PROGRESS REPORT NO. 14

KINETICS OF OXIDATION AND QUENCHING OF COMBUSTIBLES IN EXHAUST SYSTEMS OF GASOLINE ENGINES

D. J. PATTERSON

PERIOD: APRIL 1, 1970 to APRIL 30, 1970

April 1970

This project is under the technical supervision of the:

Coordinating Research Council
APRAC-CAPE 8-68 Steering Committee

and is work performed by the:

Department of Mechanical Engineering
The University of Michigan
Ann Arbor, Michigan

Under Contract No. CAPE-8-68(1-68)-CRC
and Contract No. CPA-22-69-61-HEW

LONG-RANGE OBJECTIVES

It is well-known that a significant amount of CO and unburned fuel may be consumed in the exhaust system of gasoline engines. Such combustion phenomena in exhaust reactors may be used to advantage to reduce the emission of these undesirable constituents. This process is the basis of exhaust air injection systems currently installed on some automobiles.

The overall objectives of this three-year research program are:

- To determine the chemical and physical processes which affect the emission characteristics of exhaust reactors installed on selected typical engines operating at various conditions on a dynamometer test stand.
- To identify the chemical species and significant chemical reactions present before, within, and after the reactor.
- To obtain information which will be helpful in predicting the design of the next generation of gasoline engine exhaust reactors.

GENERAL

A contract has not been executed for the second year at this writing. It is hoped that a contract can be negotiated next month.

PHASE I PROGRESS

Analysis of baseline data on the 350 CID has revealed some inconsistencies in the data. Exhaust air-fuel ratio calculated by the method of Spindt does not agree well with measured air-fuel ratios. In some cases deviations of one air-fuel ratio have been noted. Carbon monoxide and oxygen readings appear to

follow consistently the exhaust air-fuel ratio. Before the duPont reactors are installed it is felt that a thorough check of the air-fuel and exhaust gas measuring systems must be made. Some repeat runs are in order which should require only a few days. The duPont reactors will then be installed.

PHASE II PROGRESS

Work involving the applications of the stirred tank reactor model to higher levels of exhaust gas combustibles has continued. The computational difficulties encountered as the conversion of carbon monoxide approached unity have been remedied. Corrections were added to offset the negative extents of reaction. The addition of reverse reactions as suggested in the March report proved unnecessary.

At the present time the stirred tank reactor model does not predict the correct steady state for conversions of 20% or less for the higher levels of exhaust gas combustibles. In particular the resulting temperature is considerably lower than that predicted from the resulting conversions. Efforts are being made to correct this inconsistency.

Finally, steps are being taken to modify an already existing statistical regression program which will analyze the kinetic data obtained from the two-tank experimental reactor.

Work during the following month will continue on the exhaust reactor model for low conversions of combustibles as well as on the regression program.

