POSSIBILITIES OF UTILIZATION OF RAINWATER IN AIRPORT OPERATIONS

Lucia Dedinská - Ján Ferenc

The Task "Possibilities of utilization of rainwater in airport operations" describes a possible project and how to implement rainwater to service the airport terminal and its possible use in the technical section of the airport. In the first chapters of the theoretical part are to modify a basic facilities useful and rainwater. It is involved the legislative work site issues. In more practical part of the thesis, I will discuss the general idea proposal on the use of rainwater from the technical and financial aspects. The main point of this work is to point out the profitability of the project to reduce the cost of media in airport operations.

K e y w o r d s: Media, rainwater, total rainfall, movement area, technical equipment

1 INTRODUCTION

An important issue of this decade is the careful treatment of water resources in our area. Serious global problem, however, population growth and the increasing needs of potable water. There fore, looking for new ways the efficient use of water resources. Just use rainwater is one of the ways to protect rare and vanishing drinking water. The operation of the airport is allocated each year tens of thousands of euros, which must be paid media costs, such as electricity, heat and water. Even the airport would make it easier to get rid of one of these items. The simplest is replaced, and the nature obtains water. The weather year affords hundreds of millimeters of rainfall, which we recklessly and irresponsibly put into the sewer instead we used it to our advantage. Trapped and filtered rainwater has good and multiple uses. The utmost in service airports could be used for flushing toilets, which represents a high volume of water. In addition to toilet, rainwater can be used for watering paved and unpaved surfaces during the summer, the exercises in ZHZ and heating. In the introductory chapter I described the airport and its position in aviation, as well as the media required for its operation. In the next chapter I will pay closer description of its characteristics and water division. The subheads I missed or standards and regulations that define the requirements for withholding and potable water. In the third chapter, I looked from one part of the collection of rainwater from buildings and runways, and in the next section places the use of rainwater. Lastly I address the economic benefits of the introduction of rainwater into operation at the airport.

2 THE MEDIA NEEDED TO OPERATE THE AIRPORT

Before I started to write the main issue at work, I described the airport and its position in the aviation. I defined the airport from the construction and transport terms, its distribution and its equipment in order to perform its functions. The term media understand the elements necessary for the running of the airport. These elements we include water, electricity, heat and gas. These items may seem to us in addition to those of other financial costs as a small airport. Among the operating expenses excluding energy and consumables include the cost of services, payroll and personnel costs and other operating costs. Although energy costs and other non-storable supplies forming the largest item in the operating costs are not negligible. Bratislava Airport in 2011 defined the operating costs for an amount of more than three million. Košice Airport is seven times smaller than the Bratislava Airport and last year paid more for water than EUR 13 000. In addition to water, however, must also pay gas and heat. In my design work in this amount were given completely to minimize and even eliminate the years. The airport itself would be able to produce potable water, it needs to operate the airport. At the airport, the water is used in several areas of operation. Water is necessary for the operation of the terminal and in the summer, when high temperatures should be watered movement, and reinforced unpaved surfaces. The airport must perform regular exercises firemen. In the resulting air crash simulations used several fire trucks filled with potable water to extinguish a burning aircraft.

3 WATER AND ITS PROPERTIES AND LEGISLATION

The basic substance an underlying fulfilling life on our blue planet is water. Overall indication of water on earth is the hydrosphere. The chemical composition of water consists of 85.45% oxygen, 10.63% H, 2.06% Cl, 1.14% sodium and 0.37% nitrogen. Surface of 70% is water. Most water up to 96% is found in the seas and oceans. Residual water reserves are found in rivers, lakes, groundwater and glaciers. Just glaciers are the largest reservoir of fresh drinking-water. Processes determining the qualitative composition of natural waters are physical, chemical and biochemical nature. Outside of the properties of natural waters affects the overall landscape, population density and species and climatic conditions of the country. According distinguish water of the withholding, surface and subsurface.[1]

