More TECHNICAL BRIEFS

The first plant to operate on Bunker C was designed for locomotive use. It was operated on stationary test at the factory in Schenectady and on the test track in Erie for approximately 800 hours, during which more than 250,000 gallons of Bunker C were burned. During factory test and after 492 hours of fired time, the first stage turbine nozzle was oxidized to such a point it required replacement. The nozzle was inspected a number of times during the course of the test, and no oxidation was apparent for the first 390 hours. At the end of the 492-hour period, however, the condition of the nozzle showed definite attack.

Shortly after the failure by corrosion of the first locomotive nozzle during factory test, a program of laboratory investigations was started to learn more about the nature of oil ash corrosion and things which might be done to prevent it. This program has continued from that time forward and is still being actively pursued. Two basic tools which were developed and which are being used in the study are the so-called crucible tests and the small-burner tests. The results of some of the work on crucible tests and the small-burner tests have been reported in a paper presented to the ASME in December 1952. The crucible test measures the rate of corrosion of a small metallic specimen exposed to synthetic oil ashes in a porcelain crucible which is maintained at testing temperature for 20 hours in a well-ventilated air-atmosphere furnace. The small-burner test measures the corrosion effect of actual combustion gases on a small sample.

Over 5,000 such tests have been made to explore the effect of various corroding agents found in typical oil ashes, the resistance of different alloys to these corroding agents, and the effect of a wide range of additive materials which might be considered for use in treating fuel oils. Of all the alloys tested thus far, alloys of iron with a relatively high percentage of chromium are the most resistant to corrosion. The best range of these chromium-iron alloys appears to lie between 27 and 50% chromium, the best of the series being in the neighborhood of 40% chromium. The effect of chromium over the entire range from 27 to 50% is not strongly marked, but below 25% the corrosion resistance decreases sharply as the chromium decreases. Because alloys containing more than 28% chromium at present are difficult to produce, and because alloys containing less than 25% are poor in corrosion resistance, we have done most of our testing and research work on a 28% chrome-alloy and are now using this material in many of the first-stage nozzles. The straight 28% chromes are too weak at high temperatures to be satisfactory for many applications, but there is evidence that modified alloys of this type can be made which will be stronger and still have good corrosion resistance. It is not expected that they will be strong enough for highly stressed parts such as buckets. They will have sufficient corrosion resistance to give satisfactory operating life with many untreated fuels.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Power Conference, annual meeting, Sherman Hotel, Chicago, Ill., Mar 24-27, 1953. Identified by initials APC and obtainable in proceedings printed and distributed by R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Ill. $6.00.

American Society of Mechanical Engineers, spring meeting, Deschler-Wallick Hotel, Columbus, Ohio, April 28-30, 1953. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

It has, therefore, been concluded that in addition to using the best alloys at hand, some method is also needed to treat gas turbine fuels—either to remove the corrosive agents or to introduce additives which react with the corrosive ash constituents and render them harmless. Data obtained from the crucible tests to date indicate that vanadium pentoxide and sodium sulfate are the two most corrosive agents found in appreciable quantities in any of the oil ashes we have examined, so much of our work has been directed toward finding methods of reducing corrosion by these two materials. For inhibiting corrosion by vanadium pentoxide, compounds of calcium, magnesium, strontium, barium or nickel all appear to be good. Some of these have been suggested by previous investigators in this field. The fact that nickel serves as an inhibitor for vanadium corrosion is probably consistent with the fact that we have found practically all high-nickel alloys to be poor in resistance to vanadium corrosion. It may be postulated that the vanadium has a high affinity for nickel so that when the latter is introduced as an additive it ties up with vanadium and prevents further corrosion; whereas when it is present in any alloy exposed to vanadium, in certain temperature ranges at least, the nickel is attacked.

It has also been found that sodium sulfate and vanadium pentoxide to some extent inhibit one another, and a sodium containing oil relatively free from vanadium will have a more corrosive ash than one containing the same amount of sodium and approximately three times as much by weight of vanadium as sodium. In every case when a suitable amount of a calcium compound is added to a mixture of vanadium pentoxide and sodium sulphate in which the weight of sodium present is less than 0.3 that of the vanadium, a very low weight loss is obtained. Curves, given in paper, show the percentage weight loss of the crucible specimen, plotted on a parabolic scale, versus the ratio of vanadium pentoxide to the sum of the weights of the sodium sulphate plus the vanadium pentoxide, on a linear scale. The simplified synthetic ash represented by the abscissa covers a range in composition from pure sodium sulphate on the zero end to pure vanadium pentoxide on the 100% end of the scale. As can be seen, the minimum corrosion rate occurs in the high vanadium oxide half of the ash scale when calcium is added to the mixture. Results such as these are the basis of a fuel specification proposed in August 1951, the essential features of which are given in Table I-3. *APC Paper, no number.*

Fuels and Firing

3,000,000 kw Operating Experience with Modern Reheat. *By Otto de Lorenzi, Combustion Engineering, Inc.*

Between January 1, 1946 and January 1, 1953 a total of 221 units having a total rated electrical capability of 27,582,000 kw, in sizes ranging from 40,000 to 250,000 kw, were on order, under construction, or in operation. Of this number 105 units, totaling 14,475,000 kw, were ordered between March 1, 1951, and January 1, 1953. The summary given by the author, in addition to showing size distribution of these units, also provides throttle pressures and primary steam temperatures.

(Continued on page 222)



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