



COMBUSTION OPTIMIZATION

CLEAN ENERGY TECHNOLOGIES

THERMOENERGY INTEGRATED POWER SYSTEMS



In cooperation with Alex Fassbender, a chemical engineer and executive vice-president of ThermoEnergy Corporation, the CANMET Energy Technology Centre-Ottawa's (CETC-Ottawa) Bruce Clements, have come up with a coal-fired combustion process called TIPS (Thermo-energy Integrated Power System). It delivers greenhouse gas emissions, cleansed and ready for sequestration.

The Process

The TIPS combustion process is highly efficient, reducing various pollutants. It includes a mechanism for energy efficient incorporation of carbon capture sequestration, further reducing GHG emissions.

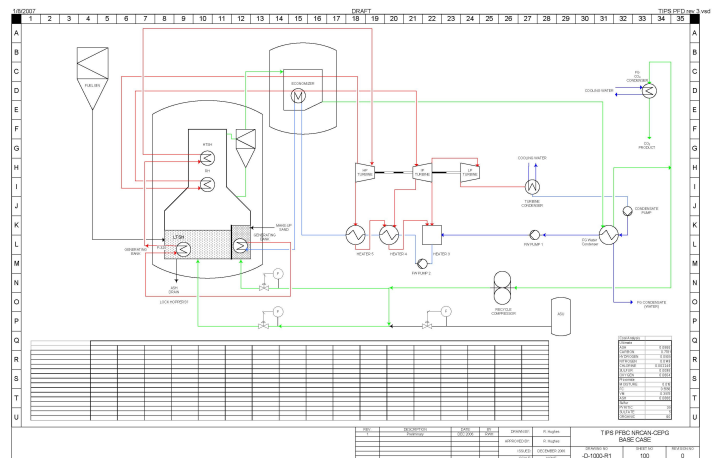
The TIPS process introduces unique variations to the coal production of the past:

- The first step is to cleanse the coal before using it
- Take room temperature air and put it under pressure – 1,250psi
- Separate the pressurized air into O₂ and N, direct the pure O₂ into the furnace to drive combustion
- Burn the coal under pressure at 1,250psi, keep the steam under pressure between 2,500 – 3,700psi; the result is ash
- The pollutants have been captured in the hot exhaust of the furnace – SO₂, N₂, Hg, particulate matter
- The fumes are passed through a condensing heat exchanger

- The exhaust fumes release the water and the remainder of the pollutants
- The CO₂ is directed back into the furnace to exploit the residual energy
- The CO₂ is then cooled into a liquid where it can be moved into sequestration

The History

The TIPS process started in 2001 with discussions with the ThermoEnergy Corporation who had a patent on the use of pressure. The pressure tended to overcome some of the constraints, however, small projects were performed using heat and mass balances on several different configurations using this waste heat in various ways. The performance results looked favourable,



ThermoEnergy Integrated Power Systems Schematic

however equipment and actual operating/capital costs were undefined.

In 2006, ThermoEnergy received a contract from NETL to further develop the best configuration. The focus was on one specific, very simple configuration with a few variations such as furnace types, extraction differences, and two coals. Using the waste heat within the FW heating system of Rankine cycle to increase boiler efficiency and use within steam cycle to get extra MW output thus offsetting parasitic power consumption.

The Benefits

TIPS does not require giant turbines to effectively produce a cleaner coal, it uses off the shelf turbines instead; a massive savings in capital and operational costs.

Other benefits to the TIPS process include:

- Small plant sizes - Furnace used can be one-tenth the size of a conventional furnace
- Higher boiler efficiency - 8% better than conventional systems
- Reduced thermal loss
- Increased power output by 8%
- Deliver pollution free electricity for less

than 8cents/kWh, compared to Ontario Hydro which sells its electricity for as little as 5.8cents/kWh and as much as 9.7cents/kWh

- No supplementary power source is required to achieve capture and sequestration

TIPS provides an opportunity to generate cheap power, using a widely available fuel, while reducing the negative environmental impacts associated with conventional coal power generation.

The Future of TIPS

Alex Fassenbender has plans to build a large-scale carbon-capture commercial power plant in the next couple years, preferably in Canada.

The combustion optimization team is ready to build a demonstration plant at the Bell's Corners Complex. Not only do they require four to five years, but also \$12mil to get the project off the ground.

For Further Information Please Contact:

Bruce Clements
Research Scientist
 (613) 943-8881
 clements@nrcan.gc.ca

CANMET Energy Technology Centre – Ottawa
Natural Resources Canada
1 Haanel Drive
Ottawa, Ontario, K1A 1M1
Canada

cetc.nrcan.gc.ca