3.1 Properties of rainwater

Rainwater arises hydrological cycle. They occur in the liquid phase and the solid. The hydrological cycle of water is described as follows: the action of sunlight on the surface evaporates water from the oceans and the wind is shifting over land, where the cooling vaporized sea water condenses into clouds and falls as rain on the earth. Originally very pure distilled water passing through the atmosphere is slightly polluted, recruits tiny dust particles and aerosols. Picking up harmful carbon dioxide, which gets slightly acidic character and flavor. After the impact of rainwater on the roof, according to the material used acid reaction water turns slightly acidic to neutral. In terms of cleanliness is most important especially rain, drizzle and snow and precipitation quality itself. Room precipitation depends on a variety of factors, given that the earth's atmosphere is clean and contains various pollutants artificial and natural character. Rainwater before treatment although there is no drinking, but it is safe and suitable for more productive purposes than mere drinking water. For the past years has been the use of rainwater in the world recorded a single case of illness or injury caused by rain water. Rainwater has many excellent positive qualities, and for some purposes it is much more appropriate than treated drinking water:

- is soft,
- chlorine and does not osmosis,
- is warmer,
- contains no minerals
- good dissolution properties
- is distilled.[2]

Besides the positive properties using rainwater in toilets and cleaning, also has environmental benefits of its introduction into service. When heavy rain may be worse water to seep into the soil. It happens in large built-up areas. Rainwater drains quickly and unnecessarily drainage into streams. To prevent it being built detention tanks that return water to flow until it stops water surge. Such spaces built to visibly affect the appearance of the country, are expensive and collect water where it just rains and pay no it immediately drains. Excess water may slowly seep into the soil, and thus unnecessary, drainage and also happens to reduce erosion. Construction of drinking water is becoming more and more difficult. On the very densely populated areas is a chlorinated hydrocarbon, which causes problems. Well treated drinking water is becoming increasingly scarce over time. This is reflected in the high price, and decrease the lower groundwater levels in areas where water is drawn. The solution would be the introduction of rainwater, thereby reducing drinking water, people would not need such a large amount of water and ecosystems should maintain their quality.[2]

3.2 Legislative documentation for surface water

Requirements for assessment of surface water quality describes several laws, such as.:

No NV. 354/2006, laying down the requirements for water intended for human consumption and control the quality of water intended for human consumption.

No NV. 269/2010 sets out the general requirements for the quality of surface waters that serve for the assessment of surface water quality in

relation to the use of surface waters, and as the assessment of impacts on water quality.

STN 75 7221: Surface water quality.

Systematic monitoring of surface water quality is focused on stretches affected by pollution. To identify and to evaluate long-term trends in quality. And also to provide indicative data for assessing the suitability of water. Selection of sampling sites is subject to hydrological conditions, distribution of agricultural, industrial activities and settlements. Surface water quality is assessed according to STN 75 7221, which assesses water quality parameters in 8 groups from A to H. Using the system classifies water quality into five classes (I to V).[3]

It is also important Decree 397 of the Ministry of Environment of the Slovak Republic in 2003, laying down the details of measuring the amount of water supplied by public water system and the amount of water discharged. The method of calculating the amount of discharged waste water and water from surface runoff and indicative figures of water consumption. This Order provides details on measuring the amount of water supplied by public water system. It also provides the amount of waste water discharged into the public sewer system and method of calculating the amount of discharge and the method of calculating the amount of water diverted from surface runoff to sewer.[4]

4 ENVISAGES THE USE OF RAINWATER FROM SURFACE RUN OFF

The possibility of the use of rainwater runoff has virtually every building. Capture rainwater catchments area consists of roof structure or paved area from which rainwater then drain rainwater sewage pipes into a holding tank. In our conditions, rainwater only used hot water and still can replace up to 60% water needs. The average need for potable water is 150 liters per person per day, and approximately 60% of this need can be replaced by water from precipitation. Important is the replacement of drinking water for flushing toilets, representing nearly one third of the total average demand of drinking water. Here we highlight significant environmental benefits of using rainwater.[5]

