Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Biomedicine

journal homepage:www.elsevier.com/locate/apjtb

Document heading

Prospects of effective microorganisms technology in wastes treatment in Egypt

Emad A Shalaby*

Biochemistry Department, Faculty of Agriculture, Cairo University, Giza, Egypt, 12613

ARTICLE INFO

Article history:
Received 15 January 2011
Received in revised form 18 February 2011
Accepted 10 March 2011
Available online 30 March 2011

Keywords:
Effective microorganisms
Wastes treatment
Egypt
Sludge dewatering
Wastewater
Pollutant
Organic matter
Decomposition
Bacteria
Contamination

ABSTRACT

Sludge dewatering and treatment may cost as much as the wastewater treatment. Usually large proportion of the pollutants in wastewater is organic. They are attacked by saprophytic microorganisms, *i.e.* organisms that feed upon dead organic matter. Activity of organisms causes decomposition of organic matter and destroys them, where the bacteria convert the organic matter or other constituents in the wastewater to new cells, water, gases and other products. Demolition activities, including renovation/remodeling works and complete or selective removal/demolishing of existing structures either by man-made processes or by natural disasters, create an extensive amount of wastes. These demolition wastes are characterized as heterogeneous mixtures of building materials that are usually contaminated with chemicals and dirt. In developing countries, it is estimated that demolition wastes comprise 20% to 30% of the total annual solid wastes. In Egypt, the daily quantity of construction and demolition (C&D) waste has been estimated as 10 000 tones. That is equivalent to one third of the total daily municipal solid wastes generated per day in Egypt. The zabbaliin have since expanded their activities and now take the waste they collect back to their garbage villages where it is sorted into recyclable components: paper, plastics, rags, glass, metal and food. The food waste is fed to pigs and the other items are sold to recycling centers. This paper summarizes the wastewater and solid wastes management in Egypt now and future.

1. Introduction

Environmental management, wastes recycling, treatment and disposal, pollution control and prevention and wastewater reuse became the most important issues and in the top of the global agenda[1]. Waste water usually can be processed for disposal or recycling by one or more steps. The first step, usually, is the preliminary and primary treatment, which is physico-chemical treatment. Because of the objection properties of the effluent, the secondary treatment, which is biological treatment, is employed. The operation involves the biological degradation of organics, both dissolved or suspended materials by microorganisms under controlled conditions. Biological treatment can be accomplished in a number of ways, but the basic characteristic of the system is the use of mixed microbial culture: bacteria, fungi and / or algae, for the conversion of pollutants. In most cases, organic materials are converted to oxidized products, mostly carbon dioxide and new microbial cells (the sludge). The organic materials serve as an energy and carbon sources for cell growth[2].

A major problem facing municipalities throughout the world is the treatment, disposal and/or recycling of sewage sludge. Generally, sludge from municipal waste mainly consists of biodegradable organic materials with a significant amount of inorganic matter[3]. However, sludge exhibits wide variations in the physical, chemical and biological properties[4]. At the present time, there are a number of methods being used to dispose of sewage sludge from disposal to landfill for land application. Although there are many methods used, there are numerous concerns raised regarding the presence of constituents including heavy metals, pathogens and other toxic substances. This requires the selection of the correct disposal method focusing on efficient and environmentally safe disposal.

*Corresponding author: Dr. Emad Shalaby, Ph.D Biochemistry, Biochemistry Department, Faculty of Agriculture, Cairo University, Giza, 12613, Egypt.
Tel: +2 010 120 3313
Fax: +2 3774 2600
E-mail: dremad2009@yahoo.com, emad2e0m0a1d@yahoo.com
Foundation Project: Supported by a grant from Sanko Company for EM Production and its products; and by a grant from JICA Agency, OIC, Okinawa, Japan.

New technologies are being produced to assist in the treatment and disposal of sewage sludge, conforming to strict environmental regulations. One of these new technologies being proposed is the use of effective microorganisms (EM). The technology of EM was developed during the 1970's at the University of Ryukyus, Okinawa, Japan[5]. Studies have suggested that EM may have a number of applications, including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control and household uses[6].

