CENFuel

CENTechnology Applied to Coal

Clean Coal: The world's first production of 99.87% pure coal derived fuel for large scale power plant use. Cheaper energy production while almost totally eliminating pollution. US Patent – 4,780,112

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CENfuel - GENERAL APPLICATIONS

Although much has been written about **CENfuel** as a fuel for power stations, it is most versatile and can be utilised and used in units large and small. The following indicates the many categories in which **CENfuel** can be accepted for use in units employed within industrial, military and domestic fields.

AIRCRAFT TURBINE:

C130 U.S. transport aircraft
Small combustion chamber - speed in mil. secs.
C130 turbine tested with **CENfuel**

LARGER/SMALLER UNITS:

Easier to operate larger than smaller units
CENfuel size for C130 = 5 microns
Larger gas turbines can be 100 microns
Larger micron preparation reduces **CENfuel** cost.

SEVERAL METHODS OF DRYING PRODUCT:

HEAT SOURCE REMOVES GAS USING:-

Combustion gas
Boiler to provide dry steam
Fluid bed driers

GAS TURBINE:

25MW initially used within the plant.
Excess (23MW+/-) can be sold to the grid.
System services various function from beginning
Hot gas source
Starts as distillate - then to **CENfuel.**

25MW GAS TURBINE PACKAGE:

Sold as a package bought "off the shelf"
Available immediately or within 90 days
Incorporated within the base load - used at peak loading times
Initial **CENfuel** requirements approx. 1 1/2 - 2MW

CENFUEL PLANTS: Environmentally friendly and secure throughout.

GAS TURBINE BLADE DESIGN:

To eliminate erosion and corrosion correct blade design is very important.
Shape and metal used are important.

MAINTENANCE : **CENfuel** operated gas turbine power stations should operate 100,000 hours or more without problems occurring
Regular blade inspection undertaken as specified
Several years usage prior to major maintenance
CENfuel being clean reduces maintenance.

ALISON GAS TURBINES:

In Australia successfully used for pumping lines
Controlled by computer some 1,000 miles away

GAS TUBINES:

Erosion on blades is caused by potassium, ash and other component deposits.
Ash turns to gases.
Vanadium / cadmium and other heavy metals create havoc.
Titanium at high melting temperatures create particle wearing.
Distillates cause erosion - can be cured by the use of additives.
Additives can/do stick to blades requiring water washing.
Additives can change the elements in the oil - causing softening. Oil refineries can remove all metals from the crude.
Erosion occurs when using heavy oils which still contain certain particulates..
Heavy oils although cheaper in price are costlier in time, maintenance and energy lost.
Erosion/corrosion small parts per million - insufficient to harm gas turbines.

NUMEROUS AND VARIED APPLICATIONS :

CENfuel with its very low ash level can be targeted at a full range of heat appliances, gas turbines and internal combustion engines. Targets include but are not confined to:

a) Conversion of oil and gas fired boilers.

b) Specially designed CENfuel power generation installations.

c) Heat appliances including:
Steel mills soaking pits - Ceramic industry curing furnaces
Metallurgical industry - Space heating, etc.

d) Fuel for diesel engines (ships, industrial and agriculture).

e) Fuel for presently fired petrol engines (redesign fuel application of existing engines),

f) Fuel for gas turbines - specific emphasis on combined cycle power generation installations.

g) Fuel applications for military vehicles- e.g. tanks, personnel carriers, helicopters.

h) Base feed stock for ethylene plants.

i) Correct selection of feed stock coal- manufacture of industrial carbons.

j) Use CENfuel process to re-cycle valuable materials from alumina pot line waste.

NOTE: **Only Oil Companies Can Remove The Particulates During Processing - Unless Buyers Have Installed Oil Refining Equipment They Are Unable To Further Cleanse The Purchased Oil**

POTENTIAL FOR MILITARY APPLICATION

- The stable nature of **CENfuel** ensures that it may be transported at ambient pressures without fire risk or explosive events.

- 2mm **Cenfuel** is delivered for use in vehicles - ships - armoured vehicles - helicopters, etc.

    - 2mm **CENfuel** is delivered for use in gas turbines or diesel engines.
    - The 2mm delivery size is a major asset in logistical equations.
    - 2mm **CENfuel** is common to a number of operational units.
    - The particles of **CENfuel** consists of pure carbon with attached volatiles.

- The characteristics of the fuel under combat conditions would be as follows:

    - Non-explosive when penetrated by solid round H.E. or incendiary.

    - **CENfuel** will not ignite when contained within sealed holding tanks.

    - Air will not penetrate to the centre of the fuel mass.

