RESEARCH OF RAIN WATER USING POSSIBILITIES

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Abstract. Today the main problem of water handling facilities in Latvia is inadequate supply of inhabitants with clear drinking water from the centralized water supply system. In Latvia in many places there are old, worse for wear, not effective waste water collection and cleaning systems. Rain water using is in line with the strategical aims of the state: "Careful using of nature resources and safe for next generations". That solution is according to the European Union strategical aims – to decrease and optimize water and energy resources using. In the paper the focus is accentuated on description of the principles of the developed innovative rain water collection and supply system. The rain water quality, its using possibilities for households, domestic and other technical needs is explored. The developed technology will promote usage of freshwater recourses and decrease the harmful influence on environment.

Keywords: rain water, water collection, wastewater.

Introduction

In Latvia the main problems of water handling facilities are insufficient supply with clear drinking water of central water supply systems. The worse for wear, inadequate and ineffective waste water collection and treatment systems cause waste water leakage and mixing with ground water. Those problems are especially urgent in rural areas and farmsteads.

Autonomic rain water collecting, filtering and supply systems conform with the State strategical document of Latvia 2007-2013 year period projects about long-term development "Intelligent employment of nature recourses and environment saved for future generations, to harmonize economical development and using of nature recourse to national economy and social progress will be not achieved on unreasonable nature recourses and environment deterioration overcharge" [1].

These solutions are in accordance with the EU strategically aims – to decrease and optimize consumption of water and energy recourses, to ensure suitable use, avert losses of labor force, water recourses, other losses and provide suitable using of that.

In situations of unforeseeable circumstances as spring floods that happened in Latvia, Lithuania and other countries in March, 2010 flood water of melting snow can mix with waste water and fill up the ground water wells and other potable water taking places. In that case water taking places become polluted, and without special extra cleaning and boiling water is not usable for domestic needs, because that can bring on illnesses as hepatitis, other infections, bacteria and microbes (Figures 1, 2) [2].

Fig. 1. **Floods in Latvia, Zemgale region March of 2010**

Fig. 2. **Floods in Latvia**

The ground water well self cleaning process takes very long time, therefore in these situations rain water filtering, collection and using for domestic needs (without using for food) are good alternatives. Mechanically filtered rain water is in good condition for using for laundry, rooms cleaning, WC, etc.

Additional chemical filters improve the water quality and that can be usable also for bath, shower, dishwasher machine, etc. Rain water collection systems will relieve centralized potable water supply systems, so consequently all to that related resources. Potable water will be used just for drinking and cooking of food.

Management plan of the Daugava Basin Area of 2010-2015. At the moment in Latvia there are not sufficiently developed centralized water supply and sanitation systems and not enough high quality of drinking water. The direction No 8: "Long potency employment and development of environment and nature recourses". The mission is to guarantee good quality of drinking water and improve the sanitation systems. That aims are in accordance with the EU Council and Parliament directives 98/83/EK on the quality of drinking water, 2000/60/EK politics to save the water quality and 2008/105/EK standards of nature quality in the area or water recourses politics [3].

The Latvian Investment and Development Agency (LIAA) using under preferential conditions of the European Social funds (ESF) is supported by the Ltd "Terma" presented project "Autonomic water supply and heating system, using floor heating with flue gas, waste water regeneration and biological using." In the result collaboration with Rezekne Higher Education Institution (RA) Engineering Faculty (IF) Latgale Suitable Development Research Institute (LIAPI) via projects "WATERPRAXIS" and "Transfer of Nature Technologies: Rezekne University – Business companies" has been established.

Mainly wet air in Latvia is blow from the Baltic see and it ensures a high amount of rain and snow: in average per year the rainfalls are 600-700 mm. The highest amount of rainfalls is in the highland of Rietumkursa and west hillside of Vidzeme (750-850 $mm \cdot year^{-1}$). That means in Latvia it will be profitable to use rain water for domestic needs, and at the same time save wholesome underground water recourses. In many places around the world research is carried out in the possibilities of rain water collection and using possibilities [4-7]. The chemical content of rain water mostly affects the matters of ambient atmosphere. The atmosphere air quality observations in Latvia display, that mostly the air quality is in a good condition, just except few separate cases, when there are exceeded norms of sulphur, nitrogen oxide and heavy metals. But frequently in atmosphere high concentration of hard pieces and benzol is observed [8, 9].

Materials and methods

Theoretical description of innovative rain water and divided sanitation system technology development. Figure 3 describes an innovative water supply and sanitation system. Rain water of the roof surface 1 trough the collector groove 2 flows via filters of mechanical (and chemical) admixtures 3 and separate admixtures. Rain water is collected in the tank 5, that is located above the level of consumers, and guarantees water supply to consumers by power of gravitation and without electricity consumption. In the tank the rest of sediments settle. The filtered water is delivered to consumers for domestic needs (without drinking and food necessity).

