

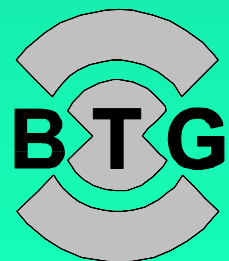
Ethanol Gel as Domestic Fuel



Biomass Technology Group BV

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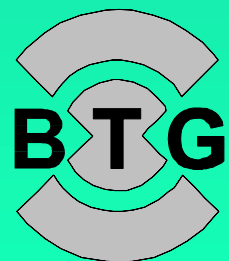
Piet Visser



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Ethanol Gel as Domestic Fuel

- Introduction
- Gelfuel
- Packaging and Regulators
- Combustion of Gelfuel
- Test Methodology
- Results
- Comparison with other Fuels

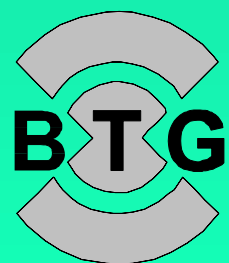


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Ethanol Gel as Domestic Fuel

Introduction

- Initiative of WorldBank RPTES Program
- Manufactured in Zimbabwe
- Existing Fuel for Camping, Starting Barbeques and Fires and in the Army
- NEW: Substitute Fuel for Wood, Charcoal, Kerosene and Gas in Domestic Cooking in Africa

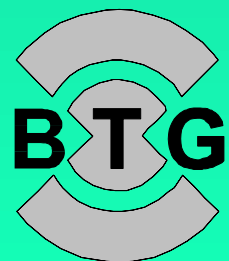


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Ethanol Gel as Domestic Fuel

Gelfuel

- Composition:
 - Ethanol
 - Water
 - Thickening Agent
 - Coloring and Flavouring Agents
- Gel Consistency, like Mayonaise or Toothpaste
- Combustion Value of 22.3 (MJ/kg)



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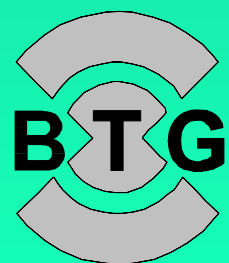
Packaging and Regulators



Plastic Bottles



Sachets



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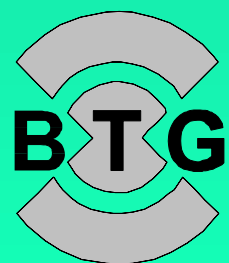
Packaging and Regulators



Tin with Old Regulator



Butterfly Regulator



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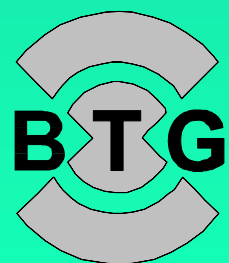
Combustion of Gelfuel

Ethanol Vapour + Oxygen (Air) → Fire

- Diffusion Flame
- Premixed Flame

Evaporation:

