TSA GREEN

INTRODUCTION

A technology that significantly transforms
the future of energy and waste

THE FOLLOWING 'WASTE TO ENERGY' TECHNOLOGY IS THE FIRST OF ITS KIND IN THE WORLD.

Waste to Energy as one of the key projects of TSA Energy is a Superior Technology that has been designed to process Solid BioDegradable Waste with more than 20 Man-years of intense Research and Analysis, behind it.

Be it Municipal Solid Waste [MSW], Agriculture Crop Waste from Corn and Sugarcane, Slaughter Waste, Poultry Waste, Fish Waste, Animal Dung, Night Soil, Weeds like Water Hyacinths and Water Lettuce, our Plants can process and Bio-Methanise them, to produce a Very High Quality of BioGas.

WASTE IS NO LONGER WASTE

The Quality of Gas produced is far Superior to all others available from Bio-Methanisation Processes.

- Gas Output is 40% more than any other with our multi-stage Bio Reactors and Re-Breather System.
- Methane content is 95-98% after Refining with our Technology and Hydrogen Sulphide is reduced to 0.003%;
- The Calorific Value being 8500 Kcal/m3, this BioGas can be substituted for CNG to be used to run Gas modified Vehicles, besides its use for Domestic and Industrial heating.
- All this with Zero Emissions or Effluents.
- No Carbon Footprint.
- Attain valuable Carbon Credits.

Uses with assured Income Generation

- The BioGas coupled with our Smart Proteum Super Enrichment Technique, generates more Electricity with a lesser Gas Consumption. Hence it facilitates a much lower cost of Electric Power Generation. Presently it is less than half the cost of Thermal Power Generation in India
- The BioGas can be Bottled in Cylinders or piped for Domestic and Industrial Use with our new Nano Technology ;
- And can be used to run vehicles modified for CNG with the Cylinders or through Pumped Distribution due to it's high Calorific Value.

Additional Revenue Streams

- The whole process produces NPK Rich Fertiliser and a High Alkaloid Pest Repellent, as By-Products that brings in substantial Revenue.
- The Design of the Plant is Modular, SCADA Controlled and supports High Redundancy Aiming at near Zero Downtime.

TECHNOLOGIES

Microbial Incubated Bio Reactor that produces 40% more BioGas

Bio Reactor

This Organic Fuel Technology is a Multi-stage, variable HRT, Microbial Incubated Bio Reactor System that aids in production of highly purified combustible Natural Gas in quantities that outrun other available Technologies by more than 40%. The Unit is Modular and designed for all Future expansion.

The technology used in the reactors for digestion is called Variable Hydraulic Microbe Incubated Auto balanced Anaerobic Bio-Reaction. There are three stages of digestion in this process.

In the first stage, the large organic polymers those are present in the feed that arrives from the previous processes are broken down into their smaller constituent parts to enable the bacteria in the subsequent stages of the reactors to access the energy potential. These constituent parts or monomers such as sugars are readily available to the large population of microbes. This process of breaking these long chains structures and dissolving the smaller molecules into solution is also called hydrolysis. Therefore hydrolysis of these high molecular weight polymeric components is the necessary first step in this process. Through this stage, the complex organic molecules are broken down into simple sugars, amino acids, and fatty acids.

This stage also produces some quantity of Acetate and hydrogen, which can be directly used in the third stage of this process to form BIOGAS. However there are other molecules such as volatile fatty acids that are compounds with chain length greater than acetates that needs to be catabolised into easily convertible compounds before it reaches the third stage of the process. The Second stage in this process, uses a different group of microbes, and starts with further breaking down of the remaining components by fermentative bacteria. Here volatile fatty acids are converted along with ammonia, carbon dioxide and hydrogen sulfide as well as other by-products. This part of the second stage is similar to the way milk becomes curd. Simultaneously specific bacterium is made available to

Bio Reactor

handle harmful hydrogen sulfide and convert it into hydrogen and elemental sulphur. Sulphur dissolves in water and hydrogen is used back in the process. A third set of bacterium would use the converted fatty acids, ammonia, carbon dioxide and hydrogen to produce largely acetic acid and some more carbon dioxide and hydrogen.

The Third and the terminal stage is where large amount of BIOGAS is produced. Highly specialised microbial population, accurately acclimatised and finely placed utilise all the intermediate compounds from stage one and two and systematically convert them to methane, carbon dioxide and water.

