

Fad or Future?

An expert evaluates whether digester-gas-fed fuel cells and microturbines are cost-effective sources of power

by

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Various Uses for Anaerobic Digester Gas

- Anoxic gas flotation
- Blend with natural gas.
- Burn in boiler for
 - process heating,
 - space heating,
 - space cooling,
 - chilled water.
- Burn in internal-combustion engine to direct-drive mechanical equipment and produce hot water.
- Burn in fuel cell, gas turbine, internal-combustion engine, microturbine, or Stirling engine to produce electricity, steam, or hot water.
- Burn in grit, garbage, rag, scum, or sludge incinerator.
- Burn in street lamps.
- Compress to 250 bars for use as a vehicle fuel.
- Food preparation.
- Gas mixing system.
- Operation of laboratory equipment (burners, muffle furnaces, ovens, refrigerators, sterilizers, water stills).
- Production of chemicals (carbon dioxide, methanol, sulfur).
- Vaporize chlorine and sulfur dioxide prior to being used in disinfection systems.

Types of Fuel Cells

- Alkaline fuel cell
- Direct borohydride fuel cell
- Direct carbon fuel cell
- Direct ethanol fuel cell
- Direct formic acid fuel cell
- Direct methanol fuel cell
- Electrogalvanic fuel cell
- Formic fuel cell
- Metal hydride fuel cell
- Microbial fuel cell
- Molten carbonate fuel cell
- Phosphoric acid fuel cell
- Planar solid oxide fuel cell
- Protonic ceramic fuel cell
- Proton exchange membrane fuel cell
- Reversible fuel cell
- RFC – redox
- Tubular solid oxide fuel cell
- Upflow microbial fuel cell
- Zinc–air battery

Comparison of Molten Carbonate and Phosphoric Acid Fuel Cells

Item	Molten carbonate fuel cell	Phosphoric acid fuel cell
Electrolyte	Alkali carbonate	Phosphoric acid
Charge carrier	CO_3^-	H^+
Operating temperature	600°C to 700°C	190°C to 210°C
Catalyst	Nickel	Platinum
Fuel-cell hardware material	Stainless steel	Graphite
Energy use efficiency	46+	36 to 40
Electrical	75+	75+
With heat recovery	Usable — all at 320°C	Usable — all at 60°C or with high-heat option (half at 60°C and half at 120°C)
Waste heat		
Concerns	Corrosion of electrodes	Reduced conversion efficiency with time

Technologies Used To Clean Digester Gas

Technology	Pollutant(s) removed
1. Cooling	water vapor
2. Absorption into liquid	carbon dioxide, dissolved sulfur compounds (normally hydrogen sulfide), particulate material
3. Adsorption onto a solid	dissolved sulfur compounds (normally hydrogen sulfide), halogen compounds, siloxanes
4. Biological systems	dissolved sulfur compounds (normally hydrogen sulfide),
5. Carbon molecular sieve	Carbon dioxide
6. Conversion using a reactive chemical	dissolved sulfur compounds (normally hydrogen sulfide)
7. Liquid-redox	dissolved sulfur compounds (normally hydrogen sulfide)
8. Membrane separation	water vapor, carbon dioxide, dissolved sulfur compounds (normally hydrogen sulfide)

For Further Reading

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