Capture of CO2 from Biogas and Production of Industry worthy CO2 and Compressed Biomethane.

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ACBCCU- 2018

Awareness and Capacity Building Carbon Capture & Utilization

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Life on earth is at the Mercy of Continuation of carbon Cycle

Human Development @ Mercy of Carbon Systems

Life on Earth

Au trophs

Somatic Heterotrophs

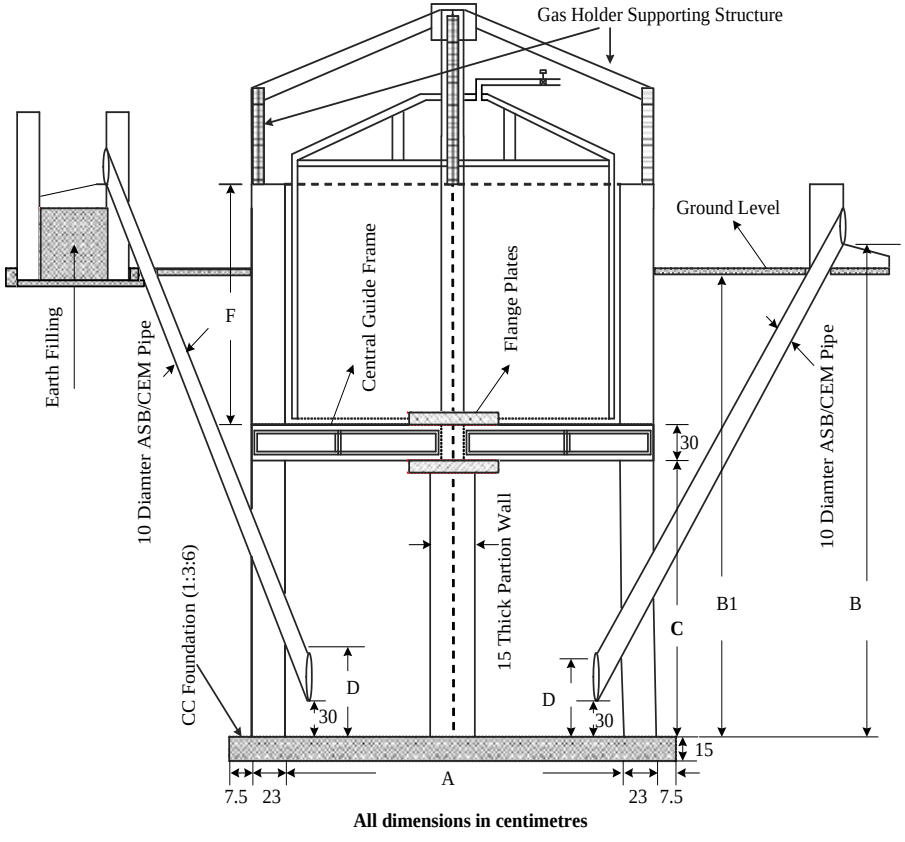
Focus on Bioenergy @ IIT Delhi

- Rural systems can harvest biomass resources.
- Current practices of biomass utilization are inefficient/incomplete.
- Bioenergy is carbon-neutral.
- Amenable to off-grid power generation.
- Operable at micro capacities.
- Cleanest form of biofuel is biogas.
- Wide range of end-uses
  - Electricity production
  - Heat generation and
  - Transport fuel

Robert Boyle

Scientific interest in the manufacturing of gas produced by the natural decomposition of organic matter, was first reported in the seventeenth century by Robert Boyle

Anaerobic Digester
Biogas plant (20 m^3/d) capacity available at IIT Delhi



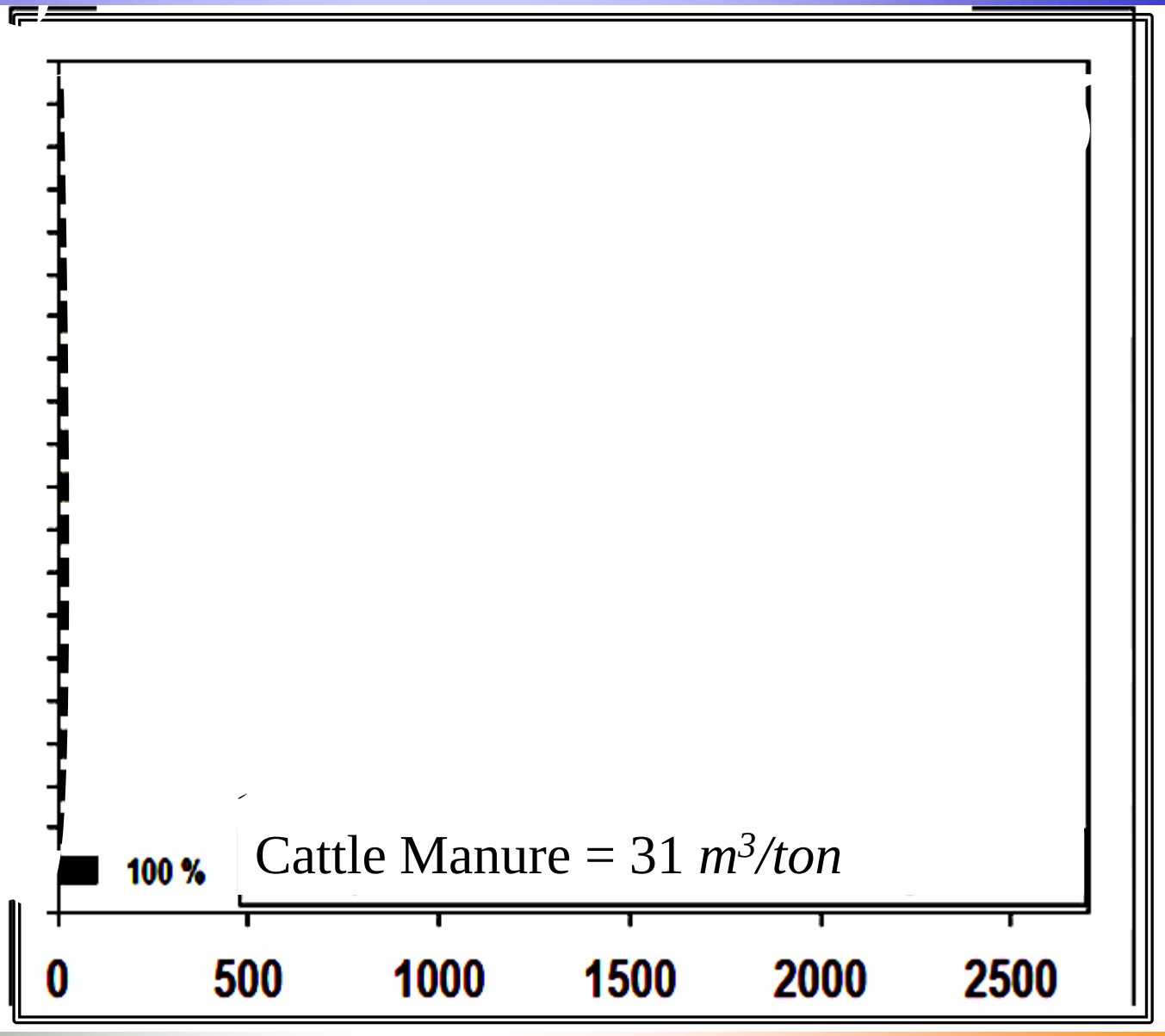
Biogas Production

- Anaerobic digestion is a naturally occurring bacterial process that produces methane and carbon dioxide from decaying organic matter in the absence of oxygen.
- A digester is an artificial environment which sustains anaerobic digestion by harnessing natural bacteria.
- Organic material is digested by bacteria in a closed reactor vessel and biogas is produced.
- This controlled digestion process is normally accelerated by increasing the reactor temperature into;
- the mesophilic range (normally between 30-37ºC, or
- the thermophilic range (normally between 55-65ºC.

Tradition : Cattle manure as A feed material for Biogas Production

- Biological degradation is possible thru parasitic microbes.
- Cattle manure contains inherent parasitic microbes.
- These microbes grow in population by consuming energy available in volatile solids.
- Only volatile solids are biologically degradable.
- In general cattle manure contains 20% of solids by mass.
- Nearly 80% of these solids are volatile solids.
- Cattle manure is a two in one feed material and easy to engineer the biomethanation (digestion) system or digester.

