection)

* reverse-osmosis (desalinate water, simultaneously remove organics and bacterial pollutants);

* combined (combine several of the specified methods).

Effective operation of household filters depends both on the properties of the materials used in it and the composition of the water to be treated. When choosing a water treatment device, it is most reasonable to consider the effective trapping of the contaminants found in the local water. The Content of contaminants in water is defined by the composition of the natural water, the level of the technology at the centralized water treatment facility, and the condition and material of the pipeline system.

At the moment there are no widely recognized criteria to assess the effectiveness of filters and the feasibility of their applications. Most publicized recommendations are

often narrow and unjustified. Their common feature is a short random list of contaminants which filters are tested for, and most importantly, these recommendations are not adjusted to the specific water that is to be treated.

Domestic and foreign filters for household treatment of potable water number over a hundred names. However, filter ratings do not take into account the properties of potential water to be treated. This assessment of the effectiveness of any filter must be taken into account.

It is impossible to give concrete recommendations for the application of any filter, knowing nothing of the water to be treated, even if there are certification services. Sometimes there is lack of regulatory documents on filters and filter testing methods, and some methods are controversial.

As for the hygienic certification of filters, this only relates to the sanitary reliability of the device. So, neither a hygienic certificate nor a standard filter certificate can prove that a device is suitable and effective for a particular region, and can only certify the relative safety of the device itself.

Therefore, to choose the best performing filter one should consider the following data:

1) tap water composition at the spot of water consumption with regard to the typical seasonal deviations;

2) characteristics of materials used in the filters and their efficiency given the specific contaminants;

3) bacteriostatic properties of the filters and their components;

4) requirements on the quality of drinking water which ensure its good organoleptic properties and safety.

Tap water used in various regions of Ukraine and in Kyiv, in particular, is characterized most of all by the following indicators that exceed standards: colour, turbidity, iron, aluminum, oxidation susceptibility. See Table 1 for the results of the study on effective operation of some household filters that are widely applied.

The research was carried out by the Laboratory for Ion Exchange and Adsorption at the Chemical Technology Department of the National Technical University of Ukraine (KPI). The analysis (Table 1) showed that the household filters available on the Ukrainian market, which are mostly foreign-made, in most cases fail to remove the above contaminants and to meet the requirements in Ukraine and abroad.

Table 1. Changes in indicators of effective operation of various household filters during tests of tap water in Kyiv

Filter name, manufacturer	Filtering materials	Resource, l		Removal degree, %			
				Major indicators of water quality			
		According to passport	In practice	Colour	Turbidity	Hardness, total	Total content of organic substances, chemical absorption of oxygen
Brita, Germany	Activated coked carbon, ion exchange resin, silver-containing filter, fiber	150	100	64-12	48-12	48-27	29-12
Barrier JSC METTEM Technologii, Russia	Activated coked carbon, ion exchange resin, silver-containing filter, fiber	500	350	51-11	81-14	0	34-15
O/o RO-2127, AMETEK, USA	Reverse-osmo-sis membrane	4500	Have not been identified	100	100	100	98
Izumrud-KF S&R Association "Ekran", VNIIMEDTEH, Russia	Diaphragm electrolytic module, sorbent	2000000	Have not been identified	0	0	0	2
C1 AMETEK, USA	Activated birch carbon, compact cellulose	1100	700	67-2	100-19	0	27-4
Ecosoft-1, MNPP "Ecosoft", Ukraine, Kyiv	Activated coked carbon, ion exchange resins, silver-containing ion exchange resin	600	800	100-71	100-64	71-9	97-72
ECO-22 GO BEST, USA	Ceramic membrane, silver-containi-ng AU	not mentioned	Have not been identified	47	100	0	17
Instapure F-3CE, Teledyne Water Pik, USA	Silver-containi-ng AU	760	400	51-0	13-0	0	34-5

At the same time, the problem could be solved through new original technology of tap water secondary treatment, which was developed by the Laboratory for Ion Exchange and Adsorption at the Chemical Technology Department of the National Technical University of Ukraine (KPI) and ECOSOFT Research & Production Co. The filters based on this technology have multiple-stage system of treatment with the specific combinations of high-effective sorption materials, which are selected and modified with regard to Ukrainian water:

- metacrylic macroporous cation-exchange resin to remove temporary hardness (causes scale formation) as well as heavy metals and manganese ions;

- mixture of polymeric sorption materials of the various basic capacity to remove organic admixtures, iron, aluminum, nitrates, to decrease turbidity and colour;

- activated carbon to remove chlorine and its derivatives, to improve organoleptic indicators, to decrease turbidity and colour;

- silver-containing bactericide component that provides for microbiological stability of the water treated.

