The Central Filtration Plant

At the Eshkol Site

MEKOROT

ISRAEL NATIONAL WATER CO.

Introduction

Mekorot National Water Company Ltd. considers the reliable and regular supply of top-quality water to its customers to be of paramount importance. As part of its commitment to supply high-quality water, Mekorot built the Central Filtration Plant at the Eshkol site. The Filtration Plant, the only one of its kind in Israel and the fourth largest in the world, places the State of Israel at the forefront of the Western World in the treatment of drinking water.

The treatment of drinking water is one of the key subjects on the agenda of the world's developed countries. In Israel, the Ministry of Health established standards of water quality, through the public health regulations. All suppliers of water in Israel must comply with these water quality regulations, which are periodically updated.

Israel has four main sources of drinking water. The first and most important source is the Lake Kinneret (Sea of Galilee). This is a surface water source which daily provides drinking water to about half of Israel's population. The second water source is groundwater, obtained through wells from two main aquifers: the sand stone coastal aquifer and the limestone mountain aquifer. Some wells are drilled through limestone rock of the country's mountains to the mountain aquifer, and some wells are drilled through sand and sandstone along the coastal plain to the coastal aquifer.

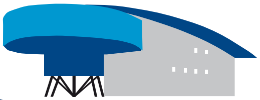
Another water source, midway between the surface water and the aquifers is spring water in northern Israel. The fourth source of drinking water is desalinated seawater and brackish water.

The water obtained from each of these four sources is chemically distinct. The difference in water quality is due to a number of reasons, including the regional geochemistry aquifer media (the composition of the rocks through which the water flows), the type of the water source, and the salinity level of the water. Water from the limestone aquifer is rich in calcium, magnesium and bicarbonate - hard water.

In addition to the difference in the chemical composition of each of the water sources, the microbiological quality of the water also varies because of the differences in sensitivity and exposure to contaminants.

Turbidity affects the aesthetic quality of water (appearance), interferes with disinfection, and at high levels may indicate presence of contaminants. Under present drinking water standards, turbidity is a foremost important parameter of drinking water quality being an indicator of its microbiological health related quality, particularly in surface water.

Natural water contains a certain quantity of natural microorganisms as well as those originating from human activity. The latter microorganisms (bacteria and viruses), which enter surface water sources from municipal and industrial wastewater, cattle sheds, and recreational activities, are liable to include pathogens. Surface water is also likely to contain



The Central Filtration Plant at the Eshkol site. Potografh: Albatross single-cell cysts of parasites, such as *Giardia lamblia* and *Cryptosporidium*, which are resistant to common disinfection processes. Research and experience around the world indicate that the most effective way to remove the disease causing parasites and turbidity particles is advanced filtration technology.

In all advanced countries, "mandating surface water filtration" rules have been introduced for drinking water supply systems to ensure removal of the pathogenic parasites. The turbidities of filtered surface water are limited to below 1.0 Nephelometric Turbidity Unit (NTU) (mostly <0.5 NTU).

For the same reason, the increasingly stringent drinking water standards introduced in Israel limited the turbidity not to exceed 1.0 NTU (desired 0.2 NTU). To meet this requirement it was decided to build the Central Filtration Plant at the Eshkol site in Beit Netofa Valley. The plant, one of the most advanced and complex of its kind, was built by Mekorot, together with expert Israeli and international companies. The plant further upgrades the quality of water carried by the National Water Carrier - the national water network's primary water artery. The Central Filtration Plant prevents the accumulation of algae in regional and municipal reservoirs, improves water clarity, and significantly reduces clogging of irrigation systems and recharge wells.

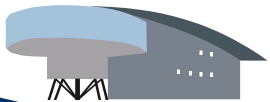
The Central Filtration Plant includes sophisticated operating processes, combining the most advanced technologies with many engineering disciplines. The plant's control system operates automatically, requiring a smaller operating staff.

The Central Filtration Plant heralds the launch of a new era of water treatment in Israel and it is a testimony to Mekorot's efforts to provide higt quality, clear, fresh water that is the safest, cheapest and greenest alternative available.

Treating The Sea of Galilee Water – The National Water Carrier

The Sea of Galilee (Lake Kinneret) covers 270 hectares. It is Israel's main source of surface water during both droughts and years of heavy rainfall. The maximum daily output from the Kinneret to the National Water Carrier of 1.7 million cubic meters. Mekorot provides through the National Water Carrier an average of more than 300 million cubic meters of water a year. Record pumping from the Sea of Galilee occurred in 2004, amounting to 527 million cubic meters.

The route of the lake's water to the tap begins at the Sapir site, the first pumping station of the National Water Carrier, located on the northwest shore of



the lake. The pumped water flows through open channels, pipes, and reservoirs to the Eshkol Site. The water that reaches Eshkol contains constituents that entered the Kinneret water from the Upper Jordan watershed, such as suspended solids causing turbidity, microorganisms (bacteria, viruses, parasite cysts, etc) and organisms produced by the photosynthetic and other bioactivities in the lake: algae and other single cell organisms, larvae and snails.

In order to improve the water quality and bring it to a maximum level of clarity, the water undergoes a series of treatments that make it potable. After the treatments, the water enters the National Water Carrier 108-inch pipe, which carries it south to the regional water supply systems across the country, and from there to residential, industrial, and agricultural customers.