Biogas Potential of Bio-degradable Solids



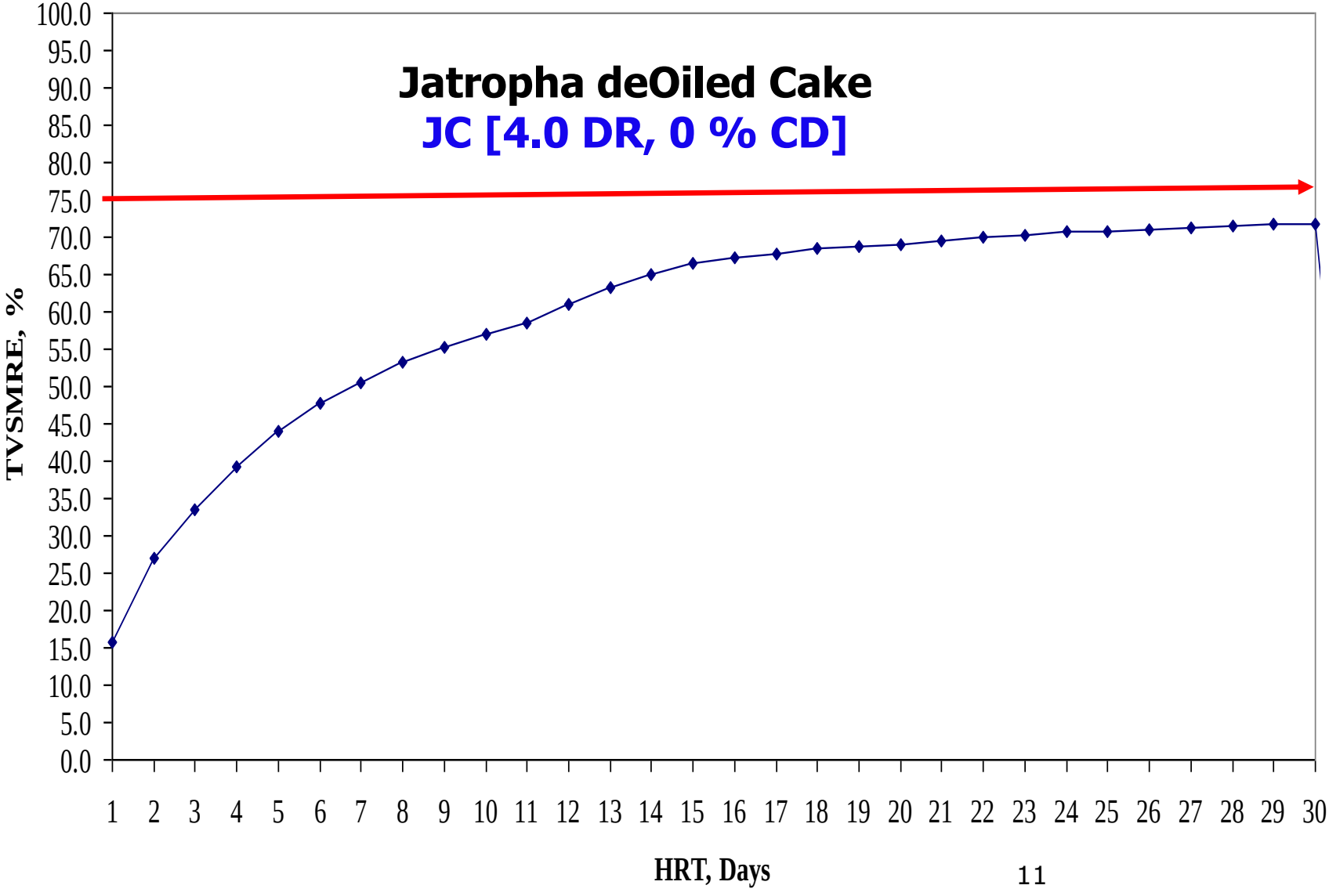
Fitness of Non-Edible Oil Seed Cakes

Dry Pongamia Seed Cake

Seed Cakes
soaked in water

Dry Jatropha Seed Cake

Total Volatile Solid Mass Removal Efficiency



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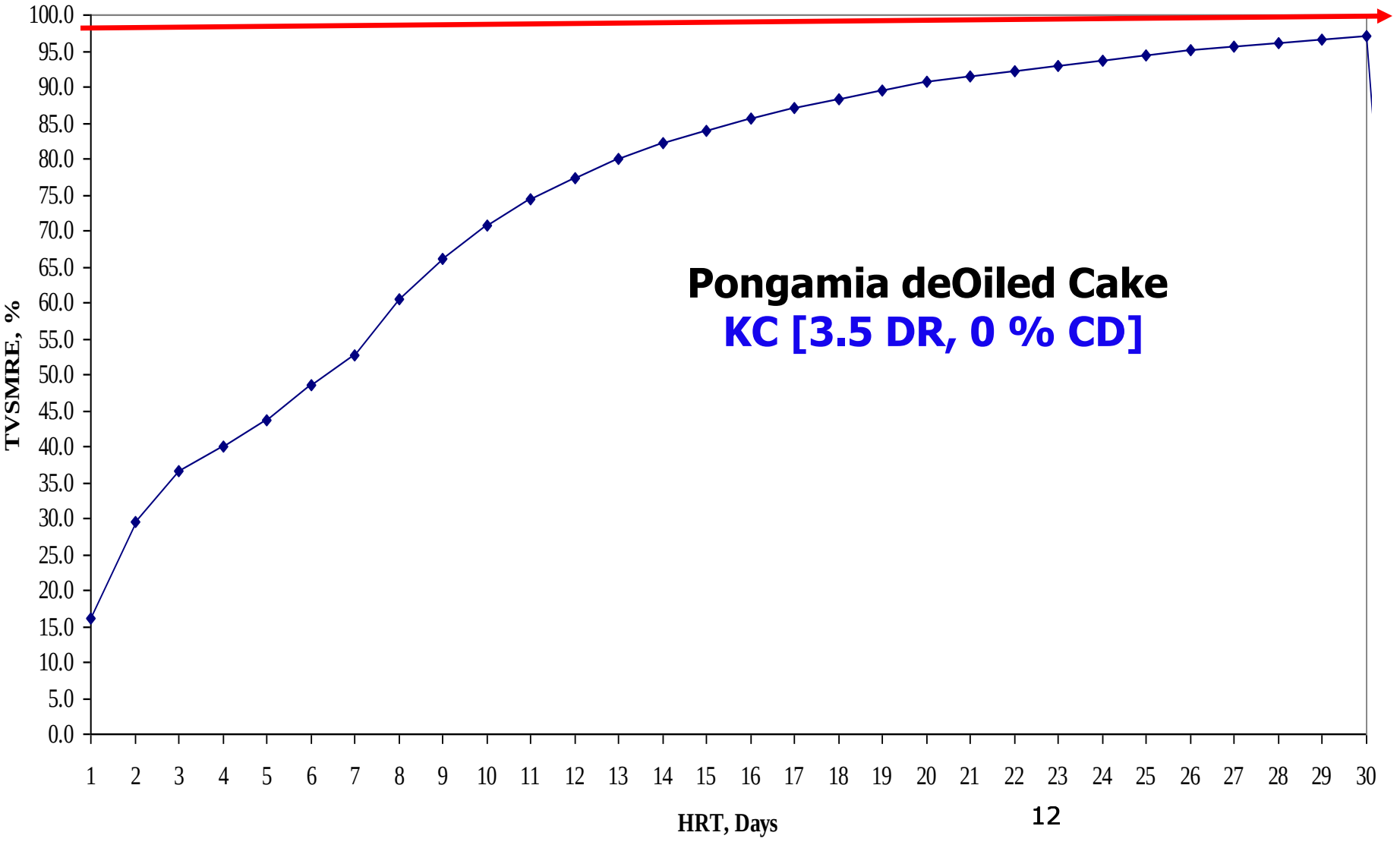