    - Incendiary rounds will cause a charring of the fuel in localised areas with eventual extinguishing of the incendiary round/s.

    - Fuel spill is non-toxic - non-flammable - non-explosive -

    - **CENfuel** can be cleaned by being : swept, vacuumed or shovelled.

    - **CENfuel** acts when contained in out-board tanks tends to act as thermal isolators - explosive compression buffers - and to a degree - armour protection.

    - **CENfuel** is non-polluting when burned.

    - **CENfuel** when produced under military control would be cost about US$60 per tonne or less - replacing diesel - fuel oil - AV1.

    - Studies have commenced on the use of **CENfuel** in helicopter turbines.

    - The above noted **CENfuel** attributes would enhance the serviceability of military transport under combat / accidental impact conditions.

CENfuel CAN BE PIPED OVER LONG DISTANCES
THIS ELIMINATES THE NEED FOR GRID POWER LINES

- **CENfuel** as a "clean fuel" can be piped over vast distances without "aids" to effect its progress along a dedicated pipeline.

- **Piped fuels can be an enormous asset for countries having limited railways and roads. Inadequate infrastructure presents a major problem when considering the movement of fuel needing to travel vast distances from the mines to power stations, or ports for exporting purposes.**

CENfuel DISTRIBUTION

DISTRIBUTING CENfuel:

- It is essential that **CENfuel** during transportation is kept clean and dry.

- **CENfuel** can be shipped in bulk within large ships under a gas blanket.

- At the receiving end **CENfuel** will be taken off on a conveyor under strict supervision and control for delivery into storage bins or otherwise.

- **CENfuel** can be off-loaded direct into the **CENfuel** plant from a charter ship moored alongside the plant. To keep the freighting costs down, a large ship say 30,000dwt is preferable. It is necessary to ensure that the local port can accept this tonnage.

PRODUCTS PRODUCED Using CEN Technology

CENfuel:	Made from any type of black or brown coal.
(From raw coal)	Suitable for gas turbines, vehicles, trains, certain household equipment, etc.

CENgraphite: 99.9 % high quality graphite. Electrodes, shapes, car brake discs.
(From graphite ore)

Activated carbons:
Activated carbons used by water authorities to cleanse raw water.

CENcarbon: For most industrial carbon needs.

Crystalline silica: Used within the ceramic industry, etc.

Aluminium fluoride:
Used as a fluxing agent and electrolyte in aluminium smelting,

Alumina oxide : For refractories and feed stock of aluminium pot lines.

Heavy metal fluorides or oxides:

Vanadium, mercury, thorium and various rare earths used in a variety of specialised industries.

New Development :

CENTech has devised a special application for the treatment of waste electrodes and pot line waste from aluminium smelters.

The process allows recovery of the residual carbon, graphite, contaminating metals and minerals. These normally prevent the disposal of such wastes by conventional means, unless the disposal is strictly controlled within environmental direction.

NOTE: Silica and Alumina are released in industrial quantities.

Example: **Indian Coal Analysis** - from –

http://www.osc.edu/research/pcrm/emissions/coal.shtml

350 Megawatt Plant – Uses 2,600,000 metric tons per year

40% Carbon
40% Coal ash
20% Misc (Hydrogen, Sulfur, etc)

40% of 2,600,000 m/t = 1,040,000 m/t of ash

Indian Coal Ash Analysis – from –

http://www.tifac.org.in/news/flymine.htm

Silicon Dioxide	SiO2	59.007%
Aluminium Oxide	AL2O3	19.551%
Iron Oxide	Fe2O3	15.35%
Titanium Oxide	TiO2	03.158%
Potassium Oxide	K2O	01.271%
Calcium Oxide	CAO	01.151%
Manganese Oxide	Mn2O3	00.197%
Zirconium Oxide	ZrO2	00.184%
Strontium Oxide	SrO	00.028%
Nickel Oxide	NiO	00.042%
Niobium Oxide	Nb2O5	00.012%
Vanadium Oxide	V2O5	00.049%

59% of 1,040,000 m/t will be Silica

Silica (59% of 1,040,000 m/t) = 613,600 m/t +/-

19.5% of 1,040,000 m/t will be Alumina

Alumina (19.5% of 1,040,000 m/t) = 202,800 m/t +/-

Balance of 20% m/t can be sold to merchants specialising in the separation of various chemicals/metals

There is a ready market for both Silica and Alumina they are required within industrial sector of the countries where it is made, and can become an export commodity for those countries.

STATISTICS CONCERNING THE USE OF CENfuel

The following provides immediate answers to many questions which have during the past years been asked by interested parties during presentations.

