Challenges in Handling and Utilization of Paddy Straw for Energy Generation

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Can Burning of Paddy Straw in the Field be Stopped?

- **Time Period for Clearing the Field for Sowing Next Crop**: 30 - 40 days

- **In Mechanized/Manual Harvesting Leftover Plant Height is**: 8-12” / 6-8”

- **Uprooting this Portion to Clean the Field, Farmers has to Incur Additional Cost, besides Time and Labour Constraints. So Economic and Faster Action for Farmers is to Burn**

- **So, Burning Can be Reduced but It Can't be Stopped**
Key Challenges in Handling & Utilization of Paddy Straw for Energy Generation

• **Fuel Management – Collection, Transportation, Storage and Processing**

• **Appropriate Conversion Technology to Generate Energy**

• **Required Conducive Regulatory and Policy Framework**
Fuel Management – Collection, Transportation, Storage and Processing

Challenge - Secured supply of required quantity and quality of Straw at a competitive price for sustained operation of the plant

Collection of Paddy Straw

Requirement of Paddy Straw for 1 MW Plant - 22-25 MT/day

Requirement for 10 MW Plant - 220-250 MT/day

Annual Requirement for 10 MW Plant - 66000 – 75000 MT/day

Average Straw Production per Hectare - 5MT/ha

Catchment Area to meet the Requirements - 15000 ha
Requirement of Machinery for Collection from the Field

Each Balers can Collect - 10-12 Ton/day
Total No of Bailer Required - 150-160
Total Investment - INR 2250 lakh or 225 million

In addition to arranging equal no of tractors & Other machineries

Bailers remain Unused for Rest of Year ??
Transportation of Paddy Straw to Depos/Plant Site

Extremely Low Bulk Density - 30 to 40 Kg/m³

Modified Tractor Trolley Can Carry Max : 4-5 Tonnes/trip

So, Total Straw Transportation in Day : 40-50 Tonnes
(Presuming 10 Trips /day)

So Collection of 75000 T in 30-40 days, Require Movement of 1500 Trolleys/day to Collection Depos

To Move 250 T Straw to Plant – 50 Trolley Load Every Day
or
5 Trolleys/hour Which mean One Trolley in every 12 Minutes
Storage of Paddy Straw at Depos/Plant Site

Collection Centres Requires –

• large area for collection
• Need to be equipped with weighbridge, moisture meter, security, fire system, adequate lighting, water, sanitary facility etc.
• Storage has to be done scientifically to ensure the maximum storage in minimum area and considering the fire risk involved
• Adequate moving space for tractors and trolleys should be there
• Susceptible to self combustion so fuel safety is a huge challenge considering the volume of storage
• Degrade fast if subject to air and moisture.
Processing of Paddy Straw

• Paddy Straw Fibers are Flexible making it difficult to Cut & Shred
• High Silica –Contents make Low Life of Preparatory Devices mainly Cutter Blades (Few Hours Only)

Briquetting for Gasification

• Making Pellets/Briquette from Paddy Straw is difficult due to its Physical & Chemical Characteristics and not a Feasible Option to Use in the Gasifiers
• 20/25 Briquetting Machines of Capacity Range of 5-10 tones /day need to be installed & operated continuously for Sustained Plant operation

De-baling & Cutting for Feeding into Boiler

• De-baling by Removal of Twine & than Chopping
• Excessive Blade Wear and Tear due to Abrasive Nature/Inherent Sand from the Field
Physical and Chemical Characteristics of Paddy Straw

Physical Characteristics

- Flexible Fibers making it Difficult to Cut/Shred
- High Silica Content – Low Life of Cutting Blades/ choppers
- Degrade Fast in Open (Due to Moisture) – Loss of CV
- Susceptible to Self Combustion in Dry Atmosphere
- Low Bulk Density – 30-40 kg/m³

Chemical Characteristics

- High Percentage of Alkali and Chlorides
- Medium to High Ash Content
- Comparatively High Moisture (10% & Fixed Carbon 15%)
- Composition can Vary in the Same Zone depending on the Soil Condition & Use of Chemical Fertilizers
Appropriate Conversion Technology to Generate Energy

Thermal Conversion Technologies

- **Gasification Technology** - Paddy Straw is the most difficult feedstock for Gasification in Conventional Down draft/Updraft Gasifiers because of Poor Flow of Straw inside the Gasifiers, High Content of Silica, leading to formation of Clinkers/Slag, High amount of formation of Tar & Ash and Poor Quality of Producer Gas [lower calorific value of gas produced, contaminated with high amount of impurities – ash & tar] making it least suitability for Utilization in the IC Engines for Generation of Electricity.

- **Combustion Technology** – Limited Experience but Process Works Fairly well Except Corrosion and Feeding Issues Need to be Taken Care while Designing the Boiler

**Biological Conversion Technology** - With the Emergence of Appropriate Pre-treatment Process to Remove Lignin from the Paddy Straw, Anaerobic Digestion for Production of Liquid Fuels and or Production Bio-CNG in a Decentralized Manner seems to be a Techno - Commercially Viable Option
Fouling and Chlorine Corrosion  (Reported by Thermax India)

Na/K (15%) > fouling
Silica (70%) > Slagging /Erosion
Cl (0.15%) > Corrosion

Chloride Corrosion
Absence of Conducive Policy and Regulatory Framework

Policy Framework

Financial Incentives - Availability of Grant/Subsidy,

Physical Incentives - Allotment of Land on Lease, Tax Holidays, Exemption on VAT, Access to Low Cost Long Tenure Debt, etc.

Regulatory Framework

• Preferential Feed in Tariff,

• Willingness of Discom to buy Costly Power vis-à-vis cheap Power from Solar/Wind

• Evacuation to Grid – Require Firm Power which may not be possible in case of Gasification of Straw
Possible Suggestions/Recommendations

• Select Energy Generating System which Run on Multi-feedstocks instead of just based on Paddy Straw;

• Preferred Technology should be Combustion or Biological Conversion as Gasification of Straw is not yet Proven at Scale

• Create Conducive Policy and Regulatory Framework to Promote the Sector

• A Detailed Assessment of Availability of Paddy Straw and Other Biomass is a must before deciding Size/Capacity of the Power Plant
Thank You