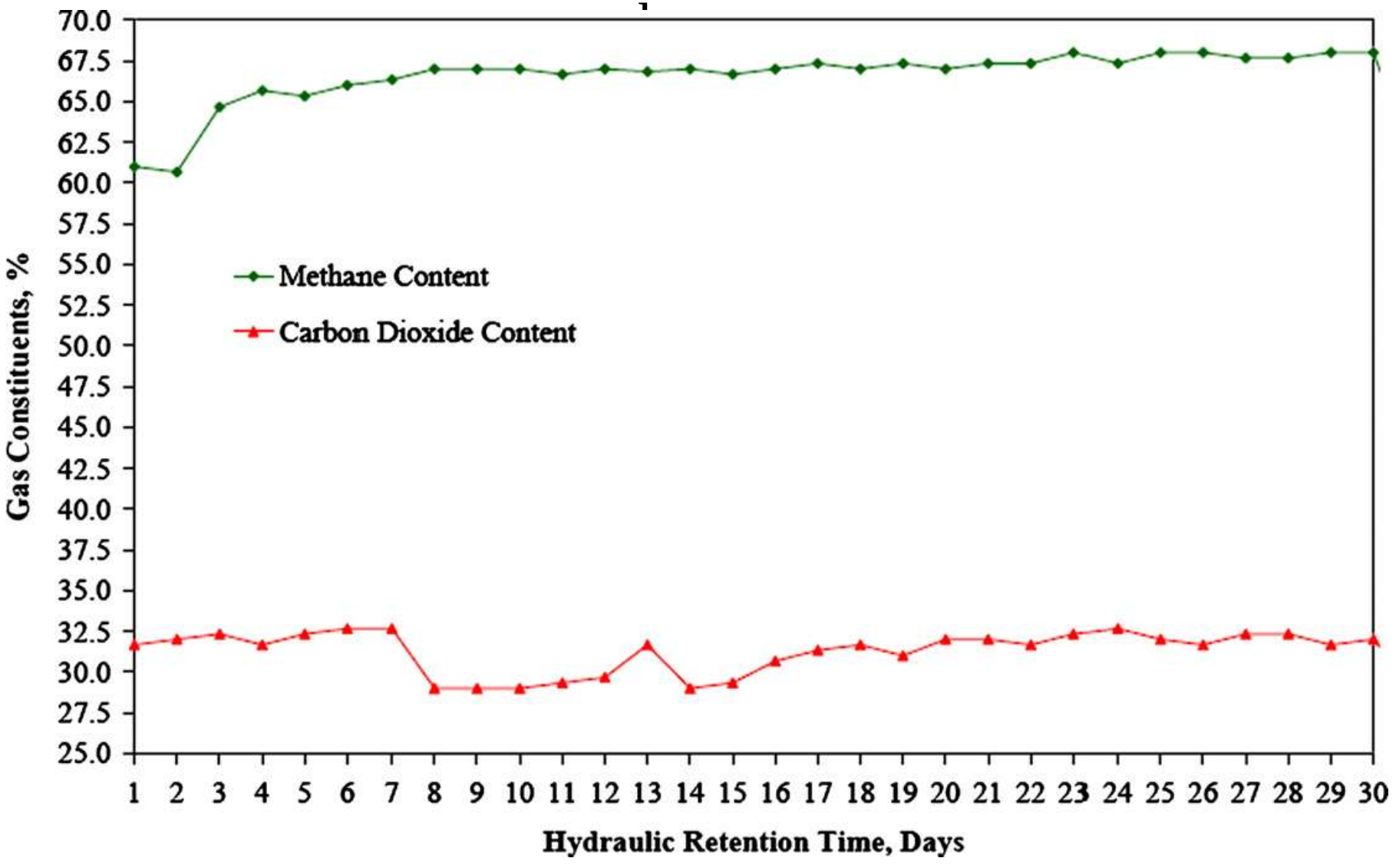
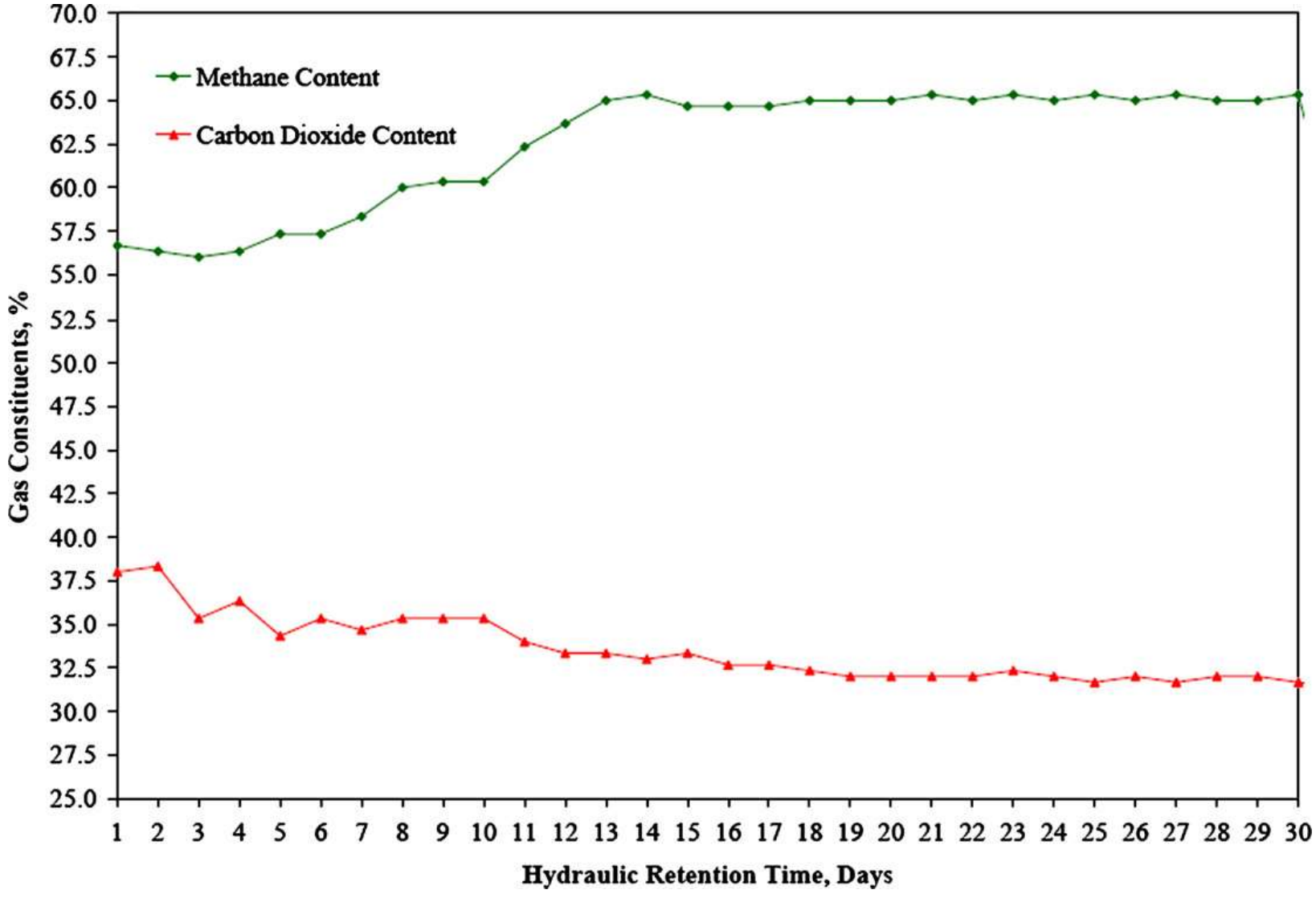


Variation of methane and carbon dioxide content in produced biogas from jatropha oil seed cake



Variation of methane and carbon dioxide content in produced biogas from pongamia oil seed cake substrate



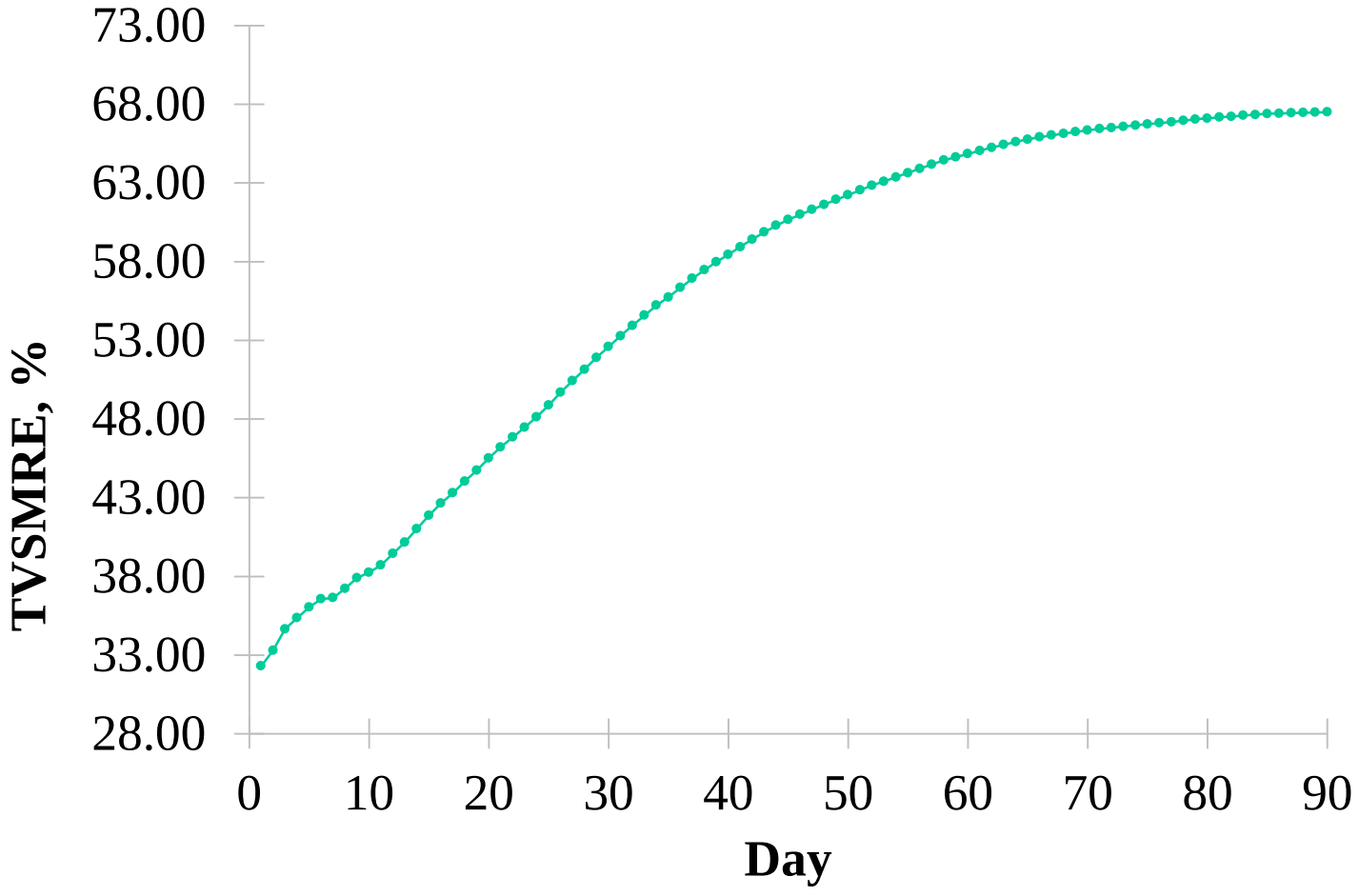
N, P & K Contents of Biogas Spent Slurry