Proportion of the components is identified on the basis of admixtures content in the original water, which allows for high quality of treated water regardless the properties of the original water.

See Table 2 for water quality indicators before and after treatment by ECOSOFT household filters, which have combination of sorption materials adjusted to the content of tap water in Kyiv.

All materials used in the ECOSOFT filters are approved by the Ministry for Health Protection of Ukraine for applications in the water treatment process. The filters give opportunity to obtain drinking water of the best quality with physiologically balanced mineral content. The filters productive capacity makes up to 16 l/hour (resource makes 600-800 l subject to tap water quality) and up to 100 l/hour (resource makes 2,500-3,000 l).

A range of conventional size large capacity facilities (0.5 through 5 m3/h) was designed with applications of the above mentioned materials as well as strong acid cation exchangers. They are intended for use in cottages, offices, kindergartens, hospitals, resort places, etc. These facilities are designed so that periodic regeneration of sorbents is automatic.

Table 2. Indicators of treatment quality of tap water in Kyiv at the household filter «ECOSOFT»

Volume of passed tap water, l	Indicators of water quality							
	Colour, degree	Turbidity, mg/l	Hardness, total, mg-eq/l	PH	Total organic substances content, Chemical absorption of oxygen, mgO_2/l	TDS, mg/l	Aluminum, mg/l	Iron, mg/l
100	0	0	1.54	6.2	<0.4	145	0.16	0
200	3	0.25	2.02	6.2	0.98	161	0.18	0.01
300	3	0.3	2.42	6.2	0.63	178	0.13	0.05
400	3	0.4	2.7	6.3	1.22	197	0.11	0.03
500	3	0.6	3.06	6.3	1.31	214	0.15	0.04
600	3	0.5	3.22	6.3	0.85	230	0.14	0.03
700	3	0.5	3.9	6.7	0.43	268	0.11	0.02
800	6	0.4	4.02	6.9	0.44	289	0.18	0.03

The principal difference between this technology and other available techniques is the opportunity to carry out softening; iron phase-out; organic substances, and aluminum and nitrates removal at the same stage and in one device. The mixture of sorbents is regenerated by the sodium chloride solution. The sorption capacity of the regenerated ionites, and all other components, is renewed in full upon regeneration. The quality of treated water complies with all requirements of GOST 2874-82 «Drinking water. Hygienic requirements and quality control.». To gain the best drinking quality, water additionally passes through the filter filled with activated carbon and bactericide component.

This technology may be implemented with the use of standard ion exchange equipment and by means of automatic control, which is normally used for water softening. It requires only some corrections in the regeneration regime cyclogram. Application of this technology, as numerous cases show, improves the quality of purified water and cuts treatment expenses significantly (2-2.5 times).

ANNEX VII

AN ANALYSIS OF STATE OF THE DRINKING WATER PROBLEM IN UKRAINE

Prof., Ph.D. Tatyana Eu. Mitchenko,
Candidate of Sciences, Natalya V. Makarova
National Technical University of Ukraine (KPI)
Laboratory for Ion Exchange and Adsorption

Every year the problem of drinking water treatment becomes more and more urgent in almost every country of the world. This is related to the deteriorating environmental situation everywhere. To comply with acting standards, drinking water must be safe both according to epidemiological and radioactive parameters, and have sound chemical and favorable organoleptic properties. In other words, the content of harmful elements in water, including both chemical and radiological substances, as well as microbiological indicators, must not exceed set norms (maximum allowable concentrations - MAC).

Improvements to current standards incorporate the extension of the list of regulated substances and more precise identification of their MAC in water. For example, the WHO standard regulated only 9 substances in water in 1970, whereas the standard of 1984 regulated 27 compounds, and in 1993 this grew to 95 compounds.

