BIOGAS: A GLOBAL PERSPECTIVE

David C. Stuckey
Chemical Engineering Department, Imperial College, London, U.K.

ABSTRACT

Biogas technology (BGT) can alleviate many pressing problems in developing countries, such as rural energy shortages, low agricultural productivity, and poor public health. Despite this potential and the heightened interest of many developing countries and funding agencies in the technology, BGT has not been implemented widely or rapidly, except possibly in China.

The objective of this paper is to critically assess the current status of BGT in developing countries with respect to technical, economic, and social-institutional factors and to draw some conclusions about its viability and the primary factors that inhibit its widespread application. Courses of action to enhance the viability and implementation of BGT will be suggested.

The paper examines four general aspects of BGT: (1) the degree of penetration of BGT in developing countries, (2) the technical status of various biogas digester designs, and their current problems, (3) the economic viability of biogas in the various areas of application, (i.e. domestic, community, feedlots, and industrial), and (4) the broader social and institutional factors related to BGT. Various strategies are proposed to consolidate current information and enhance the future viability of BGT.

INTRODUCTION

The process of anaerobic digestion of organic materials is commonly referred to as 'biogas' because of the biological nature of gas production. In recent years developing countries have shown considerable interest in the use and application of biogas for several reasons. First, the escalating costs of fossil fuels and the decreasing availability of renewable sources of fuel have forced many developing countries to consider the use of renewable energy technologies (RETs) for example, solar, wind, and biomass-based technologies, such as biogas, power alcohol, and gasifiers. Of these techniques, biogas has one of the lowest financial inputs per kWh of output. In addition biogas is one of the most 'mature' in terms of years of use and number of units installed, and has the potential to alleviate some of the more pressing problems in developing countries—for example deforestation and reliance on the importation of...
fossil fuels which leads to severe balance of payment problems. Although biogas has the potential to reduce deforestation and the importation of fossil fuels, data to show this effect have not yet been obtained.

Second, because biogas mimics natural environmental cycles, such nutrients as nitrogen, phosphorous, and potassium are conserved in the process and can be recycled back to the land in the form of a slurry. This is in contrast to the burning biomass where most of the nutrients are lost, for example, with wood stoves and gasifiers. The application of slurry reduces the need for chemical fertilizers, such as urea and superphosphate, and in addition enables humic materials to be recycled. This recycling preserves the physical properties of the soil and enables high agricultural productivities to be maintained.

Third, because the biogas process digests animal manures and nightsoil, it has the potential to considerably reduce plant, animal, and human pathogens. The cycle of reinfection is broken and considerable improvement in public health results.

Finally, because biogas is a clean-burning fuel, its domestic use can reduce the incidence of eye and lung problems that are commonly encountered with such smoke-producing fuels as firewood, agricultural residues, and coal.

Furthermore, biogas is a versatile technology and can utilise a wide variety of organic feedstocks, such as animal manures, nightsoils, agricultural residues, aquatic plants, and organic industrial wastes. Hence, in addition to being a multifaceted technology, it has potential application to many environmental and social milieus.

Despite its many benefits, biogas has a number of drawbacks, the major one being the cost of most current designs. This cost is a major impediment to BGT's diffusion in rural areas of the Third World where it may amount to a substantial fraction of a family annual income. In addition, technical problems related to maintenance and low gas production during the winter months have occurred as well as social-institutional constraints related to acceptance and diffusion of the technology.

Based on available evidence, however, the benefits of biogas in developing countries outweigh the drawbacks. It is puzzling therefore that only two developing countries, China and India, have installed large number of units, although these numbers represent only a small fraction of the potential based on biomass resources. Why has this situation arisen? Critics of biogas would answer that there are inherent problems in the technology and that BGT is not economically viable. The situation however, is complex and demands a more detailed and objective examination before firm conclusions can be drawn about the viability of this technology in developing countries. In addition, biogas is merely one example of a technological intervention in rural areas of the third world, and past experience has shown us that such interventions are fraught with unforeseen problems which all too often lead to failure.

This paper will critically assess the current status of BGT in developing countries with respect to both technical and socio-economic