It is these compound that make-up the Crude BIOGAS. The remaining, nondigestible material along with the mortal remains of bacterium and used-up water is excreted from the system. The excreted material from the system is converted into high NPK fertiliser, which are nitrogen fixed and phosphate solubleised and an organic high alkaloid pest repellent.

With this Invention the BioMethanization process is optimized to 95-98% purity after Refining and this Organic Gas produced can also be used as Compressed Bio-Gas (CBG), for Vehicles already running on CNG without any further modifications to the Vehicle's Engine.

Super Enrichment

Protium Accelerating Super Enrichment that generates More Electricity at lesser Gas Consumption. Hence lower cost for Generation.

Technology for Power Generation

This is a proprietary fuel enrichment technique based on the outcome of 20 man-years of research and development. A special spiral accelerator strips hydrogen atoms into high-energy protons. Refined fuel gas along with a blend of Oxygen is bombarded by high energy protons in a specialised thermo-sonic reactor with carbon dioxide as moderator, and fired at high pressure and temperature in a specially designed engine, which amplifies the

fuel-work conversion by several folds by enhancing the flame velocity and thus permit the engine to operate with leaner air-to-fuel-ratio mixture than otherwise possible. It also shortens the burn time of the main fuel air mix, putting more pressure on the piston through a longer effective power stroke, and in doing so takes more out of work. Further the high temperature in the combustion chamber and the high-energy protons breaks down the oxygen and hydrogen (from hydrocarbons) molecules in to free radicals, simultaneously increasing the flammability bandwidth of the fuel (from 5-15% to 4-75%). The chain reaction initiated by those free radicals will cause a simultaneous ignition of all the primary fuel.

Since all of the contents of the chamber ignite at once, no flame front can exist and without which there is no pressure wave to create knock. The near absence of carbon monoxide and un-burnt hydrocarbons confirms a very complete and very fast burn. Cooler exhaust temperatures (20 C lower) show that more work is taken out during the power stroke. More torque from less fuel at the same RPM verifies that higher pressure from faster burn, acting through a longer effective power stroke, produces more torque and thus more work from less fuel. We use an air-fuel mix so lean that under normal circumstance, it takes the entire power stroke (180) to complete combustion. The SPARSE process detailed above would decrease the burn time of the entire mix by a factor of 10.

If a spark advance of 4 were assumed, the burn would be complete at about 14 past top dead centre. Such a burn would be both rapid and intense. The piston would have moved less than 2% of its stroke by the end of the burn, allowing more than 98% of its travel to extract work. The extreme temperatures from such a rapid and intense burn are of such short duration (about 2% of the time) and temperature through the reminder of the power stroke, will, on average, be much cooler. The lower exhaust temperatures observed can be viewed as evidence for this occurrence.

A part of Spiral Accelerator, Complete SPARSE reactor enriching fuel at the campus, The Engines for power generation and Fully computerised auto-synchronisation panel. We use an air-fuel mix so lean that under normal circumstance, it takes the entire power stroke (180) to complete combustion. The SPARSE process detailed above would decrease the burn time of the entire mix by a factor of 10. If a spark advance of 4 were assumed, the burn would be complete at about 14 past top dead centre. Such a burn would be both rapid and intense. The piston would have moved less than 2% of its stroke by the end of the burn, allowing more than 98% of its travel to extract work. The extreme temperatures from such a rapid and intense burn are of such short duration (about 2% of the time) and temperature through the reminder of the power stroke, will, on average, be much cooler. The lower exhaust temperatures observed can be viewed as evidence for this occurrence.

Essentially, our reactor reduces the cost of production of per unit of electricity significantly by using nearly less than half the gas required compared to the conventional methods.

The generators required for our technology have specially designed engine and governor systems. These engines have computerized engine control, which works on input from parameters relating to air-fuel changes, engine intake vacuum, engine speed, air-fuel ratio (lambda sensors), oxygen sensors and precision spark ignition systems. The compression ratios of our BIOGAS engines are different from conventional gas engines and measures the quality of gas that are very essential for the long life of these engines. These engines virtually have no harmful emissions. The emissions are typically water vapour and small traces of NOx due to the nitrogen in the air.

a Part of Spiral Accelerator
b Complete SPARSE reactor enriching fuel
c The Engines for power generation and
d Fully computerised auto-synchronisation panel

With this Innovative Technology the Electricity Production Cost is 60% less than Conventional Electricity Generation. And it provides a Grid Connectivity with a Demand based Synchronised Power Generation. Truly, First of it's kind in the World.

