17 Future Prospects of Biotechnology for Odor Control

Fethiye Ozis, Arash Bina, Joseph S. Devinny

17.1 The Growing Need for Odor Control

The world’s populations are simultaneously growing and migrating to the cities. This produces rapid expansion of urban areas into the surrounding countryside where they encroach on land dedicated to waste treatment, industry, and agriculture. Farmers are seeking increased efficiency through measures that grow animals in dense concentrations nearer the point of consumption. Rapid development of new materials and new industries creates a host of exotic chemical discharges. Odors form the burgeoning fast food industry are a special problem – coffee and fried chicken may smell great when you are ready to eat, but the continuous smell of roasting beans or stale grease becomes offensive. All of these trends mean that populations are more often living close to odorous facilities, and it means that odor control is an ever more pressing air quality problem. Cries from the farmers and treatment plant operators of “We were here first!” will have little effect.

With respect to odors, ugliness is entirely in the nose of the beholder. We have evolved to recognize some compounds as associated with danger: the smell of human waste is offensive because those individuals who avoided contact with it were less likely to die of disease, and the smell of spoiled food prompts us to avoid eating meals that could threaten food poisoning. The perception that an odor is foul is the body’s way of telling the brain that it is best to go elsewhere.

In modern society, we frequently encounter odors that no longer represent a health risk – it is not dangerous to be downwind of a dairy. But while the nose may not provide accurate warning of the presence or absence of a health risk in modern society, the evidence suggests that unpleasant odors can cause adverse physiological and neurogenic responses. The study by Schiffman et al. (2000) found that the most frequently reported health complaints related to odors include eye, nose, and throat irritation, headache, nausea, diarrhea, hoarseness, sore throat, cough, chest tightness, nasal congestion, palpitations, shortness of breath, stress, drowsiness, and alterations in mood. Certainly, unpleasant odors can cause human nuisance and physical discomfort.

Noxious and foul odors also have economic consequences. Foul odors can reduce property values in affected neighborhoods from 15 to as much as 90% (Kleemeier et al. 2002; Weida and Hatz 2002; Anstine 2003). The offensive odors
affect the quality of life, so that fewer people and businesses may be attracted to the region, potentially lowering property values.

Even where health and economic consequences cannot be demonstrated, the social and political consequences remain. Businesses that release odors may find their futures threatened by an angry local community.

Thus, growing population, the trend towards urbanization, urban sprawl, new factories, factory farms and fast food have combined to make odor a leading issue in environmental protection. The public demand for control has never been greater, and the need to protect the public from nuisance and perceived health and safety threats is rapidly growing. It is unquestionable that the general market for odor control is expanding, and probable that the expansion will be rapid in coming years.

17.2 Biotechnology is an Important Alternative

While it seems certain that the odor control market will expand, we must also ask what portion of it will be served by biotechnology. Customers can choose from many technologies, and assessing the prospects of biological systems requires that we determine what portion of the odor market can be taken from the competition. Historically, combustion, adsorption (activated carbon), and absorption (chemical wet scrubbing) were the primary technologies used to remove odorous compounds from air discharges. While the first biofilters were tried at least as long ago as the 1950s, it was not until the mid-1990s that biotechnology took its place in the US market. Each odor control technology has strengths and weaknesses, and the advantages and disadvantages (Ozis 2002) of competing odor control technologies can be summarized (Table 17.1).

As has been demonstrated in the previous chapters of this book, biofilters and biotrickling filters can be effective and economical in many applications. Biological treatment is appropriate for large flows because the challenge of managing a biological system is much the same for a large or small system, and management costs per unit flow become relatively high for small flows, although there are exceptions, such as the systems designed for rag drying by Bio-Reaction Industries (Stewart et al. 2000). It is more likely to be competitive for low concentrations of contaminant because high VOC concentrations may make incineration possible without additional fuel. The contaminant, of course, must be biodegradable and water-soluble, but these thresholds are not very high: benzene is commonly considered a low-solubility compound, but it is readily removed in biological treatment systems. Biological systems generally have a low specific activity – rates of contaminant destruction per unit volume of reactor – and the reactors must correspondingly be larger than competing devices for a given load. Thus, biological systems are not competitive where space limitations are severe. Biofilters have not yet been applied to waste streams including inert particulates like soot or dust. These non-biodegradable materials will be captured, but will accumulate in the biofilter until it clogs, so that packing replacement or cleaning will be necessary. Biotrickling filters