



Changes in the ecological properties of organic wastes during their biological treatment



P. Kuryntseva^a, P. Galitskaya^b, S. Selivanovskaya^{a,*}

^a Department of Applied Ecology, Institute of Environmental Sciences, Kazan Federal University, Kazan, Russian Federation

^b Department of Landscape Ecology, Institute of Environmental Sciences, Kazan Federal University, Kazan, Russian Federation

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ABSTRACT

Organic wastes, such as the organic fractions of municipal solid waste (OFMSW) or sewage sludge (SS), have become a serious environmental problem in Russia as well as in other countries. The use of these wastes as soil amendments allows their negative impact on the environment to be minimized. However, before these wastes can be used, they need to be treated appropriately in order to decrease their level of hazard. In this study, composting of raw SS, OFMSW, a mixture of these two wastes (OFMSW + SS) at a ratio 1:2 as well as the anaerobically digested variants of these wastes (SSd, OFMSWd and OFMSWd + SSd) mixed with oiled sawdust was performed. Composting was conducted in the containers containing 20 kg of the wastes. The results of three elutriate bioassays (with water flea *Daphnia magna*, infusoria *Paramecium caudatum* and radish plant, *Raphanus sativus*) and one contact bioassay (with oat plant *Avena sativa*) were used to indirectly estimate changes in the hazardous properties of the biological treatments. Besides, C_{org} , N_{tot} content and pH were analyzed in the process of composting. Within the study stability tests to determine maturation process completion were not carried out.

It was revealed, that in the process of anaerobic pretreatment for 15 days, the toxicity increased by a mean of 1.3-, 1.9- and 1.1-fold for OFMSW, SS and OFMSW + SS, respectively. During composting, the toxicity level of these pretreated samples decreased more rapidly as compared with those which were not pretreated. As a result, the toxicity levels of the elutriates from the final composts made of pretreated wastes OFMSW, SS and OFMSW + SS were three-, two- and 17-fold lower for *D. magna* and 15-, 21- and 12-fold lower for *P. caudatum*. As follows from phytotoxicity estimations, composts from digested substrates became mature on the 60th day and had a stimulation effect on the plants after the 90th day of incubation. For the composts prepared from raw substrates, a significantly longer period was needed for maturation. On the basis of ecotoxicity changes of the wastes treated, it can be concluded that anaerobic pretreatment of the municipal solid wastes is an effective acceleration tool for further composting and that waste mixtures can be treated more efficient as compared with raw wastes.

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1. Introduction

According to a report by the Ministry of Natural Resources and Environment of the Russian Federation, 5,000,000 tonnes of waste is produced annually across the country (State report..., 2013). Organic wastes, such as the organic fractions of municipal solid waste (OFMSW) or sewage sludge (SS), have become a serious environmental problem in Russia as well as in other countries (Borowski, 2015; Ağdağ and Sponza, 2007; Kapanen and Itävaara, 2001). The management of OFMSW is an important and challeng-

ing task in industrialized countries. In Russia, these wastes are mainly disposed of in landfills, which leads to loss of land, underground water pollution by landfill filtrates and the emission of landfill gases, which contribute to the greenhouse effect (Li et al., 2013; He et al., 2011).

In addition, organic wastes after the treatment can be used as soil amendment that can improve soil quality and decrease the use of inorganic fertilizers (Hachicha et al., 2012; Himanen and Hänninen, 2011; Tiquia and Tam, 1998). Since organic wastes are a potential source of organic matter and nutrient elements such as nitrogen, phosphorous and potassium, they can be used for soil fertilization and to increase crop yields.

However, as far as the organic wastes can contain pathogens, heavy metals and other toxic compounds they should be treated

* Corresponding author.

E-mail address: Svetlana.Selivanovskaya@kpfu.ru (S. Selivanovskaya).