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WATER SUPPLY IN THE SUBURBAN SECTORS OF THE COUNTY CAPITAL CITIES OF MOLDAVIA

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Abstract. In the last years, for the water supply of some agroindustrial, school collectivities, or for restrained sectors of some populated areas situated at the towns peripheries, there have been built establishments of water, also called 'microstations of water treatment', representing a superior solution for water supply in comparison with the traditional local means. These microstations use underground water sources that frequently accomplish the known criteria of drinkableness. The establishment of water includes only the sectors of capture, storage and distribution. The capture is achieved through two, maximum three wells that are drilled in the immediate vicinity. The main condition for the location of such stations is that the quality parameters of the water drawn through these wells situate themselves in the first category of drinkableness. In other words, the water taken could be distributed for consumption without a too expensive potabilisation process.

For treatment, inside the microstation a microinstallation for treatment is used, in which occure operations of decantation, filtration, dedurisation and chlorination. For storage, tanks, located inside the station, are usually used. The distribution network can be fitted with street pipes located at useful distances (300 m), sometimes with interior installations, too.

In the county capital cities, according to the data obtained from RA Romanian Waters, in 2008 there were 14 such microstations (1-Botoşani, 3-Suceava, 2-Iaşi, 1-Piatra Neamţ, 1-Vaslui, 2-Bacău, 1-Focşani, 3-Galaţi).

These microstations are quite expensive and thus are not for everyone. Therefore, the water supply for individual households or for some groups of individual households (which cannot be connected to the centralized system of

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drinkable water supply) is done predominantly through fountains, using water sources from the phreatic waters of the area.

Fig. 1 - The microstation of drinkable water preparation for Rachiti neighbourhood which is located in the NE area of Botosani municipality

Fig. 2 - The microstation of drinkable water preparation for Scheia zone, located in the SE area of Suceava municipality

1. Fountains

Regardless of their type, fountains are composed of two structural components:

- a construction which ensures the contact with the ground-water layer (the fountain body);
- a protected system for getting the water outside.

These must meet a minimum of hygienic-sanitary conditions regarding the specific features of the water source, the location place, the construction elements, the operational aspects and the measures taken to protect water quality.

The water source. To obtain a water of good quality an aquifer layer of a medium or large depth is chosen, which constantly ensures the amount of water needed. We must not prefer the first water layer encountered, especially if it is less than 4 m deep, because the layer of soil found above cannot achieve a complete self-purification of an intensely polluted and contaminated water, dependent on the atmospheric precipitations and the external temperature.

The location of the fountain. The location of the well should take into account two criteria: functional and of security. Thus, it is placed as close to home as possible and far from the usual sources of pollution found in a household: privy, stable, platform garbage, animal droppings pit (30 m). The highest point of land will be chosen in order to avoid the leakage of the rain waters and various impurities from the surface of the soil to the fountain, in the clean sector of the court, with wholesome soil.

The costruction elements. The penetration until the aquifer layer is made by digging a hole with a conic shape with the top on the direction of advance and the subsequent assembly of the elements of construction, or by drilling. Resistant and waterproof construction elements are used: blocks of stone or brick well grout between themselves, cylindrical coils of concrete joined with cement mortar, metal tubes. The concrete tubes entering the aquifer layer are provided with holes (weep holes) that allow water to enter the fountain. On a height of approximately 1 m above the ground surface the construction shell of the fountain is arranged, also made of tubes of concrete. The construction shell of the fountain is covered with a mobile lid, easily manipulated, in order to guard against the infiltrations, accidents through fall and the penetration of foreign bodies. Above all these elements of construction, a roof is made, with a large enough opening for a complete protection.

At the wells equipped with a pump, in which the water stagnates inside the metallic tube and it can freeze in winter, an adequate protection is ensured by means of muffs or booth.

