

Management of biowaste, having a potentially elevated hygiene risks in composting and anaerobic digestion facilities.

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T. Beffa, University of Neuchatel and MADEP SA, C.P. 415, 2002 Bevaix

The use of biological treatment with composting or with anaerobic digestion followed by composting is growing in importance as a means for the elimination of municipal and industrial biowaste. Indeed, these technologies allow for an economical and environmentally friendly alternative to incineration or dumping.

Nevertheless, these industrial bioprocessing techniques for waste recycling may present certain hygiene risks. In particular, when the composting is managed in a nonprofessional manner. In these cases, where the pathogens are not completely eliminated, they may be dispersed through the air and further develop to high concentrations in the fresh compost (several million per gram of compost or per m³). The principal biorisks are due to the presence of pathogens such as the mold *Aspergillus fumigatus*, Salmonella, actinomycetes, virus, worm parasites, toxins, etc.

Hygiene biorisks need to be identified and solutions need to be found to avoid and eliminate these risks as they may pose a grave danger with respect to:

- Employees of composting operations (though direct contact with the compost or through inhalation of the aerosols),
- The inhabitants in the vicinity of the composting installations (by inhalation of the aerosols),
- The users of the finished compost product (though direct contact)
- The soil and the animals (pathogens can survive after application onto the earth during many months).

Our work (1994-2002), financed by Swiss National Scientific Research Fund (priority program and biotechnology, biorisk module) permitted the identification and evaluation of risks present on site at industrial size composting and anaerobic digestion facilities. Technical solutions were proposed and adopted thereby significantly reducing or eliminating hygiene risks.

Our search through the compost piles led us to the discovery that they are populated with literally billions of bacteria per gram; present a wide diversity of highly thermophilic (high temperature loving 60-80 degrees C) bacteria, which serve to degrade organic waste at quasi-infernal temperatures. These elevated temperatures are created through the intensive management of the compost, commonly referred to as **Thermocompostage**.

This intensive management is achieved by an initial mixture of organics, which is balanced in the C/N ratio (Carbon/Nitrogen), which should be in the range of 25-35. An aeration and controlled humidity (45-55% water), as well as frequent mixing and turning (at least 2 times per week). The conditions may vary as a function of the type of waste treated and the equipment employed. The frequent turning of the composting mass, irrespective of the

system used, redistributes the microorganisms, enzymes and water in the most homogeneous manner throughout the mass of degradable substances, and to favorize the aeration due to mixing and an improved porosity in the mass.

In conclusion, the Thermocomposting technique improves and accelerates the degradation of waste, rapidly kills most of the pathogens for man and plants, avoids the repopulation of the finished compost by pathogens, avoids the formation of odors, and permits the production of a compost of excellent quality within just 8 - 12 weeks.

This type of management should be applied universally for industrial size composting and aerobic digestion + composting facilities in Switzerland and around the world.

In Switzerland, current regulations and directives with respect to composts do not guarantee a safe processing or ensure finished compost that is without danger for man. Spot check analysis is one sure way to manage the risks that this activity carries. Instructions and new recommendations from the Federal and State authorities are necessary. In the final phase of our research financed by the Swiss National Fund, it is proposed to establish regulations and recommendations to define the quality of composts.

To reach this objective, it is indispensable to conduct on composting and anaerobic digestion + composting handling more than 100 tons/year:

- analysis on the hygienic quality of the composts (for ex. 2 or 4 analyses per year, at 6 month or 3 month intervals).

- analyses of the principle pathogens, which may be, present in aerosols and dispersed through the air. This to guarantee the security of the workers at the composting facility and to protect the persons situated in the immediate surroundings of the installation (for ex. one analysis per year or every two years).