The said standards make the basis for the EU Directive 80/778/EU, which currently regulates drinking water quality in the European Union. These requirements are usually fundamental while working out the national regulations in most countries. In Ukraine drinking water quality is assessed in accordance with the acting GOST 2874-82 «Drinking water. Hygienic requirements and quality control», which has been in effect since 1984, and DSANPIN «Drinking water. Hygienic requirements to water quality in centralized water supply», Reg.No. 136/1940 of 15 April 1997 (approved by Ministry for Health of Ukraine).

See Table 1 for key indicators of the drinking water quality introduced in Ukraine, compared to WHO and EU standards, as well as the Russian Federation draft regulations «Drinking water. Requirements and control of water quality in centralized water supply». The above comparison of standards show that the Ukrainian standards do not meet requirements of regulatory documents on drinking water recognized in international circles, neither in the number of indices regulated, nor in the quality of the standards.

The problem of drinking water treatment is especially urgent in Ukraine. According to the data published by Ministry for Health and Ministry for Environment and Nuclear Safety in the National Environmental Health Action Plan in 1998:

- every year up to 10% of researched samples of tap water do not meet standards on organoleptic properties, total mineralization, or chemical substances content;

- almost every eighth sample of drinking water from rural water pipelines and every third one from the decentralized water supply system fail to meet bacteriological limits;

- as the water pipeline network is in poor state, the number of accidents is dozens of times higher than in European countries;

- drinking water in Ukraine is a significant risk factor in contagious diseases;

The quality of drinking water consumed in Ukraine depends on the following key factors:

- condition of the water supply sources;

- compliance with technological regime at the central waterworks;

- the sanitary and technical condition of the treatment and distribution

systems for centralized drinking water;

- the level of laboratory monitoring of water quality at all stages of treatment and supply.

Table 1. Drinking water quality limits

No.	Name	Unit of measureme-nt	Standard					
			GOST 2874-82	SANPIN No.136/1940	WHO	EU	Russia draft GOST on water TsSV	
							1 stage	2 stage
1	2	3	4	5	6	7	8	9
Organoleptic indicators								
1	Appearance	-	-	-	-	-	-	-
2	Smell	Mark	2	2	Must be pleasant	2-3 (0)	<2	Must be pleasant
3	Taste and flavor	Mark	2	2		2-3 (0)	<2	
4	Colour	degree	20	20 (35)	15	20 (1) according to Pt/Co scale	20	15
5	Turbidity	EMF	1.5	0.5 (1.5)	2.0	10 (1) mg/l SiO_2	2.6	1.0
Toxicological indicators								
1	Aluminum	mg/l	0.5	0.2 (0.5)	0.2	0.2 (0.5)	0.5	0.2
2	Barium	mg/l		0.1	0.7	(0.1)	0.1	0.1
3	Beryllium	mg/l	0.0002		-	-	0.0002	0.0002
4	Boron	mg/l			0.3	0.3	0.5	0.3
5	Molybdenum	mg/l	0.25		0.07	-	0.25	0.07
6	Arsenic	mg/l	0.05	0.01	0.01	0.01	0.05	0.01
7	Nickel	mg/l		0.1	0.02	0.02	0.1	0.02
8	Mercury	mg/l		*	0.001	0.01	0.0005	0.0005
9	Lead	mg/l	0.03	0.01	0.01	0.01	0.03	0.01
10	Selenium	mg/l	0.001	0.01	0.01	0.01	0.01	0.01
11	Strontium	mg/l	7.0		-	-	7.0	7.0
12	Fluorine and fluorides	mg/l	0.7-1.5	0.7-1.5	1.5	1.5	1.5-0.7	1.5-0.7
13	Chromium (+6)	mg/l		*	0.05	0.05	0.05	0.05
14	Cyanides	mg/l		*	0.07	0.05	0.035	0.035
15	Cadmium	mg/l		*	0.003	0.005	0.001	0.001
16	Lindan	mg/l		Pesticides 0.0001	0.002	Pesticides 0.0001	0.002	0
17	DDT	mg/l			0.002		0.002	0
18	2,4-D	mg/l			0.03		0.03	0
19	Atrazin	mg/l			0.002			
20	Simazin	mg/l			0.002			
21	Benzene	mg/l			0.01	-	0.01	0
22	Benzo-a-pyrene	mg/l		*	0.0007		0.000005	0
23	Phenols	mg/l		* Chlorophenols 0.0003	-	0.0005 (Phenol index)	0.25 (Phenol index)	0.25 (Phenol index)
24	Chlorinated ethylene: 1,1 dichloroethylene, trichloroethylene, tetrachloroethylene	mg/l		*	- - -	- 0.7 0.4		