Over the years, the water treatment processes at the Eshkol Site have been extended in accordance with the Ministry of Health's drinking water regulations, and with changes in the primary use of the National Water Carrier's water. In 1964, 80% of the water was designated for agricultural use, and 20% for urban needs. Since the 1970s, there has been a substantial increase in the proportion of the National Carrier's water for urban consumption, reaching about 70 percent at the beginning of the millennium. At the same time, drinking water quality standards have become stricter. As result, Mekorot has installed innovative water treatment technologies that include physicochemical and biological treatments.

Physicochemical Treatment

The original treatment for reducing turbidity included natural sedimentation in the large reservoir at the Eshkol Site, in order to remove suspended solids that are washed in by Jordan River floods. During the 1980s, Mekorot developed an additional treatment for turbidity removal by adding alum (aluminum sulfate) to the water, to flocculate suspended particles converting them to large flocs (agglomerates) that are efficiently removed by settling in the sedimentation reservoir.

Mekorot's use of alum is considered a unique development in two aspects. One is the use of ejectors (hydraulic mixing additives) system for the rapid mixing of alum injection. The second is utilizing the hydraulic energy of the water flow in the Netofa Channel to carry out the flocculation process. This saves the need for a mechanical mixing system.

During the 1990s, the system was upgraded, as a result of which the alum costs were cut by 30%. The sludge removal method was upgraded and carried out continuously by a pump installed on a barge that floats on the surface of the reservoir. This is part of a complete mechanical sludge treatment system using thickeners and a dewatering belt press, which, at the end of the process, results in recovery of the liquid part of the sludge to the inlet of the sedimentation reservoir. The solids are removed to a separate area for drying and burial.

The improvements and upgrades in the sedimentation and flocculation processes enabled the removal of most of the suspended solids and the decrease in the water's turbidity to relatively very low values, considering settling is the only separation process.

At the same time Mekorot improved the chlorine-based treatment process for water supplied from the Eshkol reservoir. Chlorine dioxide (a stronger disinfectant) was added to chlorine as the main disinfectant in the 1980s, and chloramine was introduced as the secondary disinfectant in the 1990s. Chloramine is a weaker disinfectant that ensures residuals in the water for a prolonged period because of its stability and eliminates bacteria regrowth. The combination of chlorine dioxide as the primary disinfectant with chloramine as the secondary disinfectant does not form trihalomehanes and is a unique development by Mekorot, which has demonstrated its effectiveness over the years.

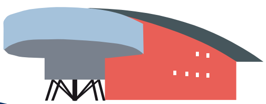
Biological Treatment with Fish

Mekorot was a global pioneer in the development and implementation of biological treatment of nuisance causing organisms, such as algae, snails, and other small organisms found in surface water. They grow and multiply in the reservoirs, contaminate the water by making it turbid and causing undesirable odors and taste. The company exploited natural treatment means thereby reducing the need for undesirable chemical additives to the water. Biological treatment, initiated in the early 1970s, uses fish as "sanitary agents". The method is based on ecological principles, whereby various natural growing organisms in bodies of water serve as food for various fish. The "sanitary" fish eat the algae and other organisms without contaminating the water.

Under the biological method developed by Mekorot, the northern reservoirs of the National Water Carrier at Eshkol and Tzalmon were populated with various fish species, while preserving the natural balance between them as an essential factor in the success of the treatment.

The first fish used were Tilapia and Common Carp. The Tilapia mostly feed on algae that grow on the reservoirs' banks and zooplankton. The Galilee Tilapia feeds on *Peridinium* algae, responsible for most of the suspended solids in the Kinneret water and in the National Water Carrier.

Common Carp feed on organic material in the water and churn the bottom mud. By churning the bottom mud, the Carp aerate the upper sedimentation layer on the reservoir bottom, thereby preventing the growth of *Oscillatoria* algae, which creates foul taste and odors. Shortly after the reservoirs were populated with carp and later with Mullet, customers' complaints ended. The activity of these fish greatly benefited Mekorot and its customers. First, populating the reservoirs with fish made it possible to dispense with more dangerous and expensive alternatives, such as laying pipe network for chlorination at the bottom of the reservoir. Second, it cut the high costs of draining and cleaning the reservoir, and avoided the need to shut down the National Water Carrier while maintenance was being carried out. In addition, the



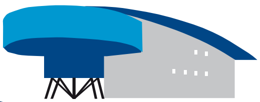
The open channel of the National Water Carrier system. Photograph: Eli Degani

Carp and the Mullet decimated the Chironomidae larvae (a mosquito-like insect) on the bottom of the reservoir. As a result of the success of these activities, other fish species were introduced into the reservoirs, including Grass Carp and the Black Carp from China, Silver Carp, and the Bighead Carp.

Since its implementation, Mekorot's biological method has demonstrated its effectiveness, and it is now also being used to reduce problems of blockages in irrigation systems that receive water from the reservoirs. In addition to water treatment, Mekorot invests a lot of effort in monitoring water quality with the most advanced online monitoring equipment.

Advances in Turbidity Treatment

Turbidity standard (NTU)	Year	Treatment for meeting the turbidity target
25	-	Natural settling
10	1987	Addition of alum to the sedimentation during Upper Jordan floods
5	1983	Addition of alum during winter
4	1991	
3	1994	Addition of alum throughout the year
1	1996	Engineering and operating improvements
0.2 (desired)	2007	Central Filtration Plant



Water Treatment at the Eshkol Site

There are two reservoirs at the Eshkol Site: the 1.5 million cubic meter sedimentation reservoir, and the 4.5 million cubic meter operating reservoir.

