Műszaki Katonai Közlöny

XXV. évfolyam, 2015. 1. szám

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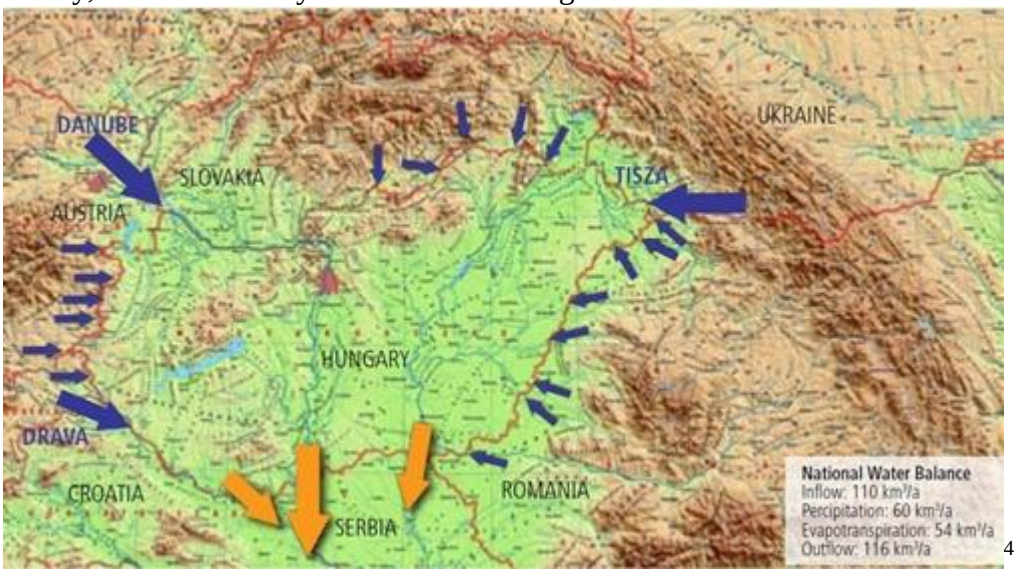
POSSIBLE UTILIZATIONS OF RAINWATER ON THE CAMPUS OF NATIONAL UNIVERSITY OF PUBLIC SERVICE FACULTY OF MILITARY SCIENCES AND OFFICER TRAINING[2]

Rainwater is usually only drained away, and is not utilized. Despite that, that the water during its natural circulation is the purest in this form. Why is it not used? Even now there are several methods developed to collect, store and use rainwater. My essays main goal is to present these applications on the campus of the National University of Public Service Faculty of Military Sciences and Officer Training.
Key words: rainwater, irrigation, roof surface, tank

INTRODUCTION

Hungary is very fortunate by the terms of hydrogeology. We have high quality and plentiful water reserves, thanks to the Carpathian basin. There is an ample supply of groundwater in the whole country, which is usually the base of drinking water.[3]



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Surface water entering and exiting Hungary

The question arises, why is there a need for collecting rainwater in our country despite such favorable circumstances. There are several answers to the question. First of all, we have to make an effort to preserve this favorable state, as long as possible. According to scientists problems related to water shortage will arise sooner or later in Europe also. On the coasts of the Mediterranean sea difficulties related to water management have already risen, which are expected in our country as well. It is common that groundwater is exploited at a higher rate than it can be replenished through rainwater. As a result wells dry out, and on the coasts