The following allows those viewing CENtechnology /CENfuel for the first time to fully comprehend the many valuable benefits which are derived by the provision of a clean fuel - CENfuel - and the method - CENtechnology - which is in itself a technique allowing for the utilisation of everything found in coal ash, thereby saving precious resources at present wasted through the burning of raw coal, and the depositing of the burner waste as ash or clinkers into landfills.

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CENfuel	**OTHER FUELS**
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*** Approx. USD60 +/- m/t. ex-plant (raw coal + processing cost)**	*** Oil/diesel USD350 +/-**
*** Ash as low as 0.2% 40% +/-**	*** Indian Coal fired ash 40% -**
*** Moisture - less than 1%**	*** Indian Coal normally 8% +/-**
*** BTU 15000 – 15500 12000**	*** Indian Coal fired BTU7996 -**
*** Sulphur less than 0.01% 5%**	*** Indian Coal Sulphur 0.5% -**
*** CENfuel = 100% carbon. or a "cleaned" Particulates/metal oxides removed.**	*** Coal fired plants use raw coal coal, normally washed with limited quantities of particulates removed.**
*** CENFuel Efficiency 51%-55%**	*** Coal fired 31% - 34%**
*** Availability of plant 98%**	**+/-* Coal fired approx. 86% +/-.**
*** Pollution greatly reduced or eliminated.**	*** See "Coal fired contaminants"**

*** No ash - no landfills required.**	*** Landfills required. Tonnage as per ash in coal.**
*** Limited water. Moisture in coal used.**	*** Coal fired water towers require considerable tonnage.**
*** CENplant 12-18mts. to build. Combined Cycle years +/-.** **Gas Turbine Plant built in 2 1/2 -3 years.**	*** 300MW Coal fired built in 5/6**
*** CENfuel Plant requires standard equipment Equipment can be supplied locally when meeting International/NSW Australia standards regulation.**	*** Equipment normally takes longer dates.**
*** CENfuel dry stored has an unlimited shelf life.**	
*** CENfuel does not freeze.**	*** Coal moisture freezes in the stack, etc.**
*** CENfuel is non-toxic, flammable or explosive.**	*** Combustion in coal can be hazardous.**
*** CENfuel is near pure carbon and volatiles.**	

CENfuel MEETS INTERNATIONAL ENVIRONMENTAL STANDARDS

Cenfuel Meets The Required International Environmental Standard To 2005 And Beyond.

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CENfuel POINTS OF INTEREST

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COSTS / SAVINGS BASED ON 300MW POWER STATION

RAW MATERIALS TO THE PLANT

CONVENTIONAL:	**CENfuel:**
COAL AT USD $20 M/T	
1.3 MIL. M/T @ $20 /ton	500,000 M/T @ $60 /ton
USD 26,000,000	USD 30,000,000

SAVINGS WITH CENFUEL:

Added Fuel Cost -	**USD -4,000,000**
35% to 55% Increased Efficiency	**USD 5,200,000**

Savings	**USD 1,200,000**

Plus

No Pollution means minimal pollution equipment
Reduced maintenance
Reduced downtime
Minimal waste disposal
Compliance to government regulatory standards without added cost

Conversion to CENFuel saves a power plant $1.2 million per year and provides for pollution free power generation at less cost. The CENFuel is sold to the power plant at a reduced cost. This sale funds an equal amount of industrial carbon to be sold at market as well as the entire amount of marketable by-products.

SPECIFIC POINTS TO NOTE IN RELATION TO THE CHANGE OVER OF A COAL FIRED THERMAL GENERATING PLANT TO A CENfuel OPERATION

BOILERS IN COAL FIRED PLANTS :

- Coal fired boilers mechanism change to **CENfuel** compatible configuration are site specific in their application and ultimate design.

- Large coal fired steam generating boilers are normally of a highly individual nature - each potential change over will be studied individually to ascertain the most cost effective design criteria - capital outlay - efficiency of operation.

- In some cases - a new boiler will be designed and installed to the existing steam plant.
  - the change over point is at the steam delivery valve.
  - all existing steam plant equipment is left in-situ and connected to the new boiler structure.

- When composite **CENfuel** firing is considered - the boiler takes on many of the characteristics of a natural gas fired boiler.

  - The boilers are smaller.
  - Less complex and substantially less capital intensive to construct.
  - Scheduled maintenance and overhauls extend the life expectancy of the steam plant - main equipment and auxiliary equipment can be dramatically extended.
  - Boiler structures eventually wear out - making the conversion of such units to a **CENfuel** fired plant an attractive long term proposition.

