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**INTEGRATED OPERATION OF A PRESSURIZED GASIFIER, HOT
GAS DESULFURIZATION SYSTEM AND TURBINE SIMULATOR**

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6.2 Integrated Operation of a Pressurized Gasifier, Hot Gas Desulfurization System and Turbine Simulator

CONTRACT INFORMATION

Contract Number DE-AC21-87MC23170

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Period of Performance September 30, 1987 to September 30, 1994

Schedule and Milestones

Project Schedule

OBJECTIVES

The overall objective of the General Electric Hot Gas Cleanup (HGCU) Program is to develop a commercially viable technology to remove sulfur, particulates, and halogens from a high-temperature fuel gas stream using a moving bed, regenerable mixed metal oxide sorbent based process. This technology will ultimately be incorporated into advanced Integrated Gasification Combined Cycle (IGCC) power generation systems. In IGCC applications, HGCU will improve overall power generation cycle efficiencies by 1 to 2% compared with conventional low-temperature cleanup technologies, and will also offer the potential for reducing plant capital and operating costs.

The HGCU Program is based on the design and demonstration of the HGCU system in a test facility made up of a pilot-scale fixed bed gasifier, a HGCU system, and a turbine simulator in Schenectady, NY, at the General Electric Research and Development Center (GE-CRD). A modified GE MS6000 gas turbine combustor and a film-cooled, first-stage LM6000 nozzle assembly are incorporated into the turbine simulator.

The objectives of the turbine simulator testing are (1) to demonstrate the suitability of fuel gas processed by the HGCU system for use in state-of-the-art gas turbines firing at "F" conditions (2350°F rotor inlet temperature) and (2) to quantify the combustion characteristics and emissions of such a combustor. The turbine simulator program also includes the development of experimental combustors based on the rich-quench-lean concept to minimize the conversion of ammonia and other fuel-bound nitrogen species to NO_x during combustion.

The HGCU system and turbine simulator have been designed to process approximately 8000 lb/hr of low heating value fuel gas produced by the GE fixed bed gasifier. The raw fuel gas is provided to the HGCU and turbine simulator systems at 280 psig and 1000°F. The HGCU system has utilized several mixed metal oxide sorbents—including zinc ferrite, zinc titanate, and Z-Sorb (a proprietary zinc-based sorbent developed by Phillips Petroleum Company)—with the objective of demonstrating good sulfur removal and mechanical attrition resistance as well as economic cost characteristics. Demonstration of halogen removal and the characterization of alkali and trace metal concentrations in the fuel gas are subordinate objectives of the overall program.

BACKGROUND

As a result of the availability of advanced gas turbine combined cycles that fire at temperatures of over 2350°F and the advent of integrated gasification/oxygen separation technology, IGCC plants now offer overall plant efficiencies of 42–44% with extremely low emissions of SO_x , NO_x , and particulate.

Although the capital cost of IGCC technology is higher than conventional coal-fired steam turbine plants, it is rapidly dropping and is approaching competitive levels. As IGCC power generation technology reaches the early stage of demonstration and commercialization, the first plants built will use conventional low-temperature gas-cleaning technology. However, the goal of HGCU is that when fully developed, it will represent a "second generation" clean-up technology offering further improvements in IGCC power generation efficiency and operation flexibility, as well as reduced capital and operating costs.

Fuel gas derived from coal by gasification processes contains sulfur in the form of H₂S and COS at concentrations of up to several thousand parts per million (ppm). In order to comply with increasingly stringent environmental regulations and to meet the conditions required for the long life of gas turbine components, it is necessary to reduce both the sulfur and particulate in coal-derived fuel gas to low levels. In the temperature range of approximately 800–1200°F, mixed metal oxides, such as zinc oxide, react with these gaseous sulfur species, forming metal sulfides under reducing conditions. These metal sulfides can then be regenerated to their original oxide state, producing a sulfur-dioxide-rich off-gas suitable for conversion either to sulfuric acid or to elemental sulfur. GE Environmental Systems, Inc. (GEESI) has patented a moving bed process to utilize mixed metal oxide sorbents to remove sulfur from a high-temperature fuel gas stream and regenerate the sorbent for reuse while producing a byproduct stream suitable for the recovery of sulfur. The history

of this project and the concurrent development of high-temperature particulate removal systems based on cyclones has been documented by Smith et al. (1987) and Cook et al. (1988, 1989, 1990, 1991, and 1992). In addition, the previous development of the mixed metal oxide sorbents and turbine simulator have been documented by Ayala et al. (1992, 1993) and Feitelberg et al. (1993).

