BIOGAS TECHNOLOGY FOR POVERTY REDUCTION AND SUSTAINABLE DEVELOPMENT

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INDIA

Commercial Sources of Energy

Electricity, HSD, kerosene, LPG, natural gas, coal, etc.

- have medium to large subsidy

Renewable sources of Energy

Solar Photo-Voltaic, solar thermal, biogas, biomass, wind etc

-also have subsidy / incentives, but these are not attractive

Important sources of renewable energy

- Solar energy
- Wind energy
- Tidal energy
- Ocean energy
- Hydro power
- Biomass energy
- Geothermal energy

Biomass Conversion Processes

[i] Thermo-chemical conversion
[ii] Biological conversion

Important Substrates

- **Common animal dung**
- **Dry crop residues – pretreatments**
- **Poultry litter, pig manure**
  – CH_4 yield 100-200% higher than Cow dung
- **Fruits & vegetable waste**
  Kitchen & Dining Hall Waste
- **Agro-processing waste / effluent**
- **Energy crops**

Important negative points

- **High investment :**
  Rs 6000-3000/m^3
- **High water requirement**
- **Management of digested slurry**
- **CO_2 contents is very high, 40-50%,affects engine operation**

*** High sensitivity to temp. variations**

National Programme on Biogas Development

Objective :

Promotion of Family Type BGP

Designs :

1. **Fixed dome; Deenbandhu, Janta**
2. **Floating dome; KVIC**

No. of plants set-up: 3.27M
(potential 12 M)

Community / Institutional BGPs

Capacity : **15 – 85 m^3**

No. installed : **3075**

Major cause of failure : **Management problems**

Animal dung

Annual production ≈ 615.6 MT

Cakes	**:**	**300.0 MT**
• **Composting**	**:**	**93.0 MT**
• **Biogas**	**:**	**40.0 MT**
• **Not collected**	**:**	**182.6 MT**

Potential Available

- **No. of Family size BGPs : 12 M**
- **Save 200 MT of fuel wood &**
  Produce 400 MT manure/year

Achievement, No.of BGP Installed = 3 M

Cattle dung based systems

- **IS 9478:1989 family size biogas plant – code of practice (capacity 1-10 m^3)**
- **Floating dome – KVIC, Pragati**
- **Fixed dome – Janta & Deenbandhu**
- **Institutional/community BGP**

  Capacity upto 85 m^3, multiple units

  Floating dome KVIC type
- **Familiar technology**
- **Gas yield 70-240 l/kg TS (55% CH_4)**
- **H_2S scrubbing not needed for engine use**

Anaerobic Digestion

Purposes / Benefits

- **Produce clean & easy to use fuel**
- **Nutrient reclamation : Nutrients are not destroyed but made more available to plants**
- **Waste stabilization**
- **Pathogen inactivation**

Community Biogas Plant of 85 m^3 capacity

Working satisfactorily since 1988 at Islamnagar, gas being used by 50 farm families, average gas yield : 50-70 m^3 per day

Kitchen Waste Based Biogas Plant installed at Shegaon

Capacity 10 m^3

Horizontal Flow Field Plant

- **Digester cap. : 9 m^3 , RT : 50 d**
- **Feed rate : 80-90 kg/h**
- **TSC - fresh substrate : 20-30 %**
  - Feed slurry : 10%
- **Average gas yield : 4-5 m^3 / day**
- **Power rating of shredder : 1.5 kW**
- **Cost of plant : Rs 60,000**
- **Plants working well since 2001**
- **Technical bulletin published**
- **Plants installed at 5 more locations**

Horizontal Flow Biogas Plant installed at Zonal Training Centre, Western Railway, Udaipur

Capacity 6 m³, feed 80-100 kg KDW/d, Gas Yield 154-226 l/kg dm

Biphasic system for VMW

- **Separate acid & methane reactors.**
- **Optimum parameters may be maintained easily .**
- **Obviates problems of pretreatments, scum breaking and slurry flow.**
- **100 kg/d system developed and evaluated.**
- **Gas yield 1.5 - 2.0 m^3/d (methane 70%).**

