**ОДЕСЬКА НАЦІОНАЛЬНА АКАДЕМІЯ**
**ХАРЧОВИХ ТЕХНОЛОГІЙ**

# ЗБІРНИК
# НАУКОВИХ ПРАЦЬ
## *МОЛОДИХ УЧЕНИХ, АСПІРАНТІВ ТА СТУДЕНТІВ*


**ОДЕСА**
**2017**

ББК 36.81 + 36.82
УДК 663 / 664



**Одеська національна академія харчових технологій**
Збірник наукових праць молодих учених, аспірантів та студентів
Міністерство освіти і науки України. – Одеса: 2017. – 357 с.

Збірник опубліковано за рішенням вченої ради від 04.07.2017 р., протокол № 17
За достовірність інформації відповідає автор публікації

РОЗДІЛ 6

# СОЦІАЛЬНІ ТА ЕКОЛОГІЧНІ АСПЕКТИ СУЧАСНОЇ ЖИТТЄДІЯЛЬНОСТІ

**Literature**

1. Zlotnikov A.K. Albit biopreparation for crop improvement and crop protection – Podolsk, PFOP, 2006.
2. Nazarov A.V., Hilarionov S.A. Potential for using microbial-vegetative interaction for bioremediation // Biotechnology. – 2005, – No. 5.

## TESTING OF CO-VERMICOMPOSTING OF A FAT-CONTAINING SEWAGE SLUDGE AND WASTE ACTIVE SLUDGE

**Chernyshova O.O., PhD student of the Faculty AEEnOGT**
**Odessa National Academy of Food Technologies, Odessa**

In conditions of maintaining at the appropriate level environmental safety of the country, a special problem is the utilization of sediment, sewage and sludge from municipal wastewater treatment and industrial purification facilities. Sediments are classified according to the place of their accumulation. The primary sediment is formed in the primary settler; it mainly consists of solid fractions settled by gravity. The primary untreated sediment has an unstable component composition and a sharp unpleasant odor. Secondary sediment is formed as a result of the purification operation. In most cases, secondary sediment is a waste activated sludge from aerobic reactors and biofilters. The secondary sediment, in contrast to the primary one, has a less severe odor, but there is also instability component composition. The third type of sewage sludge mainly consists of inorganic substances such as clay, lime; organic constituent of the sediment is insignificant and unstable. The latest one is a sediment from an anaerobic bioreactor; it is a flocculated biomass, which composed of bacteria and various protozoa. In Ukraine, the main way to eliminate sewage sludge is to burial in the ground. However, due to sediment composition, this method becomes inexpedient because of the risk of further contamination of the environment with a variety of organic substances, heavy metal ions and pathogenic microorganisms.

The aim of this work is to study the efficiency of utilization of waste active sludge from an anaerobic reactor and a fat-containing sewage sludge of a meat processing plant by the vermicomposting.

During the first stage of the study, the wastewater was digested with a periodic UASB reactor (Upflow Anaerobic Sludge Blanket reactor) with a total volume of 50 $dm^3$. The operation of the reactor was carried out with compliance with a thermophilic temperature regime (35–39 °C); the period of anaerobic fermentation of wastewater was 22 days. In the second stage of the study, the sludge from the primary wastewater treatment from the settler and waste sludge from the laboratory UASB reactor was mixed with the addition of cellulosic filler. The purpose of adding cellulosic filler is improving the structure of the substrate and step up removal the gases, which formed from the decomposition of organic substances (ammonia, hydrogen sulphide, methane).

**Table 1 - Population parameters after exposure**

| Parameter | Unit | Weight ratio of sewage sludge and waste active sludge | | | Control |
|---|---|---|---|---|---|
| | | 1:1 | 2:1 | 1:2 | |
| Density of population | animal unit/$cm^3$ | 7 | 8 | 8 | 8 |
| Total biomass | g/$dm^3$ | 25.9 | 27.31 | 30.22 | 23.97 |
| Total number of cocoons | units/$dm^3$ | 39 | 59 | 47 | 64 |
| Specific weight of the worm | g | 0.3 | 0.27 | 0.23 | 0.25 |

Sewage sludge and waste active sludge were mixed in a weight ratio of 1 : 1, 2 : 1 and 1 : 2. As a control sample, the vital activity of the culture in the soil was monitored. Substrates were to be processed by vermicomposting with compost worm culture *Eisenia foetida* for 36 days at a temperature of 22–25 °C. The wetness of the substrates was regulated at a level of 65–75 % under neutral pH conditions. Important parameters of the technology of vermiculture of sediments is the increase of worms biomass of and the increase their population. These data indicate to the rate of culture adaptation to the fat-containing substrate, the degree of destruction of resistant to oxidation organic substances in the sediments, and the advisability of further processing of the waste substrate. The results of the study of the population parameters at the beginning and at the end of the exposure are shown in Table 1. Changes in the physicochemical parameters of the substrates is given in Table 2.

Ammonium compounds inhibit biomass of vermiculture, therefore, studies were carried out after preliminary stabilization of substrates for 15 days with additional aeration every 30 hours in order to remove ammonia gas bubbles. According to the results of the research, it was revealed that the adaptation of worms was completed in the period of 20–25 days of exposure, from this time the mature individuals began to lay cocoons with future generation. Thus, the most favorable culture medium is a substrate with a weight ratio of a mixture of sewage sludge and waste active sludge of 2 : 1, the number of cocoons is 59 units, which is higher by 33 % and 20 % than in the first and third substrates, respectively. In the control sample, the culture quickly adapted to the substrate, during the first week there was active worms growth changed by a sharp dying out at the beginning of the third week, probably due to a lack of nutrients.

