

# Renewable electricity generation from biogas of anaerobic co-digestion of sludge, cattle manure and water

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## Introduction

- AmD of cattle manure (CM)- Long initial start-up phases biogas production, low methane yield ;
- AcoD - increased microbial diversity, biodegradability and accelerated hydrolysis process, resulting in an improvement of hydrolysis rate, reduced lag phases and increased biogas recovery;
- Sewage sludge (SS) as a co-digestion - eases the digestion of aggregates of particles, floating materials and wastes with unfavorable fluid dynamics;
- Viability of energy supply from the energetic conversion of biogas generated by the AcoD in biodigester of rural properties.

## Material and Methods

- Laboratory of Rural Electrification and Alternative Energies



**Figure 1.** Indian model benchtop biodigesters

- Experiment I - 100:0:0 and 0:100:0 SS:CM:DW
- Experiment II - 50:25:25, 25:25:50, 33:33:33, 25:50:25 SS:CM:DW
- Correction of biogas volume - used the combined gas law
- Generated electric power - highest cumulative biogas yield (CBY) among SS:CM:DW ratio, influent amount (SS, manure produced on a UFRRJ's Dairy Cattle, and DW) and the equivalent cubic meter of gas with electricity

- CBY is the relation between accumulated production and the amount of affluent placed in the biodigester (1.7 kg)
- Result - compared to the energy demand of the Dairy Cattle Sector of UFRRJ.
- Energy economy - 2.94969 US\$ for rural properties located in Rio de Janeiro with consumption above 300 kWh

## Results

- SS co-digestion - accelerated biogas production
- 25:50:25 SS:CM:DW - higher cumulative production
- Experimental data on the cumulative production - exponential model, in which 28.15 L were obtained
- The efficiency of anaerobic co-digestion of SS and CM - a higher cumulative biogas production than in the single substrate digestion of SS and CM
- SS - High immediate production
- CM - long lag-phase for digestion
- Intermediate production profile to the previous ones was noticed when balancing the three co-digesters.
- The CBY - 16.56 L kg<sup>-1</sup>, 0.48 L g<sub>TSadded</sub><sup>-1</sup> and 0.59 L g<sub>VSadded</sub><sup>-1</sup> to 25:50:25 SS:CM:DW
- Biodigesters in rural properties for electricity generation - monthly 2600 kWh and economy of US\$ 7669.19.

## Conclusions

- It was concluded that the implantation of biodigesters with 25:50:25 SS:CM:DW to produce electric energy from biogas allows energy self-sufficiency of the property, enabling the sustainable development of the activity through the proper disposal of waste and economic gains to the producer.