The drinking water supply pipeline 4 of a separate drinking water system delivers clear water to the sink 7 for drinking and food necessities and in case of rain water deficit fills up the minimal level of the rain water tank 5. Periodically potable water of the pipeline 4 by high pressure will be used to wash up the tank 5 inside of sediments.

The water heater 6 heats up water for shower and other needs that are not related to cooking food. Water of the tank 5 will be used for the laundry machine 8, dishwasher machine 9 and other domestic needs.

In contradistinction to groundwater, rain fall water does not contain chalky minerals that have corrective influence functions of the laundry and dishwasher machine. It is not necessary to use water emollient agents. Washing detergent and powder necessary can be used considerably less. That has an impact on washing expenses, and waste water does not contain so much harmful admixtures.

The waste water sanitation system is divided in two parts. One part delivers waste water of WC to the organically polluted waste water tank 14. The second part of waste water is provided for chemically polluted waste water and delivers it to the thank 11. The mechanical filter 13 of the passageway drains the excessive water from the organically polluted waste water tank 14 to the chemically polluted waste water tank 11, were aggressive and corrosive chemically polluted water

from washing detergent, powder and other chemicals destroys and neutralizes microbes and organic pollution. The chemically polluted waste water 11 via the filter 12, that absorbs harmful chemicals, is drained to the ground. When the organically polluted waste tank 14 is full with viscous waste, it is pumped out and transported to centralized bioreactor and biogas, heat, electricity and fertilizer for agriculture are produced.

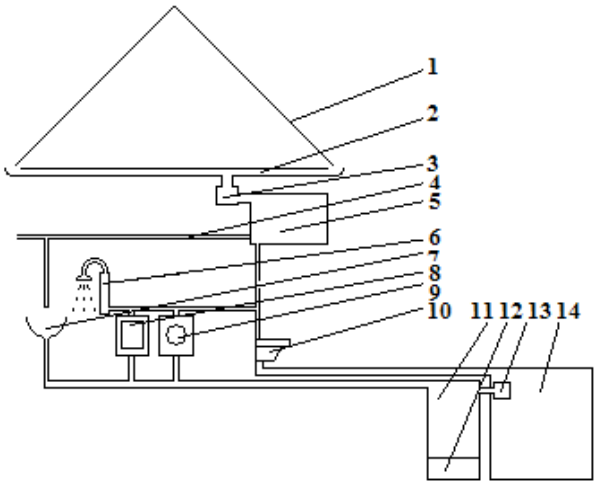

Fig. 3. **Innovative rain water and divided sanitation system:**
1 – roof; 2 – collector groove; 3 – filter of mechanical (and chemical) admixtures; 4 – clear potable water supply pipeline of centralized system; 5 – rain water tank; 6 – water heater for shower; 7 – sink; – dishwashing machine; 9 – laundry machine; 10 – WC; 11 – chemically polluted waste water tank; 12 – filter to ground; 13 – mechanical filter of passageway; 14 – organically polluted waste water tank

Description of the experimental object. An experimental object is made, that contains 63 m^2 of the outhouse plastic roof, plastic collector groove, filter of mechanical admixtures, 1 m^3 water tank, water outflow valves for different farm holding needs as washing, watering garden, etc. The rain water tank can become filled up in 2 raining days (Figures 4, 5).

To avoid the rain water quality worsening, the water tank is cowered by a special coating that stops the photosynthesis process and avoids sun heating. The pipe for watering garden is perforated and provides slow leaking to the drain off water tank if the rain will not fall longer as two weeks.

Analysis of rain water. The test samples of water were taken in March, August and December, 2009. Before elementary analysis the samples of rain water become mineralized. Detection of elements in rain water has been made with inductively coupled plasma optical emission spectrometer OPTIMA 2100 DV ICP/OES from Perkin Elmer.

Measurements of pH are done by pH meter WTW pH 323, precision ±0.02, and electrical conductivity by concentration of anion in rain water.

Fig. 4. **Rain water collection system**

Fig. 5. **Rain water collection tank**

Results and discussion

In rain water were detected the following elements - As, Ca, Cd, Co, Cr, Cu, Fe, Li, Mg, Mn, Mo, Ni, Pb, Se, Sr, V, Zn. Fig. 6 and 7 show concentration of metals in rain water by year 2009. In the samples As, Li, Mo, Se, and V were not detected, high concentration of Ca, Mg, Zn was detected (Figures 6 and 7).

High concentration of Pb, Cd, is related to pollution of atmosphere by auto transport and flue gases of burning fuel (Figure 6), rain water contains many heavy metals in urban territories.

