CORRELATION OF FURNACE OPERATION AND TEST RESULTS

by

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Introduction

Upon successful completion of a stack emissions test, it is not uncommon to hear an observer from a regulatory agency remark that the unit will never be operated again with such a low emission rate. It is perhaps even more common to hear the one responsible for plant operations remark that now that the test is over they can get back to burning refuse the way it is supposed to be burned. In short, the close control desired for a complicated and lengthy test program would not seem to lend itself to the exigencies experienced in the day-to-day processing of municipal refuse.

Rarely have multiple stack emission tests been run under varied but known furnace operating conditions so that the effect of operating changes on stack emissions can be observed. Such a series of tests was run at the Oceanside Disposal Plant, Town of Hempstead, Long Island, New York. The data obtained may be instructive.

Test Procedures

General Unit No. 2 at the Oceanside Disposal Plant, which was originally commissioned in 1965, was extensively rebuilt and revised as Phase 1 of an ongoing improvement program. The improved unit went on stream in 1974 and underwent a series of three stack emission tests during the Winter of 1974-75. The actual stack tests were run by Environmental Laboratories, Inc., of Mount Vernon, N.Y. in November 1974, January 1975 and March 1975. Method 5 techniques were used. The same personnel participated in all three tests. During the tests, the unit was operated by regular operating personnel from the Town of Hempstead. However, all operating parameters were monitored by personnel from Charles R. Velzy Associates, Inc.; and from one test to the next, modifications were made in operating procedures as described hereinafter.

A cross-sectional view of improved Unit No. 2 is shown on Figure 1. Unprocessed municipal refuse is continually fed onto a four section rocking grate stoker. Flow of underfire air can be controlled to grate sections 2, 3 and 4. The furnace walls at the grate line are air cooled silicon carbide blocks. The remainder of the furnace wall surface is formed of water cooled boiler walls coated to an elevation of 8.5 m

(28 ft.) above the grate line with silicon carbide material. Overfire air can be introduced through two inch diameter nozzles at two levels in each side wall and through the front and rear walls. Gases pass from the furnace through a boiler bank and exit at a temperature of approximately 588 K (600 F) to an electrostatic precipitator. Precipitator spark rate and rapper settings were consistent throughout all tests. The boiler generates steam at 3.2 MPa (450 psig) saturated. Auxiliary fuel was not used during any of the tests. The incinerator burning capacity 318 metric tons (350 U.S. tons) per day.

Test No. 1 The first test was scheduled following weeks of operation on the newly improved Unit No. 2. The regular plant operators had received training on the new equipment and overall operation had been monitored by the resident engineer. No specific instructions were given for the test since the purpose of this particular test was twofold:

1. To determine stack emissions using normal everyday operating conditions.
2. To serve as a preliminary test prior to official compliance tests for the State.

The refuse burned during this test was somewhat damper than the material burned in subsequent tests although it was not nearly as wet as typical spring weekend refuse.

Burnout was excellent based on visual inspection. The bulk of the combustion took place on grate 2, with final burnout essentially completed on grate 3. Grate 4 was virtually free of combustion during most of the test. It was obvious that a great deal of excess air entered the furnace through grate section 4. It should be noted that although air could be controlled to each undergrate section, air, once admitted, could migrate from one undergrate section to another. This problem is being alleviated in an improvement phase presently underway.

The overfire air system was operated so that some air was introduced through all nozzles but none of the air was at high velocity. Thus, the overfire air was not used effectively.

Test 2 Since Test 1 did not indicate compliance with contractual requirements, the second test was also scheduled as a preliminary test.

Steps were taken to improve combustion and reduce emissions. Charging rate was held to the rated design. Overfire air was limited to high velocity jets in the lower side walls. Although less overfire air was used, flame intensity was greater and combustion generally appeared to be better.

The combustion bed on the grates was generally the same as for Test 1 with a significant amount of excess air passing grate 4.

The refuse burned during the test was the driest of the three tests.

Test 3 Two of the three runs in Test 2 were essentially in compliance with contractual requirements. Therefore an official compliance test was scheduled.

During the test the active combustion zone was spread over grates 2 and 3. Final burnout took place on grate 4. As in the other tests, burnout was excellent.

Charging rate was controlled to maintain a good bed on the grates rather than to maintain a fixed firing rate.