Functional aspects. The water removal system should prevent the water pollution through the contact with human hands or by direct watering of the animals. Therefore, it is preferable to built pump wells or with devices for the mechanical overturn of the bucket, respectively the restriction of the bucket opening facet with a metal piece in the form of "X". To water the animals, a sewer is built, which carries the water across the protective perimeter of the fountain in a trough or a tank of concrete. Aside from the periods of use, the bucket must remain in the body of the fountain and the fountain must be covered with a lid.

The protection of the water quality. Around the fountain, two areas of protection are arranged. The first area with 'severe regime' has a mean radius of 3 m; it is battered (with a slope of 4-5 cm for each distance of 1 m) from the fountain to the periphery and is paved with cubic stone, river stone or it is concreted. This area is fenced and provided with a gate for access. The second area with a 'restriction regime' continues the first one to an average distance of 30 m from the fountain. On this surface, covered with grass and maintained in a thoroughly clean condition, there must not be any sources of contamination or impurification.

Hygienic-sanitary advantages and disadvantages. The water supply through wells presents a relative degree of sanitary security and only in the case of pump operated wells and which are protected from pollution we can talk about a certain security in terms of preserving the water quality.

To the increased and frequent posibilities of pollution and contamination we can also add the difficulties met in the activity of checking by laboratory examinations of the chemical and bacteriological qualities of the water, and also the necessity of some periodic sanitation works, which are extremely expensive in the case of fountains drilled at a great depth. There is also the issue of the instability of the flow, as well as some deficiencies of the water quality.

The advantages of using wells consist of the good taste of the water, the superior quality of the caught water, the restricted area of the pathology transmitted through the fountain water.

Synthesized, the advantages (strengths) and disadvantages (weaknesses) are shown in the following table:

Strengths	**Weaknesses**
providing the necessary water for household	access to drinking water is determined by the existence of the ground-water layer at a low depth (up to 10 m)
the low price of the investment	there is the great danger of the water contamination (wells up to 10 m depth and without clearance certificates from the environmental protection); in this case, septic tanks should be constructed to protect the water table, although the regulations do not provide for it
the maintenance can be done easily and with minimal costs	the well may lose flow at certain times of the year and the water is no longer in the quantity desired by the user
the restricted area of the pathology transmitted through the fountain water	because the investment cost is low and it implicitly belongs to every inhabitant, it may happen that people do not pay sufficient attention to the system, to its exploitation and maintenance

According to the building manner, wells may be:

1.1. Dug wells. They are built to capture some sources of water at 12-15 m depth and can be provided with: bucket or dip bucket, elevator cups, pump. The inside of the well may be paved with stones or made of concrete tubes (fig. 3).

Fig. 3 Well paved with stone Well made from concrete tubes

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1.2 The fountain with bucket or dip bucket. The lifting and descenting system of the bucket can be with counterweight and balance, with a pulley fixed on an horizontal shaft; with chain, rotating spindle and crank or wheel. Some wells have simple mechanisms for emptying the water by capsizing the bucket and its forced bent collecting the water in a lateral sewer.

1.3. The fountain with elevator cups. Has a variety of metal cups fixed at small distances from each other on a chain or a metal strip in a closed circle, which moves between two toothed rolls (one outside and one under the water level) with the help of a crank or a wheel. A metallic reinforcement covers the device for emptying the cups (picture 4). The water is collected in a trough or a pipe under which a container (bucket, drum, cup, etc.) is placed.

1.4. The fountain with pump. Provides both protection against pollution and contamination and hygienic removal of the water. The structure elements are the tubular suction-rejection pump (located on the side of the fountain on a concrete board) and the suction pipe with the suction drain at its lower end.

b. The drilled fountains.

They differ by the depth to which the aquifer layer is.

1.1. The Norton type fountain (the abyssinian well);

It is met in regions with an aquifer layer composed of sand and gravel at depths below 10 m. For their construction, perforated metal tubes are used, airtightly joined by screwing. The first tube has a sharp tip in order to allow the entry into the layers of soil. After the contact with the ground water table, a plate of concrete on which the pump is attached is fitted up at the soil surface.