The Sedimentation Reservoir

Removes turbidity caused by suspended solids. Water flows into the reservoir from the Netofa Channel, and after preliminary treatment flows through a distribution channel, which slows the flow to a uniform rate across the reservoir. At the far end of the reservoir, the water is collected in a concrete channel which carries it to the operating reservoir.

The Operating Reservoir

Collects the water for regulating supply and for emergency needs. The water flows from the reservoir by gravitation to the national system, thereby saving energy. Water pumping is carried out according to calculation of time/cost rates, when electricity rates are low (usually at night and on weekends), and water is supplied to customers as needed.

Treatment processes at the Eshkol Site

Rapid Mixing (coagulation) – alum and sulfuric acid are injected into the water flowing along the Netofa Channel to break the colloidal stability of suspended particles. The injection is carried out by a unique injection system that ensures rapid and uniform dispersal of the chemicals.

Slow Mixing (flocculation) – the addition of alum and sulfuric acid into the water causes suspended particles to flocculate (to form large agglomerates) by exploiting the hydraulic energy of the water flowing through the channel.

Sedimentation – the flocs settle on the bottom of the sedimentation reservoir and the clean water flows to the operating reservoir.

Operational reservoir – the water is stored to ensure reliable supply and to keep it clean with the use of fish.

Sludge treatment – sludge that settles in the sedimentation reservoir is pumped out, sent to thickeners and from there to dewatering belt press. The resulting "cake" (sludge with high solids content) is carried by the conveyor belts to clearing tanks. The supernatant from the thickener and the filtrate from the belt-press are returned to the inlet of the sedimentation reservoir where new water is added from the Netofa Channel.

Construction of the Central Filtration Plant – Background

In 1991 Professor Menahem Rebhun of the Technion, Israel Institute of Technology, proposed designing a filtration plant with a very high filtration rate - 20 meters/hour, twice the normal filtration rate. The practical meaning of this rate of filtration is lower construction and operation costs of the facility. The proposal was based on the very high effectiveness of Mekorot's upgraded physical-chemical treatment (flocculation and sedimentation) for the National Water Carrier, that resulted in very high removal of the bulk of suspended solids and turbidity.

In April 1992, the Israel Water Authority appointed a steering committee on filtration chaired by Professor Rebhun. The committee's task was to examine the effect of the new regulations on the future supply of water from the Kinneret and other surface water sources. The committee included representatives from government agencies, Mekorot, the Union of Local Authorities in Israel, and water experts.

After several months, the committee unequivocally advised the Water Authority that the water in the National Water Carrier must be filtered in order to continue to serve as Israel's primary source of drinking water. On the basis of this report, the Water Authority and the steering committee examined alternatives for implementing the filtration process. This study, carried out by Tahal Consulting Engineers Ltd., evaluated three alternatives:

1. Dispersed filtration – filtration would be carried out at a great number of filtration sites, which would be built along the national water network and at the entrance to major cities.

2. Central filtration – filtration would be carried out at a central filtration plant at the beginning of the supply system, in other words, at the exit from the Eshkol reservoir.

3. Groundwater as the only source of drinking water – aquifers would be the sole source of municipal drinking water, and water from the National Water Carrier would be used exclusively for agriculture.

The results of this study indicated that the central filtration at the Eshkol Site is the only feasible and most economical alternative.

Two years later, in 1995, Tahal and its partners, **CDM** (Camp Dresser and McKee) of the United States and Balasha Yalon Engineering Consultants Ltd. (Israel), conducted a comprehensive study, which thoroughly examined the alternatives. A comparison of the alternatives found that the central filtration alternative was cheaper, costing half as much as the dispersed filtration alternative and obtained the highest score for the quality variables measured: reliability, quality of service, flexibility for future changes and others. The alternative of the "groundwater as the only

The Sedimentation Reservoir. Photograph: Moshe Shai source for drinking water supply" was ruled out as impractical.

On the basis of these conclusions, the committee advised the Water Authority to proceed with the filtration project and built a central filtration plant at the Eshkol Site.

In 1996, general planning of the plant began. The estimated cost was $100 million. At this stage, Mekorot designed, built and operated an advanced Pilot Filtration Facility at the Eshkol site, which would provide data to assist in planning and designing the plant, that would comply with the water quality targets at a minimum investment and operational costs.

The study and design approval stage also included an engineering review by an international team of experts. When approval was obtained in 1999, Mekorot published an international tender for a P.Q. (Preliminary Qualification of candidates) for the chief contractor and civil engineering works, to build the plant in a "turn key" project. Mekorot would take over the responsibility for operating and maintaining the plant after its construction and running by the contractor for a period of six months. The tender specified the experience and capabilities of the contractors to build a project of this kind: to handle all final planning activities, the procurement of equipment, construction, managing of subcontractors, and initial operation.

Two years later, Mekorot published another international tender for contractors who passed the P.Q. sorting stage. After a meticulous sorting and rating process of the bids, the EL-PC joint venture was declared the tender winner in March 2003. The joint venture comprised the following companies:

* **Black and Veatch Contracting Ltd**. (formerly Paterson Candy) of the United Kingdom

* **Black and Veatch International** of the United States

* **Project International Ltd**. of Israel

Solel Boneh Building and Infrastructures Ltd. of Israel was the consortium's subcontractor for the civil engineering work.