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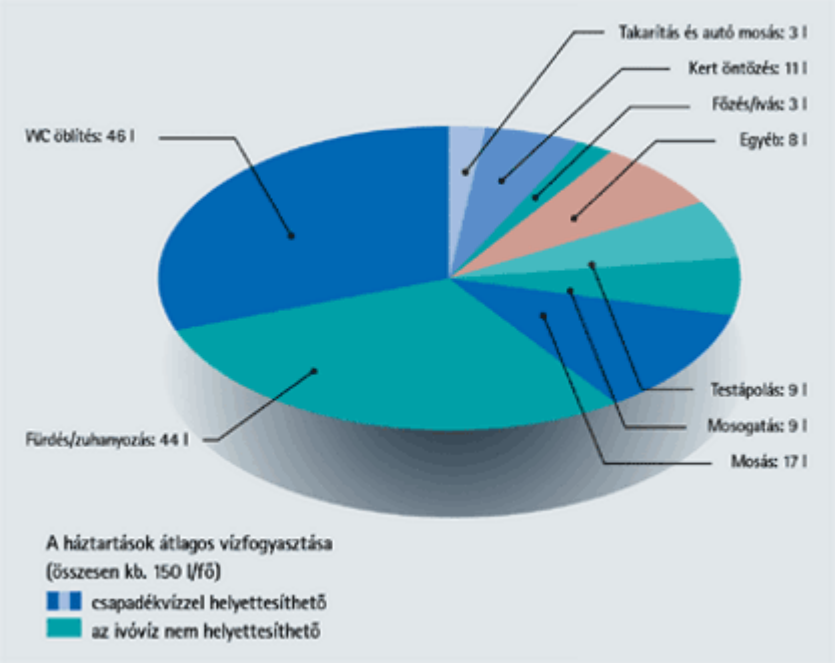
[3] http://www.budapestwatersummit.hu/ezer-viz-orszaga/ivovizkincs/magyarorszag-a-vizhatalom-371/ 2015. 06. 07.
[4] http://www.budapestwatersummit.hu/data/images/vizhatalom_2.jpg 2015. 06. 07.

seawater pushes into the depleted groundwater reserves. Because of this the tap water in several coastline cities is already mildly salty.[5]

Another possible approach to the problem is through finance. Budapest is in a fortunate situation in this regard, because its water pricing can be listed in the cheapest category.[6] However in our case we are talking about a whole campus. This means more than 400 cadets, who live on campus 10 months out of a year, at least 5 days a week. Added to this are the employees of the university, the soldiers of the Ludovika Battalion, the Armed Security Guard, cleaning and maintenance staff who work on campus daily. There are also students attending classes from other facilities or to exercise on campus.



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Water used by one person in a day and its division

The division of one persons daily water consumption is well shown on the above graph and also is the fact that we can use up more than 150 liters of water in a day. This primarily refers to the cadets and secondarily to the personnel who live off campus, they of course will not shower, wash or clean here. Nevertheless there is another area of water usage, which is the irrigation. Under irrigation I mean the watering of the football field and the surrounding green areas. The main goal of my essay is to present the possibility to water these areas with stored rainwater and also to use this water for flushing toilets.

THE RAINWATER COLLECTING SYSTEM AND ITS APPLICATION ON CAMPUS

Based on my earlier statements it would be beneficial to use 100% of the rainwater. In the absents of this we can't plan long term water management. Sadly several European countries have restrictions on rainwater usage (it cannot be used for drinking water)[8], but in my opinion this will change.

[5] http://www.eautarcie.org/hu/03a.html 2015. 06. 07.
[6] http://vizmuvek.hu/files/public/Fovarosi_vizmuvek/tarsasagi_informaciok/pdf/Szolgatatasok_dijszabasa.pdf 2015. 06. 07.
[7] http://www.esoviz.hu/images/3_3.gif 2015. 06. 07.
[8] http://www.eautarcie.org/hu/03a.html 2015. 06. 07.

Nowadays different pollution types, such as the chemicals used in agriculture, slowly seep into even the deeper underground water reserves. In the light of this, it is not an overstatement to call rainwater the purest water source.[9]

