BIOAEROSOLS FROM COMPOSTING - QUANTITATIVE MEASUREMENTS ON BIOFILTERS AND NON-THERMAL PLASMA TECHNOLOGY

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Introduction

The reduction of emissions of bioaerosols from plants utilizing biowaste or waste treatment plants has a great importance to procedural permissions respectively by monitoring biotechnological plants (e.g. composting facilities). According to current knowledge there are a number of methods available for reducing emissions, especially for the reduction of dust. Biological waste air purification systems have currently only proven successful in reducing odor. This study examined what extent new technologies for waste air purification can contribute to the reduction of emissions of bioaerosols. In particular we tested non-thermal plasma technology in combination with a biofilter.

Material and methods

The measurements were carried out according to the VDI guideline 2066 (Anonymous, 1975), VDI guideline 4252 part 2 (Anonymous, 2004a), and VDI guideline 4253 part 2 (Anonymous, 2004b). Measurements were taken at conducted waste air sources in waste gas and purified gas in different processing combinations of biofilter and non-thermal plasma technology plant. The total count of mesophilic bacteria, mesophilic and thermophilic fungi and *Aspergillus fumigatus* as well as thermophilic actinomycetes, and aerobic spore-forming bacteria were determined by filtration and impingement. In addition the concentrations of endotoxins and dust were determined in waste gas and purified gas.

Results

The concentrations of bioaerosols determined after waste air purification showed the same level as outside air. The best results were obtained with the combination of wet biofilter and non-thermal plasma technology (variant I). With this combination the highest reduction efficiencies were gained for *Aspergillus fumigatus*, thermophilic actinomycetes, and thermophilic fungi. These microbiological parameters were reduced up to 3 to 5 decimal powers. The biofilter overstrains in the process the main purification power. The concentrations of mesophilic bacteria were increased after air purification by biofilter in variant I and variant II. Nevertheless the concentrations of mesophilic bacteria were lower in the purified gas after air purification by the non-thermal plasma technology than in the waste gas. The highest reduction efficiencies were obtained with the processing combinations of wet and dry biofilter and non-thermal plasma technology. Thermophilic fungi, *Aspergillus fumigatus*, thermophilic actinomycetes, and aerobic spore-forming bacteria were reduced to 100% with the combination of wet biofilter and non-thermal plasma technology. All investigated microorganisms were decreased for >90% by all investigated air purification processing combinations.