Construction of the plant began in September 2003. Simultaneously, Mekorot prepared for the complex and challenging task of operating and maintaining the plant. The company's preparations included, among other things, the setting up of the Central Filtration Plant Project Management Team. Mekorot Vice President Rafi Ifergan headed the Project Management Team. The primary mission of the Project Management Team was to manage and supervise the project, to ensure that it was completed in accordance with the design targets and deadlines.

The Project Management Team was overseen by a steering committee whose members included Mekorot's CEO and deputy CEOs, the Jordan District manager, and as an observer, the company's legal counsel. Mekorot engineering teams and advisers in various fields closely accompanied the

The Central Filtration Plant. Photograph: Sky Balloons process from the planning stages through the completion of construction, contributing their extensive experience and know-how. Mekorot also established a designated school to train a top-quality professional team for the facility. The team underwent both classroom and practical training, initially by Mekorot and subsequently by the Filtration Plant contractor. At the end of the six-month training and operational period, Mekorot took over full responsibility of the Central Filtration Plant.

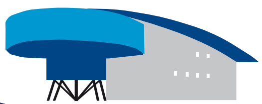
The Project Management Team members: Mekorot representatives: Daniel Sofer – Manager, Jordan District; Israel Moscovich – District Engineer, Jordan District; Rony Ran – The Project Engineer and Manager of Engineering Services Unit; Dr. Samir Hatukai, Ph.D. – Manager of Water Quality Department - The Jordan District and Process Engineer of the Project; Ayelet Simon-Vekslar, Melcer & Co. Law Office - legal advisor to Mekorot; Oded Fixler – Water Authority, Head of Development Division; Professor Menahem Rebhun – professional representative of the Water Authority; Adam Yitzhak – Project Manager; Avi Sigalat – Project Engineer; Amnon Zfati and Daniel Hoffman – Directors, ADAN Technical & Economic Services Ltd, Water Commission liaison to the Central Filtration Project.

The Pilot Filtration Facility

In 1994, Mekorot built an advanced Pilot Filtration Facility for the National Water Carrier at the Eshkol site. The Pilot Facility provided design criteria in the planning of the Central Filtration Plant, while examining the operational aspects.

Studies conducted at the Pilot Filtration Facility were ruled highly successful. The main achievements included the following:

- An especially high filtration rate of 20 meters per hour, which lowered the construction costs of the filter plant by reducing the necessary filtration area.
- Shorten the flocculation time to seven minutes, thereby lowering energy costs for treatment at the plant. Ensuring that treatment targets are met for all quality parameters for Kinneret lake water pumped into the National Water Carrier.
- Achieving better than mandated turbidity targets under current regulations, thereby complying with stricter standards anticipated in the future.
- In addition to providing design criteria, studies at the Pilot Filtration Facility resulted in scientifically and technologically valuable findings, such as demonstration of the effectiveness of chlorine dioxide as a preliminary oxidant for filtration at a level that is just as effective as ozone and other issues.



The Filtration Pilot Facility. Photograph: Moshe Shai

The Central Filtration Plant – Goals

The main goals of the Central Filtration Plant:

1. Water supply – working 24 hours a day to supply up to 1.7 million cubic meters of water daily.
2. Operation
   - Average filtration cycle of the filter – 18 hours, and not less than 12 hours
   - Effective output of filtered water of at least 95.8%
   - Filters are washed when the turbidity level of the filtered water reaches 0.2 NTU
   - Effective reclamation of waste backwash water of the filters to the operating reservoir is at least 93%
3. Water quality

At the exit of each filter

Turbidity

Desired level for operation - NTU < 0.2

Maximum permissible level - NTU < 0.5 at 80% of the time.

Maximum permissible level - NTU 1.0

Particles (larger than 2 microns)

Desired level for operation - particles per milliliter < 50

Maximum permissible level - particles per milliliter < 400 at 80% of the time

Maximum level - particles per milliliter 800

Chlorophyll A - microgram/liter < 0.1

In the supplied water

The quality of water supplied will comply with all regulatory requirements for drinking water, including:

Total Trihalomethanes (THM) - microgram/liter < 60

Chlorite – milligram/liter < 0.5

pH - at Calcium Carbonate equilibrium

Removal of viruses - 99.9%

Removal of *Giardia* - 99.9%

Removal of *Cryptosporidium* - 99.9%

Water returned to the Eshkol reservoir

Turbidity

2 NTU 80% of the time

Maximum permissible level - 5 NTU

Total Coliform bacteria - < 3/100 milliliter

Fecal Coliform - < 1.1/100 milliliter

Components of the Central Filtration Plant

The Central Filtration Plant comprises of two identical and symmetric modules that work independently in order to increase operational reliability and make it possible to turn off sections for maintenance without affecting regular production.

Preliminary Treatment

Water flows by gravity to the treatment systems through two parallel underground channels, each 280 meters in length. At the entrance of the untreated water as well as downstream, where supply control valves and flow meters are located, cut-off gates are installed for use if needed. When the water enters, it passes through high-rate mixing chambers, which comprise of a pair of parallel chambers of the same

The Pipe Gallery in the Central Filtration Plant. Photograph: Mashe Shai dimensions. In each chamber a baffle provides an up and down flow pattern. The water residence time in the mixing chambers planned for a maximum of 9.5 seconds. Dosing points for flocculants and special mixers with speed regulation provide rapid and uniform mix of the chemicals. From the high-rate mixing chambers, the water flows to ten parallel flocculators (slow mixing chambers). Each chamber comprise of two cells in series, equipped with controllable speed regulated stirrers. The total residence time in the flocculators is designed for a maximum of 6.5 minutes. The entrance and exit gate of each chamber can regulate the distribution of water between the chambers, and each chamber can be cut off independently for maintenance.

