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REDUCING THE SLUDGE QUANTITY PRODUCED FROM USED WATER PURIFICATION – A SOURCE OF PROFIT

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ABSTRACT

This paper has its origins in the analysis of a real situation met in the Water Purification Plant from Cluj-Napoca city. The produced dehydrated sludge is about 70 - 80 tonnes / 24 hours, with a density that allows for an equivalence of 1 tonne to 1 m³, 80,000 Kg or 80 m³, i.e. a huge amount and an impressive volume of material. This paper does not propose solutions to valorise or store the huge quantity of sludge, though the present solutions are quite inefficient. The stress is placed upon the sludge production sources, its transportation to the purification plants, the collection of the sludge in the purification plants and the dehydration methods that can be used. The analysis of these stages aims at identifying several measures that could lead to diminishing the amount of sludge produced after the purification of used and dehydrated water in the purification plants without affecting the quality of purified water. The measures identified are to be presented as measures that can be applied in the spirit of sustainable and efficient development. The business feature is given by the savings brought by the mitigation of the sludge amount to be stored and paid for in the ecological storage places in remote areas.

KEYWORDS: sludge, dehydration, reduction of amount, thickening, purification, expenses, profit

1. Introduction

The main source of sludge is the used water that reaches the purification plant through the sewers.

The types of materials reaching used water are:

- Toilet paper, a material that is dissolved in the toilet water, then reaches the purification plant and contributes to sludge formation;
- Small size food remains, thrown in the toilet;
- Naturally falling hair or hair coming from people who prefer to cut their hair in the bathroom;
- Debris, coming from dwelling repairs;
- Rests of sauerkraut or pickles, thrown in the sewers in spring;
- Leaves and vegetal rests from the autumn or spring garden and court cleaning;
- Cut and minced grass found after using the lawnmowers;
- Faeces from stock raising units;
- Metal and mud remains of industrial origin.

2. Experimental

2.1. An approximate calculation of the quantity of materials that normally should not reach the sewage system

Toilet paper:

Q_1 = n x q x z = 400,000 x 30 x 365 = 4,380,000 000 cm/year

4,380,000,000 cm: 200 cm = 21,900,000 toilet paper rolls per year

21,900,000 x 40 g = 876,000,000 g/year = 876 tonnes/year

where:

Q_1 = the overall amount of toilet paper reaching the system;
n = the number of inhabitants;
q_1 = the toilet paper consumption per one day;

z = the number of days used for the evaluation.

Debris and rests from the repairs of dwellings – get in the sewage system after tools and buckets used are cleaned and after intentionally throwing the debris in the toilet or directly in the street manhole:

Q_2 = n x q x z = 400,000 x 50 g x 365 = 7,300,000,000 g/year

Q_2 = 7,300 t/year

where:

Q_2 = the overall amount of debris thrown in the system in one year;
n = the number of inhabitants;
q_2 = the total amount of debris thrown by one inhabitant in the sewage system;
z = the number of days used for the evaluation.

Food remains (bread, rests, coffee grounds etc.) get in the kitchen sinks during dish washing or as they are intentionally thrown in the toilet:

Q_3 = q x n x z = 10 g x 400,000 x 365 = 1,460,000,000g = 1,460 t/year

where:

n = the number of inhabitants;
q_3 = the total amount of food remains thrown by one inhabitant in the sewage system;
z = the number of days used for the evaluation.

The figures do not represent very exact quantities because this phenomenon cannot be accurately measured and stopped.

In this paper, the authors intend to make an analysis of this phenomenon starting from the reality of several areas in Romania and to propose a coherent strategy to inform the population and to change the legislation so that the phenomenon could be eventually controlled.

The sludge produced after the purification of the used water remains after dehydration with a consistency of 20 - 25 % SU (Dry substance, including all the organic and inorganic substances found in the sludge at the moment of evaluation).

The volatile substances are those substances that define the organic content of used water.