PHASE III PROGRESS

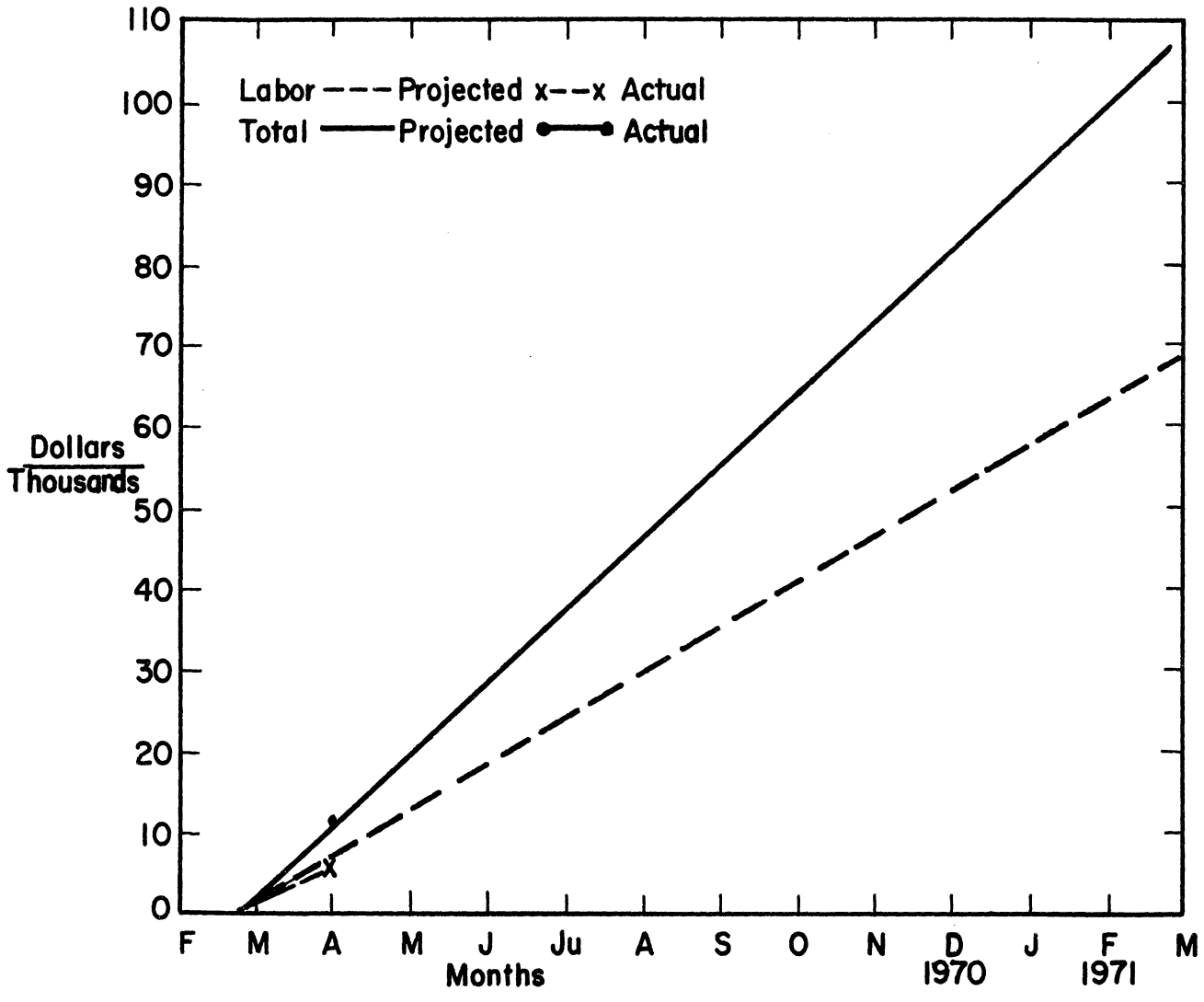
Further work on the gas chromatograph should begin next month following completion of the final examination period. The verification of the subtractive analyzer has top priority.

Some slight modifications have been made to the two-tank reactor system prior to its installation on the single cylinder engine. In particular, a leakage path through which injected air could directly enter the reactor without mixing has been sealed. A back pressure throttled valve has been fabricated. Installation will be completed next month. At this time, a major effort is being devoted to getting the two-tank system operational. This is because kinetic data is needed immediately for the math model. Three of the four students who have been working on the multicylinder engine will devote their time as required to the two-tank reactor. On the average this means a temporary 25% reduction of effort on the multicylinder engine, Phase I.

Good progress has been made on the laser-schlieren system for measuring exhaust temperature and velocity. The equipment is all installed. Some poor quality photographs have been obtained. Next a better alignment of the optical system will be made and a technique developed to synchronize the drum camera with the engine cycle events.

CRC CAPE 8-68 PROGRAM
OVERALL FINANCIAL SUMMARY

Program Total: February 24, 1970 - February 23, 1971	$106,500
Cumulative Expenditures through March, 1970	10,664
Balance	$ 95,836



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