Sl. No.	Treatment	N, %	P, %	K, %
1	CD [1.0 DR]	1.48	0.66	1.64
Jatropha oil cake biogas spent slurry				
2	JC (4.0 DR, 0 % CD)	3.60	2.20	1.72
3	JC (4.0 DR, 50 % CD)	3.30	2.10	1.69
Pongamia oil cake biogas spent slurry				
4	PC (3.5 DR, 0 % CD)	5.40	1.20	1.32
5	PC (3.5 DR, 50 % CD)	5.20	1.33	1.65

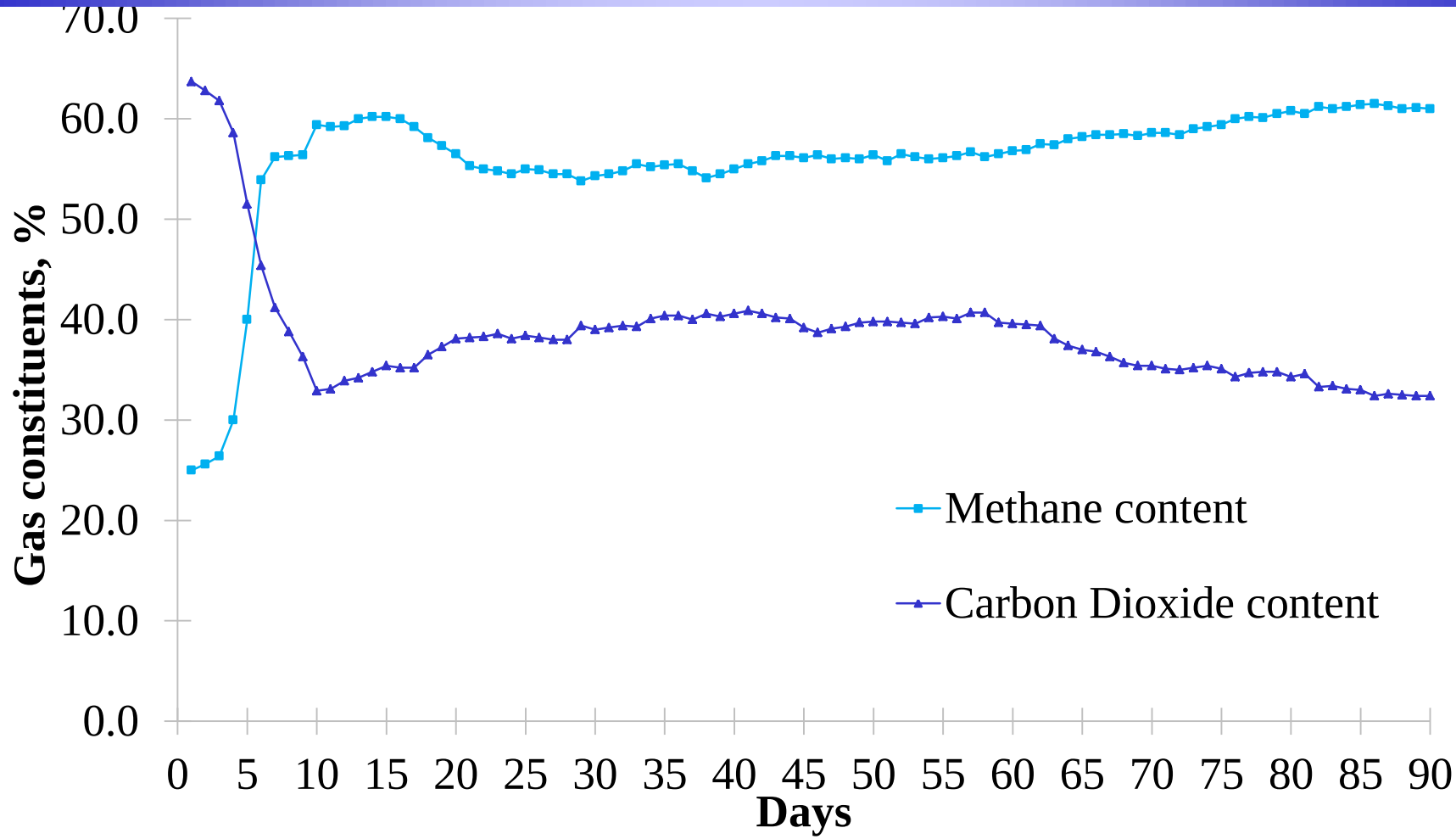
Biogas plant running solely on De–oiled Rice Bran

1 m^3/day **1 m^3/day** **0.3 m^3/day**

Total volatile solids mass removal efficiency of anaerobic digestion process



Methane and Carbon Dioxide content in produced biogas



The average Methane and Carbon dioxide percentage were recorded as 55.8% and 38.67% respectively

Different species of Seeds collected

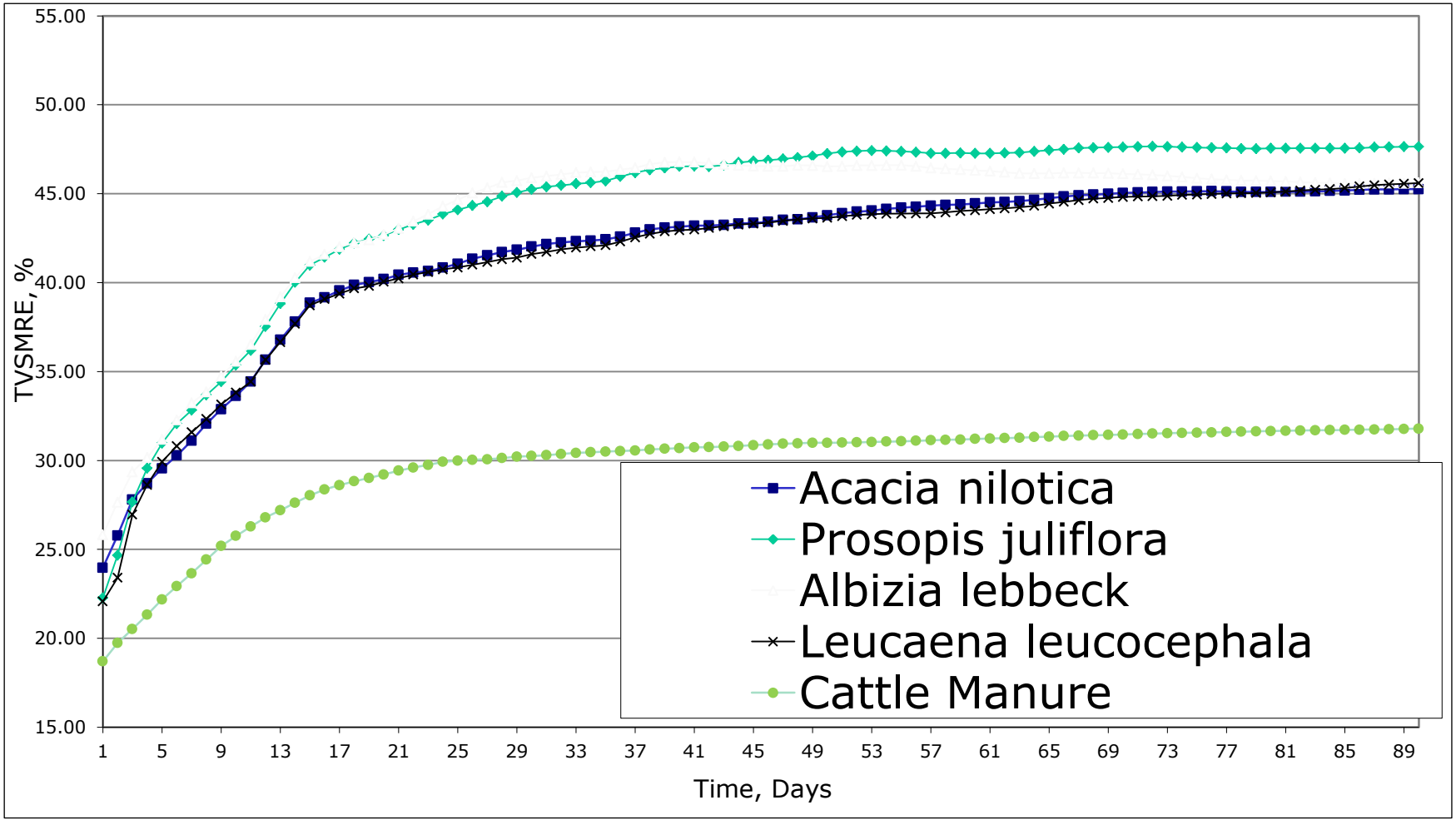
Polyalthia longifolia	*Albizia lebbeck*	*Acacia nilotica*	*Leucaena leucocephala*