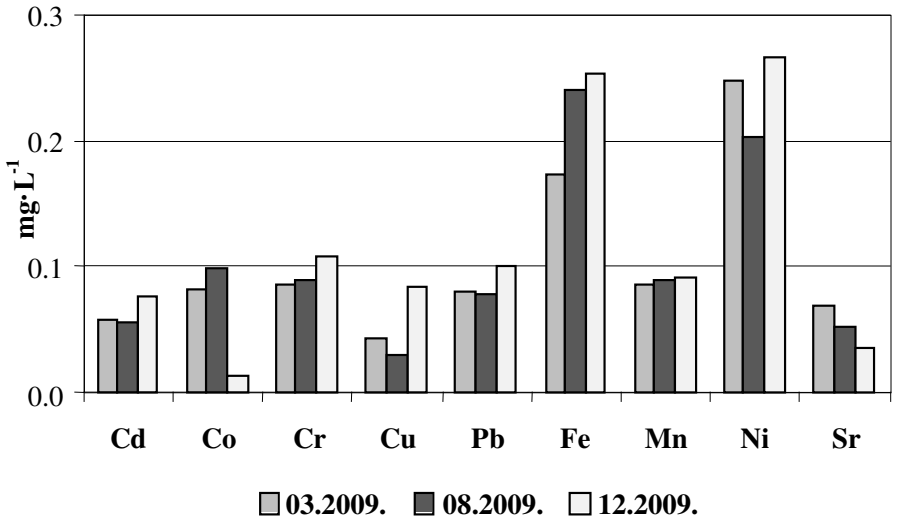

Fig. 6. **Metals in rain water**

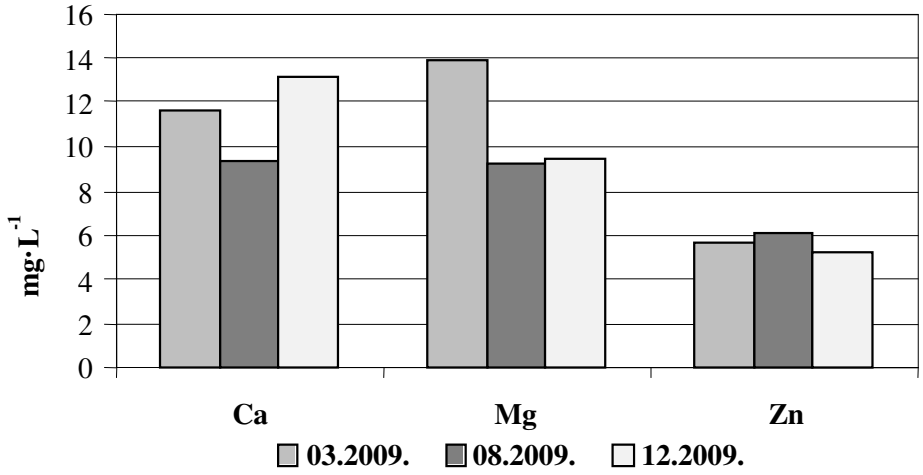

Fig. 7. **Metals in rain water**

That demonstrates that in long time without rain, on rain water collection surfaces dust sedimentation settles. The content of heavy metals is not extremely high, but it means that rain water is prohibited for using for food. After long dry time the first rain water is recommended to drain to sanitation. The electrical conductivity, pH and the content of anions has not changed substantially.

Table 1 shows average rates for water from the rain water tank. The obtained results are compared with the quality requirements of drinking water. The results show that rain water falls within the obligatory harmlessness and quality requirements of drinking water.

Application of innovative rain water collection systems. The quality of rain water (content of heavy metals, admixtures, taste, etc.) is not in accordance with the drinking water generally approved standards and norms, rain water is not allowed for use for food cooking. For domestic needs, households, garden watering, farms, bath houses, auto washing in services etc., rain water is usable. The innovative rain water collection system works by gravitation, without electricity consumption.

Table 1

Measurements of rain water quality

Measurements	Parameters of rain water	MPC for drinking water
Electrical conductivity, $\mu S \cdot cm^{-1}$	1000	2500
pH	7.6	6.5-9.5
Iron, $mg \cdot L^{-1}$	0.06	0.2
Nitrate, $mg \cdot L^{-1}$	0.2	50
Sulphate, $mg \cdot L^{-1}$	4	250
Nitrite, $mg \cdot L^{-1}$	0.036	0.5
Phosphate, $mg \cdot L^{-1}$	>2.5	-
Free chlorine, $mg \cdot L^{-1}$	0.1	-

Conclusions

1. The rain water quality is in accordance with the water obligatory harmlessness and quality requirements, and can be used as technical water for domestic needs, that are not related to food cooking.
2. In objects, where rain water using is technically and economically substantiated, that usage is welcome.

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