boiler. In addition, electricity consumption in the new process is lower than in the cryogenic process, resulting in an overall energy savings of 44 percent. Projected annual savings in the year 2010 are estimated at 44.1 trillion Btu.

Cement Particle Size Classification

A major cost in cement production involves grinding and separation of fine and coarse cement particles. Through a cost-shared effort with Construction Technology Laboratories, Inc. (CTL), a subsidiary of the Portland Cement Association, research has been completed that shows that these costs can be substantially reduced through the use of: a) controlled particle size distribution cement, b) high-efficiency classifiers, and c) mill configuration and operating changes. Full implementation of this technology would save the average U.S. producer $400,000 per year in finish grinding costs alone. In addition, plant finish grinding capacity can be increased by more than 25 percent and product quality is higher. Thirty-two plants are using the new technology and are currently saving an estimated 0.94 trillion Btu per year. By 2010 annual energy savings could reach 11.1 trillion Btu.

Membrane Distillation

Thermal distillation processes, by which feedstock components of differing boiling points are separated, are highly energy-intensive. In the petroleum processing industries about 30 percent of energy consumption is used in separations, primarily in distillation processes. With DOE support, researchers at Allied/Signal Corporation have developed an alternative separation method which is energy efficient. This method employs a membrane system to separate light hydrocarbons from a stream of heavy oils in the petroleum refining process. The process recovers solvents used in the deasphalting of heavy oils, reducing by as much as 43 percent the amount of solvent to be stripped by evaporation, leading to significant energy savings. In the membrane distillation process, a gel layer of heavy molecules from crude oil feedstock is allowed to build on the surface of a membrane, which serves as a backing material. This gel layer, controlled for growth and stability, performs the separation. The system is stable in a hydrocarbon environment of up to 50C. Potential savings by the year 2010 are estimated at 24.8 trillion Btu per year.

Carbon Dioxide Recovery Process

The rapid expansion of Enhanced Oil Recovery (EOR) has resulted in a demand for carbon dioxide, which is used in EOR technologies. Currently, the only economical sources of carbon dioxide are natural deposits and process vents at hydrogen plants. In cooperation with the Argonne National Laboratory, DOE has successfully completed a test to recover carbon dioxide by burning coal in oxygen and recycled flue gas. The major cost components of the coal-oxygen process are the capital costs of the air separation plant and the cost of the electricity required to run the plant. The capital cost of a separation plant is approximately $21,000/ton per day for a plant of 1,818 tons daily capacity. The electrical requirement is 242 kW-hr/ton of gaseous oxygen produced. The oxygen required to produce a ton of carbon dioxide with the process is 0.8 tons.

Nitrogen Sensor for Precise Fertilizer Application

Energy for production of agricultural fertilizers represents 50 percent of the total U.S. energy expenditure in crop production. Conventionally, nitrogen fertilizers are applied evenly to entire fields, regardless of uneven soil conditions. As a result, large amounts of fertilizer are wasted in areas where application is not only unnecessary, but may also be harmful to the environment. In cooperation with Crop Technology, Inc., DOE has developed a new mobile soil nitrate sensor which automatically releases precise amounts of required fertilizer as it tests the soil. The device is comprised of electrochemical sensors attached to a leading knife which runs along a field below the soil surface. The