Fig. 4 - The metallic reinforcement that protects the fountain with elevator cups situated in Bukovina Street of Botosani

The drilled fountain with cylindrical bucket (fig. 5);

It is built when the aquifer layer is at a depth of 10-25 meters, from cement tubes with the diameter of 16 cm. The metallic bucket has a diameter of 14 cm and it is equipped with a mobile bottom, which functions as a valve in contact with the layer of water and when the bucket is drawn out and with an orifice that allows the air removal during the filling with water. A metallic chain, a fixed pulley and a crank disk ensure the moving of the bucket inside the fountain. Near the fountain, on a resistant support, a tank is arranged with a tap in which the water from the bucket is collected and a tubular device designed to remove the unused water beyond the perimeter of protection.

c. The drilled fountain of great depth (the well fountain)

It is built when the aquifer layer is at a depth greater than 25 m.

d. The drilled artesian fountains

They are arranged when a water layer which is under pressure between two impermeable layers of soil is caught.

The improvement of the fountains sanitation. By the way it is built and by the operating manner, a fountain can be easily damaged, impurified or contaminated. In such cases, the sanitation improvement is necessary, that is the reconstitution of all the specific parameters of the fountain by eliminating any possibilities of pollution and contamination. For this, the following actions are undertaken, in order: the identification of the pollution and contamination sources;

their neutralization; the fountain reconditioning; the water disinfection; the control of the water quality in laboratory.

Fig. 5 - The drilled fountain with cylindrical bucket situated in Dela Street of Vaslui

- The identification of the pollution and contamination sources. The sources of pollution or contamination may be located at the ground surface or in depth and are due to the wrong location of the fountain, to shortcomings in construction or to some damages occurring during the use, to some errors in handling the system of drawing out the water or to some accidental circumstances. The successive use of some substances that modify the color of the pollutant liquid and then of the water of the fountain allows tracking the pollution source. The more used substances are fuchsine and fluoresceina.

- Once we discover the source of pollution, we take action to neutralize it. The measures taken aim to restore the sanitary perimeter for the fountain protection.

- The fountain reconditioning interests all the construction elements: body, construction shells, cover, system of drawing out the water, roof. It begins with the emptying of the water of the fountain and removing the mud and other impurities deposited on the bottom (the well emaciation). The water volume is calculated according to the formula: πR^2 x I. Whereas during the descent into the fountain there is a risk of hypoxia, check it with a burning candle. In the presence of low levels of oxygen in the body of the fountain, the flame is extinguished. The verification is done providing the protective measures, descent with safety belt and connecting cord, supervision by another person on the surface.

- The well disinfection is carried out only after all the previous operations have been fulfilled. Substances as the chloride of lime, extincted/unextincted lime, potassium permanganate are used.

- After the passage of the contact period, the water from the fountain is discharged several times until it becomes clear and without a strange smell. It is recommended that collections of samples be sent to the laboratory for chemical and bacteriological determinations.

- The rigorous observance of the sanitation measures always provides the normalizing of the fountain water qualities, allowing the consumption without risk.

In the county main cities, according to the data obtained from the Autonomous Administration "The Romanian Waters" the water supply is made individually in the proportion of 10%. The fountains have walls of concrete 70%, paved with stone 25% and of wood and other materials 5%. The water is drawn with a fountain wheel with a bucket 80%, with hydrophore 15% and the remaining with other systems. The fountains depth is of 10-20 m (65%), 20-30 m (15%), 30-40 m (10%), 40-45m (6%). The fountains are uncovered in proportion of 45%, hard cover (wood lids / plates in various stages of degradation) 30%.

By means of the the data presented above we may conclude that the risk of contamination of the wells water is the most often represented by the fact that the water is drawn through improper removal devices.

We believe that the most significant source of pollution is water contamination with human or animal waste, because of the incorrect arrangement and the small depth that allow infiltrations.