Biphasic Plant for Vegetable Market Waste

Capacity : 100 kg / d

Biphasic Plant installed at Farmer's Site near Dharwad

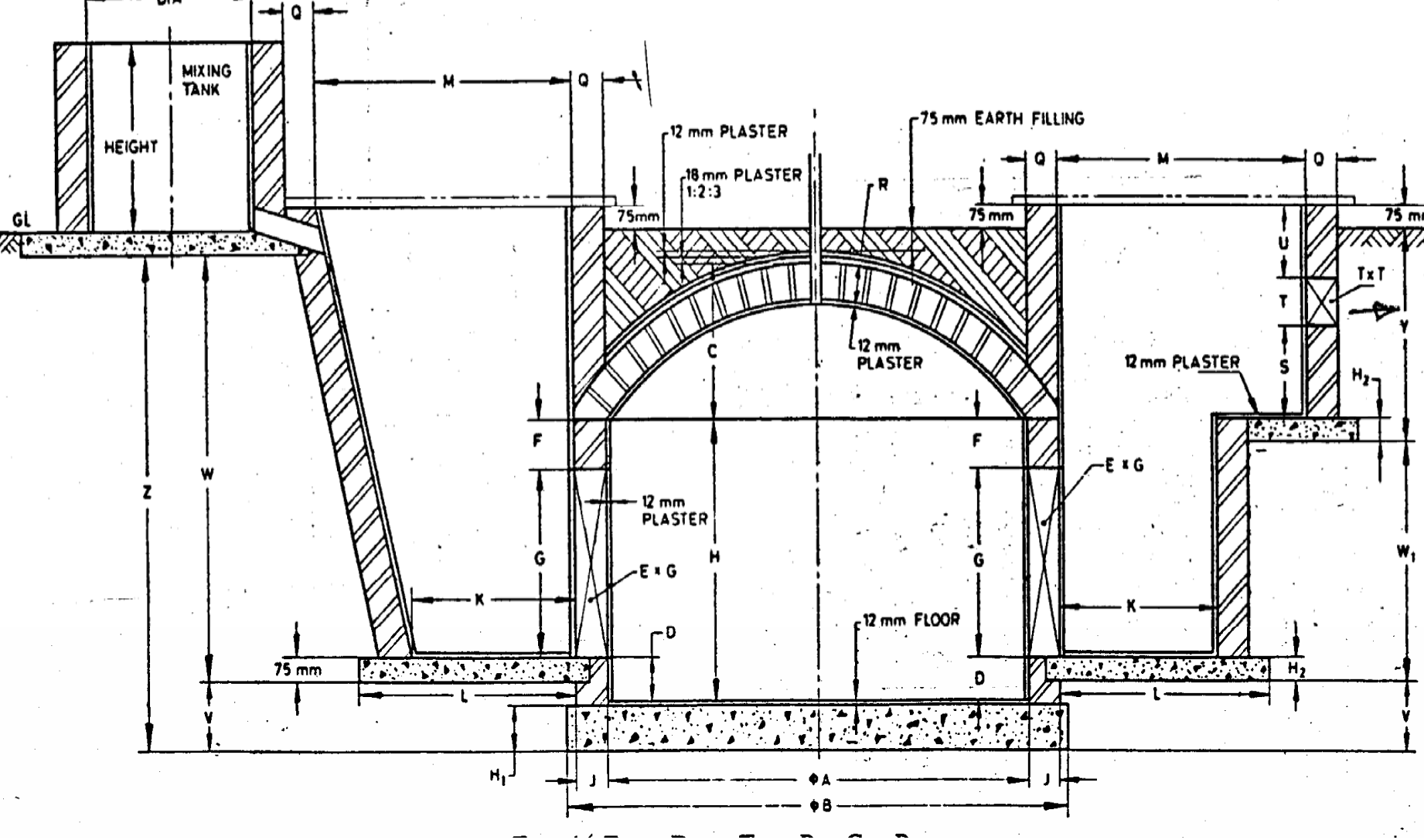
Substrate – common weeds

6 m^3 Pant Tarai Biogas Plant installed at Farmer's Site

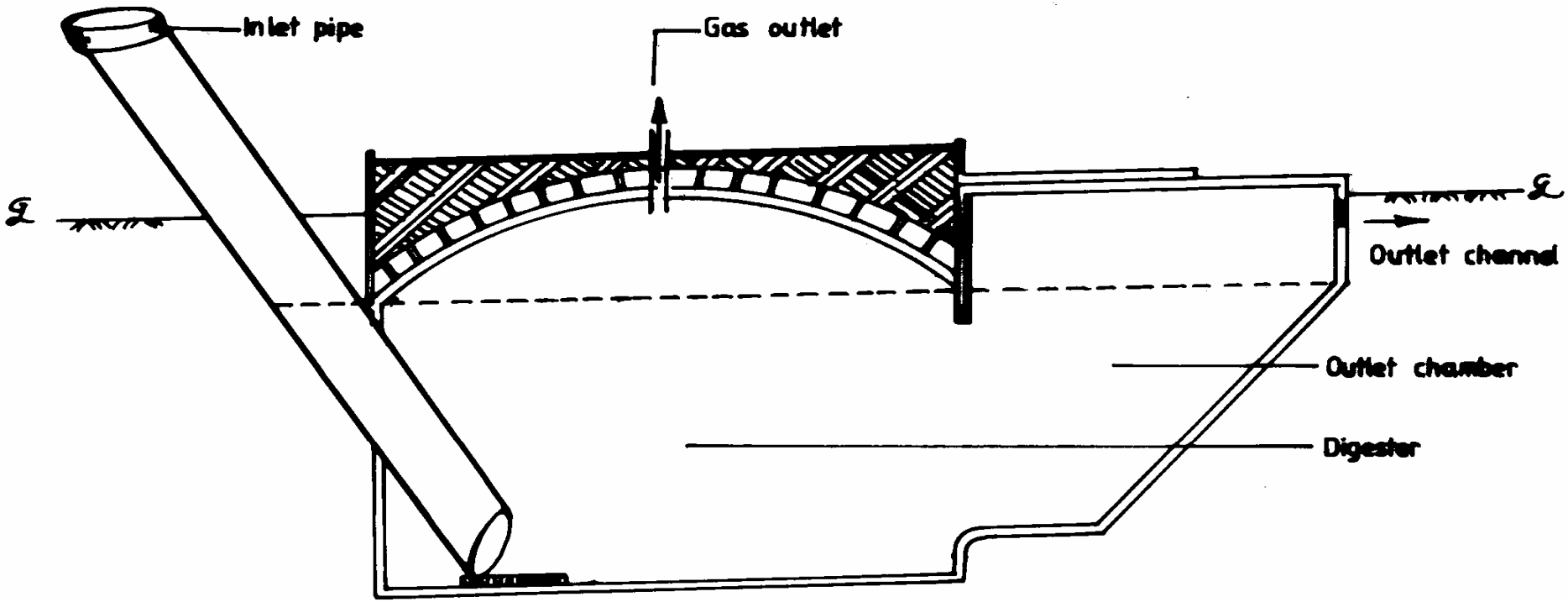
Solid-state digesters for Cattle dung

(AICRP on RES)

- No water required, Gas yield up to 30% more
- Easy handling of digested slurry (TS: 9- 10%)
- Cost : nearly same, Capacity : 2,3 &4 m^3
- 30 plants in villages, Design submitted to MNES
- Scaling-up under progress