- Available Surface
- Temperature
- Transport to combustion zone

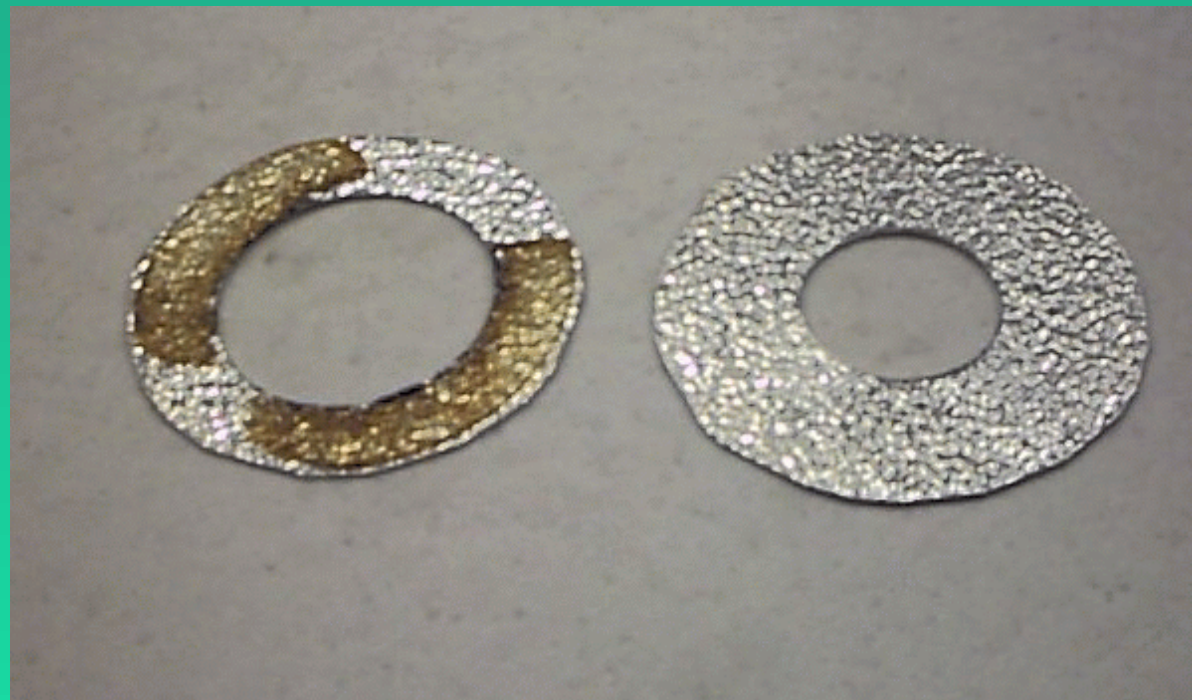


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Combustion of Gelfuel

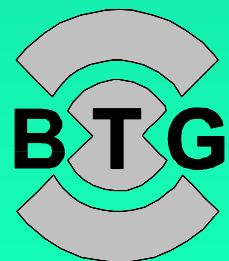
Power Control