(Table 1 continued)

1	2	3	4	5	6	7	8	9
Indicators affecting organoleptic water properties								
1	Hydrogen indicator	pH	6.0-9.0	6.5-8.5	-	6.5-9.5	6.0-9.0	6.5-8.5
2	Hardness, total	mg-eq/l	7.0	1.5-7.0 (10.0)	-	-	7.0	1.5-7.0
3	Oil products, total	mg/l		*	-	-	0.1	0.1
4	PAV	mg/l		*	-	0.2	0.5	0.2
5	TDS	mg/l	1000	100-1000 (1500)	1000	1500 (-)	1000	500
6	Iron	mg/l	0.3	0.3	0.3	0.2 (0.05)	0.3	0.05
7	Manganese	mg/l	0.1	0.1	0.1	0.05(0.02)	0.1	0.02
8	Copper	mg/l	1.0	1.0	1.0	-(3.0)	1.0	0.1
9	Sulfates	mg/l	500	250(500)	250	250 (25)	500	250
10	Chlorides	mg/l	350	250(350)	250	-(25)	350	250
11	Zinc	mg/l	5.0	*	3.0	(0.1-5.0)	5.0	3.0
12	Nitrates	mg/l	45.0	45.0	50.0	30.0 (25.0)	45.0	25.0
13	Nitrites	mg/l		*	3.0	0.1	3.0	0.1
14	Potassium	mg/l				150		
15	Calcium	mg/l				100		
16	Magnum	mg/l		10-80		50		
17	Alkalinity, total	mg-eq/l		0.5-6.5				
Chemical substances incoming and formed in the process of water treatment								
1	Chlorine residual, free	mg/l	0.3-0.5	0.3-0.5	0.6-1.0	-	0.3-0.5	0.6-1.0
2	Trihalomethanes: Bromoform Dibromochloromethane Bromdichloromethane Chloroform Carbon tetrachloride	mg/l		Total 0.1, ncluding 0.01 0.06 0.002	 0.1 0.1 0.06 0.2	 - - 0.015 0.04	 0.2 0.006	 0.2 0.002
3	Ozone residual	mg/l	0.1-0.3	0.1-0.3	-	-	0.3	0.3
4	Formaldehyde	mg/l			0.9		0.05	0.05
5	Polyacrylamide	mg/l	2.0		1.0	Acrylamide - 0.25	2.0	2.0
6	Activated silicic acid (according to Si)	mg/l	3.5		-	-	10.0	10.0
7	Polyphosphates (according to PO_4^{3})	mg/l			-	-	3.5	3.5
8	Silver	mg/l			not limited (allowable to 0.1 mg/l)			
Integral indicators								
1	Oxidation	mgO_2/l		4.0				
2	Total organic carbon	mgC/l		3.0				
Nuclear safety indicators								
1	Strontium-90	Bq/l		According to Dose Register-97 4.0				8.0
2	Cesium-137	Bq/l		According to Dose Register-97 2.0				8.0
3	Gross Volumetric Activity of a-emitters	Bq/l		0.1				
4	Gross Volumetric Activity of ß-emitters	Bq/l		1.0				

* Water should not contain admixtures in concentrations which may be identified by the standard test methods

Thus, upon intensive water chlorination, halomorphic compounds of great health danger appear. Technology violations of coagulation regime result in aluminum content increase. Corrosion of pipelines leads to exceeding content of iron.

Analysis of data on tap water quality in various Ukrainian regions including Kyiv demonstrates that it doesn't normally meet the requirements on iron, aluminum and organics content (Table 2).