The filtration system

After the flocculation process the water flows through a distribution channel to a system of filters via motorized gates in the channel. Each module contains 12 filters, each comprising two cells, for a total of 24. Each cell is filled with an anthracite granular filtration bed. Bed depth is 2 meters and the maximum filtration rate is 20 meter/hour.

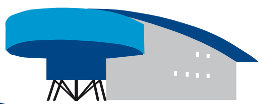
The filters are built symmetrically in each module, 6 filters on each side. Filtered water collection and backwash water supply systems (pipe gallery) are located in between. The filtered water is collected from the bottom of each filter, and then flows through the collection pipe, equipped with a regulation valve and flow meters for constant flow control system. Collection channels located in the floor of the modules gallery collect the filtered water from all the filters.

Each module also has a combined air and water filter washing system. This system includes two water pumps with a flow rate of 4,860 cubic meters/hour each, and two air blowers with a flow rate of 6,600 cubic meters/hour. The dirty wash water from the filtration bed is collected in troughs along the filtration chambers and flows into the wash water channel and then into an equalization tank.

The filtered water flows from the filters to the filtered water pumping station, located between the filter modules and the filtered water reservoir. The station includes 8 pumps, 6 in operation plus two in stand-by, with a pumping capacity of 75,000 cubic meter/hour and lifting height of 15 meters. The pumps are equipped with frequency converters enabling them to work within a water delivery range of 7,500-12,500 cubic meters/hour per pump. The pumps outlet pipes, each 48 inches in diameter, are connected to a 108-inch pipe, which divides before the reservoir battery into 2 parallel 80-inch pipes that enter the filtered water reservoir.

The reservoir, which has a 130,000 cubic meter capacity, is located between the exit of the filtration facility and the 108-inch pipe. From the bottom of the reservoir, two pipes emerge that are connected to a 108-inch pipe, which carries the water to the original 108-inch pipe of the National Water Carrier.

In each module space is available for 4 additional filters to meet future operational needs.



The Mixing Chambers area. Photograph: Moshe Shai

Waste Backwash Water Treatment Facility

The waste backwash water is returned after treatment and disinfection to the Eshkol reservoir, diluted by the fresh water in the reservoir and then fed to the Central Filtration Plant. This facility includes high-rate mixing chambers (coagulators), low-rate mixing chambers (flocculators) and four sedimentation chambers. The clear water from the sedimentation chambers is disinfected before returning to the Eshkol Reservoir.

The quality of the water from this treatment facility does not deteriorate the quality of the untreated water in the reservoir. The sludge created by the treatment process is pumped via 3,000-meter 10-inch pipe to a sludge treatment facility at the site. The sludge pumping station has four supply units with a capacity of 70 cubic meter/hour for each unit and a general lifting capacity of 25 meters.

The Sludge Treatment Facility

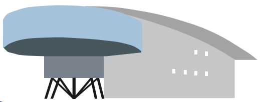
This facility receives the sludge from 2 sources. One is the sludge from the sedimentation reservoir at a rate of 300 cubic meters/hour via a pump installed on the floating barge described above, which automatically removes the sludge. The second source is the waste backwash water treatment facility, which delivers at maximum capacity 210 cubic meters/hour via 3 pumps.

A concrete routing chamber directs the sludge to two circular thickener basins that usually operate simultaneously. Each basin has a diameter of 30 meters and a capacity of 3,600 cubic meters. The residence time in the thickening basin is 12 hours, assuming an entry rate of sludge of 300 meters/hour and an exit rate of effluent of 250 cubic meter/hour. The thickened sludge is dewatered in a belt press filters. Filtrate water from the dewatering system is added to the thickener supernatant effluent. The thickener supernatant flows to treatment basins system before it is returned to the inlet of the sedimentation reservoir. A progressive cavity pump removes the sludge from the bottom of each thickening basin at a maximum flow rate of 35 cubic meters/hour. The sludge is sent to a 100-cubic meter concrete sludge tank and from there to the sludge dewatering system. It is possible to send the sludge to drying lagoons, especially during winter.

The sludge dewatering system includes two belt press filters, which are fed by a progressive cavity pump with a maximum delivery capacity of 40 cubic meter/hour. A polymer solution from the polymer preparation system is injected into the sludge feeder on each conveyor belt. Each belt press has a maximum delivery capacity of 40 cubic meters/hour, and includes a flocculation chamber, a thickening area, and a press. The conveyor belts are constantly washed with water. The filtrate is sent to a pit and from there pumped back to the distribution chamber that feed the thickeners. The resulting "cake" is transferred via a conveyor belt to containers located outside the dewatering site.

