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Small waste water treatment plants, technologies, operation and performances

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Abstract: Waste water treatment is particularly important for maintaining a clean and healthy living environment. The waste water is understood in this context, loaded water from household activities, from industry, public institutions or to other uses. The paper proposes an overview of the most common types of treatment facilities and technology of very small capacity, currently used in Europe and the end of the paper are presented some experimental data obtained on an industrial small waste water treatment plant, subject to different operating scenarios.
Keywords: waste water, treatment, small waste water treatment plants

1. INTRODUCTION

Waste water treatment plants of very small capacity, designed for a number of 5-50 people served (small treatment plants), represent the most feasible solution for situations where, for justified reasons, cannot be made public sewer network to take over waste water or connection to such a network is too difficult. Surely this financial effort is not always justified. As an alternative for waste water treatment plants of very small capacity is vacuum channel, channel under pressure, or, in extreme cases, sealed reservoirs to collect waste water, [1], [4], [7].

Deductions arising among designers and the beneficiaries are usually related to the costs involved in such a solution (initial investment, operating and maintenance costs), and treatment performance. In reality, these treatment plants are no more sophisticated or difficult to operating than other domestic plants. Related to treatment performance, these can vary quite wide limits due to instability biological treatment step. At a correct operating, parameters fall within the limits of current norms, [7].

2. CONSTRUCTIVE TYPES OF SMALL TREATMENT PLANTS AND TREATMENT TECHNOLOGIES

Small waste water treatment plants are provided for waste water treatment from households or from other customers such as holiday homes, inns, parks, monasteries, nursing homes or military units.

Not allowed as influential water loaded with industrial pollutants, storm water, surface water, groundwater and drainage, cooling water and water from pools or sauna installations. Purified water will be discharged directly into the emissary, in the rainwater channel (case of separation system), infiltrated into the soil, respectively in groundwater layer, used as water for irrigation or other uses.

Treatment performance and how to discharge treated waste water must meet the requirements specified in the Water Law. This detail is particularly important in situations when the purified water enters in the groundwater layer (irrigations or infiltrations), a situation that involves some more detailed analysis on the effect produced on groundwater. In choosing of the discharge solution will take into account both economic factors, but also the safest option in terms of water and soil protection.

As variants of execution, small waste water treatment plants can be executed at the spot or can be prefabricated. It is recommended to design plants so as to serve more households, thus ensuring continuity and better operating performance and operating costs lower.

In choosing the site and construction of the station will take into consideration that environmental effects to be minimal (especially the smell and noise). The location will be made so as not to be affected water sources and conditions of comfort in the household (or group homes). If it requires a location close to housing will be use noise shielding of the installation and provide forced ventilation above the roof level. For over ground installations, in addition to noise protection will provide protection against freezing. Waste water treatment plants are by their nature constructions that requiring large areas of land, they need to integrate environmental landscape as enjoyable as possible.

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As technology for biological treatment, plants of very small capacity may be basins with activated sludge, with biological filters (in different versions of implementation), with accumulation, with rotating biological contactors, treatment plants with aerobic bed submerged, with a membrane filter or vegetative filter bed. Execution variants are many, starting from very simple installations with self-regulation processes, to complex installations, automated or conducted through a process computer.

Obviously, performance is influenced by both adopted treatment technology and the complexity of the installation.

The most common treatment technology adopted for small treatment plants, both to designers and operators - beneficiaries are those with activated sludge basin and those with biological filters and rotating biological contactors, [5], [7], [8], [9].

Figure 1 is a schematic diagram of the small treatment plant with activation basin. The variant proposed does not have primary decanter. This solution is often used when are making small treatment plants, the advantage that it does not retain by the primary settling, valuable biomass for the biological evolution. Primary stage is usually resumes to a drainage area, to mitigate rate shocks, and a grille or a sieve, to retain gross charges.