Comparison of Results

Figures 2 through 7 compare results for the three tests.

Figure 2 The relative moisture content of the refuse on the test days is reflected in the average weight per charging crane bucket.

Figure 3 For Test 1, when the regular operating personnel were left to their own devices, the unit was charged at 115% of rated load. For Test 3, when charging was controlled to combustion bed appearance, the unit was charged at 110% of rated load.

Figure 4 CO_2 percent increased when grate 4 was effectively utilized in Test 3.

Figure 5 Furnace exit temperatures increased as better control was established for overfire air and as CO_2 was increased. It should be noted that temperature is recorded at the entrance to the boiler bank after combustion is complete and after 478 - 533 K (400-500 F) of gas temperature is absorebed in the watercooled furnace walls.

Figure 6 The actual volume of stack gas at 589 K (600 F) per unit mass of refuse varies to reflect the percent CO_2 in the gas.

Figure 7 Careful observation and control of combustion conditions resulted in a major reduction in stack emissions. The dashed line towards the top of the figure is the allowable emission rate permitted by NYSCRR Part 222 for the rated load. The wavy line is an approximation of the emission rate equivalent to the Federal standard of 0.184 g/m^3 (0.08 gr/dscf) corrected to 12% CO_2 (A direct correlation can only be made for a specific refuse analysis). The dashed line across Test 2 is the average of the best two runs. It is worth noting that the third run was 175% of the average of the other two.

Lest these figures mislead some into thinking that experienced observation and control always produce the desired results, Figure 8 is offered. In all three tests, emission performance apparently worsened as the day progressed. Note that all tests began with a unit that had been in 24-hour-per-day operation for at least two days and thus was up to temperature and capacity from the outset. The regular plant operators demonstrated the most consistent performance during Test 1.

Present Operation

The regular operating personnel have adapted to the overfire air procedures used in Test 2 and 3. Combustion bed character varies from shift to shift depending on the stoker operator. It would seem that day to day operation is definitely within the emissions level allowed by NYSCRR Part 222, and it is probably close to the Federal level for new installations. Modifications to the underfire air system are presently underway to further improve combustion and reduce emissions.

■ FIGURE 1. Remodeled furnace boiler unit of the Oceanside incinerator showing the upgraded design with silicon carbide coated waterwalls among other features.