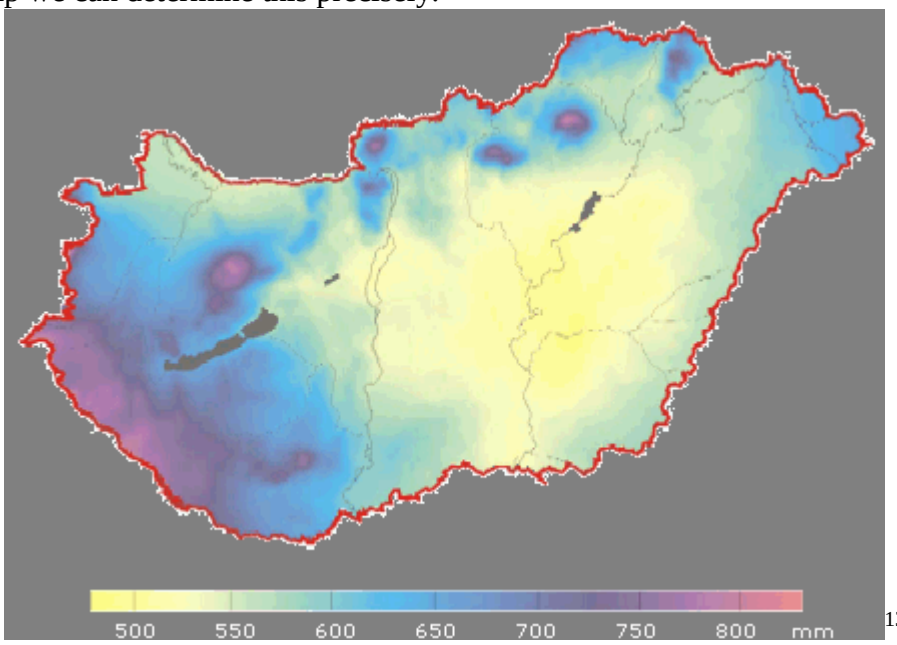
Roof

The collection of rainwater starts on the roofs.[10] This is the easiest way to preserve its purity. It is important not to collect rainwater from the solid ground surfaces, because this leads to drastic quality decline. Most roofs are good for water collection, of course with some exceptions.

- constantly polluted roofs
- thatched roofs
- asbestos cement roofs
- bitumen covered roofs
- metal coated roofs (except stainless steel)[11]

These exceptions primarily stand for rainwater that occurs at households, where home appliances may use it (washing machine, dishwasher). In our situation the rainwater would be used for flushing toilets, so the metal coated roofs would perfectly suffice.

The roof is the main element in collecting rainwater its size determines the volume of collectable water. This can be easily calculated if we know the average fall in the area. With the right map we can determine this precisely.[12]

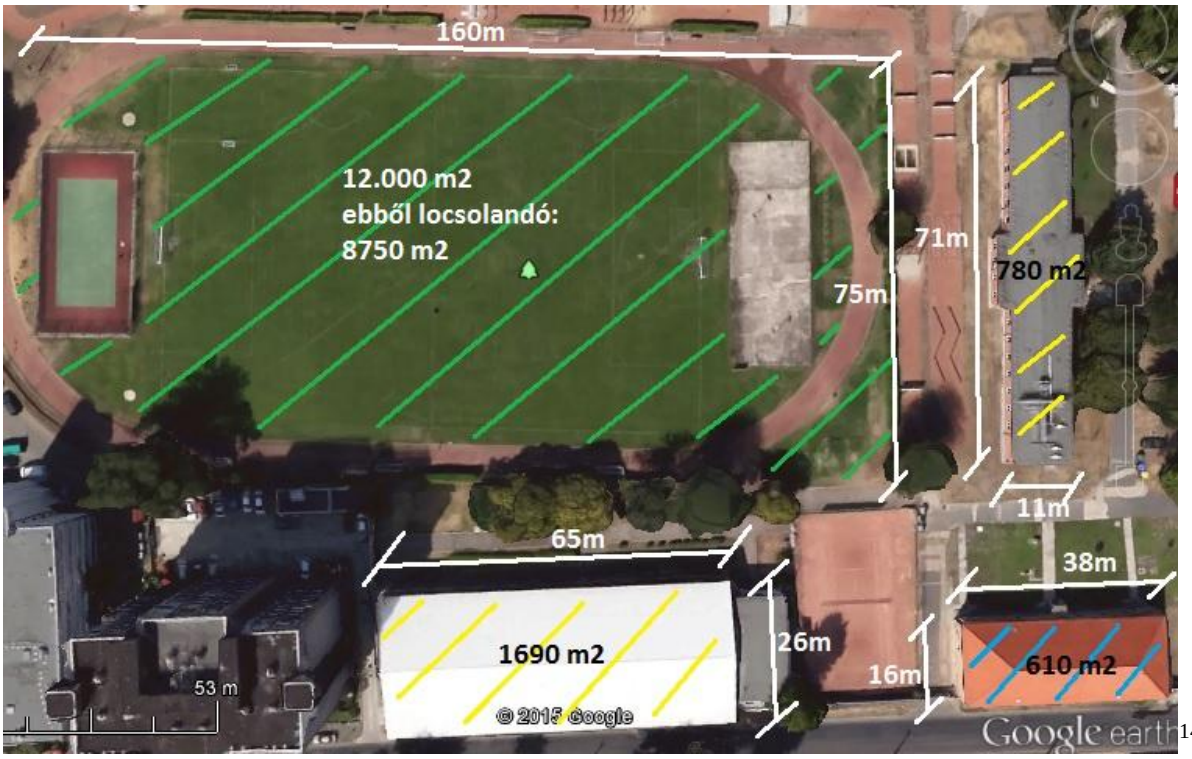


[13]