Aperture regulator



Holes Regulator

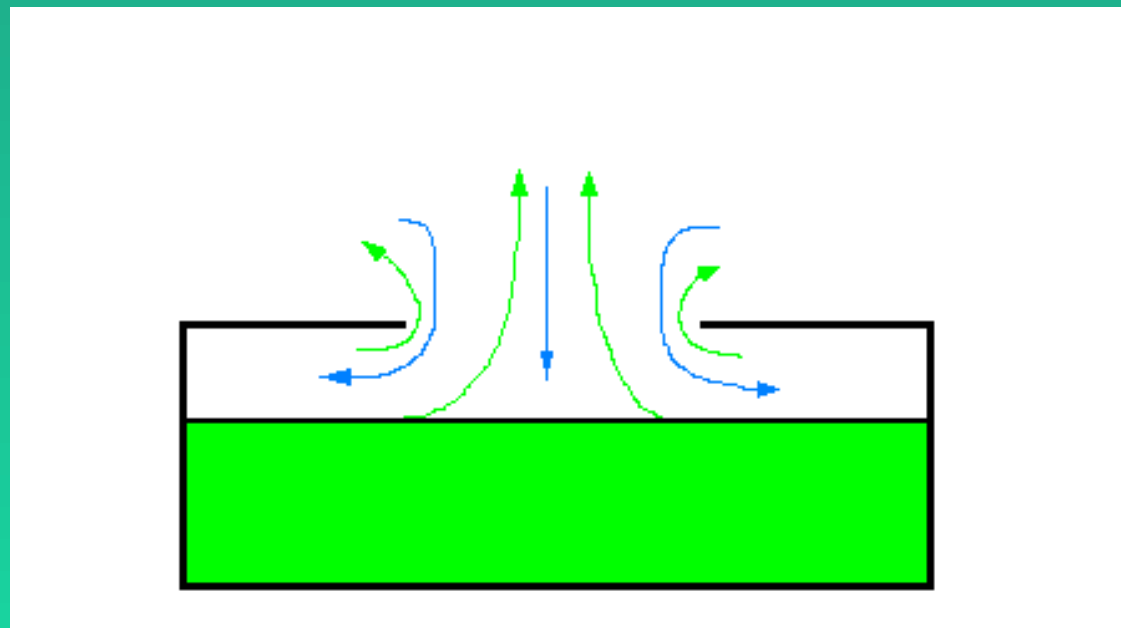


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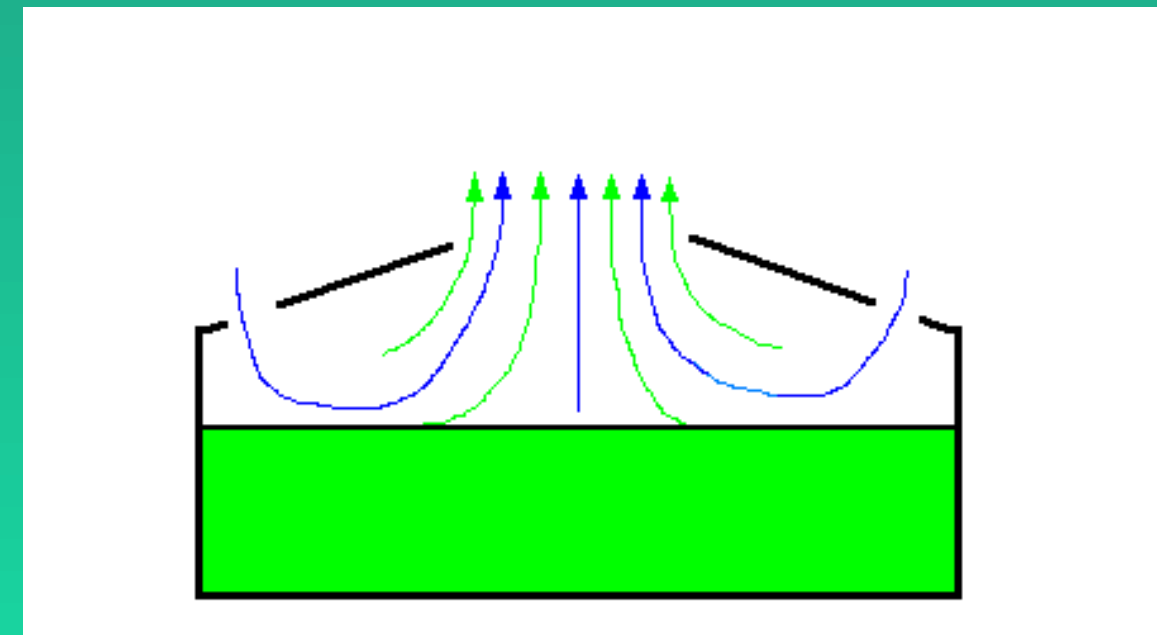
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Combustion of Gelfuel