Table 2. Some indicators of tap water quality in the city of Kyiv

Regulatory Document	Indicators of water quality							
	Colour, degree	Turbidity, mg/l	Hardness total, mg-eq/l	PH	Total content of organic substances, Chemical absorption of oxygen, mgO_2/l	Total Salt content, mg/l	Aluminum, mg/l	Iron, mg/l
Threshold values of tap water indicators during the period 01/12/98 through 01/02/99								
Real value	22-56	1.1-1.4	4.1-4.9	6.8-7.0	3.5-7.1	310-350	0.4-1.2	0.16-0.39
Necessary level of admixtures removal (%) in order to bring water quality in conformity with the requirements of:								
GOST 2874-82 (DSANPIN)	9-64	0	0	0	0-44	0	0-58	0-23
WHO and EU	60-73	0	0	0	43-72	0	50-83	0-49

Table 3 shows the data on the most frequent seasonal deviations on tap water quality in Kyiv in 1998. This data was obtained as a result of regular research carried out by the Laboratory for Ion Exchange and Adsorption certified in the system of UkrSEPRO. Moreover, Table 3 provides data on how often the water analysis exceeds the MACs set in the Ukrainian regulatory documents on drinking water quality and WHO and EU requirements on the best pure water.

Analysis of the data in Table 3 demonstrates that the content of organic substances in Kyiv tap water is in excess of the Ukrainian standards in 90% of cases, while this water is in excess of the WHO and EU standards in 100% of cases. And the quantity of excessive levels measured is 25-30% , referring to the Ukrainian standards and 50-250% referring to the WHO and EU standards.

High quality water supply in accordance with international standards requires the preparation of the necessary legislative, regulatory and metrological framework, and the establishment of an effective system for certification in the sphere of drinking water supply to provide control of compliance.

This approach will provide the amendments which need to be made to the current Ukrainian regulations on drinking water from centralized sources, in order to ensure the best regulatory requirements which approximate international standards. Furthermore, it can ensure the development of standards on bottled water, the publication of reference copies of the drinking water quality standards and regulatory framework for water quality control, methods of analysis.

The introduction of a certification system for drinking water together with materials, technologies and equipment used in the household and the drinking water supply, would enable us to ensure high quality drinking water. It would help us ensure the effective treatment of water within its reported life term, the phase-out of secondary contamination as water flows through the treatment facility, and the safety the technologies and methods used.

Table 3. Seasonal deviations of some indicators of tap water quality in Kyiv in 1998

Indicator	Real content (min-max)	Exceedance of indicator in comparison with values of the acting Ukrainian standards				Exceedance of indicator in comparison with values of WHO and EU			
		GOST (national standard) values	level of exceed-ance	Number of episodes of exceedances		WHO and EU require-ments	level of exceed-ance	Number of episodes of exceedances	
			By %	Relative	%		By %	rel.	%
1	2	3	4	5	6	7	8	9	10
March-May									
Iron total, mg/l	0.17-0.37	0.3	7-23	7/30	23	0.2	5-85	25/30	83
Aluminum, mg/l		0.5				0.2			
Total content of organic substances, chemical absorption of oxygen mgO_2/l	3.1-6.7	4	18-68	27/30	90	2	55-235	30/30	100
June-August									
Iron total, mg/l	0.091-0.4	0.3	33	1/26	4	0.2	5-100	5/26	19
Aluminum, mg/l	0.055-0.225	0.5	0	0/2	0	0.2	13	1/2	0
Total content of organic substances, chemical absorption of oxygen, mgO_2/l	3.4-6.0	4	5-50	23/26	88	2	70-200	26/26	100
September-November									
Total iron, mg/l	0.10-0.33	0.3	10	1/25	4	0.2	10-65	7/25	28
Aluminum, mg/l	0.17-0.86	0.5	72	1/3	33	0.2	83-330	2/3	67
Total content of organic substances, Chemical absorption of oxygen, mgO_2/l	4.1-6.9	4	3-73	25/25	100	2	105-245	25/25	100

(Table 3 continued)

1	2	3	4	5	6	7	8	9	10
December-February									
Total Iron , mg/l	0.17-0.39	0.3	3-30	5/29	17	0.2	5-95	17/29	59
Aluminum, mg/l	0.46-1.22	0.5	36-144	11/13	85	0.2	130-510	13/13	100
Total content of organic substances, Chemical absorption of oxygen, mgO_2/l	3.8-7.1	4	5-78	25/29	86	2	90-255	28/29	97

The introduction of a monitoring system is another important stage in resolving the problem. The data already accumulated on water contents in the different Ukrainian regions and especially in the big industrial centers is undoubtedly valuable, not only for manufacturers and consumers of filtering devices, but also for medical personnel, environmentalists, food industry specialists, etc. To date, this information is not available in any department in the country.