Cassia fistula	*Mimusops elengi*	*Terminalia arjuna*	*Prosopis juliflora*

Pongamia pinnata	*Ficus virens*	*Ficus racemosa*

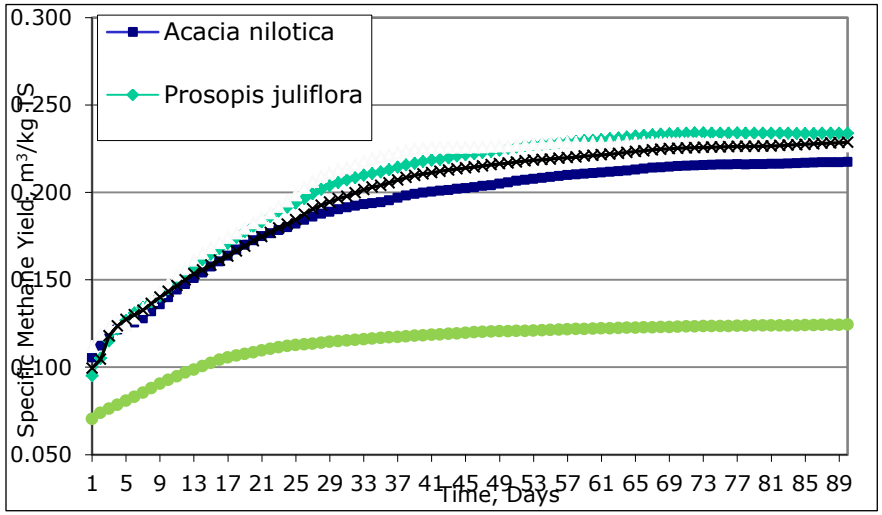
Biogas Plants running on different seed substrates in micromodel complex

Variation of total volatile solids mass removal efficiency of different feedstocks (TVSMRE)

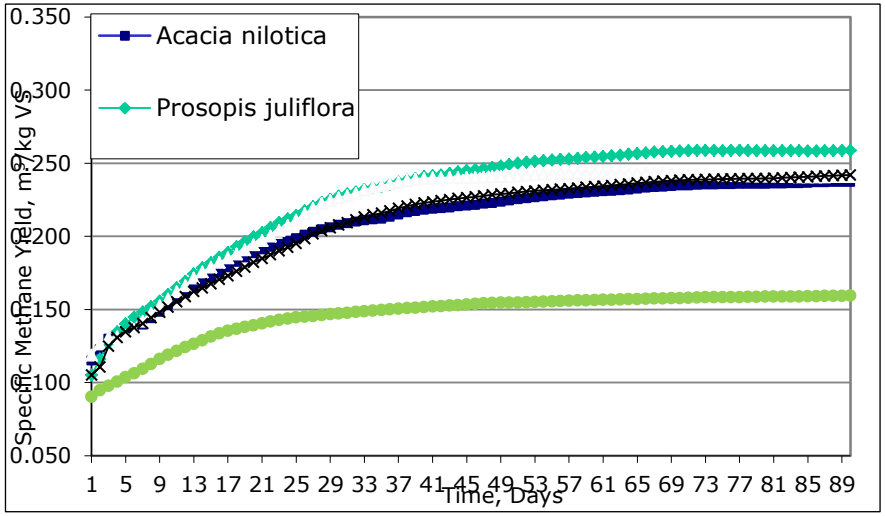


Variation of specific methane yield from different feedstocks based on their total and volatile solids content

Variation of specific methane yield (m^3/kg TS)



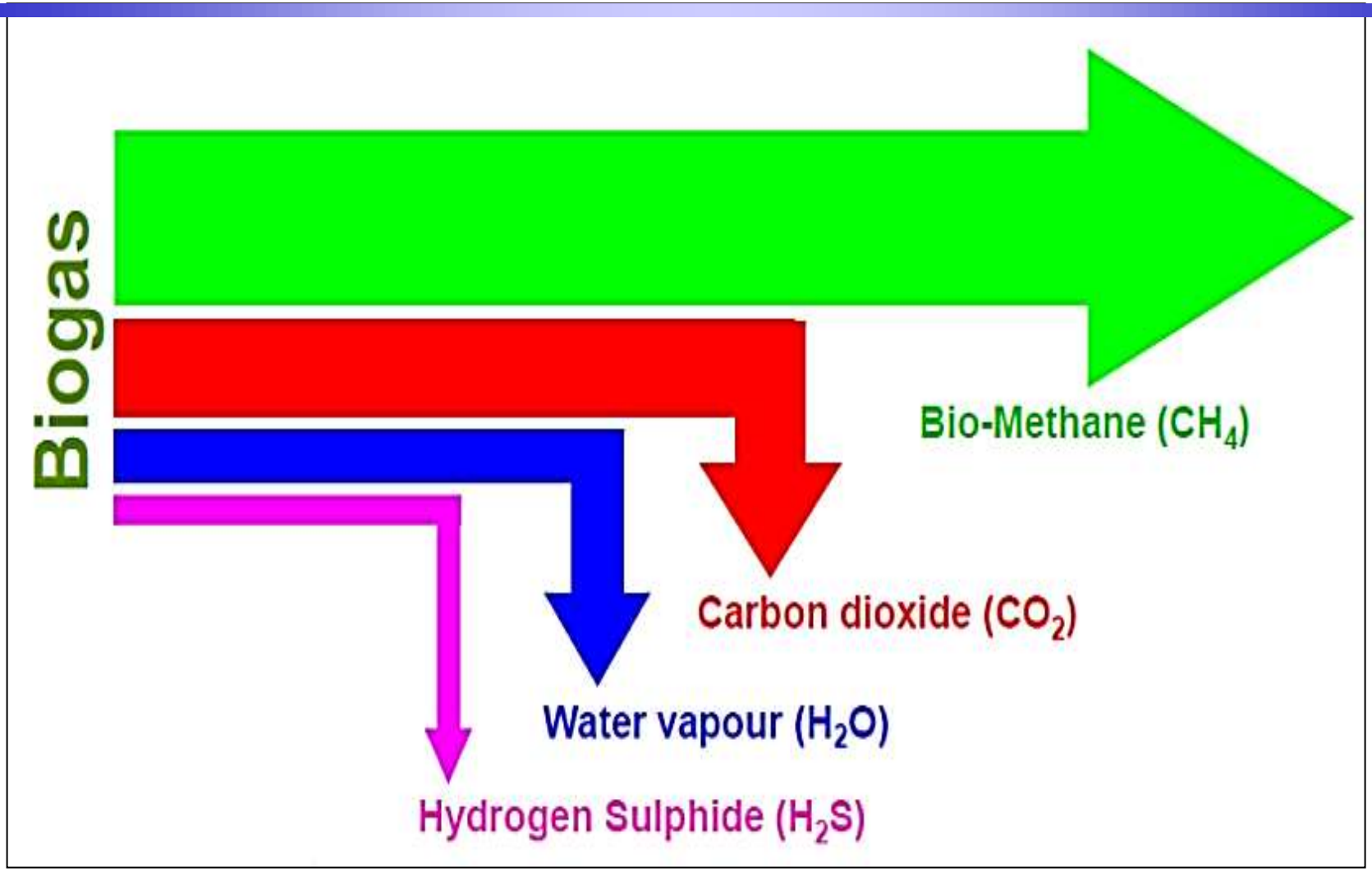
Variation of specific methane yield (m^3/kg VS)



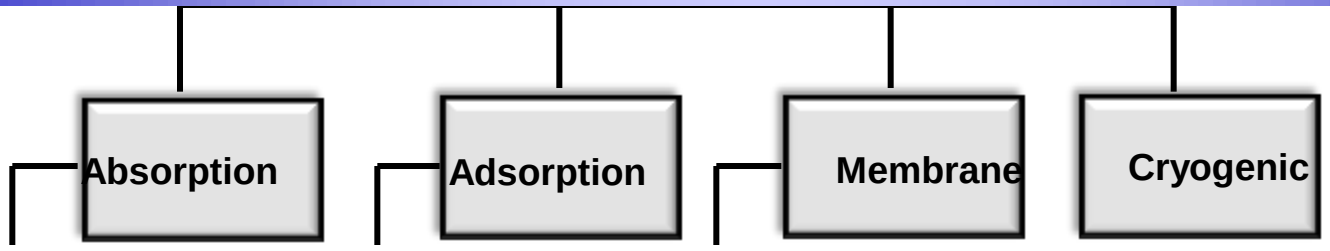
Agricultural residues to Biogas

10 tonnes/day of agricultural waste is used to generate biogas. biogas from paddystraw which is being used for operation of electrical generator to produce electricity of 1.0 MW