PROJECT DESCRIPTION

The HGCU Program is based on the design and demonstration of gas cleaning technologies at GE-CRD's Process Evaluation Facility (PEF). This work is being carried out under a current DOE contract, with the most recent schedule shown in the Schedule and Milestones section at the beginning of this paper. Construction of the basic facility was completed in late 1990, with continuing modifications and test operation taking place since that time. A summary of the test runs performed to date is shown in Table 1. These tests include 9 long dura-

Table 1. Gasifier/HGCU/Turbine Simulator Test Operation – 20 atm, 1000°F

<u>Run</u>	<u>Date</u>	<u>Run Hours</u>	<u>Coal Type</u>	<u>System Configuration</u>
1-2B	12/90-4/92	230	I6	Gasifier/HGCU/GT Valve
3	8/30/92	88	I6	Gasifier/HGCU/GT Valve/MS6000 Simulator
3A	2/7/93	120	Anthracite	Gasifier/HGCU/GT Valve/MS6000 Simulator
4	6/13/93	100	I6, Crown II	Gasifier/HGCU/GT Valve/Simulator/Halogen
5	11/1/93	103	I6, Crown II	Gasifier/HGCU/GT Valve/Halogen/"F" Simulator 2300°F
6	5/1/94	85	I6	Gasifier/Guard Bed/HGCU/GT Valve/Halogen/"F" Simulator 2500°F
4A	4Q94	24	I6	Gasifier/HGCU/GT Valve/R-Q-L Sub-Scale
7A	3Q94	100	I6, Crown II	Gasifier/HGCU/GT Valve/Halogen/"F" Simulator 2500°F
7B	3Q93	100	I6, Crown II	Gasifier/HGCU/GT Valve/CFB Halogen/R-Q-L Full Scale
8	4Q94	100-200	I6, Crown II	Gasifier/HGCU/GT Valve/CFB Halogen/R-Q-L Full Scale

tion runs (approximately 100 hours each), incorporating a variety of new hardware features and sorbents. Tests 4A, 7A, 7B, and 8 are scheduled for later in 1994.

A schematic of the PEF facility, as configured at the conclusion of Test 6, is shown in Figure 1. The GE-CRD fixed bed, pressurized air-/steam-blown gasifier is shown on the left. The gasifier includes a water-cooled bed stirrer, alternating pressurized coal feed lock-hoppers, and a rotating grate for ash removal. The PEF also includes a primary cyclone immediately downstream of the gasifier, the HGCU system consisting of the absorber and associated upper and lower lock-hoppers, regenerator with recycle gas system, fines screen, and elevator. A secondary cyclone is located downstream of the HGCU system, and the cleaned fuel can be directed either to the MS6000 turbine simulator or to the system flare. Using analytical instrumentation in "real time" to allow process

control, both the process fuel gas and the recycle gas are sampled extensively during the run. Solid flow is sampled hourly for later chemical analysis and to support the preparation of overall heat and mass balances.

RESULTS

Testing of the GE HGCU system has been underway since December 1990. During this period, a variety of sorbents and system configurations have been tested, including zinc ferrite and zinc titanate sorbents, single/double stage open cylindrical regenerators, and alternate recycle blower configurations. The two most recent tests, Test 5 (completed in November 1993) and Test 6 (completed in May 1994), represent the latest advancements in regenerator configuration, type of sorbent, and chloride control systems. Test 5 was based on the use of zinc titanate sorbent and included a revised regenerator configuration and a

Figure 1. GE Gasifier/Hot Gas Cleanup Process Flow Diagram

sodium bicarbonate injection system for chloride control. Test 6 incorporated the use of Z-Sorb, a chloride guard in the regenerator recycle loop, and further modifications to the regenerator internal configuration. The following sections describe the test conditions in detail and discuss the test results.

Test 5 Conditions and System Modifications

Long Duration Test 5 was performed in early November 1993 at GE-CRD's PEF using zinc titanate (L2535M) sorbent. This sorbent had been used in previous tests and had been subjected to periodic high-temperature regeneration conditions during those tests. A blend of Illinois #6 (1.9% sulfur) and Crown II (3.7% sulfur) coals were used, resulting in effective sulfur levels in the range of 2.5–3.0%.

