

SECTION 4 CATALYST CANISTER EXPOSURE TESTING

As described in Section 1, field testing based on simple exposure of the catalyst to the coal gas can be an economical means of determining the possible deleterious effects of trace contaminants. The technique is limited to fixed-bed pellets, however, as the much smaller particles of the fluid-bed catalyst cannot be contained in a perforated canister.

The primary focus of this phase of the DSRP research program was fluid-bed reactors. However, the anticipated longer duration operation of the PSDF gasifier presented a good opportunity to obtain additional exposure data on fixed-bed material.

4.1 CANISTER EXPOSURE

The plan, as with the Morgantown/GE tests described previously to determine if the catalyst had been degraded, was to test the exposed catalyst pellets in the bench unit in the RTI lab with SimROG and simulated coal gas. The key performance parameter is the 1-stage efficiency of conversion of SO₂ to elemental S, with the following variables:

- Exposed vs. non-exposed
- Pretreatment technique used (A vs. B).

Two canisters of catalyst pellets were prepared following two different pre-treatment techniques. These pretreatment techniques are not described here because they are proprietary.

The canisters were fabricated from perforated stainless steel, as Figure 11 shows, and placed on an interior support ring on the “clean” side of the Westinghouse PCD (candle-filter type particulate control device in the PSDF gasifier main train). Figure 12 is a photograph taken during a shutdown of one canister in place in the partially disassembled PCD.

Based on information supplied by SCS (Figure 13), the canisters saw 876 hours of coal gas flow over the course of two years (August 1999 to April 2001).

