O_2/CO_2 Recycle Combustion

CETC's innovative and collaborative program on flue gas recycling tackles the burning of carbon-based fuels in the most cost effective and energy-efficient way. The program helps industry to determine the most economic options for reducing greenhouse gases, SO_x and NO_x emissions and the disposition of combustion products.

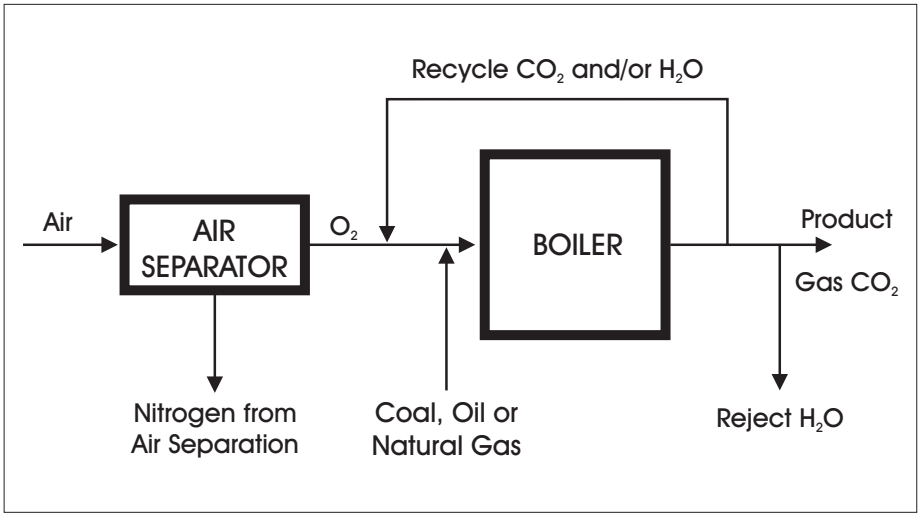
Vertical Combustor

Background

Increasingly, public concern over global climate change has focused on man-made emissions of greenhouse gases, particularly the release of carbon dioxide during the combustion of fossil fuels. Flue gas recycling offers a means of capturing CO_2 without having to dilute the product gases with nitrogen and avoids the need for gas separation after combustion. Furthermore, it allows for the most economical disposal of carbon dioxide, either through sale (such as for use in enhanced oil recovery) or by long term subterranean or submarine storage. CETC's Flue Gas Recycle Combustion Program enables industrial clients to examine the technical factors, such as oxygen/carbon dioxide ratio, that will determine the most cost-effective system.

Flue Gas Recycle Applications

The diagram illustrates the least complex application of flue gas recycle technology for new-plant or retrofit situations. The technology yields better energy efficiency when plant burning oil, natural gas or gas-derived applied to a combined-cycle



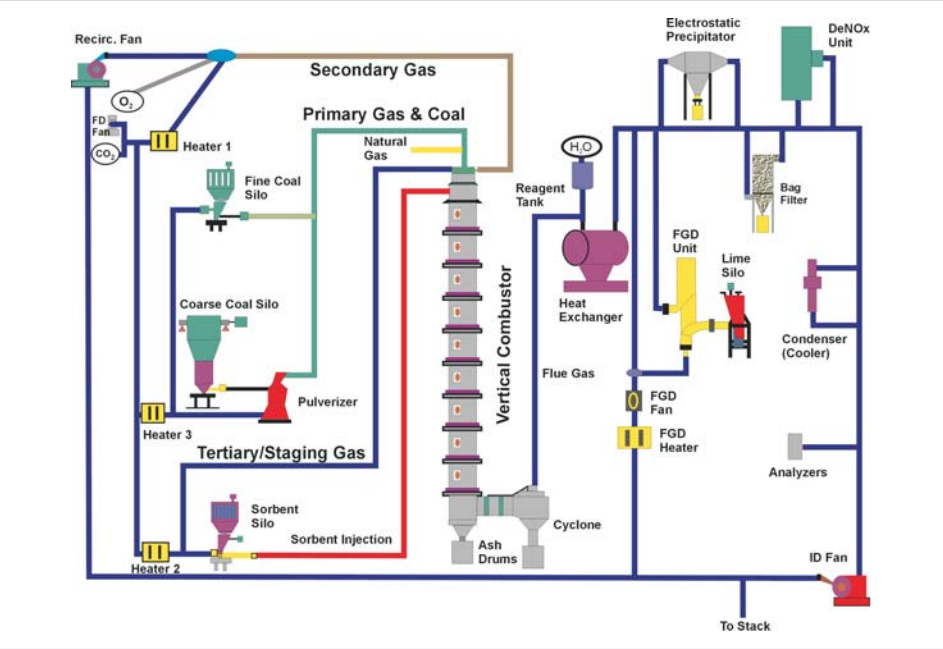
Clean Electric Power Generation Group

from coal gasification. In this case a gas turbine uses CO_2 as the primary working fluid and combustion occurs in a CO_2/O_2 medium. The use of flue gas recycling combined with a molten carbonate fuel cell is an even more efficient approach to power generation. Natural gas or gas from coal gasification is oxidized at the cell anode while the spent gas is burnt in oxygen to provide a CO_2-rich flue gas for use at the cathode.

CETC's Capability

CETC's research facilities include expert staff, pilot plant facilities, state-of-the-art modelling and simulation tools and an extensive analytical capability. Recently the program successfully renewed its registration to ISO 9001:2000.

CETC tests flue gas recycle applications in its pilot facility (see schematic). It can be configured to simulate present or proposed equipment and for a variety of fuels. Our research staff can conduct detailed studies to assess how the proportion and quality of flue gases affect potentially saleable products and emissions.



Schematic Diagram of CETC's Pilot-Scale Combustion and Flue Gas Treatment and Analysis Units

Pilot *Plant* Features

Temperatures may be up to 1800°C in the 0.3 Mw_t (1 million BTU/h) combustor and up to 200°C in the fabric filters and electrostatic precipitator. The effect of variable oxygen purity on the composition of the flue gas can be simulated. Gas flow rate, heat flux and temperature can be observed through several measuring points. Entrained fly-ash can be withdrawn for analysis at all critical points. On-line gas analysis is also available. Our staff ensure sampling methods conform to EPA protocols.

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