MICROBES IN PRODUCTION OF BIOGAS

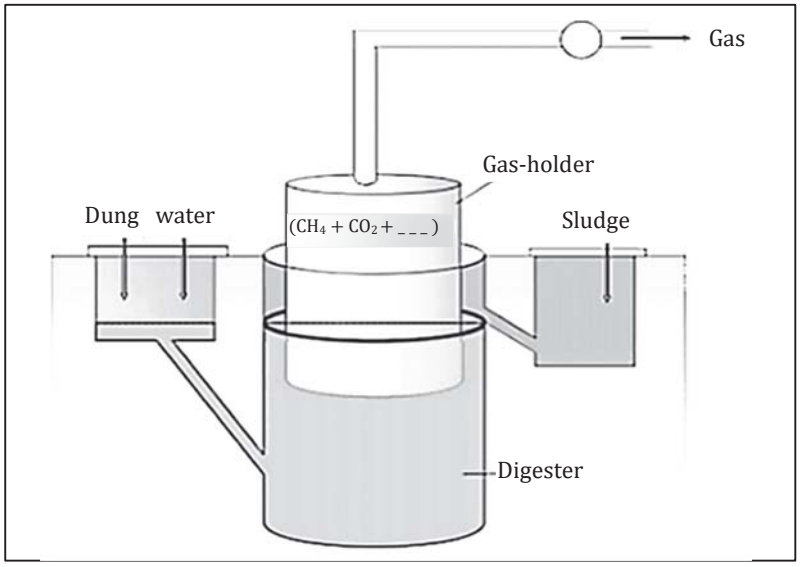
In rural regions of developing nations, it's a common practice to utilize animal dung for crafting dung cakes, which serve as fuel. Unfortunately, this practice leads to the wastage of a potentially valuable fertilizer for agricultural fields as the dung is burned. However, a more beneficial use of dung can be found in generating biogas, commonly known as Gobar Gas, while simultaneously producing a stabilized residue to serve as fertilizer.

Although the energy yield of biogas is lower compared to that of dung cakes, the efficiency of biogas burners is remarkably high. Thus, the overall outcome suggests that biogas production is more cost-effective.

Biogas, primarily composed of methane, is produced through microbial activity and serves as a fuel source. Various microbes produce different gaseous end-products during their growth and metabolism, depending on the microbes and organic substrates they utilize.

For instance, methanogens, such as Methanobacterium, commonly found in anaerobic sludge during sewage treatment and in the rumen of cattle, produce significant amounts of methane along with CO_2 and H_2. These bacteria also aid in breaking down cellulose in the rumen, contributing to cattle nutrition.

Biogas plants typically consist of a concrete tank where bio-wastes are collected and a slurry is fed. A floating cover over the slurry rises as gas is produced due to microbial activity. The produced biogas is then utilized for cooking and lighting in nearby houses. The spent slurry, rich in nutrients, can be used as fertilizer. Given the abundance of cattle dung in rural areas, biogas plants are more prevalent there. The technology for biogas production in India owes much to the efforts of institutions like the Indian Agricultural Research Institute (IARI) and the Khadi and Village Industries Commission (KVIC).



The organic wastes from the farm, including cow dung, urine, and feces, can be economically utilized to produce Gober gas, also known as biogas. Biogas typically consists of methane (50-70%), CO_2 (30-40%), and trace amounts of hydrogen, nitrogen, and hydrogen sulfide.

The production of biogas involves anaerobic fermentation of waste biomass, which occurs in three main stages:

1) Facultative anaerobic microbes begin the process by breaking down complex polymers into simpler monomers through enzymatic action. Polymers such as cellulose, hemicelluloses, proteins, and lipids are degraded into monomers, while lignin's and inorganic salts remain as residue due to their resistance to degradation.

2) In the second stage, monomers are converted into organic acids by microbial action under partially aerobic conditions, ultimately resulting in the production of acetic acid.
3) Finally, acetic acid is oxidized into methane by the activity of anaerobic methanogenic bacteria. These bacteria, commonly found in anaerobic sludge during sewage treatment, are also present in the rumen of cattle. The cellulosic material present in the food of cattle aids in the breakdown of cellulose in the rumen, playing a crucial role in cattle nutrition.

Despite the importance of cellulose digestion in biogas production, it occurs at a slow rate, making it the "rate-limiting factor" in the biogas production process.

Example: What is the purpose of returning a portion of activated sludge to the aeration tank during sewage treatment?

Solution: The small portion of activated sludge is reintroduced into the aeration tank to act as an inoculum.