Hungary's rainwater map

[9] http://www.eautarcie.org/hu/03a.html 2015. 06. 07.
[10] http://www.ciszterna.hu/index.php?link=esoviz-gyujtes 2015. 06. 07.
[11] http://ipari-szigeteles.hu/esovizgyujtes/esovizgyujtes-mukodese 2015. 06. 07.
[12] http://www.ciszterna.hu/index.php?link=esoviz-gyujtes 2015. 06. 07.
[13] http://www.ciszterna.hu/Tartalymeret%20szamito-ciszterna-hu.xls 2015. 06. 07.

Based on the map it can be concluded that Budepest, our area of interest, approximately gets 600mm of rainwater in a year. After this we only need to know the size of the roofs that we can use.



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Overhead view of campus

It shows on the picture that primarily 1690m^2 + 780 m^2, namely 2470 m^2 of roof surface is available for collecting rainwater. If this proves to be insufficient the roof areas indicated with diagonal blue stripes can also be used adding up to 3080m^2.

After this we have all the data that we need to calculate the amount of rainwater that we can collect. An Excel chart will aid us in the task.[15] We have nothing else to do, but insert the roof surface area in square meters and the annual amount of rain in millimeters. We get that with our prime choice of roofs we could collect 1.259.700 liters of water, with all three roofs this adds up to 1.570.800 liters.

Gutter

This water has to be channeled, thus the roofs need gutter systems, which are capable of directing the water into tanks. Apart from this the gutter system has another function, namely filtering. Regrettably there will always be some sort of contamination on the roof witch must not get into the tanks. This could be leaves, bird droppings, moss, insects and so on. It is beneficial to pay attention to not letting the smallest amount of material get to the roof, and

[14] Based on Google Earth and my own editing the key to the document: green diagonal lines: area that needs to be watered; yellow diagonal lines: primary water collecting surfaces; blue diagonal lines: secondary water collecting surfaces

[15] http://www.ciszterna.hu/Tartalymeret%20szamito-ciszterna-hu.xls 2015. 06. 07.

later on into the stored water. Because of this tree branches should be kept away from roof surfaces, thus making the filters job easier during autumn.[16]

The filtration is usually done in two steps. First is the filtration of larger objects, like leaves. These filters should be cleaned a few times, but at least once a year. Second is the fine filtration where objects larger than half millimeters get filtered out (bird droppings, seeds). These filters are made from copper or titanium alloy and need no maintenance, but have to be checked from time to time.[17]

Tank

We arrived to a very important element, since the tanks purpose is to store the water that we have collected. Aside from this it can contain a built in filter, which can ensure the removal of contaminations and bacteria. Thanks to this the collected water can be stored for a much longer period.

It is rather important to choose the right sized tank. If it is too small it can cause the tank to run out too early and we will be unable to irrigate. If it is too big, we will have an amount of water with is never used and only piles on the upkeep costs.[18]

In the calculation of the proper size of the tank the previously used excel chart can aid us again.[19] We insert the size of the area we wish to water ($8750m^2$) into the right bracket and the chart will calculate the size of the tank needed. By this we get $53m^3$, based on this I have come to the conclusion that we have an excess of $700.000m^3$ of water collected of the roofs. This can be used to flush toilets. Determining the amount needed for this is not easy. The usage of the building is not even and the frequency of toilet use is also not exact. In my opinion inserting 50 persons into the equation is sufficient. More people use the facilities, but the equation calculates the daily demand of flushing water. Based on this the chart estimates a $63m^3$ tank for us. Based on the number of attendants and the size of the buildings I would suggest that a $42m^3$ tank should be installed to the building indicated with number one, and a $21m^3$ to the building represented by number two.

The next question is that what type of tanks are available. In this regard the situation is very good, a wide variety of tanks can be considered. We can choose from several manufacturers wide variety of size and build. It is advised to pick one with the matching capacity to our estimations. Based on this, the most optimal choice is:

[16] http://www.ciszterna.hu/index.php?link=esoviz-gyujtes 2015. 06. 07.
[17] http://ipari-szigeteles.hu/esovizgyujtes/esovizgyujtes-mukodese 2015. 06. 07.
[18] http://www.ciszterna.hu/Tartalymeret%20szamito-ciszterna-hu.xls 2015. 06. 07.
[19] http://www.ciszterna.hu/Tartalymeret%20szamito-ciszterna-hu.xls 2015. 06. 07.