Nano Storage Technology

This Nano Technology that enables a Low Pressure High Volume Feature for Bottling and Piped Gas for both Domestic and Industrial Use.

Methane gas is traditionally difficult to compress which means capture and storage must be done in large containers.

For Domestic Piped Organic Natural Gas and Domestic cylinders we have successfully developed a low-pressure high volume domestic cylinder using Nanotechnology. This effectively assembles and stores gas molecules just like how you stack soft drinks in a super market and releasing it layer-by-layer until you have used up the last available molecule. So there are no leftovers in the empty cylinder. These Cylinders are programmed to store only our Plant produced GAS and so no adulteration is possible.

The Following BIOGAS storage Technology enables storing seven times more Methane gas

With this Innovative Technology the Electricity Production Cost is 60% less than Conventional Electricity Generation. And it provides a Grid Connectivity with a Demand based Synchronised Power Generation. Truly, First of it's kind in the World.

BIOGAS

PROPERTIES

Below properties make this BIOGAS, one of the safest fuel gas on Earth. The composition of this Organic Gas mainly consists of Methane (CH4) along with traces of Carbon dioxide, hydrogen sulphide, nitrogen, hydrogen and oxygen.

Particulars	Unit	Value
Calorific Value	MJ/M3	36.19
Wobble Index	MJ/M3	40.00
Max. Ignition Velocitv	M/Sec.	0.398
Combustion Air Requirement	M3air/M3gas	9.60
Max. Co2 in Stack	Gas Vol.%	9.9
Ignition Temperature	Degree Centigrade	648.89
Flammabilitv Limits	% Gas to % Air	5to15
Buovant Temperature	Degree Centigrade	-71
Due Point	Degree Centigrade	58.65
Toxicity		non-toxic
Corrosion		non-Corrosive
Ground Water Contaminations		None

COMPOSITION

GAS	Formula	PercentageV/V
Methane	Ch4	98
Carbon Dioxide	Co2	1
Nitrogen	N2	0.06
Hydrogen	H2	0.7
Hydrogen Sulphide	H2S	0.003
Oxygen	O2	0.23

SCOPE

1) As Domestic Cooking Fuel:

This BioGas is buoyant at 71 degrees; it has a flammability bandwidth between 5 and 15%, Ignites at 650 degrees centigrade, yet has very high calorific value. This makes it as the most efficient and safest fuel for domestic cooking purposes.

Complete burning does not produce dirty carbon monoxide that mixes with food causing change in its colour and flavour. In fact it has the efficiency of LPG and safety of firewood, when it comes to cooking at home. Further it should be the

cheapest cooking gas you can ever get. And finally by using BIOGAS, you contribute in saving the planet.

For Domestic Piped Organic Natural Gas (PONG) and Domestic cylinders, we have successfully developed a low-pressure high volume Nanotechnology. This technology, assembles and stores gas molecules just like how you stack soft drinks in a super market and releases it layer-by-layer until you have used up the last available molecule. Thus no gas is wasted and the cylinder is emptied completely. These Cylinders are programmed to store only our BIOGAS so no adulteration is possible.

2) As Automotive Fuel:

High Calorific value of 8500 Kcal is comparable to CNG, thus making it an excellent automotive fuel that produces practically no harmful carbon monoxide and other polluting gases. It can be compressed to high pressure of 200 to 250 kgs for large vehicles and at 20 to 30 kg using Nano technology developed by us for smaller vehicles like Cars and motor cycles. And this is applicable in all Gas run vehicles without any more Engine modifications.

3) Industrial applications:

Industrial applications for this are many. Waste treatment and incineration, metals preheating (particularly for iron and steel), drying and dehumidification, glass melting, food processing, and fueling industrial boilers. It may also be used as a feedstock for the manufacturing of a number of chemicals and products.

In addition to these uses, there are a number of innovative and industry specific uses:

Desiccant systems: Useful for dehumidification, and can be popular in the plastics, pharmaceutical, candy, and even recycling industries. In each of these industries, moisture filled air can lead to damage of the end product during its manufacture. For example, in the plastics industry, moisture can cause cracks and blemishes during the manufacture of certain types of plastics. Adding a BioGas desiccant system to the manufacturing or drying environment allows industrial users to regulate more closely the amount of moisture in the air, leading to a more consistent and high-quality product.