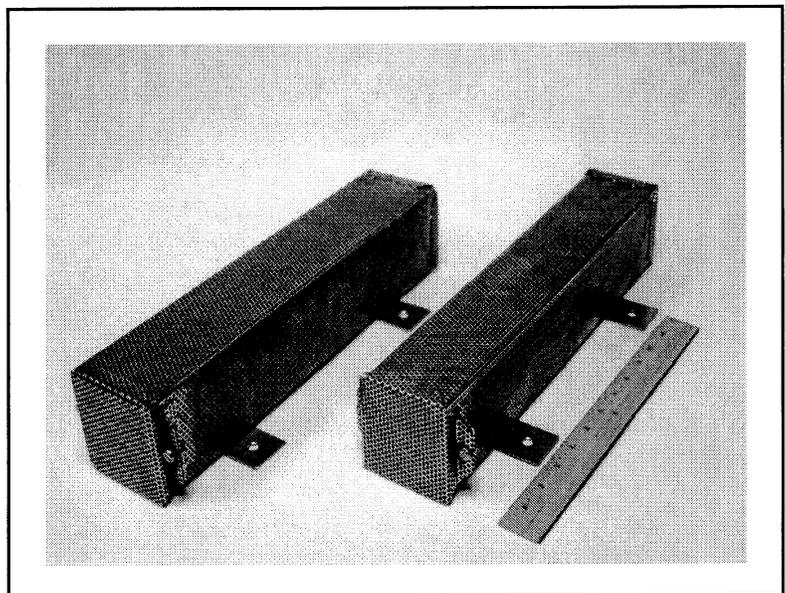


Figure 11. Perforated, Stainless Steel Canister

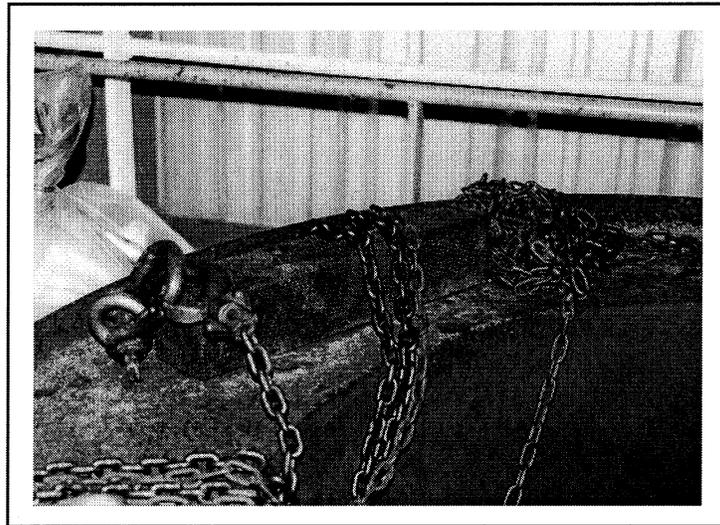


Figure 12. Canister and Westinghouse PCD

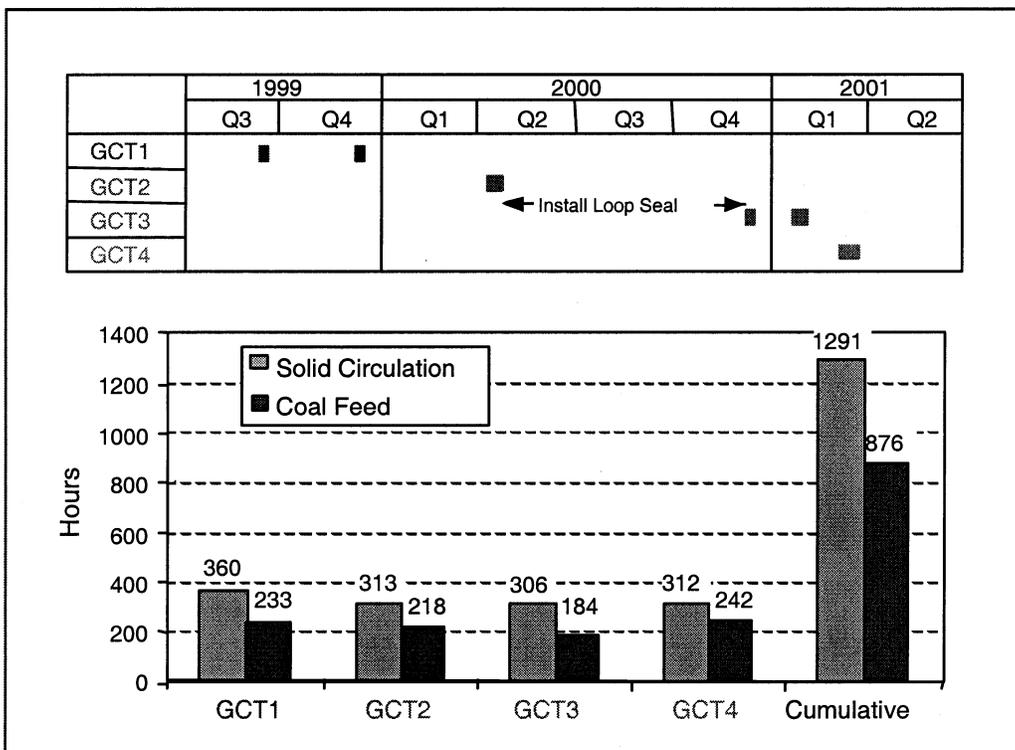


Figure 13. Transport Reactor Gasification Operations

4.2 BENCH UNIT TEST RESULTS

A 36-h bench-scale test of the PSDF-exposed canister catalyst was conducted using RTI's HTHP bench-scale unit. One liter of the catalyst was placed in a 3.0-in i.d. cage and loaded in the reactor. The catalyst was tested for DSRP efficiency at 280 psig, 600°C (1112°F), and 2000 scc/(cc.h) with a SO₂-coal gas mixture containing 2.5 vol% SO₂, 2 vol% H₂, 3 vol% CO, 5 vol% steam, 0.1 vol% H₂S, and the balance N₂. The conversion of the inlet sulfur compounds to elemental sulfur was 85-90%—as compared to the 98% conversion performance of freshly activated catalyst—and remained at this level throughout the 36-h test, indicating negligible carbon burn-off during the test.

To explain the lower performance of the PSDF-exposed catalyst, fresh catalyst, freshly activated catalyst, and PSDF-exposed catalyst were analyzed as shown in Table 5. The surface area and pore volume of the

Table 5. Analysis of DSRP Catalysts

	Fresh, unactivated	Freshly activated	PSDF exposed
Active ingredient (wt%)	0.04	3.03	1.06
Surface area (M ² /g)	188.5	168.3	80.8
Pore volume (cm ³ /g)	0.59	0.52	0.26

PSDF-exposed catalyst were lower by about 50% each. In addition, the PSDF-exposed catalyst contained nearly 67% less active ingredient than the freshly activated catalyst. The results indicated sintering and removal of active ingredient from the PSDF-exposed catalyst due to oxygen exposure at PSDF, offering a possible explanation for the lower performance of the PSDF-exposed catalyst as compared to freshly activated catalyst. The oxygen exposure at PSDF occurred during startup and in between gasification runs.