Water Quality Monitoring and Control

To guarantee the reliable supply of high-quality water, a state-of-the-art integrated network of monitoring

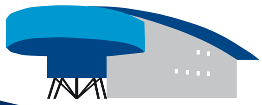


9 Chlorinators ranging from 6 to 200 kg/hr.
Photogrph: Moshe Shai

and control instruments have been installed at the plant. These instruments monitor both the water quality and the treatment and operating processes.
The continuous water quality monitoring and control system uses the following means:
1. Monitoring instruments installed in the plant – These instruments are based on innovative and reliable methods for monitoring water quality at the different stages of the treatment processes and supply. One of the instruments also measures the size and number of suspended particles in the water at a sensitivity of 2 micrometer. At key points, more than one measuring device is installed for the same parameter as back up to ensure high reliability. Skilled staff checks and meticulously calibrate the instruments daily.
2. Laboratory testing of water samples – Water samples are frequently taken to Mekorot's central laboratory at the Eshkol site, where they undergo complex bacteriological, biological, and chemical tests. The parameters measured, the location of the samples, and the frequency of the sampling are carried out in accordance with the Ministry of Health guidelines and as stipulated in Israel's drinking water regulations.

The Central Supervisory and Control System

The Central Filtration Plant functions in accordance with the demands of the water supply system in order to ensure reliable water supply in terms of both quality and quantity, at a stable economic price, and under various operating conditions. Regular operation includes the planning, selection, and execution of operations, as well as changes in water delivery to the plant, the rate of stirring, the number of operating filters, the washing of filters, operating volume of the filtered water reservoir, and other factors.
The operating system and the monitoring instruments are linked to a central control room using a Supervisory Control and Data Acquisition (SCADA) system. In addition to collating and monitoring data, this system supports a decision-making system for the optimal operation of the filter plant, and provides real-time alerts about any deviation from the operational stipulations or water quality regulation. The control room is manned by trained operators who monitor the operation and control the water quality 24 hours a day, 7 days a week from the start of the water treatment process until the delivery of water to customers. In the future, Mekorot will install this system at its general **SCADA NT** system.



The Central Control Room: monitoring, supervision and control of water quality and operations.
Photogrph: Naftali Hilger

Technical Data

Plant output

Annual filtration capacity ... more than 500 million cubic meters
Average annual output .... 330 million cubic meters
Maximum daily output .... 1.7 million cubic meters
Maximum hourly output .... 75,000 cubic meters
Average daily output .... 904,110 cubic meters

Sedimentation reservoir

Volume .... 1.5 million cubic meters
High-rate mixing (coagulation) . . 20 ejectors in two rows in the Netofa Channel
Low-rate mixing (flocculation) . . Flow through the channel for four kilometers

Operational Reservoir

Volume .... 4.5 million cubic meters
Treatment method .... use of fish for biological control

The new central filtration plant:

Water treatment chemicals: Aluminum sulfate (alum), chlorine, chlorine dioxide, sulfuric acid, fluorosillisic acid, cationic polymer, nonionic polymer, sodium hydroxide, ammonia

High-rate mixing chambers

Number 4
Dimensions of the chambers (in meters) .... 3.5 x 3.5 x 2.0
Residence time .... 9.5 seconds

Slow-rate mixing chambers (flocculators)

Number 20
Dimensions of the chambers (in meters) .... 5.5 x 5.5 x 6.7
Residence time .... 6.5 minutes

Filters

Number .... 24 (option for additional 8 filters)
Number of cells in each filter 2
Filtration area per filter .... 162 square meters
Total filtration area .... 3,888 square meters
Maximum filtration rate .... 20 cubic meters/hour
Filtration media .... Anthracite
Effective diameter .... 1.50-1.70 millimeters
Depth .... 2.0 meters

Washing of filters

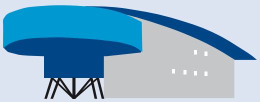
Method .... air/water
Maximum flow rate of air ... 72 cubic meters/hour/square meter
Maximum flow rate of water .. 60 cubic meters/hour/square meter
Number of air blowers 2
Air blowers' capacity .... 6,600 cubic meters/hour
Number of backwash water pumps 2
Water Pumps' capacity .... 4,860 cubic meters/hour