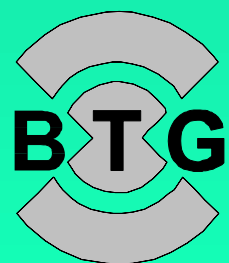
Power Control



Aperture Regulator



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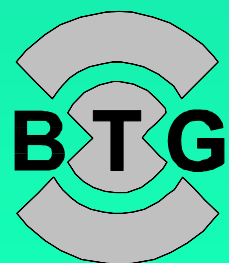
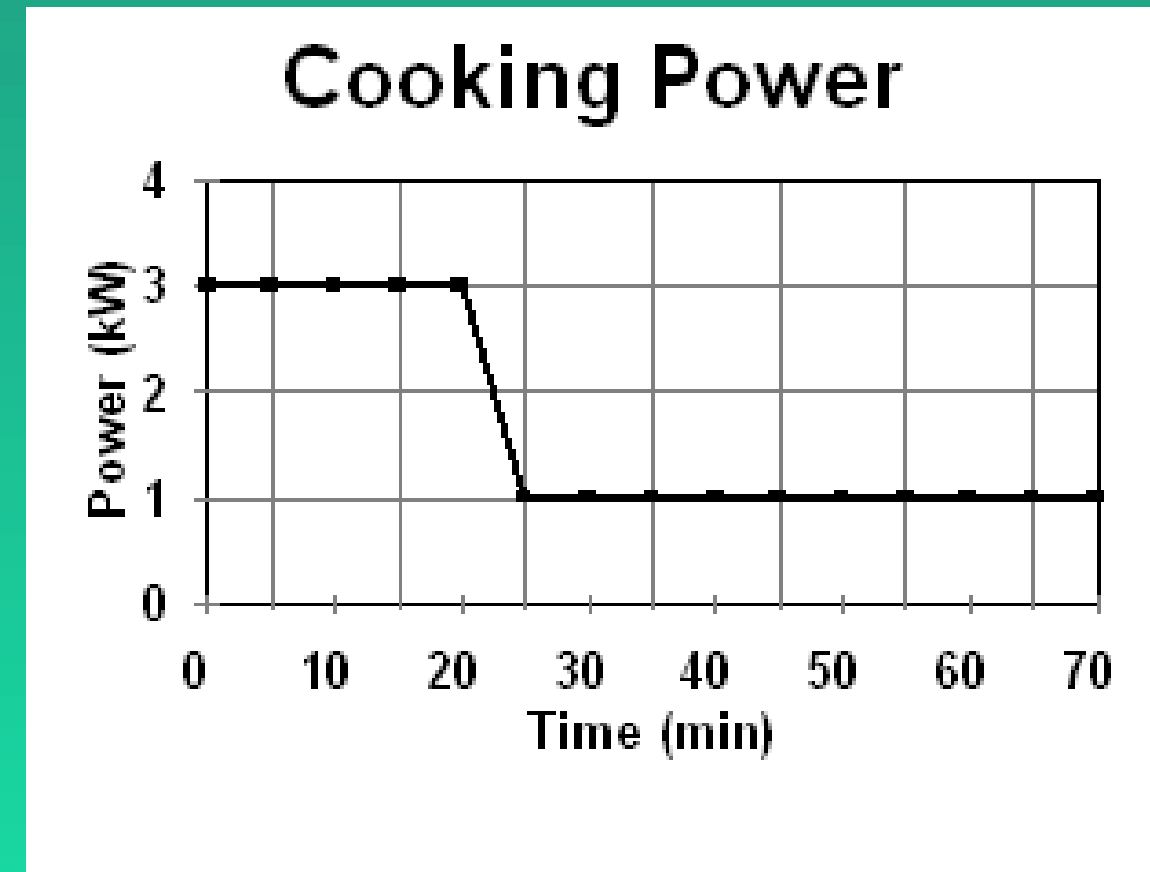


Ethanol Gel as Domestic Fuel

Test Methodology

Waterboiling Tests

- Maximum Power, P_{max}
- Efficiency at P_{max} , E_{max}
- Minimum Power, P_{min}
- Efficiency at P_{min} , E_{min}

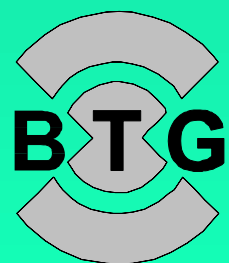


Ethanol Gel as Domestic Fuel

Test Methodology

Procedure

- Stove with Pan on Electronic Balance
- Readings Every 5 Minutes



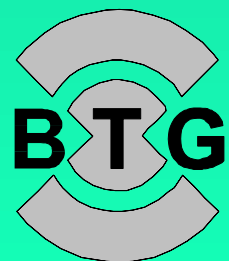
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Results