Biogas Upgrading: The Gas Separation Problem

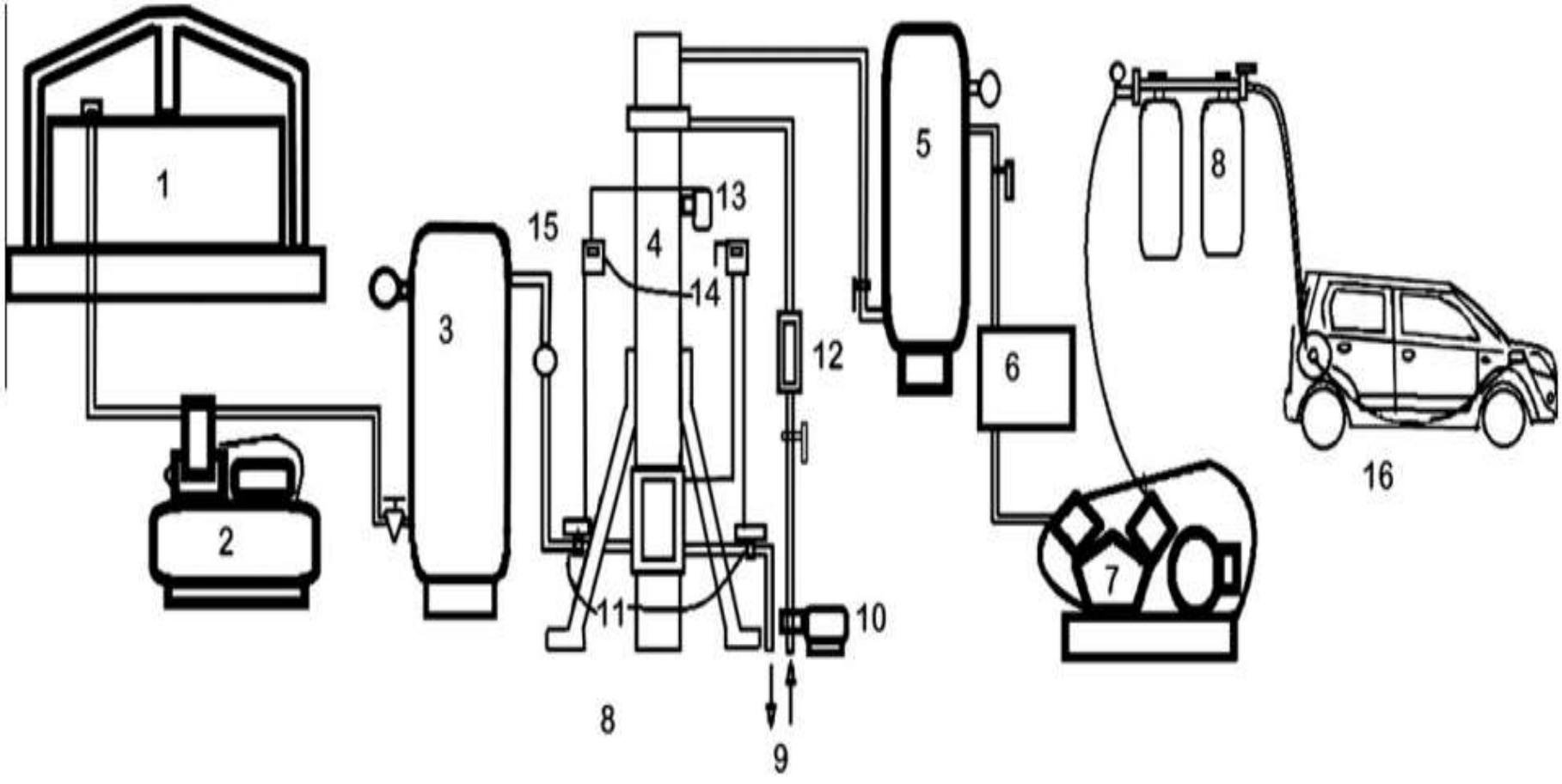


Techniques for Carbon Dioxide Removal



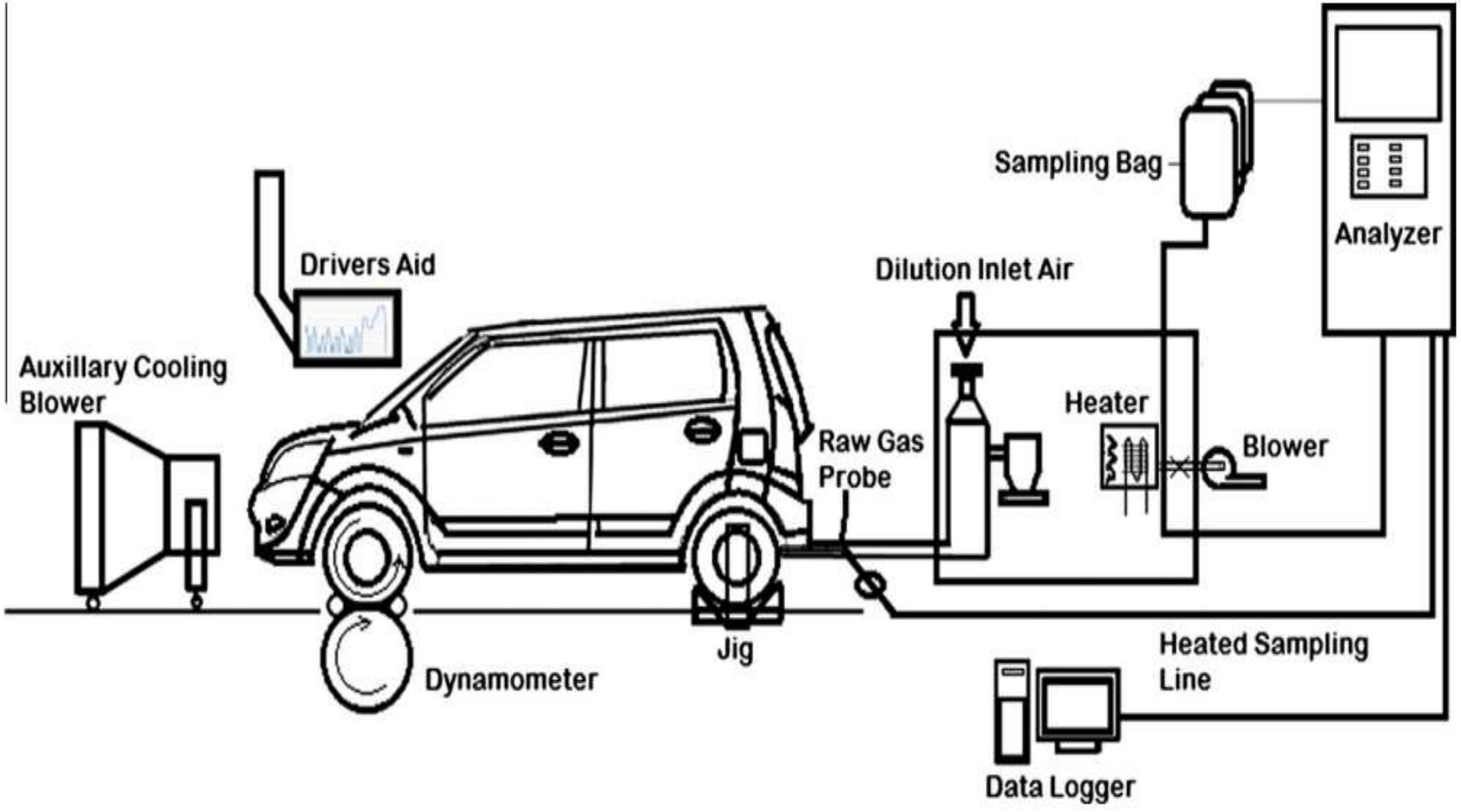
- ***The established technologies for the separation of CO_2 from biogas are based on the differences in their molecular properties or the thermodynamic and transport properties of the components in biogas.***

