СЕКЦІЯ 7 – ПЕРЕРОБКА ТА УТИЛІЗАЦІЯ ПРОМИСЛОВИХ І ПОБУТОВИХ ВІДХОДІВ. СУЧАСНІ ЕКОТЕХНОЛОГІЇ ВОДООЧИЩЕННЯ І ВОДОПІДГОТОВКИ. ІНТЕГРОВАНЕ УПРАВЛІННЯ ВОДНИМИ РЕСУРСАМИ. АЛЬТЕРНАТИВНІ (ВІДНОВЛЮВАЛЬНІ) ДЖЕРЕЛА ЕНЕРГІЇ ТА ЕКОЛОГІЧНО БЕЗПЕЧНИЙ ТРАНСПОРТ

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HOW TO CHOOSE SMALL WASTEWATER TREATMENT PLANT?

Annotation. The paper presents a methodology of choice of a small wastewater treatment plant for single homesteads or facilities serving up to 50 people. The selection criteria were divided into 4 groups: technical, environmental, social and economic. They depend on who is the decision maker: a private owner or commune authority. Appropriate calculators in the form of Excel spreadsheets are recommended to be used during appraisal procedure.
Key words: Sewage, life cycle analysis, on-site treatment, decentralized sanitation

1. Introduction

In many countries all over the world there are unsewered areas in which small individual wastewater treatment plants (WWTPs) and/or holding tanks are operated to protect human health and surrounding environment. Soil or surface water can be used as a receiver of the on-site treated wastewater. There are several technologies and plenty of the on-site (up to 50 inhabitants) plant constructions. The proper choice of such a plant is not easy as it depends on many site specific factors and applied equipment [1]. In the literature and internet one can find relevant information and adequate tools to solve this problem, however there is also plenty of disinformation.

In the years 2016-19 a development project VillageWaters, leading by Natural Resources Institute LUKE (Finland), focusing on wastewater treatment in sparsely populated areas was carried out. The project was funded (3 million EUR) by the Interreg Baltic Sea Region Programme 2014-2020, which supported integrated territorial development and cooperation for a more innovative, better accessible and sustainable Baltic Sea Region. Six countries were involved in the project: Estonia, Finland, Latvia, Lithuania, Poland and Sweden. As a result Wastewater Guidelines [6] and computerized Information Tool were created. The Information Tool is a small database concerning available technologies and costs under conditions of the above mentioned countries.

Another tool, the EVAS (EVAluation of Sustainability), has been recently developed in the frame of Ph. D. study at Chalmers University of Technology (Sweden) by C. Cossio [2]. Its description is illustrated with some Bolivian examples. A similar, but simpler, approach was proposed earlier by Błażejewski and Mazurkiewicz [1], illustrated by an assessment of 5 types of WWTPs under Polish conditions.

The goal of this paper is to discuss selection methodologies and compare current decision-support tools concerning small WWTPs in unsewered areas.

2. Main selection criteria

Selection criteria depend on who is the decision maker: a private owner or commune authority? The selection criteria can be divided into 4-5 groups, e.g.:

a) *Technical* – is the site (plot) located further than 30-40 m from the nearest existing or planned sewer?; What are the soil-groundwater conditions? Is there a sufficient area to construct soil dispersal system (min. 10 m^2 per person)? Is the selected technology well established and credible?

b) *Environmental* – is the site located in a protection zone? To what degree the sewage must be treated? Is the technology energy consuming?

c) *Social* – is the treatment system accepted by potential users and their neighbors? Is it possible for later users to participate in the plant construction and thus reduce investment costs? Does it generate new jobs?

d) *Economic* – Are the users willing to pay for construction, operation and maintenance? Is it possible to utilize existing wastewater holding tanks as septic tanks of bioreactors? Is it possible to reuse the treated wastewater?

The list of questions can be much larger, as in the questionnaires presented in EVAS [2]. The EVAS assessment procedure is based on a set of sustainability indicators and sub-indicators in five dimensions (technical, environmental, social, economic, institutional). Each indicator or sub-indicator is scored using a traffic light scale (0 to 4) indicating unsustainable-low-medium to high levels of sustainability.

A selection procedure of on-site WWTP with a soil absorption system using an analytical hierarchy process (AHP) was presented by Hämmerling and Spychała [4]. To select the best option out of four ones they considered two criteria: the treatment system and receiver conditions. The analyses were based on certain attribute values, consulted earlier with decision-makers' or the usefulness of average values obtained from appraisals performed by several independent specialists.