The regenerator, previously modified in Test 4 to include a single-stage annular configura-

tion, was further modified for Test 5 to include a two-stage annular configuration. These modifications are shown in Figure 2.

The regenerator modifications were made to improve control of sorbent temperature in the regenerator, which was found to be a problem in Test 4. Freshly sulfided sorbent, which also includes tar (associated with the GE fixed bed gasifier) entering the top of the regenerator is very reactive. For that reason, the oxygen content of the recycle gas must be reduced in order to control the sorbent temperature rise caused by the exothermic regeneration and tar oxidation reactions at the top of the regenerator bed. To complete the regeneration of sorbent in the middle and bottom of the regenerator, however, additional oxygen is required. In a single-stage configuration it was difficult to satisfy both criteria.

To solve this problem, a two-stage regeneration approach was reinstituted in the regenerator. In the

Figure 2. Hot Gas Cleanup Regenerator Modifications – Test 5

modified regenerator configuration, the sorbent passes through two regeneration stages, each with an independent air (oxygen) control, allowing control of the oxygen content and temperature of the sorbent in each stage. In addition, larger valving and piping were installed in the air feed and off-gas bleed lines to increase the flow capacity of these systems.

As previously reported, chlorides in the coal gas cause problems to the HGCU system by adsorbing onto the sorbent in the absorber and being transported to the regenerator, where they are released in the recycle gas. In the recycle gas, the chlorides react with both the sorbent and the SO_2 in the recycle gas to form zinc sulfate and zinc chloride deposits in the recycle loop heat exchangers. This condition causes blockage of the heat exchangers after several days of operation. To prevent this problem, a fuel gas chloride removal system was designed and installed for demonstration in Test 5. The chloride removal system consists of a pressurized sodium bicarbonate powder injection system located upstream of the primary cyclone. The sodium bicarbonate powder flow is metered through a feeder and transported to the coal gas piping using a dilute phase nitrogen transport system. Sodium bicarbonate powder injected into the hot fuel gas stream at 1000°F rapidly calcines to sodium carbonate, forming highly porous particles. The sodium carbonate reacts with the hydrogen chloride in the coal gas to form solid sodium chloride within the particles. The particles, consisting of unreacted sodium carbonate and sodium chloride, are captured by the primary cyclone. The location of the sodium bicarbonate injection system is shown on the system schematic (Figure 1).

The MS6000 turbine simulator configuration was not modified significantly from the

previous test. Improvements were made to the nozzle cascade cooling circuits to improve cooling flows to the leading and trailing edges of the vanes. In addition, an automatic temperature control system was incorporated to maintain a constant firing temperature despite variations in the fuel gas heating value caused by the movement of the gasifier stirrer.

Test 5 Results

The results of Test 5 are summarized in Figure 3. The figure plots the inlet and outlet temperature of the absorber and the outlet H_2S levels of the gas leaving the absorber. The data is shown for the entire week's operation; periods when the absorber was off line are indicated by decreases in the absorber temperatures. The turbine simulator was operational for 41 hours. Most of the turbine simulator operation was at 2100°F combustor exit temperature, with two hours of operation at 2300°F .

The gasifier was operated for 103 hours in Test 5, with 65 hours of integrated operation of the HGCU system. The input sulfur loading ranged from 4000 ppm H_2S on Monday to nearly 6000 ppm H_2S on Tuesday and was lowered to approximately 4000 ppm Wednesday through Friday. As shown in Figure 3, the H_2S levels in the fuel gas downstream of the absorber ranged from 50–500 ppm during the test. This corresponds to a sulfur removal range of 90–97% overall.

The test was interrupted several times when the absorber was taken off line. The first two interruptions, on Tuesday evening and Wednesday morning, were caused by poor performance of the regenerator, as evidenced by outlet H_2S levels in the 300–400 ppm range. This degraded performance was caused by incomplete regeneration of the sorbent in the regenerator. As a result, the absorber was removed from the coal gas stream, allowing the regeneration process to continue without the addition of freshly sulfided material to the regenerator.

Post-test material analysis indicated that the sulfur levels in the sorbent leaving the regenerator during these periods were in the range of 2–3%, indicating that regeneration of the sorbent was incomplete. Although both periods of off-line regeneration were successful in improving the performance for several hours, the outlet H₂S levels again increased to the 300–400 ppm range.