Chemicals, mainly used in agriculture, as pesticides and nitrates, are another source of fountain water contamination. Thus, as a result of the analysis carried out by employees of the water laboratory of the Siret and Prut basin directorates (action initiated at the end of 2006 by the Ministry of Environment to find new sources of drinking water) of 50 wells in the county main cities, they have found that a percentage of 64% had exceeded the maximum allowed for insecticides (between 0.001-4.81 mg/l), and analysis for triazine herbicides has revealed that in 73% of the samples, the average C.M.A. (0.74 mg / l) was exceeded, values between 0.016-24.41 mg / l and an average value of 3.66 mg / l being registered.

In conclusion, it is obvious that the loading of the water with pesticides it is not explained only by the quantity used. An explanation for the present situation could be the prolonged use of pesticides of the first generation, (technical substances such as DDT and HCH have been banned since 1985) which have a low degree of biodegradation, including the organo-chloride insecticides, also adding to this explanation their wrong management: application, transport and incorrect disposal.

Tab. 1 - Water quality indicators collected of the wells located in the county main cities in the period 2006-2008

City	Year	No. of fountains analyzed	No. of fountains with the concentration of NO_2 >100 mg/l	No. of fountains exceeding the total number of coliforms	No. of fountains exceeding the total number of coliforms from faecal substances
Botoşani	2006	10	8	4	2
	2007	15	12	3	1
	2008	17	13	3	1
Suceava	2006	5	1	0	0
	2007	7	2	1	1
	2008	10	2	1	1
Iaşi	2006	15	7	6	3
	2007	15	7	6	3
	2008	18	8	7	4
Piatra Neamț	2006	3	1	0	0
	2007	3	1	0	0
	2008	3	1	0	0
Vaslui	2006	4	0	4	1
	2007	8	3	5	2
	2008	8	3	3	2
Bacău	2006	10	8	6	4
	2007	14	10	8	6
	2008	15	10	8	6
Galați	2006	20	15	6	5
	2007	26	15	6	4
	2008	20	15	6	4
Focşani	2006	8	8	5	4
	2007	10	9	5	4
	2008	10	9	5	4
Total		274	137	91	62

According to R.A. The Romanian Waters

The most common physical deficiencies which led to the fountains contamination with different pollutants are associated with the lack of a concrete plinth, or with the fact that this is damaged, and also with breaks in the well shell and the drainage channel. However, severe, dangerous contamination is usually associated with the latrines located too close to wells. Most of the open wells are contaminated, reaching levels of at least 100 coliform bacteria of faecal provenance per 100 ml of water.

In table 1 we present the water quality indicators collected of the wells located in the county main cities in the period 2006-2008.

Of the 274 wells analyzed during the three years, we found out that C.M.A. (100 mg / l) NO2 was over the limit in 50% of wells and the number of wells that exceeded the total number of coliforms originated from faeces represented 22.50%. We should mention that during the three years, the analysis was repeated in the same wells and only in a few cases, new ones have been investigated.

2. The sources

Springs are waters of depth which, due to favorable hydrogeological conditions, naturally draw out at the surface of the soil, downward or upward. (Picture 6).

Fig. 6 - The spring The Lion Mouth of Bucecea (Botoşani)

The aquifer layer structure determines their quality:

- *good* - if it is composed of sand and gravel and
- *suspect* - if it is composed of fissured limestone rocks (Karst with an increased degree of permeability for surface waters).

The hillside sources are caught in capture chambers, in the real point of their exit. The chambers are provided with ventilation, protected with sieves, pipeline of overfilling prolonged until the effective place of discharge and pipelines for the water departure (supply pipeline). Upward springs are captured in concreted rooms, like dug shafts, down to the contact with the aquifer layer.

3. Meteoric waters supply

This method of water supply is not advisable in terms of hygiene, even if it ensures the collection of the waters in tanks or buried tanks, equipped with filter of sand and gravel and covered with a lid.

In the current stage of development, a rational and economic water supply installation must be based on the nearest and the best natural source of water, the technological schedules of treatment, guidance and distribution of the water should be the most effective, the materials of construction used there hould be the most economic, and the exploitation should be according to the quantitative and qualitative parameters mentioned in the initial project.

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