Line Diagram of Janta Biogas Plant

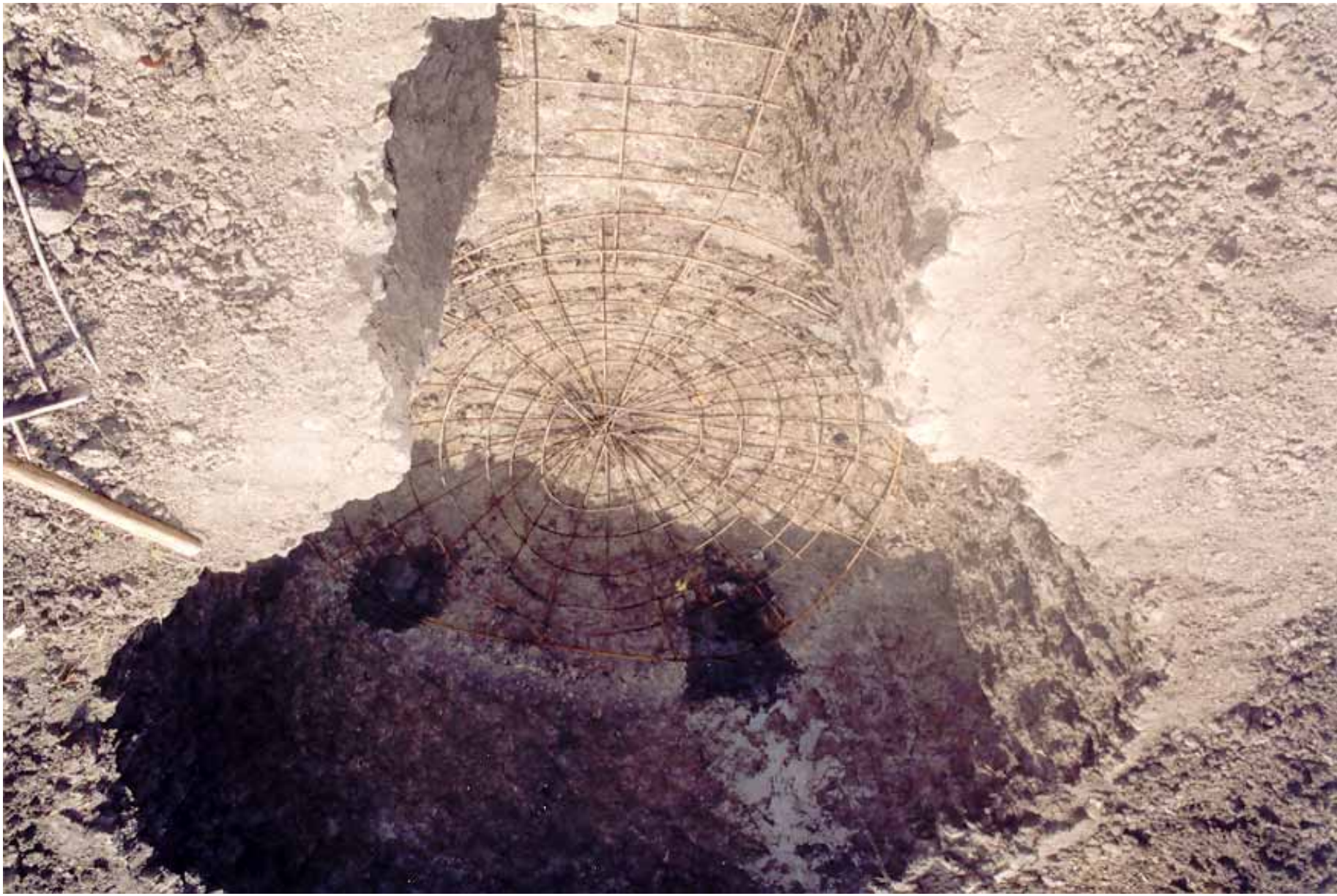


Line Diagram of Modified Janta Biogas Plant for Solid-state Digestion of Cattle Dung

Modified Janta Biogas Plant for Solid-state Digestion of Cattle Dung

EXCAVATING OF PILE HOLES

REINFORCEMENT FOR PILE FOUNDATION



REINFORCEMENT FOR PILE CAP

PREPARATION FOR RCC PILE CAP

CONSTRUCTION OF RCC PILE CAP

BRICK MASONARY WORK

BRICK MASONARY WORK

DIGESTER WITH INLET PIPE

DIGESTER WITH OUTLET

CONSTRUCTION OF DOME

A COMPLETE VIEW WITH ALL COMPONENT

PLASTERING OF BIO GAS PLANT

PLASTERING OF BIO GAS PLANT

SOLID STATE DIGESTION

Reduced digester volume

Higher gas production

Better digested slurry management

MAJOR MODIFICATIONS

- **Replacing the inlet tank with a 30 cm dia RCC pipe fixed at an angle of 60 ° with horizontal**
- **The pipe is to be projected around 90 cm above the dome of the plant and is provided with a collar on the top for easy feeding of the cow dung.**
- **The inside of the dome is provided with a thin layer of 1:2 cement and sand plaster for additional safety against gas leakage.**
- **The outlet chamber is enlarged to accommodate the total slurry displacement.**
- **The exit way from the digester to outlet is made to provide a smooth flow of digested slurry and to avoid any sharp bend.**

Average comparative performance of Janta plant at Hisar*

Parameters	Common design	Modified plant
TSC, %	8 – 10	14 – 16
Gas yield, l / kg dm	134	205
TS degradation, %	25	37
VS degradation, %	35	49
*Weekly mean ambient temperature		9-35° C

Gas Utilization

- **Thermal applications : cooking, process heat, biogas operated brooders, etc**
  - **Methane contents : 55 – 75%**
  - **Heat value : 4500-6300 kCal / m^3**
  - **H_2S burns to SO_2,**
  - **Scrubbing needed if H_2S > 1%**
- **Illumination : Biogas lamps;**
  - **1 m^3 biogas lights 60 W lamp for 6 h**
  - **Electricity generation route is more efficient but expensive for small applications**

Important Recommendations

- **Satisfactory field scale technologies are now available. Govts should encourage their refinement, commercialization & adoption at all levels.**

*** Liberal support should be extended for wider adoption of following teches:**

- **Fixed dome solid-state biogas plants**
- **Kitchen & dining hall waste based biogas plants**
- **Biphasic biomethanation system for vegetable market waste**


Thanks