The period the absorber was off line on Thursday morning was associated with plugging of the recycle loop heat exchanger. This condition required disassembly of the heat exchangers for cleaning to restore full recycle gas flow. Subsequent problems on Thursday evening associated with the sorbent elevator electrical system took approximately 12 hours to correct. The final operation on Friday demonstrated improved operational and regeneration conditions and the ability to reduce outlet H₂S levels to below 100 ppm under proper control conditions.

Overall, sulfur removal performance during Test 5 degraded in comparison with previous tests. We concluded that the performance was due to incomplete regeneration and higher sulfur input levels. Despite the incomplete regeneration, the regenerator recycle gas attained SO₂ levels of 10% for over 36 hours of operation. During shut-downs and restart periods, the regenerator loop was able to recover to high SO₂ levels quickly. These SO₂ levels are much higher than the 7–8% required by the input stream of the sulfuric acid conversion process.

Other results from Test 5 included the demonstration of greatly improved temperature control of the sorbent. The first stage of the regenerator was operated in an automatic control mode, which controlled the input oxygen level based on the peak temperature measured in the first stage. This control approach allowed the maximum temperature in the first stage to be maintained at less than 1500°F throughout the test. The second

Figure 3. Absorber Performance – Test 5

stage was manually controlled to maintain desired sorbent temperatures.

The pressurized sodium bicarbonate injection system functionally performed as designed. Approximately 20–23 lb/hr of sodium bicarbonate were injected into the coal gas stream using a nitrogen carrier gas upstream of the first-stage cyclone. The sodium bicarbonate had a residence time of approximately 1.5 seconds prior to being removed by the cyclone. The mean particle size was relatively coarse, 85% greater than approximately 75 microns and 98% less than 150 microns, and the stoichiometry was approximately 2.5:1. However, based on measurements in the fuel gas stream and a post-test solids analysis, the chloride mass balance around the system indicated that only 35% of the chloride was removed from the gas.

The mass balances for chloride and sodium are shown in Figure 4. Measurements of the chloride in the recycle loop gas were also

performed periodically throughout the test. Chloride levels in the recycle gas were found to range from 1000 to 2000 ppm, as measured in previous tests. Since the plugging of the recycle loop heat exchangers sharply limited test operation of the PEF and represented a significant problem, it was decided to add a chloride “guard bed” to remove chlorides directly from the recycle loop.

To improve our understanding of the kinetics of sodium bicarbonate reactions with HCl in hot fuel gas streams, testing was performed at the University of North Dakota Energy and Environmental Research Center’s pressurized drop tube furnace (PDTF). The tests used various powder sizes, residence times, and stoichiometry of sodium bicarbonate in simulated coal gas containing HCl. The results demonstrated that removal rates of over 90% were possible using longer gas/solids residence times, finer powder, or increased stoichiometry. The conclusion of the PDTF testing was that the PEF residence time was too short and that an improved configuration to increase both the residence time

Figure 4. Gasifier Sodium and Chloride Balance for Run 5

and stoichiometry by use of a recycle cyclone should be incorporated into the facility. However, because of the time required to revise the plant high-temperature fuel piping, this modification has been postponed until after Test 6.

During Test 5, it was observed that the sorbent pellets leaving the regenerator were not uniform in color, indicating that some pellets were not fully regenerated. This observation led to the hypothesis that the pellets were not moving through the regenerator in a uniform plug flow condition. It appears that some sorbent pellets were moving through the regenerator more quickly and did not have enough residence time to be fully regenerated, while other pellets were moving very slowly and were fully regenerated at the exit. This hypothesis was tested by constructing scale models of the regenerator geometry and flowing sand through the model to observe the behavior of a colored

tracer layer of sand. From tests on a modified regenerator model, it was determined that a diverter located in the discharge of the regenerator would greatly improve the uniformity of the solids flow in the annular section of the regenerator. The data from this testing is shown in Figure 5, indicating the ideal flow characteristics and the modified and non-modified flow characteristics. On the basis of these results, modifications to the regenerator exit were designed and incorporated into the PEF regenerator.

Disassembly of the turbine simulator after Test 5 indicated that although the simulator operated without apparent problems, the cap/cowl louvers in the head end of the combustor had been damaged. Several of the cooling louvers were damaged. The appearance of the combustor suggested that the flame structure was located very close to the head end of the combustor and was the cause of the overheating of the cap/cowl assembly. This condition was reviewed with GE Power Generation

Figure 5. Solids Flow Test – Regenerator Discharge

Engineering, and minor modifications to the axial location of the air and fuel swirler were made. In addition, the swirl angles of the air and fuel swirlers were reduced, thus modifying the location of the flame within the combustor.

