Black Liquor Gasification

Recovery of kraft black liquor, produced as a by-product in paper manufacturing, provides a significant source of energy for the paper production process. Kraft black liquor has traditionally been recovered by the Tomlinson boiler process. This process has the disadvantages of low energy efficiency, high capital and operating costs, significant air emissions, and a potential for explosions. Champion International Corporation and Rockwell International have demonstrated on a laboratory and limited pilot plant scale that kraft black liquor can be gasified in a fused salt reactor to produce low-Btu gases. The clean gases are of suitable quality to be burned directly in a gas turbine to produce electrical energy, and the combustion products can be fed to a waste heat boiler to raise steam. The gasifier will have a throughput sufficiently high and a heat loss sufficiently low to permit production of product gases with a heating value of about 100 Btu/scf. Compared to the Tomlinson boiler process, the gasification of kraft black liquor offers high energy efficiency, reduced air emissions, modularity, a higher output ratio of electricity-to-steam, and improved safety. Economic analysis indicates significant potential savings in both capital and operating costs compared with alternative systems.

Heat Recovery Membranes in Dryer Exhaust Streams

Dryers are used throughout industry in various operations which require removing moisture from a product. Energy in the form of heat is lost to the atmosphere in the moisture-laden exhaust from these processes. With the sponsorship of DOE, Bend Research has developed a membrane-based process to recover the latent heat of water vapor in dryer exhaust streams. The key element in this process is a membrane which is permeable to water vapor and impermeable to air. The pressure difference created by the membrane is used to recompress the water vapor, delivering several times more energy than the electrical energy required to drive the compressor. The membrane-based process has been successfully tested at the Crown Zellerbach paper plant in Wauna, Oregon. Applications for the process include: drying of fertilizer during its production; drying of sugar as part of its refining process; drying of paper during production; and fluid-bed drying of coal. When applied to fluid-bed coal drying, for example, the membrane-based process can recover about 30 percent of consumed energy, with an estimated payback period of 3.7 years. It is estimated that the process can save approximately 10 to 20 percent of the 1.89 quads of energy used annually in process drying applications.

High-Temperature Recuperators

Industrial processes relying on combustion heating are highly energy-intensive, particularly at high combustion temperatures where over 50 percent of the energy consumed as fuel escapes in the process exhaust. Recuperators can recover significant portions of this wasted energy by returning heat from the exhaust to the combustion process in the form of preheated air. Conventional recuperators provide combustion air at a maximum temperature of 1300 F. The development of high-temperature burner duct recuperators allows recovery of heat from exhaust gases to product combustion air with temperatures of up to 2000 F. This significant increase in combustion air temperature results in correspondingly significant increases in energy savings.

Bayonet Ceramic Tube Recuperator - A cost-shared project between DOE and Babcock & Wilcox Corporation has developed a ceramic tube recuperator for use in steel plants. The recuperator is a two-stage unit; the first stage is a ceramic recuperator which can withstand continuing high temperatures, followed by a second-stage metallic recuperator which provides a higher level of heat recovery efficiency. Since its installation in 1982 at the Babcock & Wilcox site, this unit has achieved a 42 percent fuel saving. Projected annual savings for this type of recuperator in 2010 are estimated at 42 trillion Btu.