Biogas enrichment and Filling system

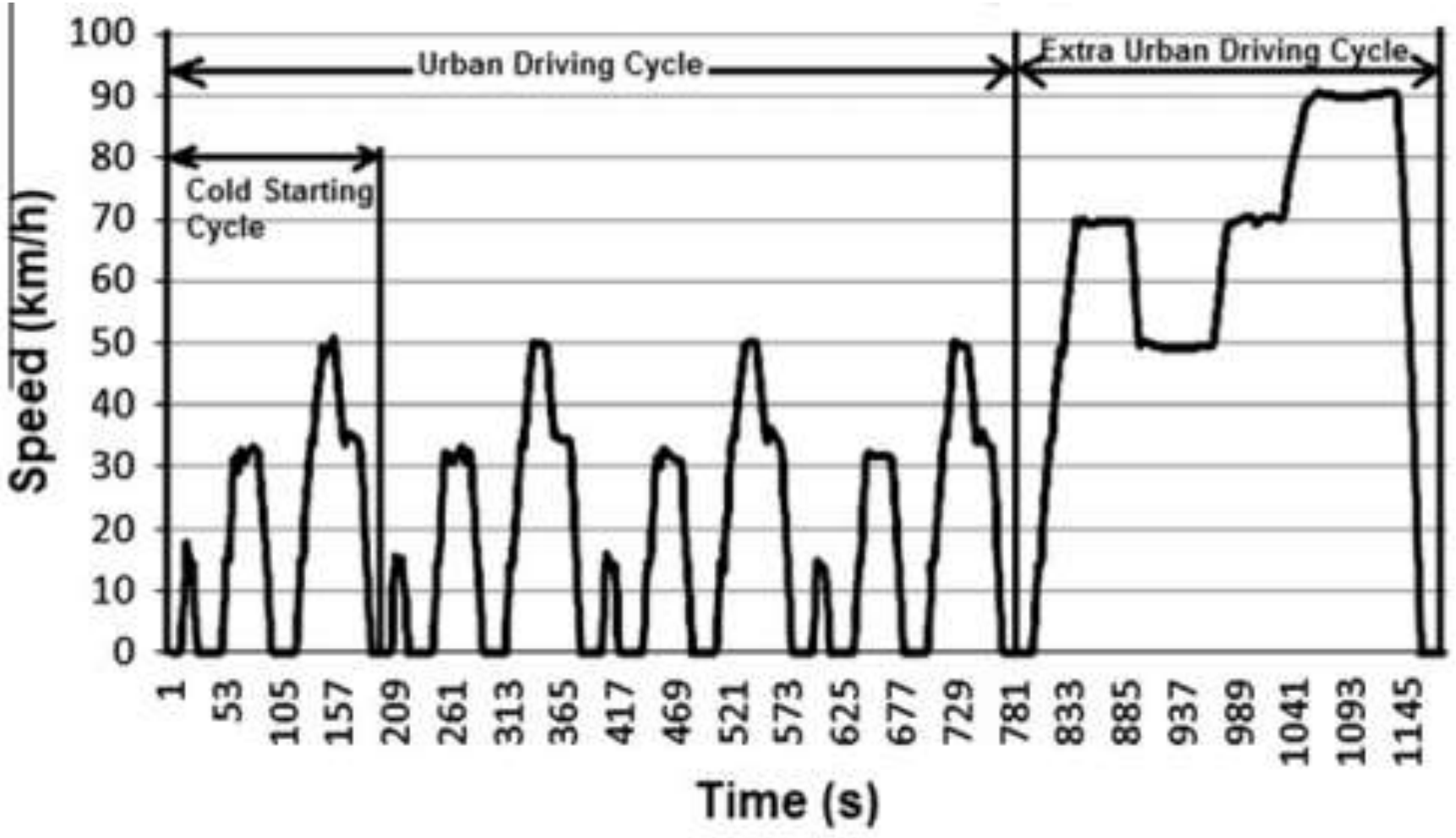


(1) Floating Dome type Digester. (2) Low Pressure Compressor. (3) Raw Biogas Storage Vessel. (4) Water Scrubbing Unit. (5) Enriched Biogas storage Vessel. (6) Moisture removal System. (7) High Pressure Compressor. (8) High Pressure Storage Tank with Dispensing Unit. (9) Water Inlet and Outlet from Tank. (10) Water Pump. (11) Pneumatic Controlled Valves. (12) Rotameter. (13) Pressure Sensor. (14) Programmed Logic Control Unit. (15) Pressure regulating Valve. (16) Bi fuel Vehicle.

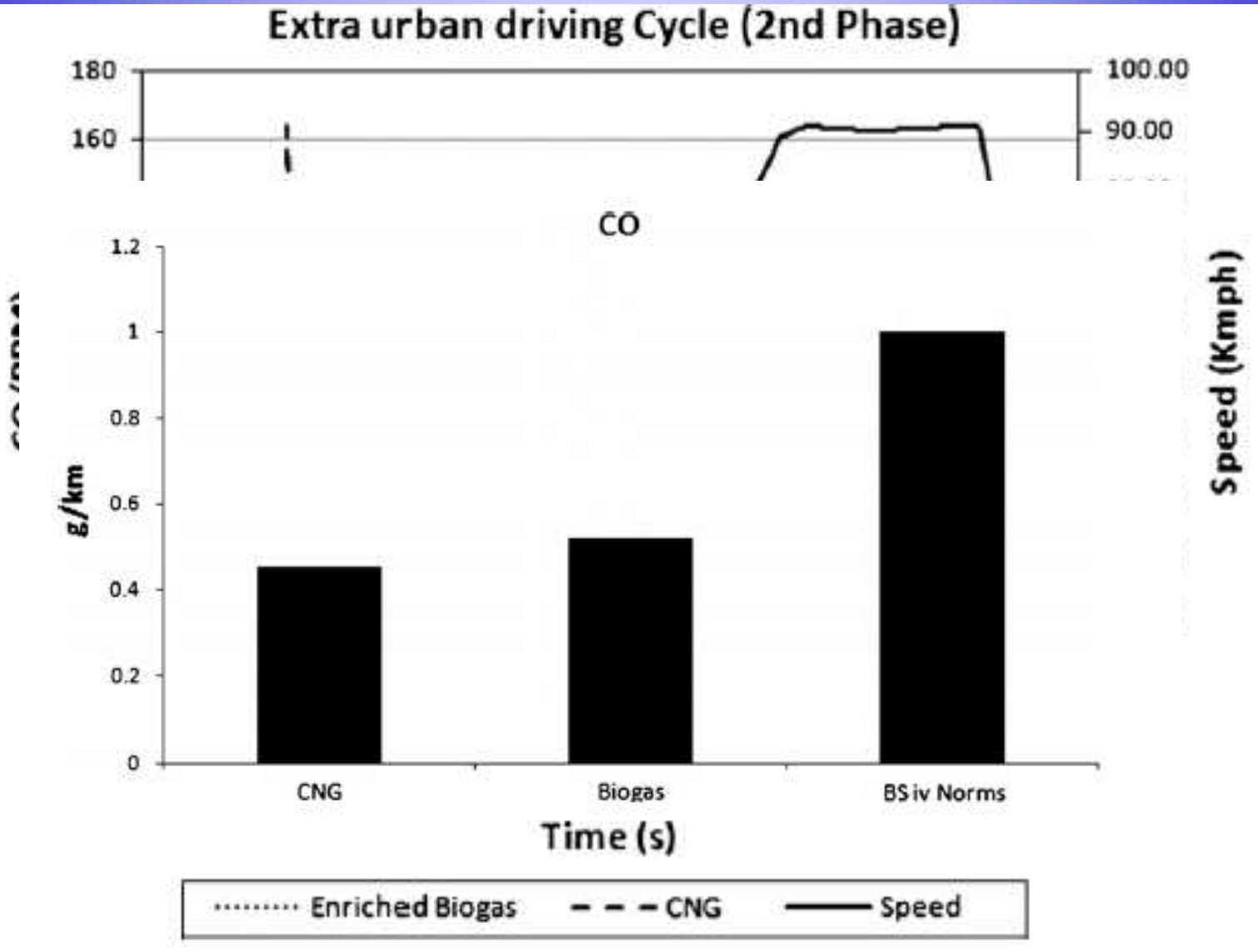
Testing of Vehicle in Standard Laboratory