Absorption systems: Can also be used extensively in industry to heat and cool water in an efficient, economical, and environmental-friendly way.

Co-firing technologies can also help in increasing industrial energy efficiency,

and reduce harmful atmospheric emissions. Co-firing is the process in which it is used as a supplemental fuel in the combustion of other fuels, such as coal, wood, and other biomass materials. For example, a traditional industrial wood boiler would simply burn wood to generate energy. However, in this type of boiler, a significant amount of energy is lost, and harmful emissions are very high. Adding to the combustion mix can have a two-fold effect. it emits fewer harmful substances into the air than a fuel such as wood. Since the energy needed to power the boiler remains constant, adding to the combustion mix can reduce harmful emissions. In addition, the operational performance of the boiler, including its energy efficiency, can be improved by supplementing with this GAS. For instance, in wood fueled boilers, adding this GAS can compensate for the use of low grade, wet wood, allowing it to combust more quickly and completely. This type of co-firing can also be used in the generation of electricity, whether on-site or in a centralized power plant.

Absorption Chilling is another application, where this BioGas can be used as a thermal source to produce low temperatures for chillers, air conditioning and refrigeration.

4) Power Generation:

Refined BioGas along with a blend of Oxygen is bombarded by high energy protons in a specialised thermo-sonic reactor with carbon dioxide as moderator, and fired at high pressure and temperature in a specially designed engine, which amplifies the fuel-work conversion by several folds by enhancing the flame velocity and thus permit the engine to operate with leaner air-to-fuel-ratio mixture than otherwise possible. This is done with our New " Protium Super Enrichment" Technology.

Our Super Enrichment reactor reduces the cost of production of per unit of electricity significantly by using nearly less than half the gas required compared to the conventional methods.

Workout for a 400 Ton/per Day Feed Capacity Plant that produces Gas as well as Power

No.	Particulars	Quantum/Period
1.	Feed-Segregated BioDegradable Waste	400 Tons/day
2.	Required Space for the Plant	3 Acres
3.	Period for Commissioning	12 to 18 months
4.	Crude Gas Output	40,000 m3/day
5.	Refined Gas Output	24,000 m3/day
6.	By Product: NPK Rich Fertiliser	40,000 kgs/day
7.	By Product: Pest Repellant	560 m3/day
8.	Calorific Value of BioGas	8500 Kcal/m3
9.	Estimated Power Output	60,000 kWh/Day [Units]
10.	Complete Cost of Plant upto Commissioning in Tanzania	$20 Mill/ AED 75 Mill
11.	Estimated Break-Even	Approx 30 months

Workout for a 100 Ton/per Day Feed Capacity Plant that produces Gas as well as Power

No.	Particulars	Quantum/Period
1.	Feed-Segregated BioDegradable Waste	100 Tons/day
2.	Required Space for the Plant	1 Acres
3.	Period for Commissioning	10 months
4.	Crude Gas Output	9,500 m3/day
5.	Refined Gas Output	5,500 m3/day
6.	By Product: NPK Rich Fertiliser	6,000 kgs/day
7.	By Product: Pest Repellant	80 m3/day
8.	Calorific Value of BioGas	8500 Kcal/m3
9.	Estimated Power Output	12,000 kWh/Day [Units]
10.	Complete Cost of Plant upto Commissioning in Tanzania	$5.5 Mill/ AED 20 Mill
11.	Estimated Break-Even	Approx 30 months

TSA GREEN

About TSA Green

TSA Green is a subsidiary of TSA Group with primary focus on Green Energy. We are an IESP (Integrated Energy Service Provider) company active in the new and renewable energy sectors, imparting our expertise to ensure a sustainable future. Our ability as a knowledge-based facilitator spans every aspect of project management for enabling solar, wind, biogas, biomass and bio-fuel generation as well as transmission. The goal at TSA Green is to a leading provider of one of the most complete range of renewable energy services and systems to make projects eco-friendly.

Presently, our portfolio covering both residential and commercial projects includes off grid wind generators, off grid solar power systems, hybrid wind/solar systems, solar hot water systems, wind/solar electric water pumps and LED lights. Furthermore, as one of the partners in Waste To Energy Technologies, based in India, we possess the complete expertise to process solid bio-degradable waste for producing superior quality biogas.

For elaborate information
and clarifications contact:

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