Based on 25 Tests with Different Regulator and Stove Combinations

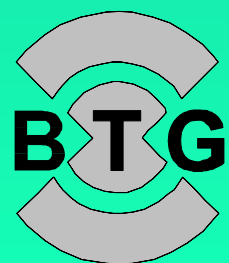
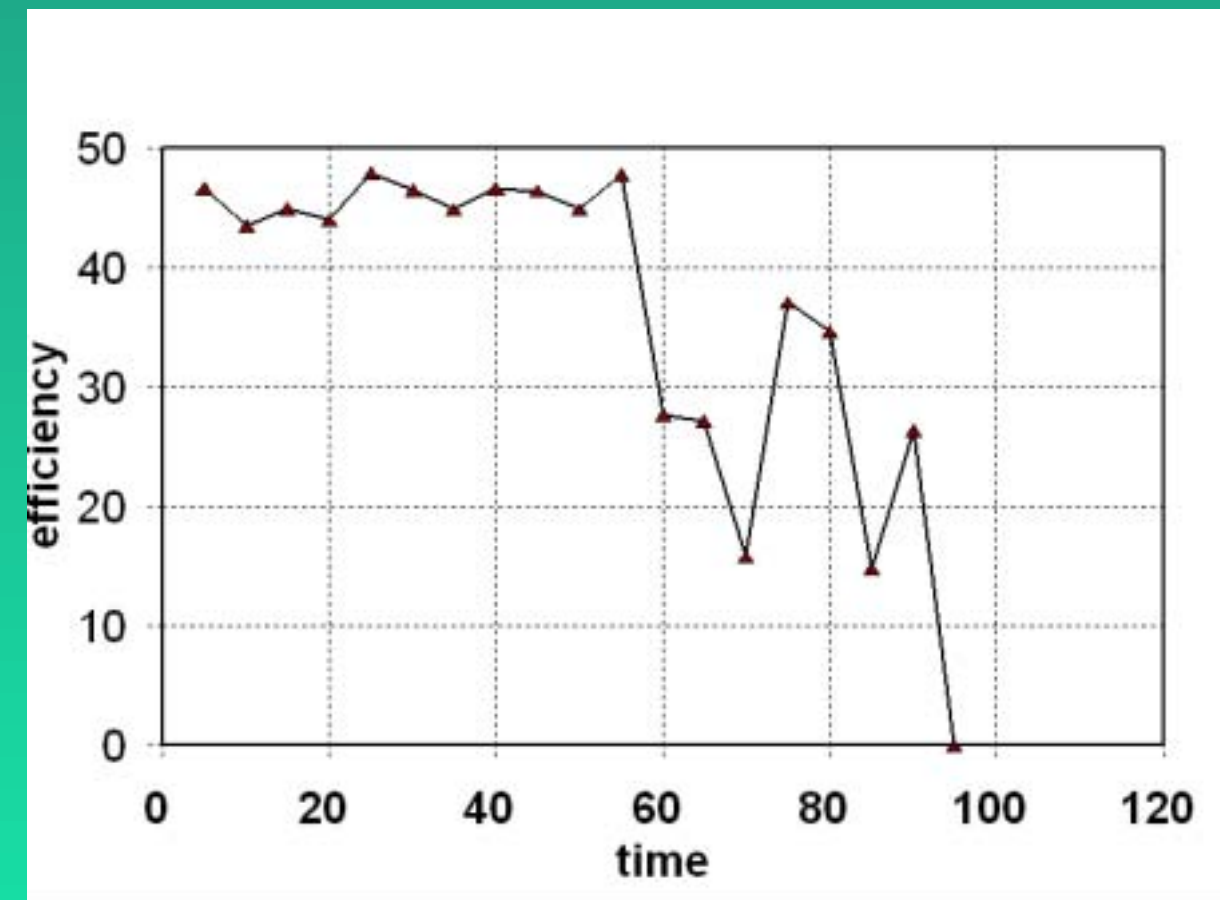