Test 6 Conditions and System Modifications

Long Duration Test 6 was performed during the period of May 1 to May 5, 1994. Several significant modifications and changes were made to the HGCU and turbine simulator systems in preparation for Test 6. The most significant change from previous tests was the use of Z-Sorb sorbent. Characteristics of Z-Sorb are detailed in a paper presented in the sorbent development session of this conference (Ayala et al., 1994).

Modifications to the lower section of the regenerator internal configuration, as shown in Figure 6, were fabricated and installed with the

objective of improving the uniformity of sorbent solids flow. The annular, two-stage regenerator configuration was retained from Test 5.

A "guard bed" was added to the recycle loop to continuously remove chlorides from the recycle gas. The guard bed is a small fixed bed contains an active volume of approximately 300 pounds of sodium bicarbonate pellets (3–4 mm). Since sodium bicarbonate will react with SO_2 as well as chlorides, the guard bed was located in the lowest temperature position in the loop, upstream of the recycle compressor. Bench-scale testing of sodium bicarbonate pellets in simulated recycle gas demonstrated that at temperatures of 500 to 550°F, reactions with SO_2 are minimized and chloride reactions will proceed rapidly.

In addition to the modifications made for Test 5, minor modifications were made to the primary cyclone to improve performance of particulate

Figure 6. Hot Gas Cleanup Regenerator Modifications – Test 6

collections during lock-hopper operation. Sorbent transfer valves manufactured by two vendors were installed in the HGCU system to evaluate alternate valve designs in high-temperature, high-solids loading applications.

Test 6 utilized Illinois #6 (1.9% sulfur) as the gasifier input fuel, producing approximately 3500–4000 ppm H_2S in the coal gas. Sodium bicarbonate injection into the coal gas was also retained during Test 6. The system was tested with finer grades of sodium bicarbonate. Because the finer grades caused bridging of the feeder, the original grade of sodium bicarbonate was used for Test 6 and no improvement in this system's performance was expected.

Modifications to the turbine simulator, as previously noted, included relocation of the air swirler/fuel nozzle, changes to the swirl angle, and blocking of dilution holes in the liner. An

improved cooling scheme for the nozzle cascade mounting flange area was also incorporated to prevent problems caused by thermal growth of the cascade relative to the mounting flange.

Test 6 Results

Test 6 resulted in approximately 80 hours of integrated gasifier/HGCU system operation and represents the longest integrated test operation to date in the program. The only hardware problem encountered during Test 6 was the failure of the sorbent elevator cable on Wednesday evening. This failure resulted in severe damage to the elevator bucket; however, repairs to the bucket and elevator were made in a very short time, and the system was returned to operation on Thursday morning.

The overall results of Test 6 are shown in Figure 7. The performance of Z-Sorb was very encouraging. Removal of H_2S from the gas stream was very good, with long periods of testing with

Figure 7. Absorber Performance – Test 6

less than 50 ppm H_2S in the absorber outlet stream. No problems were encountered with the use of Z-Sorb in a moving bed system. The sorbent flowed well and no significant water gas shift in the absorber was observed. Although an exothermic methanation reaction was predicted during the first sulfidation cycle of the material, that reaction was not observed. Post-test inspection did not reveal any agglomeration of sorbent or other signs of physical degradation.

As shown in Figure 7, the performance of the HGCU system fell off slightly during three periods on Tuesday and Wednesday. This decrease in absorber performance was associated with adjusting the regeneration control conditions to determine the best regeneration strategy for Z-Sorb. Once the proper regeneration conditions were met, the performance of the Z-Sorb returned to predicted H_2S performance levels.

One difference between Z-Sorb and the zinc titanate previously tested was the limitation on the upper temperature of the sorbent. Phillips Petroleum Company recommended that the peak regeneration temperature of Z-Sorb be limited to approximately 1350°F, significantly lower than the 1500°F peak temperature used for zinc titanate. This operational limitation required that close control be maintained over the regeneration process.

