

# ROLE OF ANAEROBIC DIGESTION IN ALLEVIATING ENVIRONMENTAL PROBLEMS IN THE UNITED STATES

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**ABSTRACT.** The United States and other countries of the world have been confronted with an array of environmental problems seriously threatening air and water quality, the global climate, and the quality of life. We now have new classes of pollutants, synthetic and hazardous, along with the old types permeating freely to deep aquifers and the stratosphere causing chronic morbidity and precipitating terminal illnesses. Man-made pollution now threatens man's infrastructure, and victimize wild life. These problems cannot be solved by technological means alone. We need good management and serious education, which are the pollution-control strategies of the future.

The world may have reached the limits for "technological fixes." This is particularly true for old technologies that survive, but cannot perform, simply because some us insist that the old must not make way for the new, and resist innovation strongly. Technology may have to play a secondary role. Bioprocesses, in particular anaerobic digestion, can play an important role in our effort to cleanup and control the environment. However, this role will not be played well by the old digestion technology that remains unmodified and inefficient for decades. New approaches are sorely needed. This presentation examines one innovative approach to digestion process development envisioned by the late Professors Babbitt, Donald and Jack Borchardt about 30 years ago. The process, known as *two-phase digestion*, has the potential to alleviate current environmental problems in the United States.

**KEYWORDS:** Environmental impact, water and land pollution, hazardous wastes, greenhouse effect, pollution abatement, energy recovery, anaerobic digestion, innovative process, two-phase digestion.

## 1. INTRODUCTION

The United States has been confronted with a host of emerging environmental problems during the last 20-25 years. These problems were not clearly foreseen by the public before the first energy crisis and the landing of a man on the Moon in the early 1970s. Americans were not concerned with water and air pollution, and were happy with "safe" (by simple chemical and bacteriological standards of the time) drinking water supplies and good food sanitation practiced by the food-processing industry, supermarkets, caterers, and restaurants. Twenty-five years ago, we were oblivious of *global warming*,

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*acid rain, hazardous wastes, groundwater contamination, nonpoint pollution, toxicological effects of chlorinated drinking water,* and other problems that emerged with time as the country entered the age of the microchips. Environmental engineers made tremendous progress during the "space age," so much so that water and wastewater treatment, and even water renovation and reuse by tertiary treatment were taken for granted by American communities. Air-pollution problems in metropolitan areas were alleviated substantially by the application of new unit operations developed to deal with emissions of particulates, carbon monoxide, and nitrogen and sulfur oxides. Successful management of the water- and air-quality problems of the 1950s and 1960s called for celebration. Unfortunately, there was little time for complacency for the American environmental engineer, who then faced a series of *hot* environmental issues that were heretofore ignored, or were subject of curiosity before 1970.

### 1.1 Environmental problem management

In general, it is possible to relate traditional and emerging environmental problems to the municipal, industrial, and agricultural sectors of the economy. A sketch of current environmental issues that have attracted the attention of the American public and the Environmental Engineering Profession is depicted in Table 1. The importance of these problems is reflected in the enacted legislation.

A review of American legislation enacted in the seventies and eighties clearly indicates that environmental problems of the 21st century need to be *managed* first by nontechnological means. The United States Environmental Protection Agency (USEPA) has been consistently sending a message that says, manage environmental problems first, and apply treatment technologies as a last resort. This is a new idea introduced to traditional engineering approach that normally calls for solving environmental problems by technological fixes. Management involves the institution of the *born-again*, common-sense strategies of *pollution prevention and waste minimization*, *cradle-to-grave* tracking and monitoring of raw and treated wastes, materials and energy recovery, application of other innovative strategies to reduce the volume, quantity, and toxicity of "wastes," and last but not the proverbial least, the utilization of waste as a resource.

### 1.2 Technological solutions

Treatment of waste should be the last step in the waste-management hierarchy simply because current technologies have limited capabilities to cope with hazardous substances and biologically recalcitrant organics. In addition, available waste treatment technologies are often unsuitable for handling such concentrated materials as municipal solid waste (MSW), agricultural wastes, and a host of industrial effluents. Clearly, conventional waste-treatment technologies cannot meet the demands of new environmental legislation. There is a need for new approaches and new systems. To this end, the USEPA,