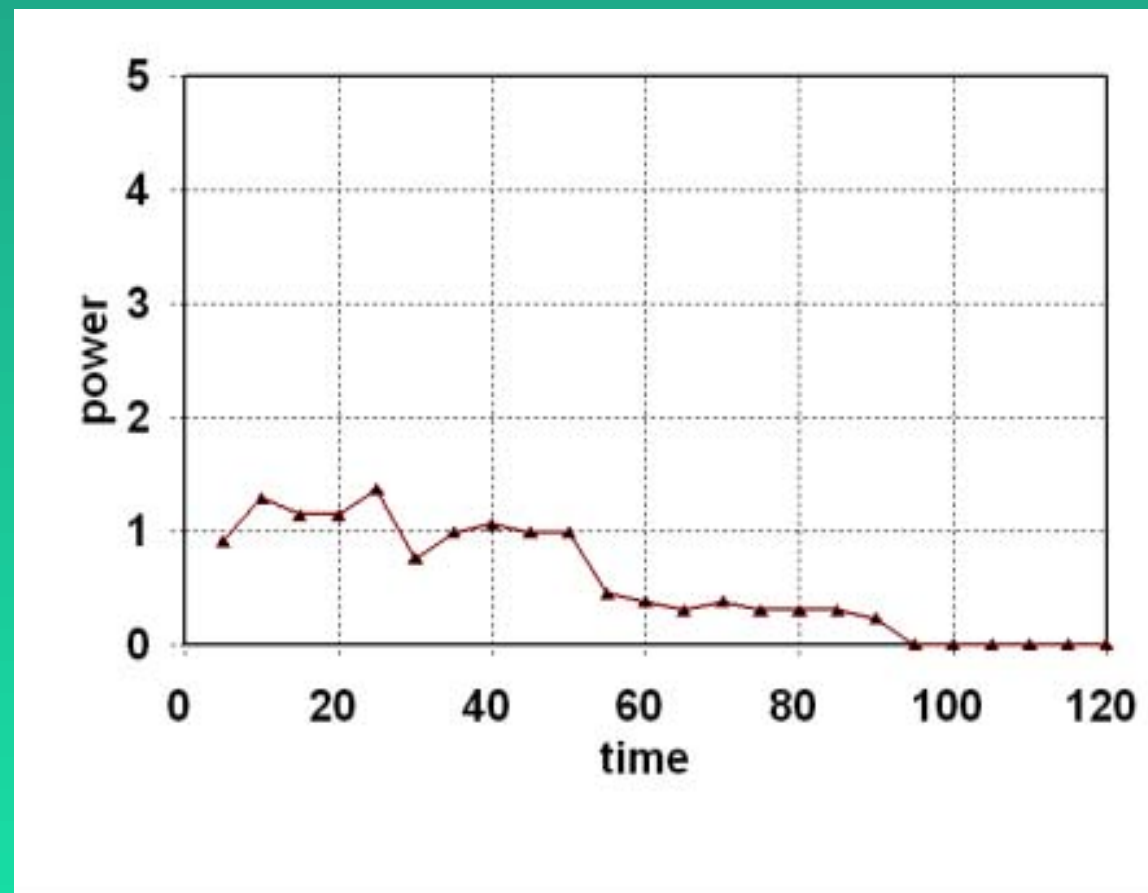
- Power varies with aperture size
- Sufficient High Power of 3 kW
- Emax of >40%
- Very Good Power Control