**Table 2 – Physicochemical characterization of substrates**

| Parameter | Unit | Weight ratio of sewage sludge and waste active sludge | | |
|---|---|---|---|---|
| | | 1:1 | 2:1 | 1:2 |
| pH | – | 7.1 | 7.0 | 7.12 |
| | | 7.0 | 6.53 | 6.81 |
| Degradation of organic substances | % | 55 | 57 | 63.5 |
| Total fat content | $mg/m^3$ | 1286 | 1649 | 1005 |
| | | 633 | 647 | 469 |
| Total bacterial counts | – | $1.65\times10^6$ | $1.8\times10^6$ | $2.57\times10^6$ |
| | | $5.4\times10^5$ | $1.34\times10^5$ | $3.58\times10^5$ |
| Total fecal coliform and E. coli | – | Not detected | Not detected | Not detected |
| Humic acids production | % | 1.62 | 1.55 | 1.65 |

Based on the results of a study of the physical and chemical characteristics of substrates, the highest degradation of organic substances, according to the decrease in the COD (chemical oxygen consumption) index, is 63.5 % in the third substrate, which indicates the presence of biomass washout from the anaerobic reactor. The results of the degree of bioconversion of organic compounds in the first and second substrates are 55 % and 57 %, respectively. These data correlate with the results of a reduction in the total amount of fats in the substrates. According to the results of the study of hygienic characteristics, the total bacterial counts decreased 3 times in the first substrate, 13 time in the second and 7 times in the third substrate respectively; the units of total fecal coliform and *E. coli* were not detected in any sample. According to the results of previous studies, the yield of humic acids in the fat-containing substrates after vermicomposting is 0.3–1.55 %. Meanwhile, it is not enough to

use its as organic fertilizers with a high content of biohumus. Biomass of vermiculture can be used as raw material for the production of fodder protein flour, veterinary medicine preparations, ophthalmic preparations, cosmetic additives, etc.

Based on the results of the research, it can be stated that co-vermicomposting of fat-containing sewage sludge and waste active sludge from UASB reactors is effective with an optimum component ratio of 2 : 1. If the proposed method of sludge utilization is applied, the total amount of waste is reduced and vermiculture can be used as biological additives to fodders.

Scientific supervisor – Doctor of technical sciences, Professor Krussir G.V.

## BIOLOGICAL METHODS OF SEWAGE TREATMENT

**Boyko V.V., Strochkovska E.A., students of the Faculty of applied ecology, energetics and oil and gas technologies**
**Odessa national academy of food technologies, Odessa**

Biological treatment is an important and integral part of any wastewater treatment plant that treats wastewater from either municipality or industry having soluble organic impurities or a mix of the two types of wastewater sources. The obvious economic advantage, both in terms of capital investment and operating costs, of biological treatment over other treatment processes like chemical oxidation; thermal oxidation etc. has cemented its place in any integrated wastewater treatment plant. Biological treatment using aerobic activated sludge process has been in practice for well over a century. Increasing pressure to meet more stringent discharge standards or not being allowed to discharge treated effluent has led to implementation of a variety of advanced biological treatment processes in recent years. The title of this article being very general, it is not possible by any means to cover all the biological treatment processes. It is recommended that interested readers, for deeper reading and understanding, refer to well-known reference books e.g. Wastewater Engineering by Metcalf & Eddy etc. This article briefly discusses the differences between aerobic and anaerobic biological treatment processes and subsequently focuses on select aerobic biological treatment processes/technologies.

Before we go in to the discussions of various aerobic biological treatment processes, it is important to briefly discuss the terms aerobic and anaerobic. Aerobic, as the title suggests, means in the presence of air (oxygen); while anaerobic means in the absence of air (oxygen). These two terms are directly related to the type of bacteria or microorganisms that are involved in the degradation of organic impurities in a given wastewater and the operating conditions of the bioreactor. Therefore, aerobic treatment processes take place in the presence of air and utilize those microorganisms (also called aerobes), which use molecular/free oxygen to assimilate organic impurities i.e. convert them in to carbon dioxide, water and biomass. The anaerobic treatment processes, on other hand take place in the absence of air (and thus molecular/free oxygen) by those microorganisms (also called anaerobes) which do not require air (molecular/free oxygen) to assimilate organic impurities. The final products of organic assimilation in anaerobic treatment are methane and carbon dioxide gas and biomass.

Conventional Activated Sludge Process (ASP) System: This is the most common and oldest biotreatment process used to treat municipal and industrial wastewater. Typically wastewater after primary treatment i.e. suspended impurities removal is treated in an activated sludge process based biological treatment system comprising aeration tank followed by secondary clarifier. The aeration tank is a completely mixed or a plug flow (in some cases) biore-

Наукове видання

# Збірник наукових праць молодих учених, аспірантів та студентів

Головний редактор акад. Б.В. Єгоров
Заст. головного редактора, канд. техн. наук Н.М. Поварова
Відповідальний редактор акад. Г.М. Станкевич
Технічний редактор Т.Л. Дьяченко