EM is a mixture of groups of organisms that has a reviving action on humans, animals, and the natural environment[7, 8] and has also been described as a multi-culture of coexisting anaerobic and aerobic beneficial microorganisms. The main species involved in EM include: Lactic acid bacteria: *Lactobacillus plantarum*, *Lactobacillus casei*, *Streptoccus lactis*; Photosynthetic bacteria: *Rhodopseudomonas palustrus*, *Rhodobacter spaeroides*; Yeasts: *Saccharomyces cerevisiae*, *Candida utilis*; Actinomycetes: *Streptomyces albus*, *Streptomyces griseus*.

The basis for using these EM species of microorganisms is that they contain various organic acids due to the presence of lactic acid bacteria, which secrete organic acids, enzymes, antioxidants, and metallic chelates[9,10]. The creation of an antioxidant environment by EM assists in the enhancement of the solid-liquid separation, which is the foundation for cleaning water[7]. One of the major benefits of the use of EM is the reduction in sludge volume. Theoretically, the beneficial organisms present in EM should decompose the organic matter by converting it to carbon dioxide (CO_2), methane (CH_4) or use it for growth and reproduction. Studies have suggested that this is the case for both wastewater treatment plants and also septic tanks. Freitag[11] suggests that introducing EM into the anaerobic treatment facilities help to reduce the unpleasant by-products of this decomposition and also reduce the production of residual sludge. These factors tend to suggest that theoretically EM should assist in the treatment of wastewater by improving the quality of water discharged and reducing the volume of sewage sludge produced.

EM is eco-friendly, safe and organic. The EM fermented garbage is supplemented with useful microorganisms which makes the compost imminently suitable for agricultural use. EM is effective in all conditions. The turning process requires 20 to 22 days with higher C: N ratio due to presence of microbes. Just spraying on garbage heap is sufficient. With easy application, EM is safe for human health. It can treat the leachate coming out form the garbage as well, and remove the foul smell form decomposed garbage. Menace of flies and mosquitoes is suppressed to the minimal by application of this technology. EM technology is not only environmental friendly but goes a step further to actually protect the environment. It suppresses harmful gases generated form garbage, as per the Pollution Control Board (PCB) norms. It is very economical. EM provides healthy environment to the workers. All these mean lower cost of operations, easy application and at the same time protection of the environment[7].

2. Wastes management in Egypt

The sludge disposed during the various water treatment processes can be a major concern for water treatment plants. Most of the water treatment plants in Egypt discharges the sludge into the river Nile without treatment. The discharging of sludge into water body leads to accumulative rise of aluminum concentrations in water, aquatic organisms, and human bodies. Some researchers have linked aluminum's contributory influence to occurrence of Alzheimer's, children mental retardation, and the common effects of heavy metals accumulation[12]. Consequently, stringent standards of effluent discharge are coming into effect, and thus proper management of the sludge becomes inevitable. The use of water treatment sludge in various industrial and commercial manufacturing processes has been reported in UK, USA, Taiwan and other parts of the world. Successful pilot and full-scale trials have been undertaken in brick manufacture, cement manufacture, commercial land application. The mineralogical composition of the "water treatment sludge" is particularly close to that of clay and shale. This fact encourages the use of water treatment sludge in brick manufacture. Several trials have been reported in this purpose. Research carried out in the UK assessed the potential of incorporating aluminum and ferric coagulant sludge in various manufacturing processes including clay brick making. A mixture consists of about 10 percent of the water treatment sludge and sewage sludge, incinerated ash was added to about 90 percent of natural clay to produce the brick[3]. It is also investigated the incorporating of two waste materials in brick manufacturing. The study used waterworks sludge and the incinerated sewage sludge ash as partial replacements for traditional brick-making raw materials at a 5% replacement level.

About 60 000 000 tones of hazardous waste are produced annually in Egypt, with adverse consequences for the environment and human health. No infrastructure capable of proper disposal exists in Egypt. For example, there is only one disposal site for storage of hazardous industrial wastes, and dangerous wastes are generally deposited together with non-hazardous wastes. The Egyptian legal framework for hazardous wastes and waste management shows a few weak points. The present regulations, those of environmental law no. 4/94, are not properly enforced.

2.1. Wastewater treatment in Egypt

In Egypt, the domestic wastewater in the rural areas is concentrated with a chemical oxygen demand (COD) as high as 1100 mg/L, which is almost two times of that in