Refractory Material Issues in Gasifiers

An Update, April, 2003

Proof-of-concept characterization of the Albany Research Center's improved refractory for slagging gasifiers is continuing in the laboratory with expanded exposure and property analyses. Results from recent rotary kiln exposure tests continue to predict improved performance by the ARC-developed brick, when compared with commercial brick currently used by the gasifier industry. In the rotary kiln test (Figure 1), a barrel lined with the test refractory materials is rotated around its horizontal axis, exposing the

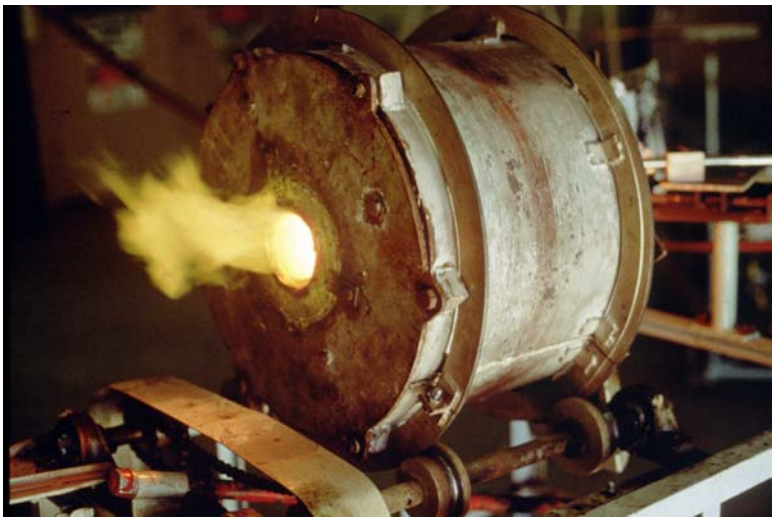

Figure 1 Rotary Kiln Exposure Test Apparatus

brick to a dynamic pool of molten coal slag. The kiln is heated by a propane torch, to a temperature in this case of 1670º C. Four types of high chromium oxide refractories (three commercial materials and the ARC-developed material) were exposed to this environment for a total of five hours. Post-test evaluation of the refractory materials indicates little or no cracking in the ARC material, as compared to extensive fracture in all of the commercial materials (Figures 2 and 3). Slag penetration was also minimized in the ARC material, to less than 20% that observed in the commercial refractories. Although the exposure conditions in the rotary kiln do not exactly mimic those found in a working gasifier, the test does simulate the same type of failure mechanisms found in spent materials removed from gasifier service. Thus, performance in this test may be considered indicative of performance in a commercial gasifier system. The results of these tests, along with tests of the material's mechanical and thermal stability, are being

used to ensure satisfactory performance of the ARC refractory prior to placing test panels of the material in working gasifiers

Figure 2a ARC-developed refractory following exposure in the rotary kiln test.

Figure 2b Commercial high-chromium oxide refractory following exposure in the rotary kiln test.

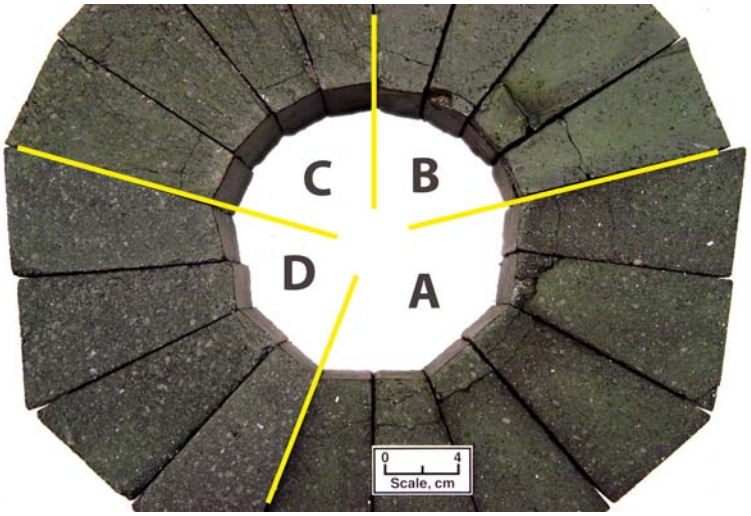

Figure 3a Cross section view of the test refractory bricks as they were oriented inside the drum during the rotary kiln test. The inner surface was exposed to slag and heat. "A", "B", and "C" are commercial materials; "D" is the ARC developed refractory.

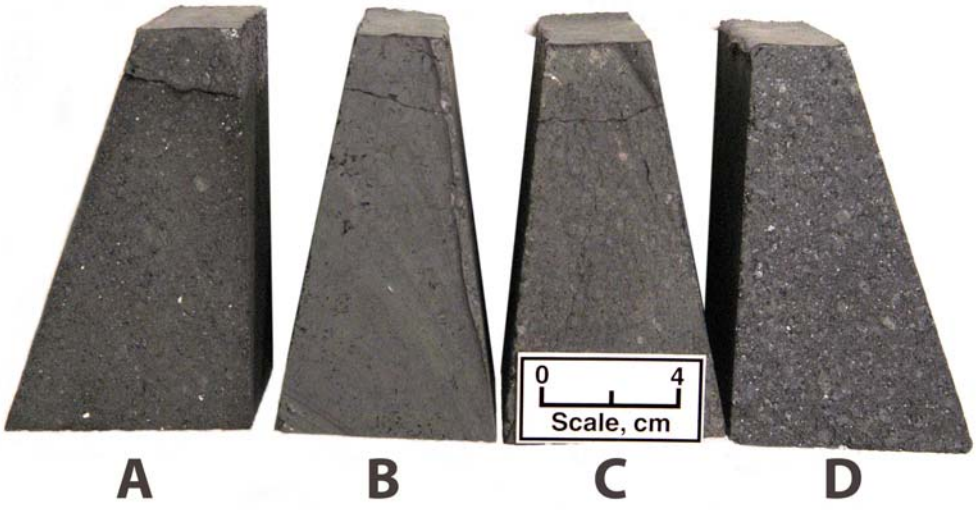

Figure 3b Higher magnification of the test brick in the same orientation as Figure 3a. Note spalling-type cracks near the exposed surface in "A," "B," and "C" that are absent in the ARC-developed refractory "D."