4.1 Technological equipment for the use of rainwater in buildings

The collected rainwater from individual sources are generally not subjected to constant physico-chemical and bacteriological control. Compared with hot water, supplying water to public water systems must undergo such laboratory tests. Piping supplying rainwater, which has not yet been drinking or has the quality of a lower grade than the grade 1, for example, water from individual sources must be separated from the rest of the distribution. They must also be appropriately marked where the drinking-water safety device must be placed against the back flow of water. Equipment for exploiting rainwater consists of:

- underground or above-ground tanks for rainwater accumulation of concrete or plastic,
- self-priming or submersible pump to ensure the transport of water to discharge,
- filters (filter to waste piping rain, gentle swirl filter and filter shaft)
- pipelines and withholding drinking water topping water storage tank. Gentle swirling filter and filter shaft.[6]

4.2 Drainage ways aerodrome movement areas

The term dewatering understands rainwater from the runways in order to guarantee the safety of air traffic. Is used to drain the effect of gravitational forces on the collected volume of surface runoff and by transverse and longitudinal tilt lanes, rainwater gets out her part of thoroughfare. Subsequently the runoff discharged to his re-engagement in the initial cycle of the ecosystem. In this regard, in complex drainage of the road are three basic methods of technical solutions:

- surface dewatering through the sewage system,

- surface dewatering through the ditches along railroad systems,
- subsurface dewatering through the drainage system.[6]

4.3 Technical equipment runway system at abstraction and draining rainwater

Rainwater paid from the airport runway systems to be re-engage with the natural circulation of water in the environment. Recirculation of water in the water cycle is essential to protect the environment and efforts to maintain at least the current state of the surrounding ecosystem. When designing rainwater management must not forget two important factors, and it is not making flood potential options for small receiving waters and equally important factor to avoid creating water deficit in the vicinity of roads. Basic possibilities of waste by diverting rain water is discharged into surface water or groundwater discharges. In terms of pollution of rainwater, before returning them to the water cycle to adjust their status at the most competitive rates. Legislation in this regard, that the only certain limits and the water authorities have subsequently still tightening requirements which are unfortunately often negative overall impact. When rainwater management in mind in particular the legislative requirements resulting from a decision of the local authority, then consideration should be given to additional factors associated with the maintenance and operation of the installations. Rain water should be properly cleaned before being discharged. The very nature of the treatment, taking into account existing legislative requirements is the role of mechanical entrapment of harmful substances. These act as an absorber of many pollutants and much of the pollution is linked precisely to solids. At the same methods used for cleaning storm water before discharge can be divided into several basic types:

- mechanical removal of sediment and solids,
- mechanical removal of sediment and floating matter by sedimentation
- rainwater tanks,
- mechanical removal of sediment and floating matter through oil separators.[6]

5 CALCULATION OF RAINWATER IN THE AIRPORT OPERATION

In Slovakia, the average rainfall of 520 mm to 2000 mm in the High Tatras. Košice Airport is located in the Košice basin where the average annual rainfall of about 600 mm. It is true that it is not the most rainfall, the attacks on our territory, but it is appropriate to this area. It may seem to us that such an average of rainfall is insufficient to operate the airport. However, account should be taken of us even surface that will capture these deductions. The larger the catchments area of the roof, the more water can be captured and subsequently used. In 2012, the airport has fallen over the territory of 549.2 mm of rainfall. This number includes only precipitation rain. During the winter months (January, February and December) last year occurred 141 cm of snow. So the total rainfall for 2012 was 690.2 mm.

Water requirements grow, as they grow and prices for its treatment and environmental needs. Every year, rising water costs in each item. Not valid only for collection and sewage, but also for drainage of water into drains. Amount, which increases the price of water may seem petty. A few cents a year not so much, and yet the main reason for the few who are aware of. It's not just about price increases treatment of industrial waters, but mainly about the depletion of our water resources. Water recycling will play an important role in the overall water supply, because we can help conserve and sustainable manage our water resources. The main advantage of using rainwater to use them in places where there is a maximum flow of rainwater entering the sewer, or if it can be connected to a public storm sewer network. Water price includes three items manufacture and supply of drinking water, drainage and waste water treatment and distribution of drinking water for public water supply and municipal water companies. Every single item for the past five years has increased by more than 15%.