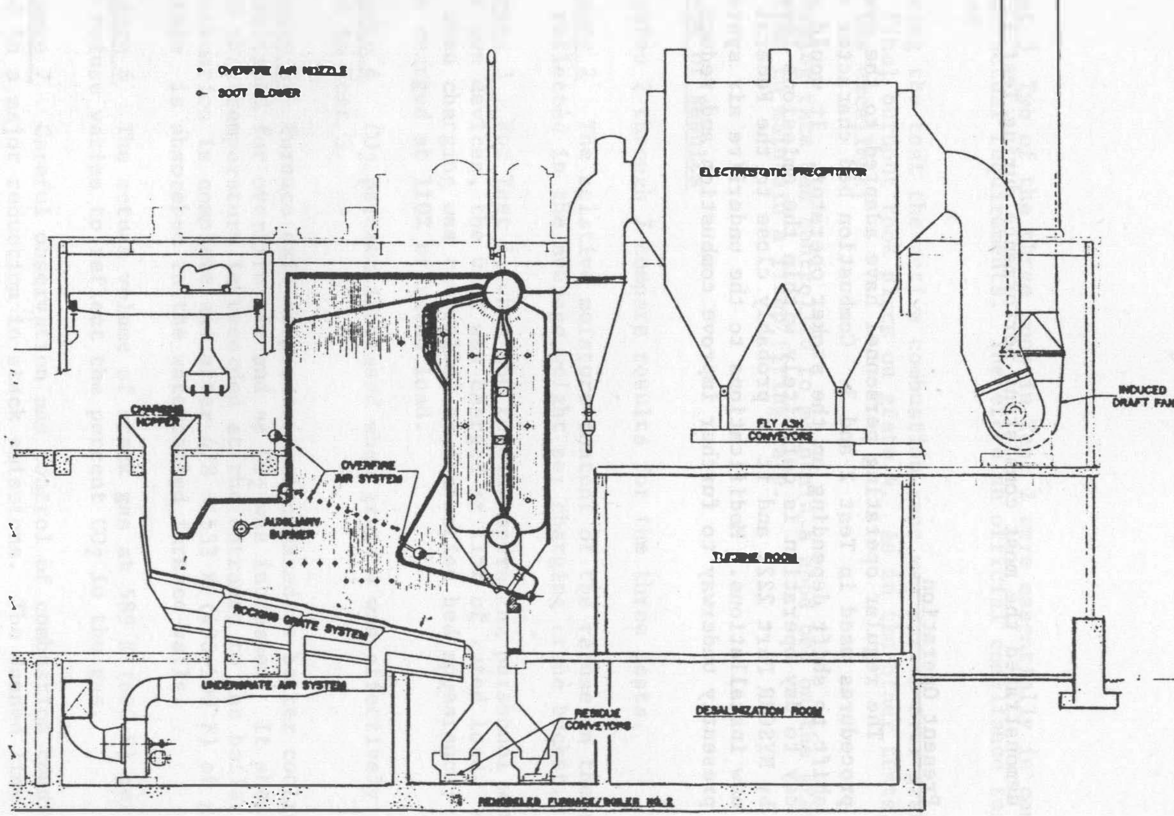
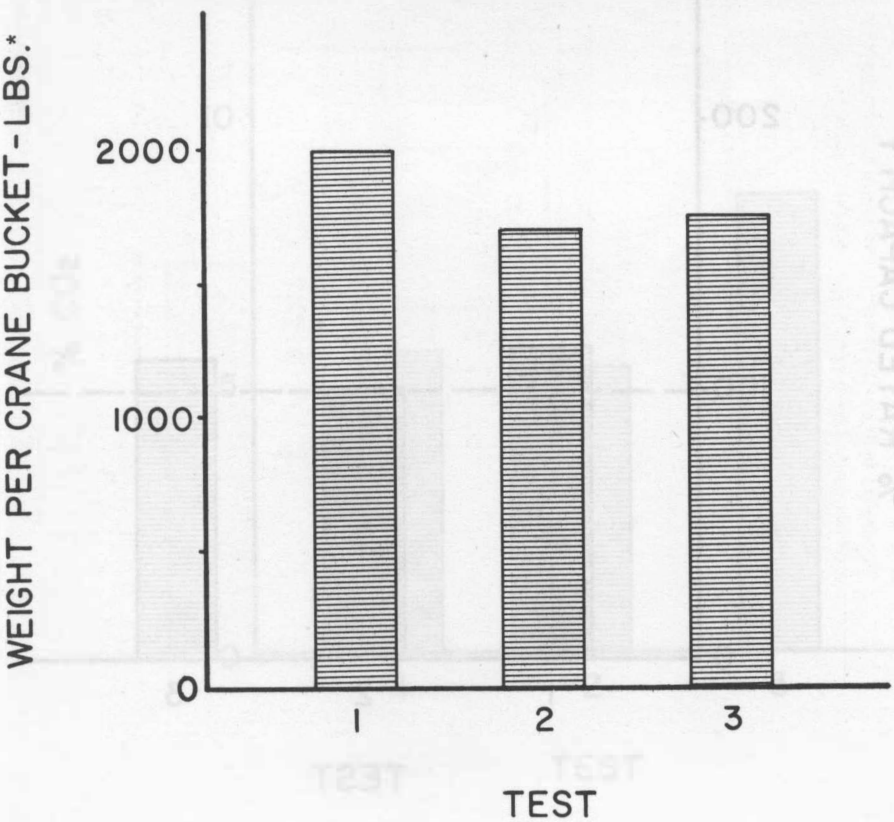


FIGURE 2



*Conversion factor: (lb) = 0.4536 (kg)