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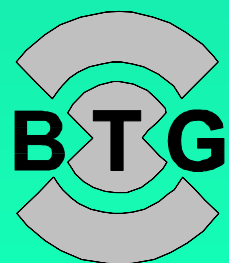
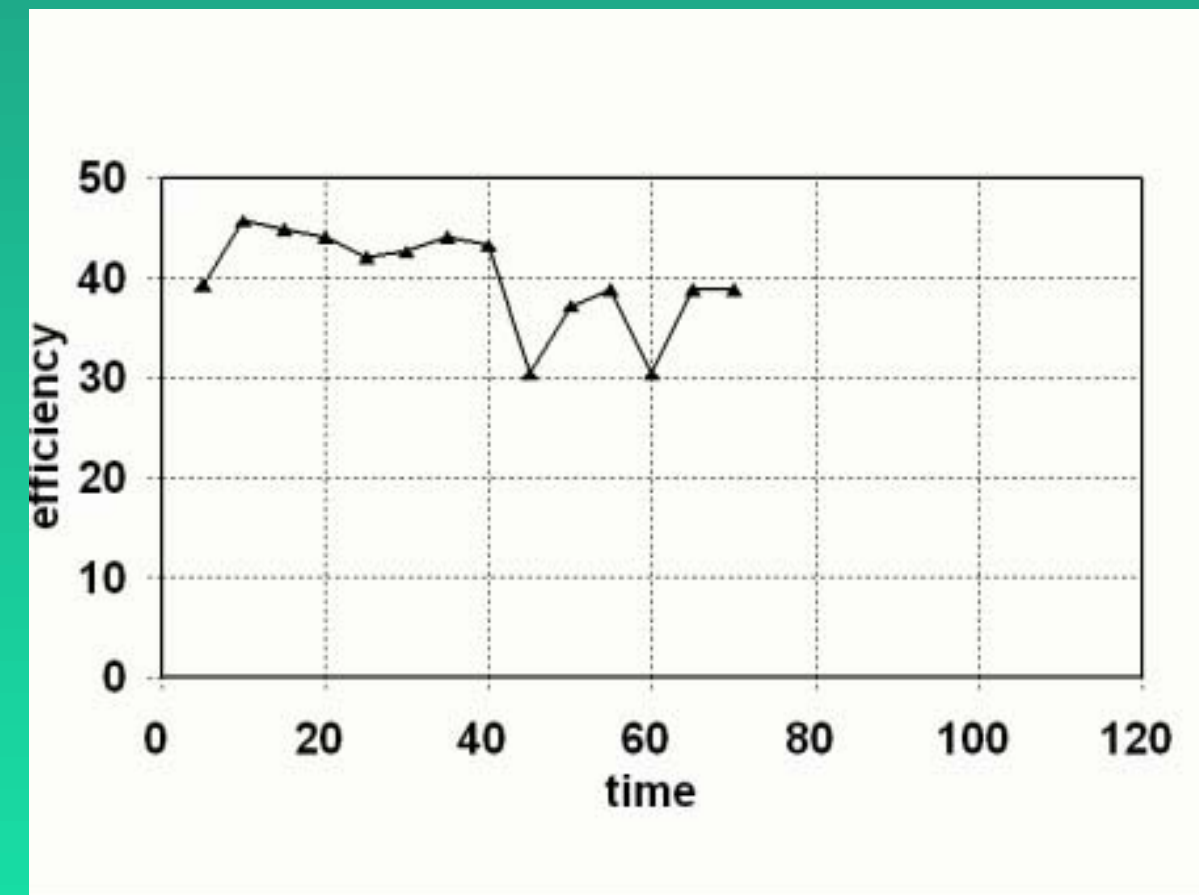
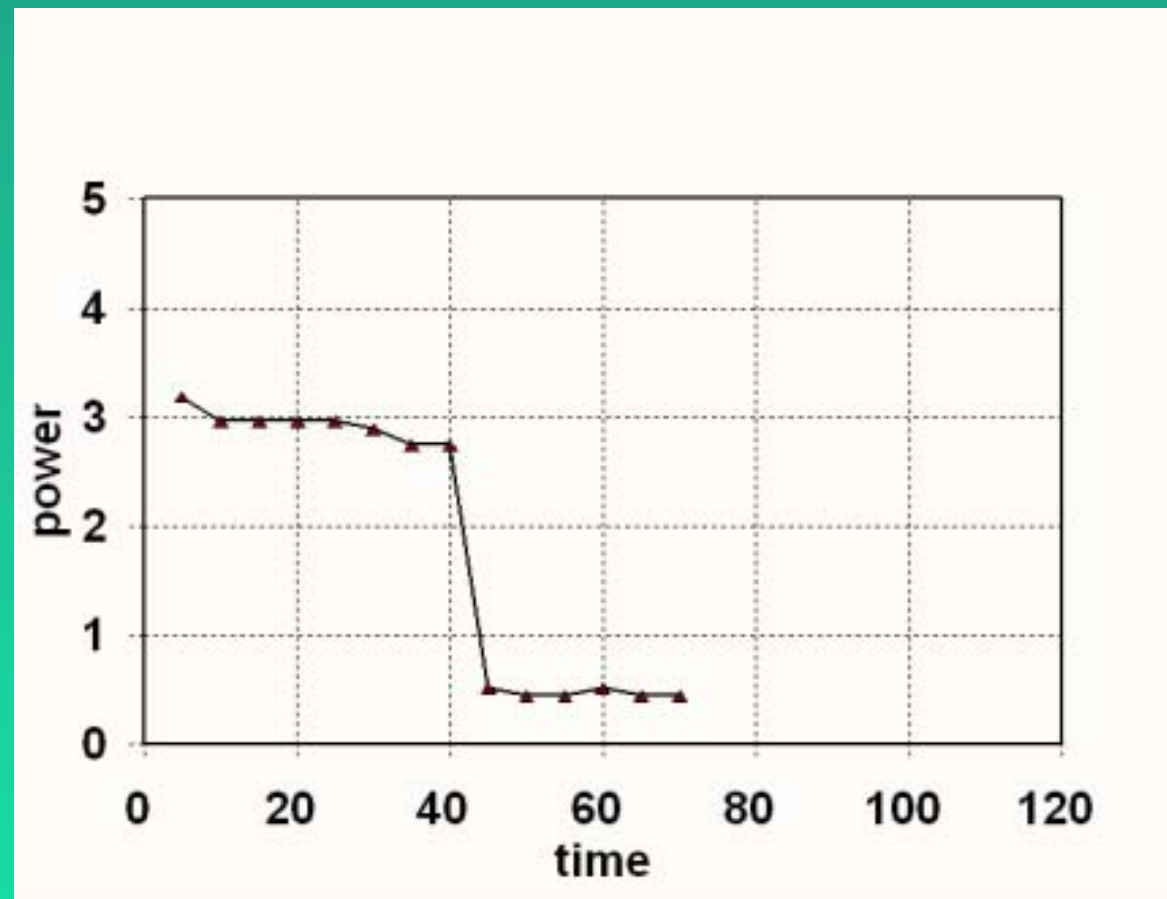
Results