Due to the different regeneration characteristics of Z-Sorb compared to zinc titanate, several operational changes (e.g., lowering the temperature of the inlet recycle gas) were necessary to maintain the proper temperatures. For most of the test, a nitrogen purge through the regenerator exit area was maintained to decompose any sulfate that might have formed during regeneration. Post-test analysis indicates that sulfate levels in the

sorbent leaving the regenerator were very low, generally less than 0.5%. Total residual sulfur in the sorbent leaving the regenerator was approximately 1% for those periods of good regeneration. These levels are significantly lower than the regenerator sorbent sulfur levels observed in Test 5. Although the use of Z-Sorb improved performance of the HGCU system, the test results continued to indicate that improved control of sorbent temperature (i.e., sufficient heat rejections), while maintaining sufficient oxygen content in the recycle gas to complete regeneration is the key to HGCU performance.

Fines were collected under the vibrating sorbent screen at the bottom of the regenerator in order to measure the attrition loss of Z-Sorb. The attrition resulting from movement of fresh sorbent through the HGCU system at ambient temperature was approximately 0.2% of the total material circulated through the system. The overall attrition loss over 8 cycles of absorption/regeneration in Test 6 was approximately 0.4% of the total sorbent moved. This attrition rate is considered to be very low at the scale of the PEF and is significantly better than the attrition rate of zinc titanite in Test 5.

A major achievement of Test 6 was the demonstration of effective chloride removal by the regenerator recycle guard bed. Chloride levels downstream of the guard bed averaged 308 ppm compared to 1000–2000 ppm in previous tests. This reduction enabled us to maintain full recycle gas flow throughout the test. The heat exchanger pressure drop was constant throughout the test.

Test 6 was the first test that did not require cleaning of the recycle loop heat exchangers during a long duration test. The sodium bicarbonate material in the guard bed did react with chlorides as expected; however, SO_2 in the recycle loop also reacted with the sodium bicarbonate and reduced the SO_2 levels to 6–7% during the test. The use of

sodium bicarbonate in the recycle loop guard bed was effective in removing chlorides; although an improved guard bed material, demonstrating lower reactivity to SO_2 while maintaining reactivity towards chlorides, is under investigation.

The performance of the sodium bicarbonate injection system for removal of chlorides in the fuel gas was found to be of the same level as demonstrated in Test 5. The system removed 25–35% of the chlorides from the fuel gas, and an improved sodium bicarbonate/recycle design is in progress.

Turbine simulator testing totaled 67 hours of fired operation. The simulator operated for over 24 hours at 2300°F combustor exit temperature and at 2500°F for three hours. The modifications to the turbine simulator were successful, resulting in low metal temperatures both in the cap/cowl area and in the combustor liner. No deposits were observed on the turbine simulator nozzle or liner after the conclusion of the test. The NO_x emissions from the turbine simulator were approximately 200 ppm (@ 15% oxygen) due to the conversion of fuel-bound nitrogen species, such as ammonia, to NO_x . Ammonia in the fuel gas was measured at 4100 ppm. Carbon monoxide (CO) and unburned hydrocarbon emissions were also found to be very low.

Vapor phase alkali measurements in the hot fuel gas (850°F) were performed by the research staff of Ames Laboratory during Test 6. This testing was performed using an on-line atomic absorption spectrometer to measure alkali directly in the vapor phase of the fuel gas. Preliminary results of this testing indicated that the alkalis in the fuel gas were present at levels well below 10 ppb. This level is well below the turbine alkali tolerance specification required by GE. Details of the turbine simulator testing and

alkali testing are discussed in a concurrent paper presented by Feitelberg et al. (1994) in these proceedings.

Overall, Test 6 was the most successful test of the HGCU program to date. Sulfur removal efficiency of 98 to 99% was demonstrated, and sorbent attrition was very low. The guard bed prevented plugging of the recycle heat exchanger during the test period and all HGCU mechanical systems (with the exception of the elevator) performed well. The turbine simulator reached "F" class turbine firing conditions with no damage to the hardware.

FUTURE WORK

Several additional tests are planned for the gasifier/HGCU/turbine simulator in calendar year 1994. Two 100-hour tests are planned for August and October to demonstrate an improved internal sorbent flow configuration for the absorber and the addition of the recirculating sodium bicarbonate chloride removal system to the fuel gas stream. The test year will culminate with a longer term test (100 to 200 hours) in December 1994. A 24-hour test of an experimental rich-quench-lean combustor will also be performed during the fourth quarter of 1994. All remaining testing in 1994 is based on the use of Z-Sorb and will be focused on demonstrating long-term durability of the HGCU system and the sorbent.

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