To calculate the theoretical volume of rainwater from the roof of the terminal we need to know the average annual rainfall for the site, flat roofs and rainwater runoff. Flat roof terminal at the Košice airport is 4 456 m², the average rainfall for last year was 549.2 mm / year and the outflow has a value of one. This data is substituted into the

formula, we obtain the theoretical volume of collected rainwater which is 2 447,3 m³. The money that is € 3818. Košice Airport last year consumed water in our € 8 and € 254.43 for sewer paid € 547.84, together it is 13802.27 €. The cost of building a system to collect rainwater would cost around € 2080. This figure is a rough estimate and is influenced by other factors.

6 ECONOMIC BENEFITS OF RAINWATER IN THE AIPOPORT OPERATION

To build a system for collecting rainwater in operation it is necessary to make some financial cost. Costs embedded in the construction of this system are not as high, but certainly returnable (I described in the previous chapter). In addition to the financial benefits of saving amount for payment for water, the airport received other benefits. One such reason is the political priority of Commerce independence. The airport would happen economically entities when taking hot water. Use their own water sources at the airport by traffic not dependent on water supply and supplier thus can not dictate a constantly increasing cost of water abstraction. All conditions relating to prices and increasing it as contractually agreed between the supplier and the customer. Under the contract, the supplier undertakes to deliver the goods to the customer, the matter determined by the quantity and type of customer and the customer agrees to pay the purchase price. The contract must be agreed purchase price, or must there be at least a manner of additional destination. The contract must contain all necessary information that will protect the buyer and the law and the supplier. These parties shall mutually agree on terms and conditions satisfactory to both parties. Payment terms are also noted in the contract.

7 CONCLUSION

Rainwater in our country yet still little used, and the most experience will be in Western Europe and America. This may be both still relatively lower than the price of drinking water in the world, and also lower investment costs for technology equipment for the use of rainwater as with us. In my thesis I tried to draw attention to the issue of the use of rainwater runoff from the airport building water supply. A more detailed description, analyses and takes into account how best to use rainwater in the terminal building, shows the basic layout of the deployment accumulation of rainwater tanks, describes a method for calculating the volume of water collected and the volume of the tank. Finally, it shows the calculation of the cost of building the system and the possible benefits and the resulting profit. When introducing rainwater collection system in the future at the airport will be given to the deployment of storage tank, that is near the terminal, but not to interfere in the buffer zones. In subsequent years, the price of water has a tendency to fall, and therefore the possibility of building technology to capture rainwater will be necessary in order to save on costs for water. The main content of my thesis was to propose a general conceptual description of the introduction of rainwater into the operation of the airport.

BIBLIOGRAPHY

[1] HOCMANOVÁ, Ž: The Basic Elements of the Environment and environmental risk factors. Košice, 2003. p. 128.
[2] Use of rainwater, [online 2005]. Available online at:<http://zmena-zacina-u teba.webnode.sk/news/vyuzitie-dazdovej-vody/>.
[3] STN 75 7221:1999: Surface water quality.
[4] Decree no. 397/2003, the Ministry of Environment SR of 19. September 2003. Available online at: <http://www.dalkia.sk/slovakia-energy/ressources/documents/2/42475,v_397-2003.pdf>.
[5] The use of rainwater runoff in buildings. Available online at: <http://www.asb.sk/tzb/vyuzitie-zrazkovej-vody-z-povrchoveho-odtoku-v-budovach-4531.html>.
[6] Technical conditions, Designing drainage equipment for roads, Methodical instructions.

AUTHORS´ ADDRESSES

Dedinská Lucia, Ing.
Cestice, 241, 04471
e-mail address, dedinska.lucia@gmail.com
Ján Ferenc, Ing. PhD., Technická univerzita Košice,
Letecká fakulta, Katadra leteckého inžinierstva,
Rampová 7, 04121 Košice, Email: Jan.Ferenc@tuke.sk