3. Software tools and their comparison

The EVAS tool is freely available in the form of the Excel® spreadsheet. It provides tables and radar plots which help to interpret the calculation results.

Life Cycle Impact can be assessed with different methods: e.g.: ReCiPe, Ecological Footprint or IPCC GWP 100 years [3,5]. Since 2007 GreenDelta has developed a computer platform openLCA – now the world's leading, open source and free software for Sustainability and Life Cycle Assessment. A repository for LCA and sustainability data world-wide, Nexus, includes a lot of databases such as ecoinvent ReCiPe. ReCiPe and Ecological Footprint are multi-parametric methods which take into account many environmental aspects in the calculation of the impacts. ReCiPe combines a problem-oriented (midpoint level) approach with a damage-oriented approach (endpoint). The Ecological Footprint method calculates the amount of productive land and water required by a population to produce the resources it consumes and to dispose of the wastes. The IPCC GWP 100 years indicator is based on the factors of climate change over a period of 100 years, considering the gaseous emissions input in the greenhouse effect.

Comparing the above mentioned tools it can be stated that the calculators in the form of Excel spreadsheets are more transparent and quick in operation than the sophisticated platforms dedicated to LCIA. The former are recommended for potential individual users and designers. The latter, more sophisticated LCIA tools are more appropriate for scholars, generalist and environmental policy makers.

4. Conclusions

In unsewered areas, the priority is to build a collective sewerage system; if it is not justified from environmental or economic reasons, individual small WWTPs shall be used.

Small WWTPs should be as simple and robust as possible. Their impact on environment and costs should be minimized.

Appropriate calculators in the form of Excel spreadsheets are recommended to be used during appraisal procedure.

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NATURAL AND ARTIFICIAL ELECTROMAGNETIC FIELDS AND HEALTH RISK: A REVIEW

Abstract. The article discusses natural and artificial electromagnetic fields (EMF). Based on the literature, it describes the changes that have occurred with the technological development in the world, with the increase of artificial sources. It also confronted the myths that have grown up around radiation-imitating devices, including 5G technology. Possible adverse health effects were presented based on information from the World Health Organization. Meanwhile, the measurement principles and acceptable standards were discussed using the example of EMF monitoring in Poland.

Key words: electromagnetic field (EMF), 5G, environmental monitoring

Introduction

An electromagnetic field (EMF) is a state of a combination of electric and magnetic fields. It has existed naturally since the beginning of the universe. Humans also come into contact with the Earth's natural electromagnetic field, electrical discharges, and cosmic phenomena daily. The vital functions of organisms are also the source of the electromagnetic field [4].

With the development of human civilization, an artificial electromagnetic field has emerged. It is present during electricity transmission in high-voltage lines and radio waves during wireless communications. Depending on its use, EMF has different parameters, consisting of frequency and wavelength [8]. Figure 1 shows the types of electromagnetic fields, starting with gamma radiation in the wavelength range of 1 pm to 10 pm and ending with radio waves in the range of 1 Hz to 300 GHz [3].

Effects of Electromagnetic Fields on the Health of Living Organisms

Since the early 19th century, the surrounding infrastructure that emits electromagnetic fields has begun to interest scientists in whether and how it affects the health of living organisms. With the increasing number of radio stations, cell phones, microwave ovens and radar devices, the topic of negative impact began to gain momentum. Knowledge of negative impact is based on many scientific and epidemiological studies [5].

Additionally, the World Health Organization reports that humans can protect and adapt to physical and biological effects. However, the problem arises with electromagnetic halves above certain levels; they can cause irreversible health changes. Over the past 30 years, more than 25,000 articles have been published on the adverse effects of non-ionizing radiation. Many studies confirm that continuous exposure to low-level electromagnetic fields does not contribute to the deterioration of human health [10].

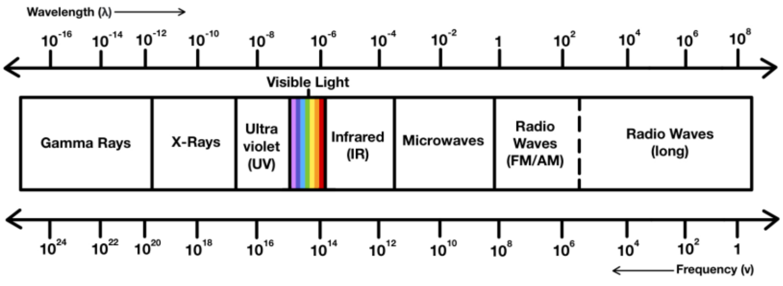

Fig. 1. **Types of radiation in the electromagnetic spectrum [2]**