Filtered water pumping station

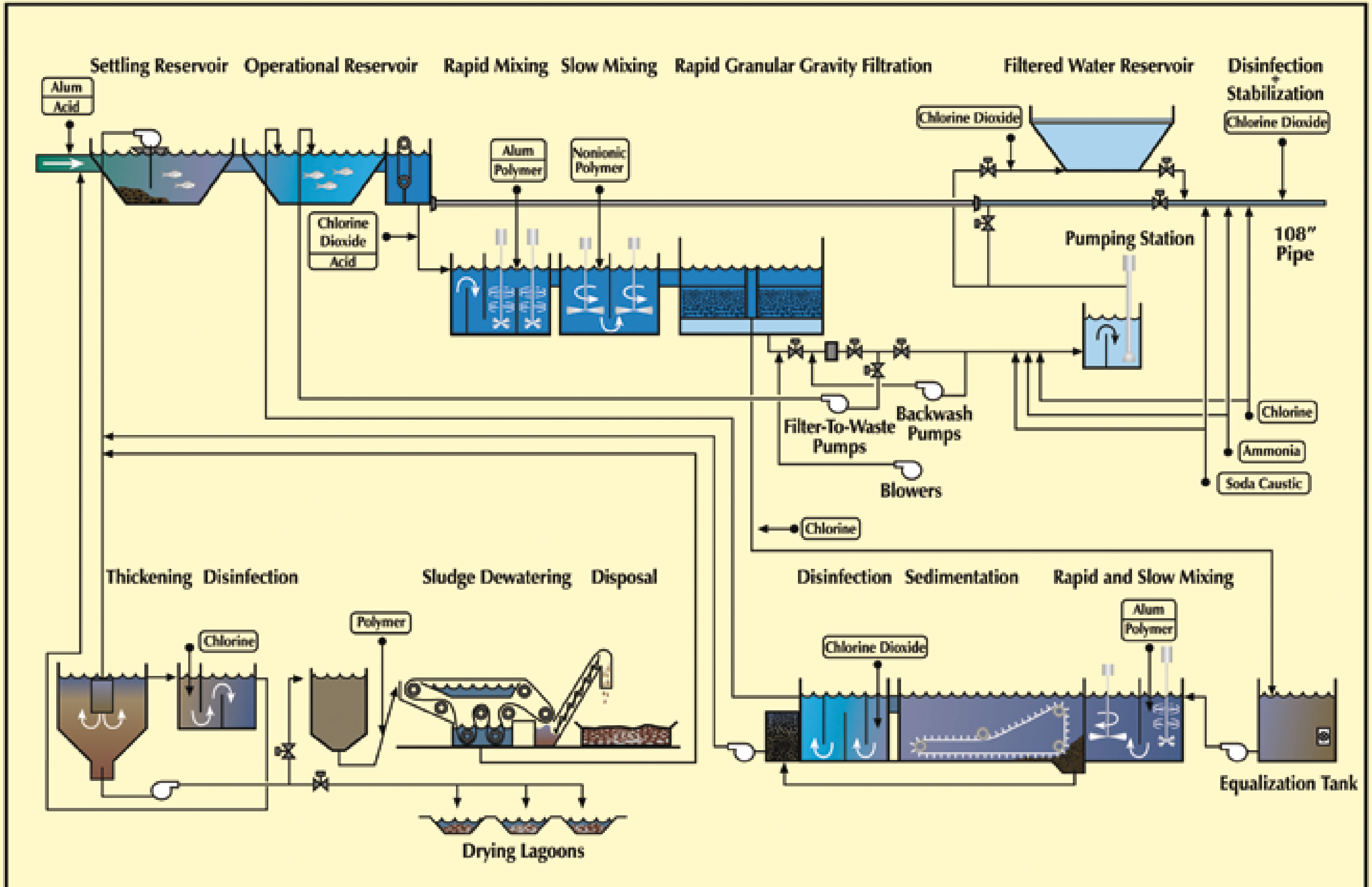
Number of pumps .... 8 (6 + 2 in stand-by)
Pump's capacity .... 7,500-12,500 cubic meters/hour
Total pumping capacity .... 75,000 cubic meters/hour
Lifting height .... 15 meters
Covered filtered water reservoir
Volume .... 130,000 cubic meters
Floating cover .... Hypalon

Waste Backwash Water Treatment Facility

High-rate mixing chambers (coagulators) 2
Slow-rate mixing chambers (flocculators) 4
Sedimentation chambers ... 4
Dimensions of sedimentation chambers (in meters) .... 80 x 10
Sedimentation rate .... 1.5 meters/hour



Process Diagram



Flow Diagram: The Eshkol Site Central Filtration and Treatment Facility

Protecting Nature and the Environment

As a "green company", Mekorot seeks to prevent environmental damage and protect nature and landscapes, especially along the National Water Carrier. The company's great sensitivity to this subject is seen in the construction of the Central Filtration Plant at the Eshkol Site in the Beit Netofa Valley. Beit Netofa Valley is the largest of the valleys in the Lower Galilee with a complete ecology of its own.

A section of the Yiftach-El creek, which flows into the Tzippori River, runs through the middle of the site chosen for the Central Filtration Plant. To protect the flora, fauna and other organisms that live in the river, Mekorot, with the collaboration of the Israel Nature and National Parks Protection Authority, diverted the riverbed to an alternative route and replanted 130 Tabor Pines originally located on the construction site to the Central Laboratory at Eshkol. The diverted riverbed was built with a closed 400-meter channel and 400-meter open channel bypassing the plant and reconnecting with the original riverbed. The final section of the diverted channel included a small pool for the preservation of various animals, including frogs, catfish, and turtles which live in the creek.

When the riverbed diversion was completed, Mekorot rehabilitated the flora and landscapes, which included collecting the original silt and returning it to nature. In view of the complexity and sensitivity of the project, the work was accompanied by a landscape architect and supervised by the Nature and National Parks Protection Authority.

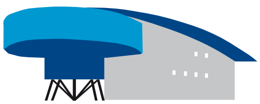
The Yiftach-El River diversion, completed in 2002, was the second diversion of the river. A section of the river was diverted during construction of the National Water Carrier in the 1960s for the purpose of building the Eshkol reservoir.

Mekorot's preparations for construction of the Central Filtration Plant also included building a new road for water treatment chemicals at the Eshkol Site, which would serve as a separate and safe route for the transport and loading of water treatment chemicals. Special loading and unloading stations were built along the new road, from tankers to large storage vessels.