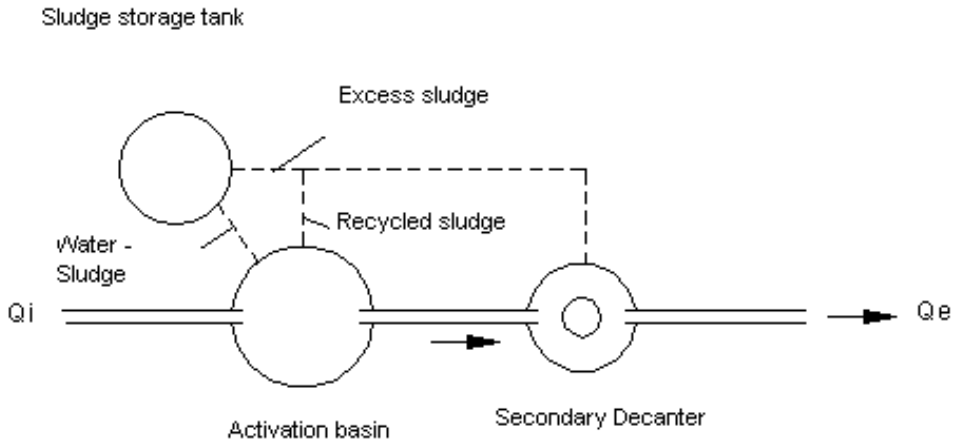

Figure 1 „Scheme of an installation with activation basin and sludge storage reservoir"

This installation is simple and can be made in monoblock version, prefabricated, except possibly the sludge storage tank. It coincides with the operation of a large capacity waste water treatment plants. For this type of small treatment plants has accumulated the largest experience in the practical implementation, operation and maintenance.

In plants with biological filter, Figure 2, the decant water is dripped over a large area of filter material on which particles is fixed a biological pellicle. Biological filters are optimally exploiting through the water recirculation. Filter material filling height will be at least 3m for a recirculation ratio r = 1, (on the maximum hourly influent flow), and at least 2m for a recirculation ratio r = 3. The primary settling these installations is mandatory. Treatment performance mentioned in the literature are very good, this type of installations being widely applied, although they can sometimes raise issues gauge construction.

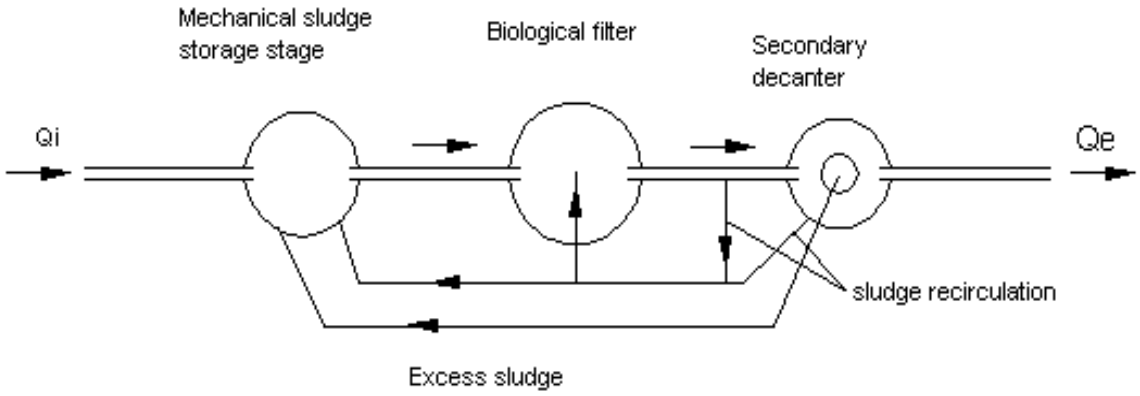

Figure 2 "Scheme of treatment installation with biological filter"

Rotating contactors consist of cylinders made of a porous material whose surface is fixed on biological membrane. These cylinders are partially immersed in

the decanted wastewater, ensuring through a slow rotation so wetting and oxygen supply of mineralizes microorganisms.