BENEFITS TO BE CONSIDERED - COAL -Vs- CENfuel :

- Calculate the inherent benefits when using **CENfuel** as the preferred fuel for coal fired plants.
  - Thermal efficiency will be calculated with the total cost of post combustion coal fired “clean up”.
  - Elements that must be considered in the equation are :
    (a) exhaust gas pollution
    (b) bottom ash disposal
    (c) high NOx generation

COAL FIRED COMBUSTION :

- To achieve the best possible combustion - the coal combustion method requires a continuous charging of the fire box with up to 12% excess air.

- This results in a delayed combustion with high heat levels in the top of the boiler.

- At this point the steam injection is with subsequent loss of efficiency to cool the very "hot spot".

- The nature of these units is such that all manner of carbon compounds are created along with NOx - CO - CO2 - SO2 - and H2O - which emerge in exhaust gas streams .

- The bottom ash which has to be disposed of contains unburnt carbons.

- The energy loss to arrive at this point is some two thirds of the energy created by the combustion of the fuel.

- The unit efficiency from energy input to the generator terminals will be no greater than 34%.

CENfuel REMOVES ADVERSE EFFECTS:

- The change over to **CENfuel** will have **none** of the above adverse effects.

    - no bottom ash deposits
    - no fly ash
    - very low NOx creation
    - very low SOx formation
    - no water generation in the exhaust stream
    - no unburnt particles in the gas stream - therefore -
    - no carbonyls and other heavy metal pollutants.

MICRONIZED CENfuel :

- **CENfuel** is introduced into boiler at micron particle sizes and as such when injected into the boiler behaves as a synthetic gas stream :

    - the particle can be size manipulated directly prior to injection
    - maintaining an optimum combustion characteristic for the fuel tailored to meet the design of the boiler -
    - excess air required to combust the **CENfuel** charge is 2% or less.

- Due to the nature of the synthetic gas cloud created by the even dispersal of the micron sized **CENfuel** particles in the chamber.

CHANGEOVER FROM COAL TO CENfuel REQUIREMENTS :

- The use of **CENfuel** in a boiler mechanism designed for coal without modifications to the boiler - is not a viable option without modifications to the boiler.

- The optimum solution is for a new boiler to be designed to create the steam condition required for the plant - using the design criteria suited to a natural gas fired boiler.

- Correctly designed transformation to **CENfuel** allows the plant to be fired at the maximum efficiency.

- The new boiler will not require the replacement of all the boiler ancillary equipment.

- When viewing the combustion characteristics of **CENfuel** as injected into a primary air stream to a boiler the micronized **CENfuel** acts as a synthetic gas.

- At this point the **CENfuel** achieves complete combustion of the fuel - provides a designed amount of residual heat.

  - **CENfuel** allows a continual utilisation of steam cycle plants with longer useful life of the boiler.

- If a gas turbine is used in conjunction with the boiler it provides the necessary gas volumes to the boiler.

- Allows for closure of less cost effective plants elsewhere in the utilities inventory.

- Where a straight change over is required - replacement of the coal fired boiler with a boiler designed to operate on **CENfuel** under optimum conditions - is a relatively simple engineering exercise.

- A new boiler will be 100% designed to create the correct combustion conditions characteristic for **CENfuel** - matching the existing steam turbine set steam conditions.

- Attractive application of **CENfuel** for electricity production by the use of modern combined cycle gas turbine engines established in smaller installations - say up to 300MW per site, located at strategic positions on the grid.

- This concept delivers cheaper power with load variance adaptability.

- Gas turbine units can be installed in module configuration allowing an economic operation down to a small % of the full operational capacity.

- It should be noted - that a **CENfuel** fired boiler does not have the same inherent danger of flame out - as a coal fired boiler.

- When considering the overall capacity of a plant and its logistical position in a supply grid - consideration with regard to outrage or maintenance down time must be made.

- Systems have historically been designed to compensate for this loss of generating capacity by the commissioning of a plant which has a substantial percentage of over capacity time.

- A not inconsiderable cost is borne by the total system allowing for the boiler shut down for cleaning and maintenance - outage can be as high as 15% of availability.

CENfuel AVAILABILITY :

- **CENfuel** fired boilers availability rated at 95% and better.

    - When **CENfuel** and the total lack of corrosive contaminants and ash deposition are taken into consideration - this claim is supportable.

- **CENfuel** will be injected into the boiler with a

    - total ash of 0.2%
    - moisture level of 1%
    - removal of particulates prior to combustion, dispenses with particulate control scrubbers and precipitators, and gas formed due to the raising of ash temperature

    - **Complete combustion of Carbons**.

    - **No Carbon Carryover**.