Indian Driving Cycle



Performance of Compressed Bio-methane Vehicle



भारतीय मानक

बायोगैस (बायोमीथेन) — विशिष्टि

Indian Standard

BIOGAS (BIOMETHANE) — SPECIFICATION

ICS 75.060

Mobile BE Unit

Bio CNG Bus

TE Narasimhan | Chennai January 02, 2016 Last Updated at 15:21 IST

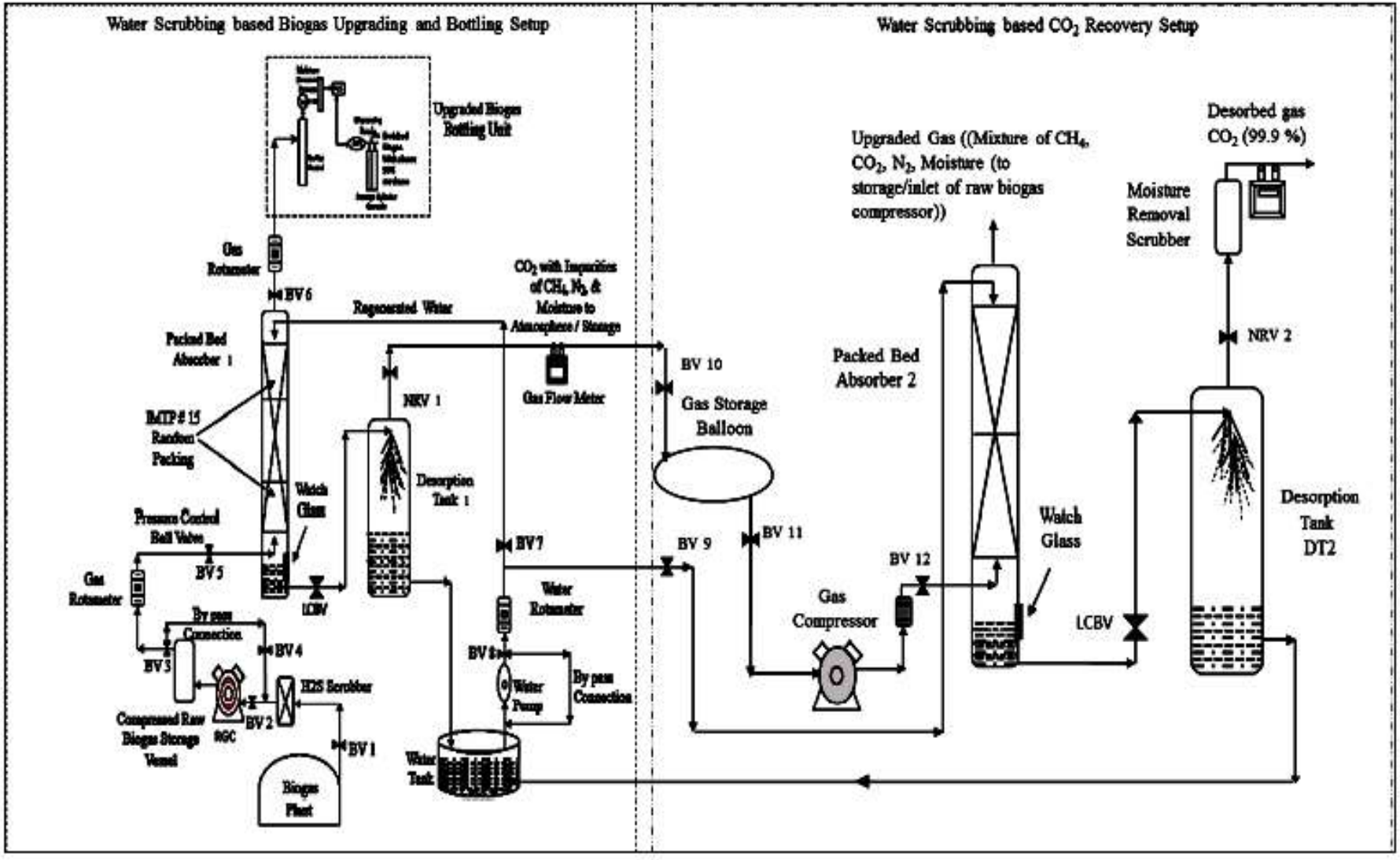
"We hope it will be commercially viable, but we need to bring down the cost for that," he said.

The company has joined hands with IIT Delhi for the purification technology part. Goenka said the company is open to share technology with entrepreneurs who wanted to set up such bio-CNG plant.

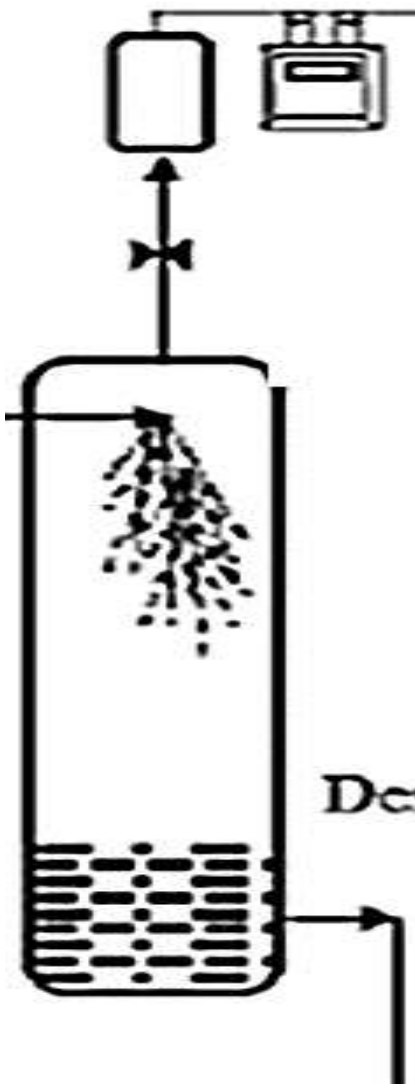
It may be noted currently Indian Railways uses biogas for shunting of engines. It was reported that Scania is planning to launch range of city buses that runs on bio fuels (bio-ethanol and bio-gas).

Automajor Mahindra & Mahindra's vehicles at Mahindra World City will be powered by bio-CNG generated at the demo plant, which was inaugurated here today. The company said what it showcased today is just a technology demonstration and the company, going forward, can also make it

Biogas Enrichment with Recovery of CO2



Low Methane Loss & High Purity CO_2 Recovery



CH_4 : 0.1% = CH_4: 0.0039 Nm³/h

CO_2: 99.9% = CO_2: 3.888 Nm³/h

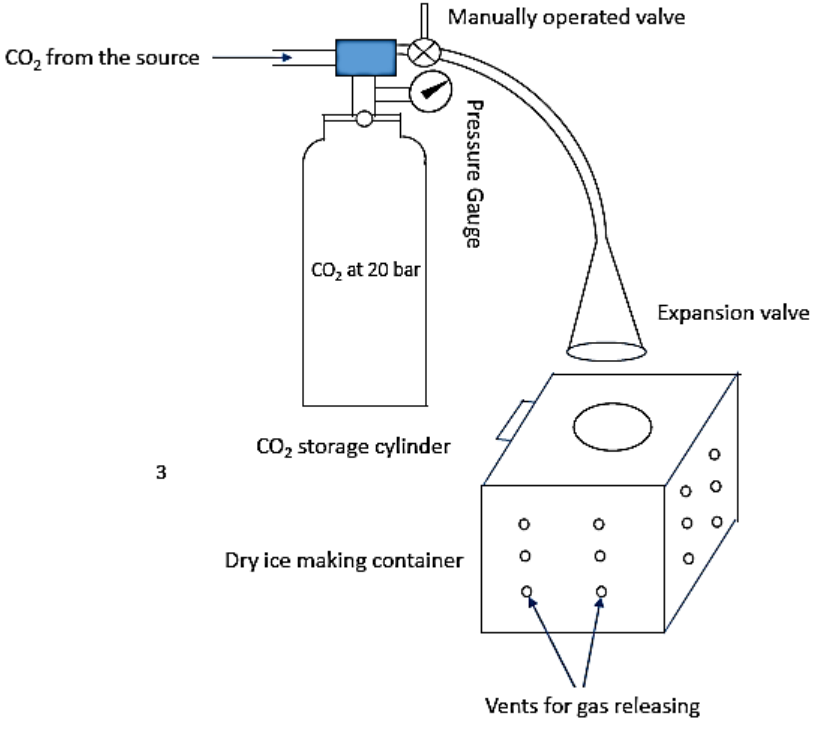
O_2 : 0.0% = O_2 : 0.000 Nm³/h

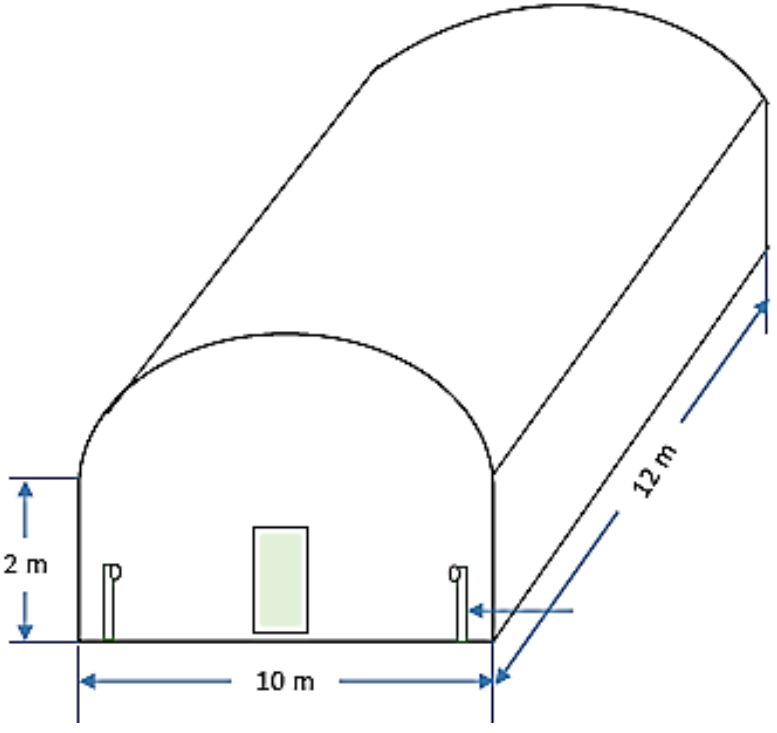
Bal 0.0 % = Bal : 0.000 Nm³/h

CO_2 Recovery η : 88.2%

CH_4 Loss % : 0.71 %

Utilization of captured CO2





Sustainable Ideas for “A painless tomorrow’s energy”

Thank you