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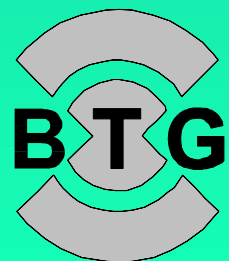
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Results



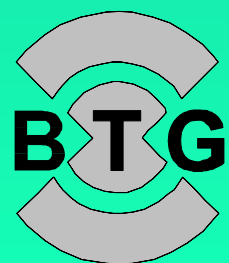
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Comparison with other Fuels

Fuel Consumption Calculation

- Based on Results Waterboiling Tests
- Preparation of a Standard Meal
- Fixed Power Regime
- 2.75 kg of Rice with 1.5 kg of Sauce



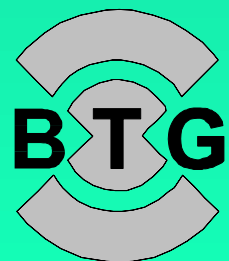
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Comparison with Other Fuels

Fuels and Characteristics

Fuel	Cal. Value (MJ/kg)	Price (F.CFA/kg)
Gas	47.5	180
Kerosene	45.7	157
Charcoal	27	90
Wood	16	45
Gelfuel	22.8	113

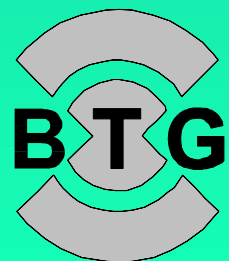


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Comparison with Other Fuels

Typical Stove	Fuel	Pmax	E _{max} (%)	P _{min} (kW)	Fuel (kg)	Costs (F.CFA)
Gas Burner	Gas	3.5	50	1.0	0.168	30
Wick	Kerosene	2.5	35	1.0	0.179	28
Pressurized	Kerosene	3.5	45	1.0	0.179	28
Traditional	Charcoal	3.0	30	1.3	0.376	34
Improved	Charcoal	2.5	40	0.8	0.262	24
Traditional	Wood	3.5	20	1.4	0.779	35
Improved	Wood	3.0	35	1.1	0.556	25
Tin with Reg.	Gelfuel	2.5	40	0.8	0.318	36



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