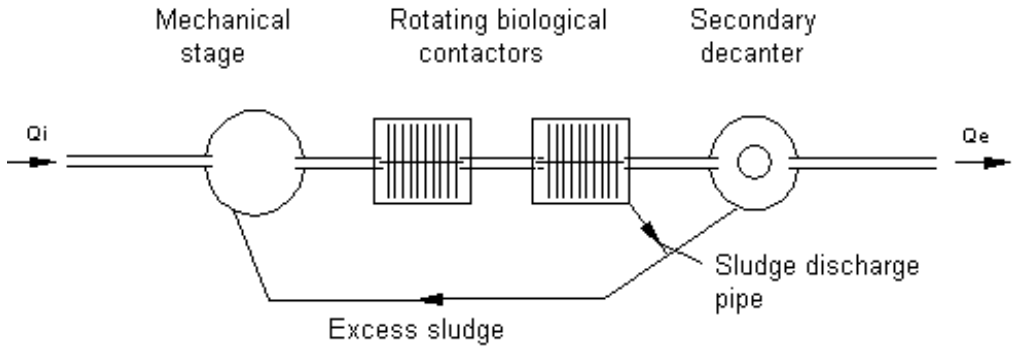

Figure 3. „Scheme of a treatment installation with rotating biological contactor"

3. CASE STUDY

In the experiments aimed to answer a small waste water treatment plant with activated sludge basin (Figure 1), a common situation in practice, namely accidental supply with clean, chlorinated conventional water. Clean water supply may intervene, [7]:

- accident, for example due to a valve defective, a float blocked, rainwater penetration into the installation and others;
- controlled, the various cleaning and maintenance operations.

Entering into the installation of clean conventional water causes dilution of the activated sludge from activation basin, dilution that lead to deteriorating biological activity. If this water contains an inhibitor, too, for example Cl, present in drinking water network, the effect will be even more pronounced.

Tests were conducted on a pilot installation, sized to serve five population equivalents; its nominal capacity is 1000 liters per day. Test duration was 90 days after the priming period.

Supply clean, chlorine water, was performed on day 30, during a cleaning and maintenance operations. The installation was fed within 24 hours, half full with clean water (drinking). Parameter pursued conduct tests was sludge index, considered as the most relevant parameter to describe the stability system. Sludge index variation is shown in the following figure in the coming days.

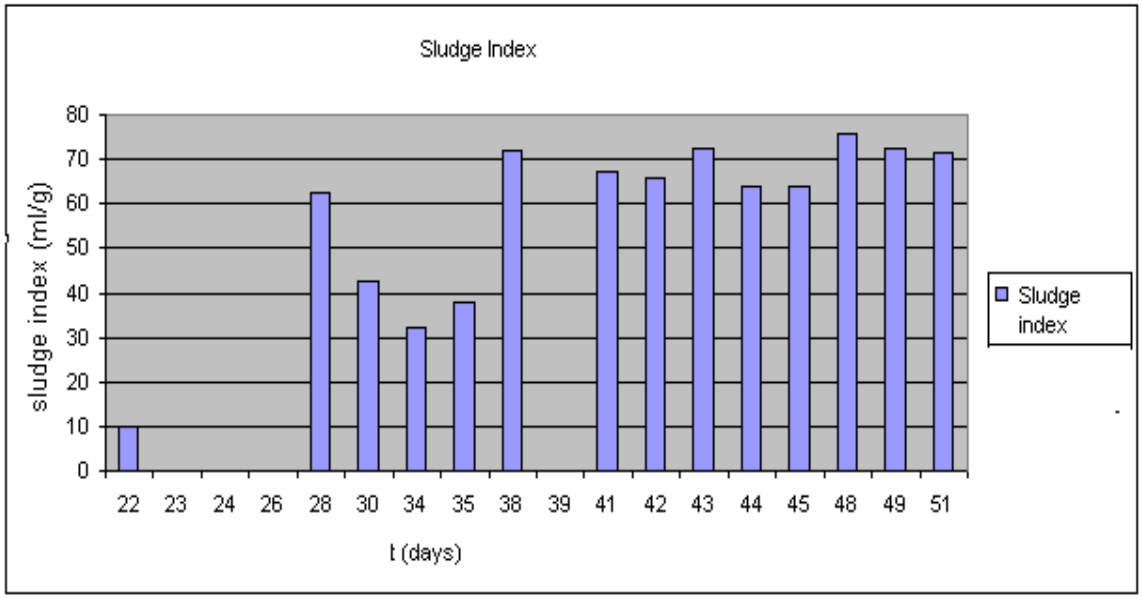

Figure 4. „Change in index of sludge after diluting activated sludge"

It can see a very pronounced decrease in the value of sludge index, from 62ml/g, to 32ml/g (i.e. about 50%); recovery time is about seven days. The other parameters analyzed have variations, which Overall, was a substantial reduction in plant performance.

