The objective of this project is to construct and operate an integrated test circuit for the Molten-Caustic-Leaching (Gravimelt) process for desulfurization and demineralization of coal. The test circuit consists of six unit operations which together provide a continuous system for leaching coal and regenerating the reactant. These units are a) a kiln for reacting molten caustic with coal, b) a seven stage water washing section for recovering caustic from the coal, c) a three-stage acid washing section for removing the last traces of metals and alkali and providing an ultra pure coal product, d) a water treatment section to provide either dischargable or recycleable water, e) a regeneration section to provide purified aqueous caustic and f) an evaporator section to provide molten-caustic for recycle to the kiln reactor.

The integrated test circuit facility will contain more than 160 pieces of equipment including filters, centrifuges, tanks, reactors, feeders and the kiln and rising film evaporator. It occupies 3700 square feet and will be fitted with 5800 feet of piping, 425 valves, 88 instruments and controls as well as a control room with computer control and data acquisition and reduction system.

The progress to date is as follows, a) 95% of the equipment has been structurally installed with the exception of the rising film evaporator package unit which is in the final stages of construction by the subcontractor, b) approximately 70% (4000 feet) of pipe and 70% (300) valves have been installed, c) all 88 instruments and controls have been ordered, 30 have been delivered and 16 installed, d) the computer control and data acquisition and reduction system is on order for delivery in April, e) a subcontract is in the process of being let for electrical hookup from the newly installed electrical substation and motor control center to the various motors, instruments and controls associated with the plant.

The integrated test circuit is scheduled for completion with checkout in June. This will be followed by 3 1/2 weeks of shakedown in which the last week will be around-the-clock three shift operation. The plant will then be operated through the summer with the objective of validating the "optimistic" base case developed by SAIC which forecasts process costs to be in the range of $55 per ton of coal. It will be the further objective of operation to test additional process improvements which may reduce these costs such as partial or complete substitution of calcium carbonate for lime in both acid wash and caustic regeneration sections, reduction in process waste water through improved waste water treatment and possibly shorter kiln reaction time.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
Two coals have been selected for test circuit shakedown and operation. These are the Pittsburgh No. 8 seam coal from the Powhatan No. 6 mine of North American coal and Kentucky No. 9 seam coal from Pittsburgh and Midway’s Colonial mines. The Pittsburgh No. 8 coal contains 4% sulfur and 10% ash while the Kentucky No. 9 seam coal contains 3.5% sulfur and 9.5% ash. These coals should be reduced well below the New Source Performance Standards by the MCL (Gravimelt) process. Bids have been received and TraDet Laboratories has been selected to provide procurement, crushing, drying and delivery of coal to the TRW test site by June 1.

Additional detail on the installation of the integrated test circuit are given below.

The final parts for the kiln reactor internal scraper were received during the past month. The planned molten caustic delivery system which will introduce molten caustic directly into the first heated zone of the kiln was found to be too large to fit between the inside diameter of the feed-end hole in the rotating kiln tube and the outside of the stationary solids feeder guide pipe. It was decided that the necessary room could be obtained by removing one inch from the radius of the Inconel kiln tube feed-end hole along with the same amount from the spiral flights located inside the kiln tube feed section. The removal will be done with a plasma arc cutting torch.

In addition to modification of the kiln tube end, the legs on the solids feeder must be cut off by one inch and the feed-end support for the scraper must be modified to allow for the lowering of the solids feeder. These modifications should provide about one inch of space into which the heated, insulated, one-quarter inch nickel molten caustic delivery tube will be installed. To reach the first heated zone, only four to five feet of unsupported (cantilevered) heated delivery tube will be required. It was suspected earlier that about six to eight feet would be unsupported. Because the heated delivery tube must make several bends, its design is an active issue.

The scraper assembly installation schedule is dependant on the heated delivery tube completion since the tube will become an integral part of the feed-end support for the scraper.

Other support systems for the kiln reactor, including the solids feed pneumatic sub-system, the gas exhaust scrubber sub-system, and the discharge train sub-system are nearly complete.

The plumbing (interconnect) for the water wash and acid wash sections has started and is 50% complete (Figure 1). Metal filings of critical pieces of equipment were submitted for analyses to ensure that the alloys required had been supplied, which was the case.
The water treatment section installation (Figure 2) is also proceeding well. The solids feeders have been mounted above the two tanks, the bag filters are in place and interconnect plumbing is 50% complete.

The caustic evaporator unit, under construction at Blaw Knox in Buffalo, New York, is near complete and has passed inspection by both the TRW design engineer and the TRW test circuit operation foreman. Blaw Knox has been authorized to finish the unit with installation of exterior insulation and the two molten caustic valves. The unit is scheduled for shipment to arrive at TRW in mid April. The evaporator will then be installed in a roofed foundation-pad area directly adjacent to the reactor section. The piping connections to the upstream caustic regeneration unit and downstream rotary kiln reactor will then be made.

General subjects affecting all systems are heaters and electrical hook-ups. The heaters for all tankage and for the dissolver pump-around loop have arrived and mechanical installation is 80% complete. Electrical hook-up appears to be more complex and more expensive than originally estimated. The current design calls for more electrical hook-ups than were envisioned prior to completion of engineering and design. In addition, the costs of electrical switching gear and purchased electrical installation labor has risen above assumed escalation factors. Another factor affecting hook-up costs are more narrowly interpreted, more vigorously enforced local ordinances requiring detailed drawings, plan checks and permits.

The TRW supplied waste treatment facility concrete work is complete. This installation will include tankage for settling and neutralization of waste liquids and slurries.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
FIGURE 2. WATER TREATMENT SECTION. THE LIME TREATMENT VESSEL AND FEEDER UNIT IS IN FOREGROUND AND THE IRON SALT TREATMENT VESSEL WITH ITS' FEEDER CAN BE SEEN IN BACKGROUND.
View of tower with hot oil thermal fluid heating unit at right bottom, hot oil, expansion tank at top and molten caustic collection tank at middle level.

Top of tower with vertical 4" shell heat exchanger at right (contains three 1" caustic evaporator tubes). Caustic steam separator, expansion tank and caustic collection tank at top.

FIGURE 3. EVAPORATOR UNIT UNDER CONSTRUCTION