FIGURE 3

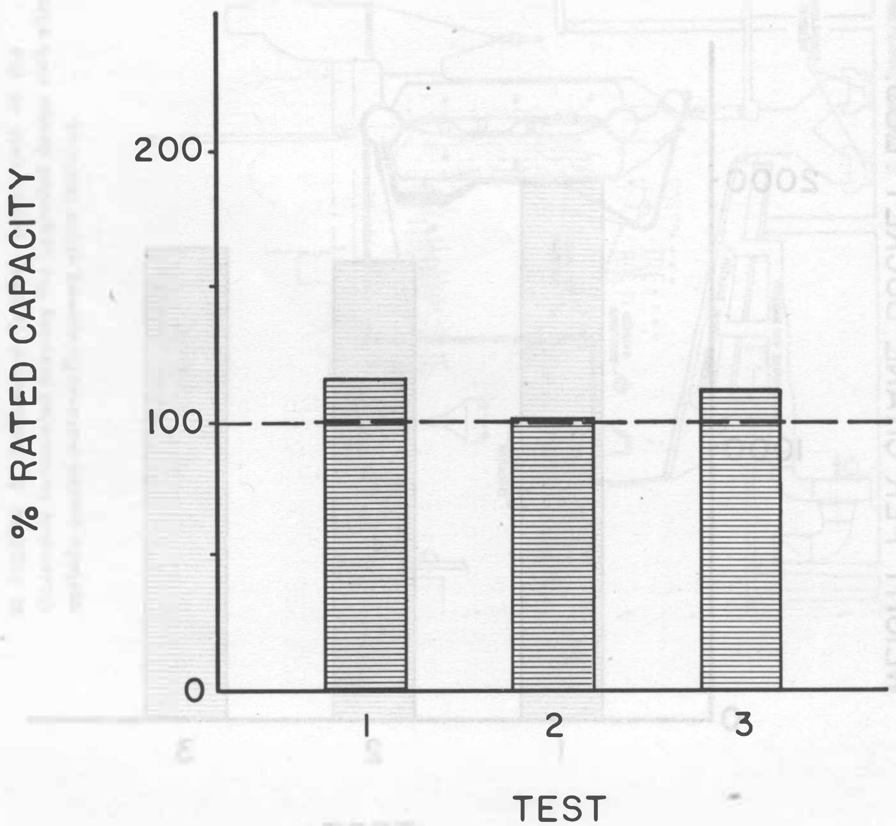


FIGURE 4

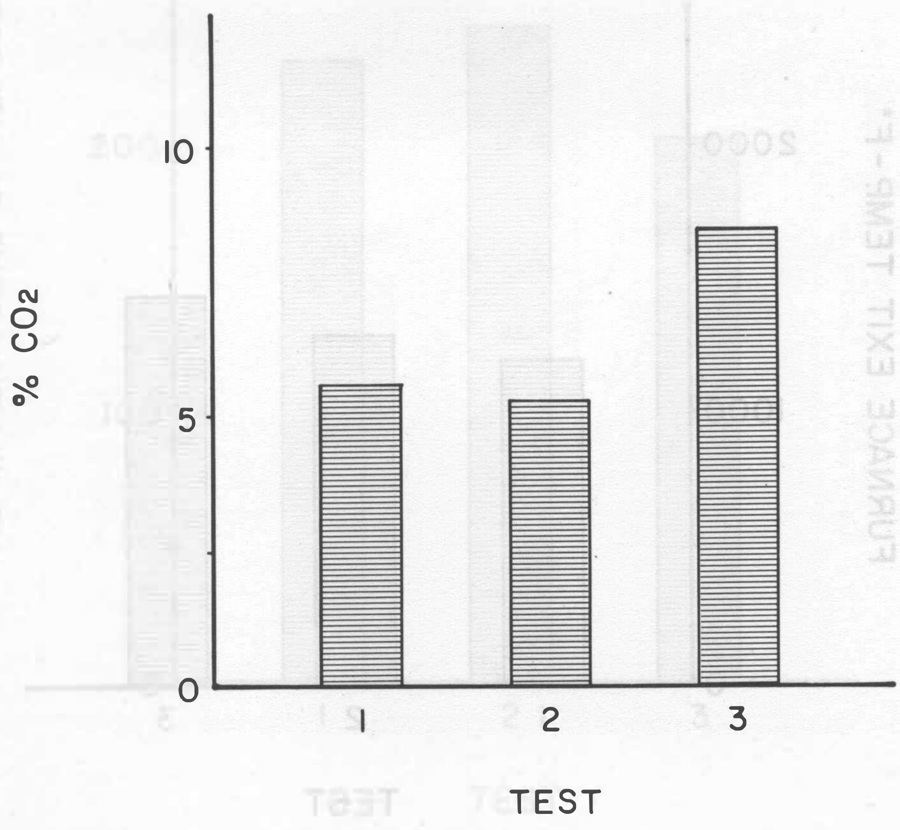