Considering that the problems of the centralized drinking water supply cannot be resolved in the near future under the current economic circumstances in Ukraine, the most practical solution to the drinking water quality problem at this stage is likely to be the wide implementation of decentralized devices for water secondary treatment and conditioning.

In this case, the following live issues remain:development of advanced effective technologies for the secondary treatment of drinking water to be used in children's and medical prevention units, the food and catering industry, cottage buildings as well as in household filters. This is the most acceptable way to guarantee improved drinking water quality in homes.

ANNEX VIII

ALUMINUM (references review)

Compiled by Lidiya Grinkevitch,
Assistant Water Coordinator

The scientific analysis of drinking water in Kyiv commissioned by MAMA-86 in the Spring of 1999 showed excessive levels of aluminum in some areas. The following paper reviews the medical evidence relating to health impacts caused by aluminum in the water supply.

Aluminum is a widespread element, which is present in large quantities in nature and forms 8% of the chemical structure of the earth's crust. Its biological role is not clear. At the same time, a considerably increased content of aluminum in environment, in particular, in drinking water sources, is an object of concern.

The aluminum content in living organisms is negligible, so it is considered a micro-element, which is always present in human organs and tissues. The human body demands 35-40 mg of aluminum daily. The permissible daily load of aluminum in the human body is 60 mg. 20 mg is ingested with food form 20 mg, and 40 mg is ingested with drinking water. Aluminum is also inhaled and deposited in lungs, but this is not active aluminum (when the aluminum concentration in the atmosphere makes 1 mkg/m3, the daily inhaled aluminum value reaches 20 mkg).

Aluminum may enter a human organism by the following ways:

- as a contaminant in food and food additives;

- in medicines (there are a number of clinical observations of medicines containing aluminum for treatment of wounds and trophic ulcer, chronic gastritis, and acute conjunctivitis. Aluminum proved to participate in the regeneration of bone tissue),

- in parenteral nutrition,

- in hemodialisis,

- with injection of hypoallergic extracts;

- with natural drinking water (aluminum is one of the most widespread elements in drinking water). According to the data, the biological power of aluminum ingested with drinking water is much higher than in cases when it enters from other sources;

- after water is treated with aluminum salts.

Nowadays the main source of aluminum in drinking water is water treatment at the waterworks, where aluminum compounds are applied as coagulants which cause the presence of aluminum in tap water in levels of 0-10 mg/l. The presence of aluminum in drinking water is often a result of shortcomings in the monitoring and treatment processes.

Hydrolysis of aluminum leads to the formation of various compounds in water (soluble and insoluble, hydroxide complex, monomeric and polymeric, organic and inorganic).

When ingested the following doses of some aluminum compounds may have toxic effects in humans:

- aluminum acetate - 0.2-0.4 mg/kg;
- aluminum hydroxide - 3.7-7.3 mg/kg;
- potash alum - 2.9 mg/kg.

If high doses of aluminum are ingested, it is difficult to remove it from organism. If aluminum is deposited in tissues, they stop functioning properly. A degree of clinical, biochemical and histological symptoms in the organism correlates to the quantity of aluminum ingested by the organism.

A field study on the assessment of drinking water quality revealed that in a given populated locality (A), the inhabitants were exposed to soft drinking water with an aluminum content ten times the Maximum Permissible Concentration for 12 years. To assess the impact of this drinking water factor on the public health in locality A, a control area B was chosen. The selection was based on identifying similar environmental factors and social and hygienic conditions. The drinking water quality in the localities being studied was similar for all main indicator values, and complied with the GOST 2874-82 «Drinking water» standard.The only exception was the level of aluminum. The level in the drinking water in locality A fluctuates from 0.5 to 10 mg/l (with average concentration calculated for 12-year period of 5 mg/l). In locality B the level was not more than 0.02 mg/l.

The health situation was researched on the basis of data such as child development histories, results of observations in outpatient departments, and an analysis of disease histories of patients with broken limbs.