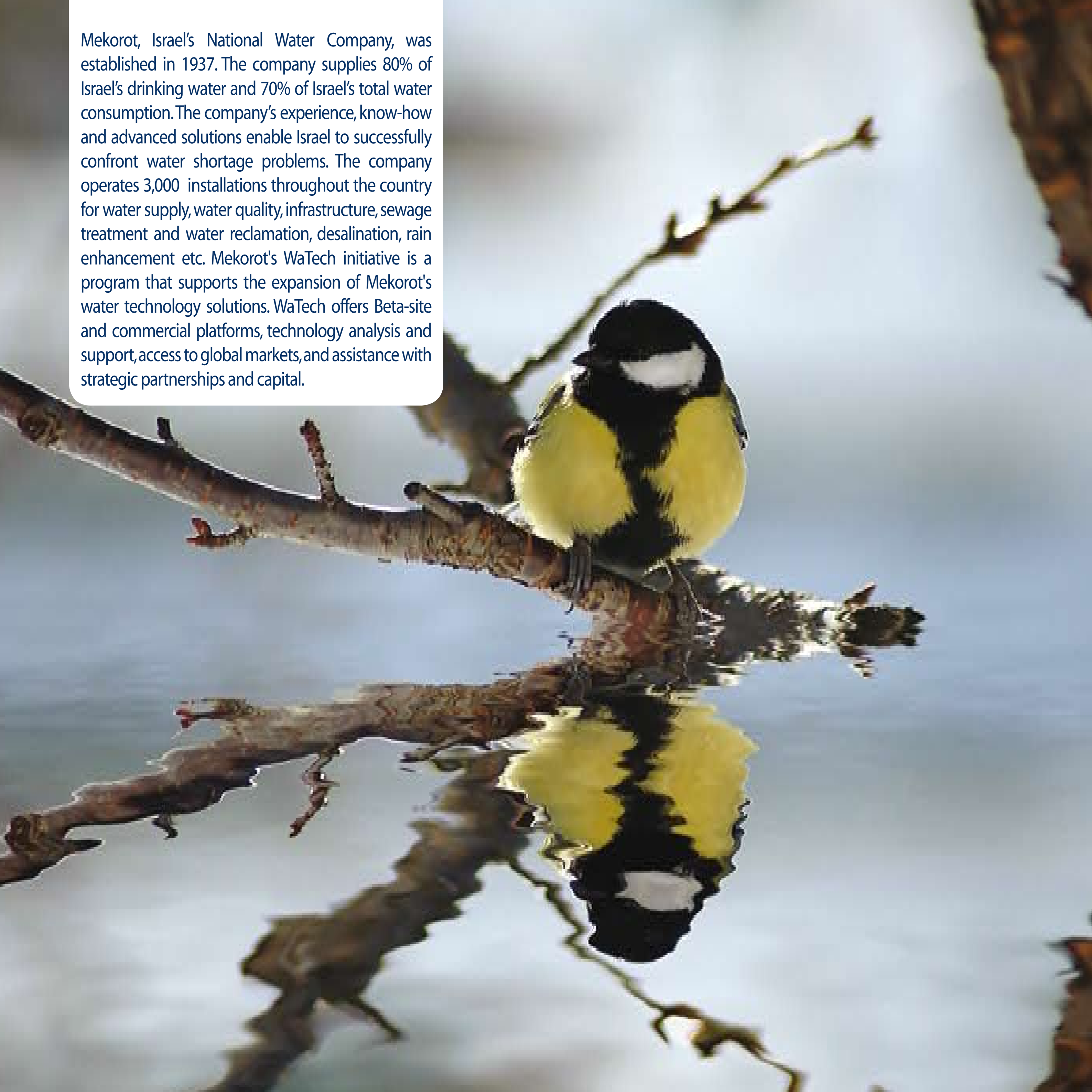
The stations are equipped with peripherals and control and operating systems for the safe, fast and efficient unloading of chemicals with minimal risk to employees, the process, and the environment. The plant will also make possible a significant reduction in the quantities of water treatment chemicals needed for Israel's water system. In addition to the special measures undertaken by Mekorot in the construction of the Central Filtration Plant, the company takes great care to implement an environmentally friendly policy at Eshkol. For example, the waste backwash water for the filters, the water released from the sludge treatment and the "cake" (sludge with high solids content) is rendered non-hazardous. The "cake" is later removed in an organized manner.

The Visitors Center

The Visitors Center of the Central Filtration Plant will be opened to the public during the second half of 2008. The center is of innovative design, including presentations and demonstrations of Mekorot's core activities and the company's contribution to Israel's water industry. The Visitors Center will also have workshops and activities, as well as a magnificent presentation about the company's future. All these will ensure an impressive, interesting and enriching experience about water in general and Mekorot in particular.



Mekorot, Israel's National Water Company, was established in 1937. The company supplies 80% of Israel's drinking water and 70% of Israel's total water consumption. The company's experience, know-how and advanced solutions enable Israel to successfully confront water shortage problems. The company operates 3,000 installations throughout the country for water supply, water quality, infrastructure, sewage treatment and water reclamation, desalination, rain enhancement etc. Mekorot's WaTech initiative is a program that supports the expansion of Mekorot's water technology solutions. WaTech offers Beta-site and commercial platforms, technology analysis and support, access to global markets, and assistance with strategic partnerships and capital.



Control Room and Visitors Center.
Photograph: Mosh Shai

MEKOROT
ISRAEL NATIONAL WATER CO.

Mekorot, Israel's National Water Company, 9 Lincoln st. Tel Aviv 61201, ISRAEL. Tel: 972-3-6230555, Fax: 972-3-6230833 Website: WWW. mekorot.co.il