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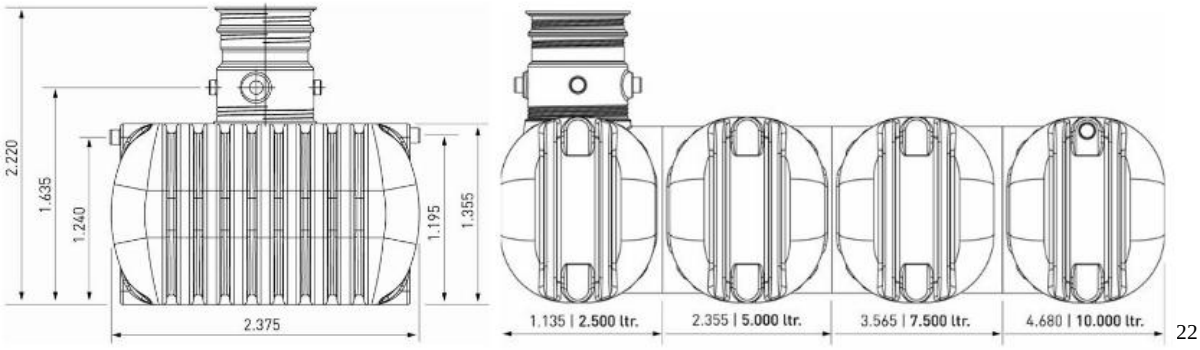
The AquaTerne (AT) 112 model of Rikutec[21]



[22]

The AT 112 models detailed build

As it is shown in the picture above, a system like this can contain up to 10.500 liters of water. In correlation with this building number one would need four and building number two would need two interconnected AT 112 systems to serve the demands.

We do have a wide range of options on the market, but we need not to be concerned with quality. Manufacturers usually have a guaranty for their products, which are made of plastic and are molded or blown.[23] Added to this the tanks have to fulfill certain demands:

- waterproofing
- light proofing
- it has to keep water at a max of 18 Celsius
- has to have an overflow
- the supply has to come from a clean sheet of water (15cm-s lover than the all time water level, this is ensured by a floating pipe)[24]

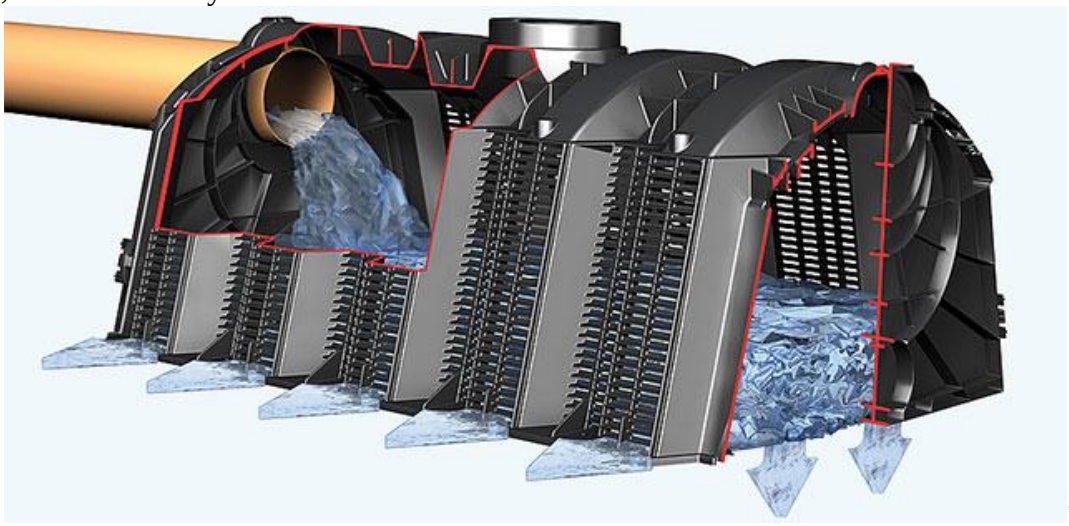
[20] http://www.esovizgyujtes.hu/media/pictures/tartalyok/files/AT112_ismerteto.pdf 2015. 06. 07.
[21] http://www.esovizgyujtes.hu/Tartalyok 2015. 06. 07.
[22] http://www.esovizgyujtes.hu/media/pictures/tartalyok/files/AT112_ismerteto.pdf 2015. 06. 07.
[23] http://www.esovizgyujtes.hu/Esovizgyujto-rendszerek 2015. 06. 07.
[24] http://ipari-szigeteles.hu/esovizgyujtes/esovizgyujtes-mukodese 2015. 06. 07.