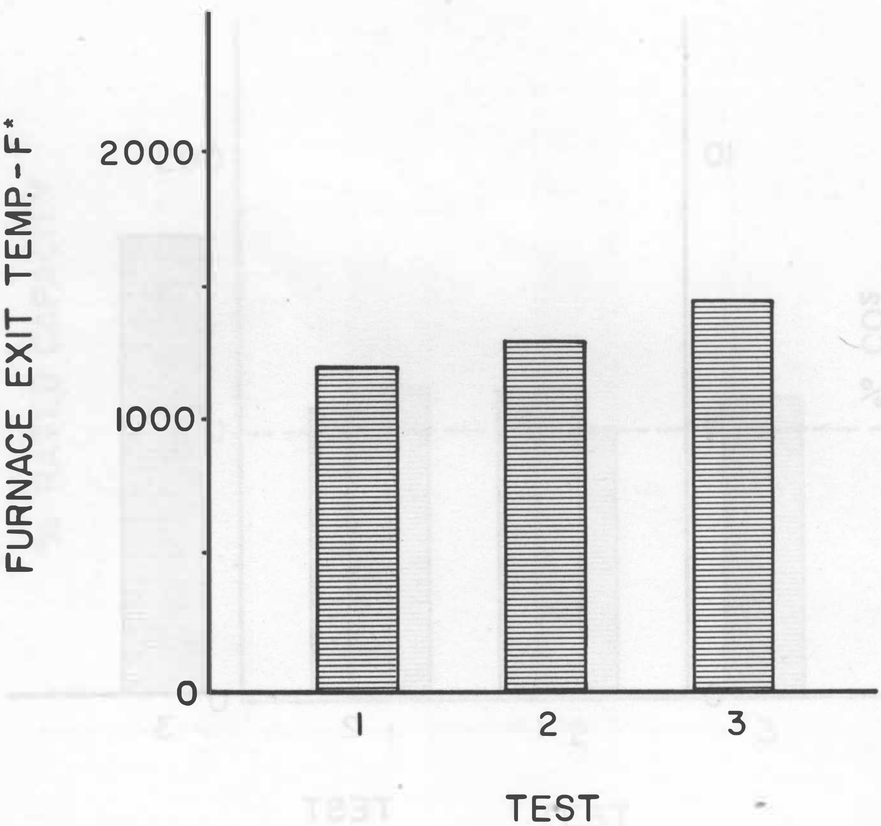
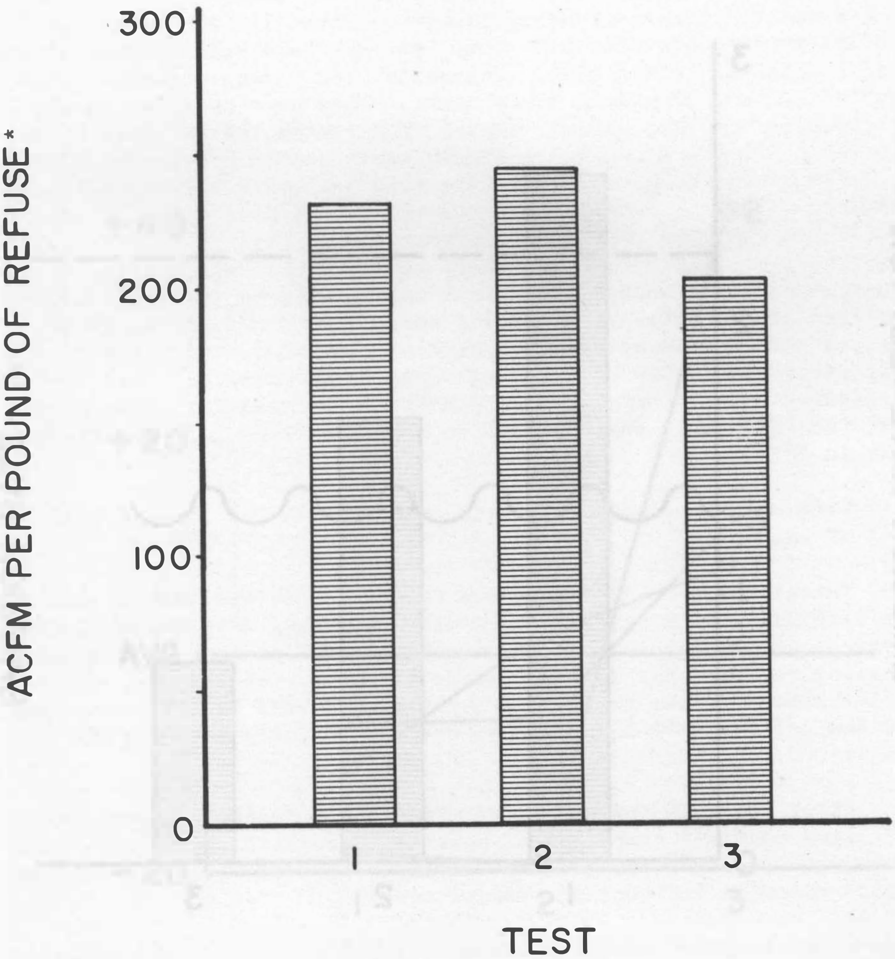