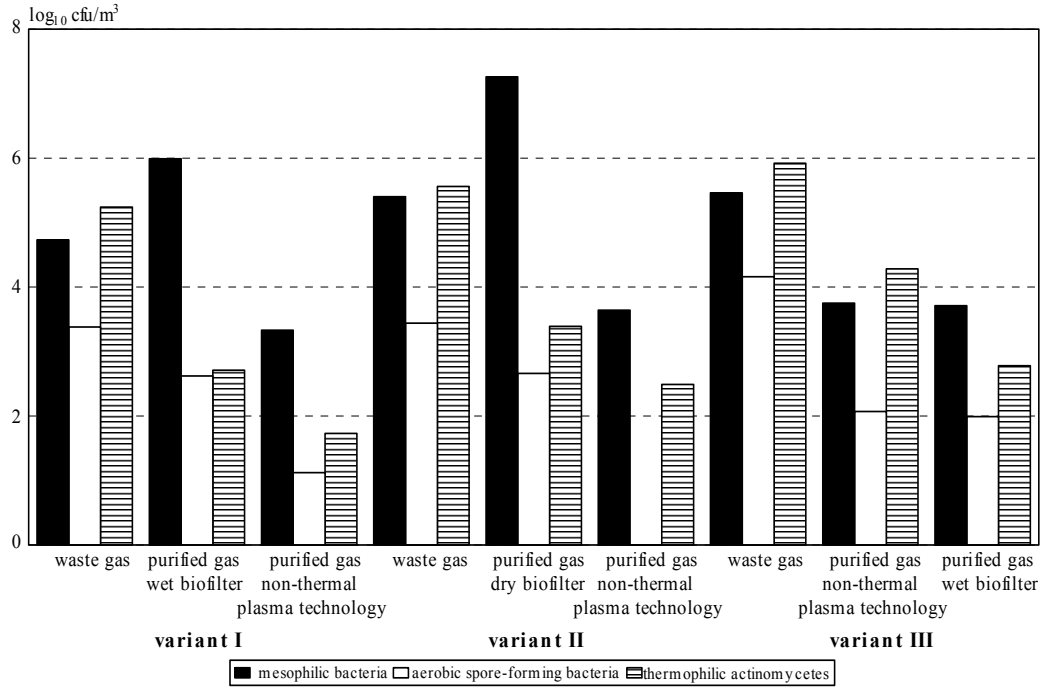

Fig. 1: Average concentrations of mesophilic bacteria, aerobic spore-forming bacteria and thermophilic actinomycetes of waste gas and gas purified by different processing combinations of biofilter and non-thermal plasma technology, determined by filtration

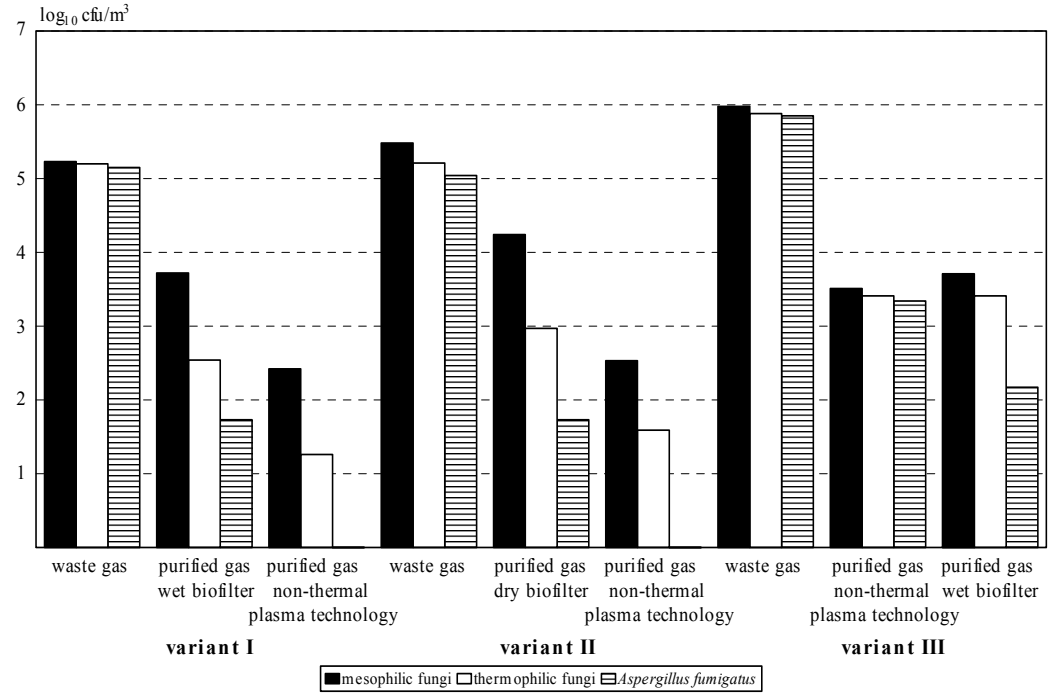

Fig. 2: Average concentrations of mesophilic and thermophilic fungi, and *Aspergillus fumigatus* of waste gas and gas purified by different processing combinations of biofilter and non-thermal plasma technology, determined by filtration

Discussion and conclusion

According to our data the investigated processing combinations of biofilter and non-thermal plasma technology are suitable for waste air purification from composting facilities. The concentrations of bioaerosols determined after waste air purification show the same level as

outside air. The highest reduction efficiencies were determined with combination of wet biofilter and non-thermal plasma technology. Especially the medically important microorganisms *Aspergillus fumigatus*, thermophilic actinomycetes, and thermophilic fungi were reduced up to 100%. Further scientific investigations are necessary because these investigations were carried out in small-technical scale and up to now there is no standard or VDI guideline for the measurement of bioaerosols in emission currents. In addition parameters for the assessment and definition of the reduction efficiency of bioaerosols by waste air purification systems must be discussed. A reduction of microorganisms of at least 99.0% is necessary in order for this to be considered an effective health measure. Comparison of the concentrations of bioaerosols of the purified gas with the concentrations in the outside air is also necessary.

References

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