The concentration of the activated sludge in the dry substance can vary in a wide range from 0,5 to 10 g/l, as commonly the activated sludge plants present a dry substance content of 1 - 4 g/l suspension. A good activated sludge (i.e. the sludge prepared to have a contribution in the biological purge of the used water) contains about 75% volatile substances.

The preparation of the sludge consists in populating it with bacteria that biologically decompose the compounds in the used water.

Bacteria can be grown in the purification plants or can be brought in activated sludge from other purification plants in use.

The calcination residue, that is what remains from the dry substance after burning in a kiln at a temperature of 600 - 800 °C, contains mineral salts and oxides of common elements from the used water which are also necessary for the growth of microorganisms.

In general, one can find: potassium (K), sodium (Na), magnesium (Mg), iron (Fe), aluminium (Al), chlorine (Cl), phosphorous (P) and other elements, in relation with the amount of water used. Among the elements the form the organic substance of the activated sludge, one can list: carbon (C), oxygen (O), hydrogen (H) and nitrogen (N).

The cellular components can take the following forms: proteins - about 60%, nucleic acids - approximately 15%, glucides/carbohydrates - 20% and lipids - 5%. Very well spread bacteria found in the activated sludge (Escherichia coli) contain between 3000 - 6000 types of molecules, of which half are small sized molecules (glucides, aminoacids, organic acids, phosphoric esters), while the rest contain 1500 - 3000 types of macromolecules (complex glucides, glucide precursors, complex lipids, proteins, ADN, ARN) [1-4].

This short description of the structures of the sludge wants to highlight the sludge content and to identify the materials in its composition.

2.2. Proposed business

A collaboration with all the companies that are concerned in the proper management of the sludge is proposed.

By presenting arguments based on measurements and filed observations, the companies could be convinced to invest in developing and promoting a strategy to inform and educate the population so that the amount of sludge from the purification plants could diminish by reducing the quantity of rests that are not allowed to be thrown in the sewage system.

Companies that could be concerned to promote this strategy:

- Producers of sludge and owners of purification plants, respectively.
- Agencies concerned with the environment protection.
- The administrations of the cities, towns and villages that possess drainage systems in their areas.

- The population that can be interested to find that the cost of 1 cubic meter of used water can be reduced.

2.3. Main benefits

The benefits from the application of this strategy can be quantified in the effect it could have upon the behaviour of the population relative to the collection of the used water and the further on expenses related to the purification of the used water. When the population is educated to properly use the very precious natural resource which is *water* facilitates the work of those concerned with water preparation, distribution, collection and significantly diminishes the costs related to this activity.

2.4. Defining the profit

Estimated costs:

a. Expenditures related to visiting the interested parties – 8,000 lei/year.

b. Expenditures to organise meeting to inform the population – 10,000lei/year.

c. Expenditures to print informative brochures and to produce educational films 100,000 lei/year

Financing sources:

The main financing source is provided by the interested parties: sludge producers and local authorities.

The project can also be funded by applying for a European financing, in the field of" Environment protection".

Estimated gains:

The finances found from diminishing the amount of dehydrated sludge amount.

A 20% reduction of the quantity of sludge produced in 24 hours means for the Purification plant of Cluj Napoca 16 tonnes/24 hours.

The cost paid to ecological dumps is about 250 lei/tonne.

$E_{ec} = q \times p = 16 \times 250 = 4{,}000$ lei/day = 1,460,000 lei/year

where:

E_{ec} = total saving.

q = sludge quantity not produced anymore, after implementing this strategy.

p = the cost paid to ecological dumps.

In this specific case, the profit is calculated by making the difference between the required investments to efficiently promote the strategy and the gains of the sludge producers.

The initiator and coordinator of this strategy can draw funding contracts with the interested parties, which are to be negotiated as a percentage of the profits of each company in this field.

3. Conclusions

The business proposed is mainly based upon the idea of contacting the interested parties, by informing them on the opportunity of running a study in this respect for each individual area and of convincing them to take part and finance such a project.

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