FIGURE 5



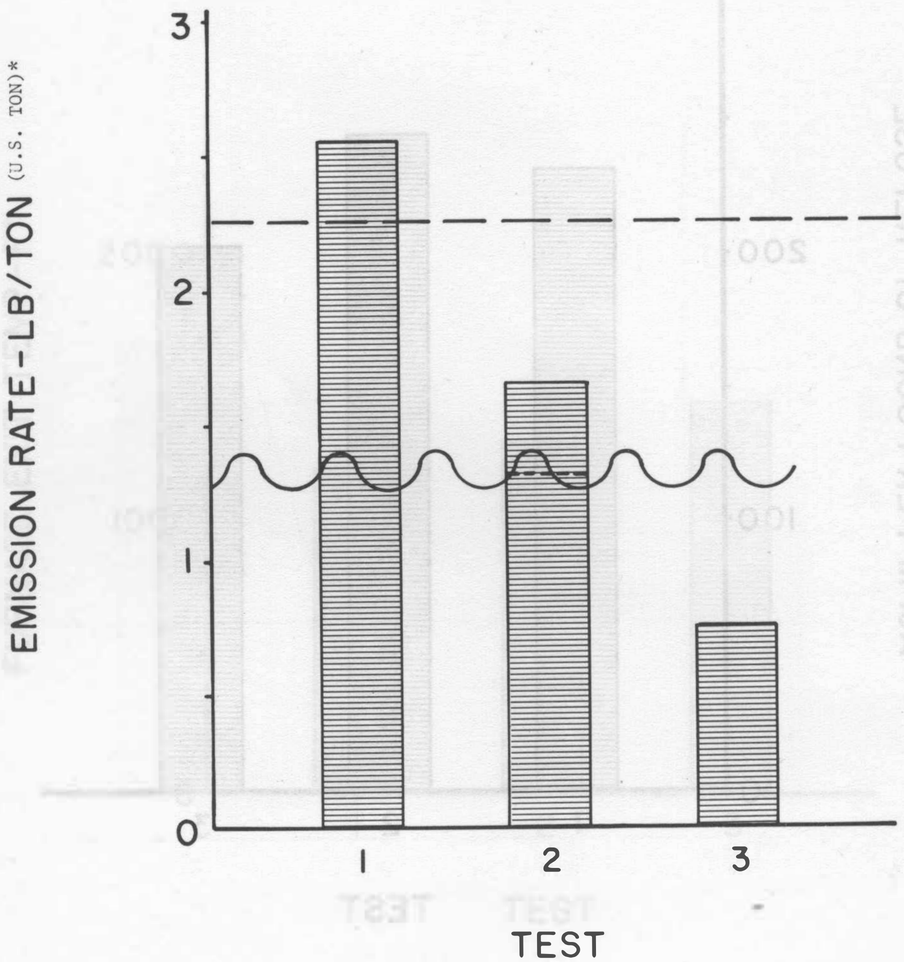
*Conversion factor: (°K) = 5/9(°F - 32) + 273.15

FIGURE 6



*Conversion factor: $\frac{ACFM}{16} = \frac{cm/M}{kg}$

FIGURE 7



*Conversion factor: (U.S. ton) = 0.9071 (metric ton)

FIGURE 8