FINAL CONCLUSIONS

Small waste water treatment plants are and remain an interesting alternative solution for a variety of situations and can be thought of as temporary or permanent solution.

Treatment performance is influenced primarily by operating mode, but also by the purification adopted technology. Operation and maintenance part being made by the beneficiary, it must be adequately trained and familiar with certain technical aspects of treatment technique. Also, the beneficiary must have a service network for both emergency and for periodic revisions.

Simple installations provide an easy operation and maintenance; instead treatment performance may be more modest. The automated installations, performance can be better, but the problem is the reliability and operating and service costs.

In adjustment and the initial priming and for a fair and proper operation, operational dysfunctions can be, [2], [3], [5], [6], [7], [10]:

- short-term, incidental, caused by small incidents, (as the one presented in case study), the installation parameters back to itself or require a minimal intervention of the beneficiary (operator);
- permanent, caused by major damage, in which case it takes a skilled and timely intervention.

Even if a failure occurs, regardless of its nature, should be considered in the analysis of damages, the quantity of pollutant discharged and not its concentration.

Major disadvantage of small treatment plants is the allocation of a site (its size is considerably larger than the connection pipe chamber), in the manner of discharge of treated waste water and treatment sludge removal.

As a temporary solution, the financial effort is still high and decommissioning and disposal installation, involves additional expenses.

REFERENCES

[1] Carabeț, A., Mirel, I., Florescu, C., 2000, „Considerații privind epurarea apelor uzate din mediul rural”, Analele Universității din Oradea, Fascicolul “Protecția mediului”, Tom V, partea a II-a.

[2] Ehrhardt, Martin, 1994, „Kostengünstige Eigen- und Fremdüberwachung bei dezentralen Anlagen– Schriftenreihe zur Wasserwirtschaft, Ländlicher Raum: Abwasserentsorgung in der Sackgasse?“, Band 12, Technische Universität Graz, Graz, Mai.

[3] Fink, Reinhard, 1994, „Wartung-, Eigen- und Fremdüberwachung von Kleinkläranlagen – ein Praxisbericht – Schriftenreihe zur Wasserwirtschaft, Ländlicher Raum: Abwasserentsorgung in der Sackgasse?“, Band 12, Technische Universität Graz, Graz, Mai.

[4] Goldberg, Bernd, 2004, „Kleinkläranlagen heut“, Hoss Media, Verlag Bauwesen GmbH, Berlin.

[5] Kainz, H., Kauch, P., E., Renner, H., 2002, „Siedlungswasserbau und Abfallwirtschaft”, Editura Manz, Viena.

[6] Mölbach, Erling, 1994, „Erfahrung mit der Umsetzung dezentraler Lösungen auf Gemeindeebene – Schriftenreihe zur Wasserwirtschaft, Ländlicher Raum: Abwasserentsorgung in der Sackgasse?“, Band 12, Technische Universität Graz.

[7] Stăniloiu, C., 2006, Teză de doctorat „Contribuție la optimizarea proceselor de epurare la instalațiile de capacitate mică”, Universitatea Politehnica din Timişoara.

[8] Stăniloiu, C., Ştefănescu, C., Gîrbaciu, A., 2009, „Trends and Recommendations for Adoption of Purification Technologies for Small Waste Water Treatment Plant”, Buletin Ştiințific UPTimişoara, seria Hidrotehnică, tomul 54(68), fascicola 1.

[9] Stăniloiu, C., Achim, C., 2007, „Microstațiile de epurare. O soluție pentru mediul rural”, Asociația generală a inginerilor din România, Buletin AGIR – Calitate, Mediu, Securitate Ocupațională – Anul XII, nr. 2.

[10] Stăniloiu, C., Ştefănescu, C., Borbely, B., Murariu, M., 2010, „Reliability of small waste water treat plant”, Buletin Ştiințific UPTimişoara, seria Hidrotehnică, tomul 55(69), fascicola 1,2.