Excess drainage

It is not by chance that there is a demand for an overflow. It is clear by our data that the roof surface will provide much larger amount of water than what we can store. This excess has to be drained.

The most practical method for this is dehydration, which refers to the seeping of the water into the soil. This is a great method, which not only drains our excess water, but also helps in with the natural water demand of plants.[25] Rainwater dehydrated under the surface level continues be stored in the soil, making this method the most preferable. In the interest of the water not causing any damage, the seeping system should be installed four to six meters from the buildings.[26]

The seeping system is built to be modular and it is made from plastic. In our case the modularity provides that it can be sized according to our needs. Of course, the longer it is built, the more evenly it can distribute the water channeled into it.

 [27]

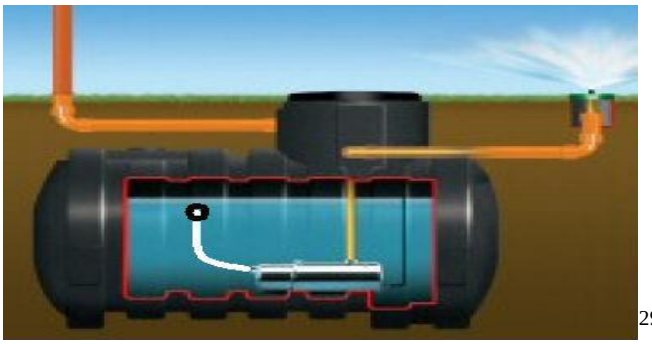
Plastic made dehydrator

The pump

Same as the previous elements, this is also an important part of the whole system. The task of the pump is to get the water where it is needed, may it be irrigation, flushing and so on. It can be installed dry or wet. In the latter it is important that the casing of the pump has to be watertight. Furthermore the pump can be automatic or manual.[28]

One of the key elements in choice making is the needed performance. It is obvious that a pump that is adequate for a home will not suffice the demand to water a football field and its vicinity. Of course the range of possible choices is wide.

[25] http://ipari-szigeteles.hu/esovizgyujtes/esovizgyujtes-mukodese 2015. 06. 07.
[26] http://www.esovizgyujtes.hu/Modern-szikkasztas 2015. 06. 07.
[27] http://ipari-szigeteles.hu/assets/images/esovizgyujtes/modern-esoviz-szikkaszto.jpg 2015. 06. 07.
[28] http://www.esovizgyujtes.hu/Szivattyuk-automatizalas 2015. 06. 07.

 [29]

Waterproof pump inside the water collecting tank

CONCLUSION

Hungary is very fortunate by the terms of hydrogeology, but this can change with time. It is beneficial to prepare for this. One method for this can be the gathering of rainwater for irrigation, flushing toilets and so on.

According to my calculations this is possible on the campus. Altogether the roof surface of two buildings would provide the annual water demand of the football field and its vicinity.

This would mean a huge investment, but the money spent would return in a few years since the irrigation and the flushing of the toilets cost a considerable amount of money every year.

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4. http://vizmuvek.hu/files/public/Fovarosi_vizmuvek/tarsasagi_informaciok/pdf/Szolgatatasok_dijszabasa.pdf
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9. http://ipari-szigeteles.hu/esovizgyujtes/esovizgyujtes-mukodese
10. 5. kép: http://www.esovizgyujtes.hu/media/pictures/tartalyok/files/AT112_ismerteto.pdf
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14. http://www.esovizgyujtes.hu/Modern-szikkasztas
15. 7. kép: http://ipari-szigeteles.hu/assets/images/esovizgyujtes/modern-esoviz-szikkaszto.jpg
16. 8. kép: http://www.esovizgyujtes.hu/media/pictures/szivattyuk/big/szivattyu02.jpg

[29] http://www.esovizgyujtes.hu/media/pictures/szivattyuk/big/szivattyu02.jpg 2015. 06. 07.