The results of the field study showed that long-term consumption of drinking water containing aluminum in a concentration of 5 mg/l causes:

* twice prolonged periods of bone tissue consolidation;
* an increase in the occurrence of anaemia by 7 times;
* an increase in the occurrence of cystitis by 4 times;
* an increase in the occurrence of dermatosis by 2 times;
* damage of psychophysiological status with the following manifestations: a reduced volume of perceived and processed information (by 30%), stable attention span (by 29%), ability to switch attention (by 55%) and concentration (by 92%).

It is found that aluminum displaces the following bioelements from a number of ferments: phosphorus, magnesium, calcium, sodium, iron.

Water soluble compounds of aluminum are absorbed in one of the specific sections of the duodenum and stomach, and binding with proteins within 24 hours of intake, they enter the bloodstream. A considerable proportion of aluminum is deposited in tissues (brain, liver, kidneys, bones). Up to 40-50% of the element introduced stays in the body for about 300 days. Aluminum is mostly discharged through the intestine (84%-94%) and kidneys (6-16%).

The concentration of more than 0.2 mg/l of aluminum in drinking water may cause some of the following diseases:

- long-term exposure may cause development of encephalopathy;

- Alzheimer's disease (some epidemiological case studies demonstrated that the frequency of Alzheimer's disease significantly grows in the areas with high content of aluminum in the drinking water);

- Parkinson's disease;

- miotrophic lateral sclerosis;

- microcytic anaemia;

- softening of bones (long-term dialysis treatment of 5 to 10 years in patients with kidney diseases leads to the development of osteopathy. Symptoms are pains in bones and muscles; x-ray demonstrates symptoms of osteomalacia; biochemical trend to hypercalcemia and hyperphosphatemia, decreased activity of alkaline phosphates, elevated deposition of aluminum in bone tissue);

- myocardiopathy;

- decreased immunological reactions in the organism;

- deposits of alluminum in long-living cells determines one of the mechanisms of body ageing;

- patients with kidney dysfunction comprise a risk group. They receive aluminum with medicines (up to 10 mg/kg). Aluminum load in patients with renal insufficiency causes complex kidney disfunction;

- Development of rachitis and muscular dystrophy in children (aluminum forms insoluble compounds with phosphates which hamper the assimilation of phosphates in the intestine, which are then removed with stool. As a result, the human body suffers from phosphorous metabolism that further leads to development of rachitis.

- aluminum shows reactivity to phospholipid components of biomembranes and causes their disintegration. It plays a role as an etiological factor in non-iron deficiency microcytic anaemia;

- neurotoxic effects.

So, the toxic effects of aluminum compounds on the human body is proved by reference data. The Maximum Permissible Concentration of residual aluminum in drinking water in our country is set at the level of 0.5 mg/l. It is categorised in the 2nd class of hazards. Some countries recommend limiting the aluminum content of 0.2 mg/l, as this substance decreases the organoleptic properties of water. But the results of the above studies of aluminum provide a body of evidence that these values are threshold for their health effect. It is necessary to conduct further research to clarify a safe level of aluminum in drinking water.

References:

1. A.K.Zapolsky, P.E.Borsuk, V.A.Kostiuk, N.V.Goliuk. Reducing content of residual aluminum in drinking water/ «Hygiena and Sanitaria» (Hygiene and Sanitation), No.4, 1989.

2. Methodical directives on study of embryotoxic effects of the chemical substances while setting their limits in water reservoirs. M., 1984.

3. L.V.Pestova, V.G.Nadeyenko, S.I.Kungurova. On toxicity of aluminum in case of exposure through drinking water/ «Hygiena and Sanitaria» (Hygiene and Sanitation), No.9, 1990.

4. V.A.Prokopov, G.V.Tolstopyatova. Aluminum: modern toxicologic and hygienic aspects. Ecologic problems and national health. /»Likarska Sprava» (Doctor Studies), 1996. No.10-12 - p.56-61.

5. Directives on Drinking Water Quality Monitoring. WHO, Geneva, 1994, v.1.

6. N.V.Tulakina, Yu.V.Novikov, S.I.Plitman, V.V.Yaroshev. Aluminum in drinking water and public health/»Hygiena and Sanitaria» (Hygiene and Sanitation), No.11,1991.