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discussion

Sulfur Dioxide Removal From Power Plant Stack Gas by Limestone Injection—

Plant Scale Tests at TVA[1]

G. C. WIEDERSUM.[2] The dry limestone process for removing sulfur dioxide from boiler flue gas has considerable appeal to a plant operator faced with conforming to more stringent limitations on stack emissions. The capital and operating costs are low compared to other proposed systems, and very little departure from normal operating procedures appears necessary. The results of the planned tests described in this paper will be awaited with interest by all those concerned with air pollution from power plants.

However, there is a basic disadvantage to this process—each pound of sulfur removed from the gas results in over 4 lb of solid product. Adding this to the unreacted excess limestone and the normal flyash greatly increases the dust loading that must be removed by the collection system.

To further compound the problem, limestone reacts preferentially with SO_3 in the flue gas, in spite of its concentration being only 1 percent to 2 percent that of the SO_2. This has been demonstrated many times where cold end corrosion, which is caused by condensation of SO_3, has been prevented by adding small amounts (compared to stoichiometric for SO_2) of calcium or magnesium compounds to the gas. However, it is the SO_3 that provides a large portion of the gas conductivity that permits efficient operation of the electrostatic precipitators. That dolomite addition is detrimental to precipitator operation was demonstrated in the tests made at St. Clair Station of The Detroit Edison Company in 1966; collector efficiency was reduced by as much as 30 percent.

The subject paper makes some mention of including tests of collector efficiency in the planned trials at Shawnee, but their importance is minimized. The statement is made, "the content of SO_3 . . . are not of major significance." It is suggested that more emphasis be given to the determination of precipitator performance with limestone addition in the planned tests because increased particulate emission could well make the dolomite system impractical.

In January, 1969, the National Air Pollution Control Administration issued its first two "Air Quality Criteria" which covered sulfur oxides and particulates. Under the "Air Quality Act of 1967," this set in operation a timetable that requires designating "air basins," adoption by the affected states of air quality standards, and filing by them of plans for enforcement by mid 1970. The standards being considered are so stringent that they will require considerable reduction in emissions of both sulfur oxides and particulates below present levels, indicating that it is no longer realistic to consider only one phase of the air pollution problem. A "systems approach" is necessary to avoid merely substituting one problem for another.

Authors' Closure

The purpose of this paper was to describe the National Air Pollution Control Administration-TVA cooperative full-scale testing program being conducted on unit 10 at TVA's Shawnee Steam Plant. The authors appreciate this very thorough and thoughtful review, and agree with Mr. Wiedersum's comments. They are a valuable supplement to the paper in placing the process, its advantages and its disadvantages, in proper perspective.

It is certainly true that substituting a dust pollution problem for a sulfur emission problem will not be acceptable. In addition, it is necessary to avoid additional problems that could result from inadequate attention to water pollution aspects during water sluicing of the collected ash, sulfur compounds and unreacted lime. All these points and other considerations are discussed in an earlier paper by the authors[3] which dealt with the process technology and with power system applications.

[1] By A. V. Slack and H. L. Falkenberry, published in the January, 1970, issue of THE JOURNAL OF ENGINEERING FOR POWER, TRANS. ASME, Series A, Vol. 92, No. 1, pp. 5–10.

[2] Senior Engineer, Engineering and Research Department, Philadelphia Electric Co., Philadelphia, Pa.

[3] Falkenberry, H. L., and Slack, A. V., *Chemical Engineering Progress*, Vol. 65, No. 12.

Basic Factors in the Capture of Sulfur Dioxide by Limestone and Dolomite[1]

G. C. WIEDERSUM.[2] As he has done many times in the past, Mr. Reid has again presented a lucid paper on a timely subject. With the current trend toward tighter limitations on stack emissions, any knowledge concerning methods of removing sulfur oxides from the flue gas is most welcome. The information presented here is of course theoretical and must be confirmed by test, but it indicates that removal of sulfur dioxide by limestone or dolomite injection may prove to be practical.

Mr. Reid's observations concerning the much greater reactivity of SO_3 relative to SO_2, which was determined in research performed for the ASME Research Committee on Corrosion and Deposits from Combustion Gases, are worthy of special note. They indicate that limestone or dolomite is likely to reduce the SO_3 in flue gas to a much greater extent than the SO_2, in spite of its much lower initial concentration. However, it is the SO_3 that largely provides the electrical conductivity of the flue gas for proper performance of the electrostatic precipitator, so it is likely that its efficiency will be reduced. The solids loading in the flue gas will be greatly increased, because every pound of sulfur removed from the gas produces over 4 lb of solid $CaSO_4$, and because there is likely to be some unreacted additive present. This situation makes increased particulate emissions almost a certainty, which are incompatible with their more stringent limitations that are being proposed along with the sulfur oxide limits.

The final determination as to whether the dry limestone process can be developed into a practical sulfur oxide removal system will be made through tests such as those described in a companion paper.[3] The results of these tests will be awaited with interest by all those concerned with air pollution from power plants.

[1] By William T. Reid, published in the January, 1970, issue of THE JOURNAL OF ENGINEERING FOR POWER, TRANS. ASME, Series A, Vol. 92, No. 1, pp. 11–16.

[2] Senior Engineer, Engineering and Research Department, Philadelphia Electric Co., Philadelphia, Pa.

[3] Slack, A. V. and Falkenberry, H. L., "Sulfur Dioxide Removal from Power Plant Stack Gas by Limestone Injection—Plant-Scale Tests at TVA," JOURNAL OF ENGINEERING FOR POWER, TRANS. ASME, Series A, Vol. 92, No. 1, Jan. 1970, pp. 5–10.