CHAPTER X

Magnitude of the Aviation Fuel Manufacturing Problem

THE foregoing discussion may seem to have unduly emphasized the problem of manufacturing aviation fuels. In this connection it should be borne in mind that fuel manufacturing methods have been equally as important as both discovery of fuel properties and engine development in the whole program of fuel-engine development.

FUEL PRODUCTION

From Pearl Harbor until V-J Day the United Nations produced about 19 billion gallons (about 60 million tons) of Grade 100/130 and the approximate cost of this amount at the refineries was three billion dollars (a gallon might cost a great deal more than a dollar by the time it was transported to an inaccessible spot in the jungle or flown over the Hump to a base in China).

Expansion of manufacturing facilities for aviation fuel in the United States from June, 1940, to V-J Day cost nearly a billion dollars and of this the oil industry provided about 75% from its own funds, only about 25% being financed by the Defense Plant Corporation.[1]

Besides the production of about 19 billion gallons of Grade 100/130, considerable quantities of 76, 68, and 50 PN grades were produced for various types of training and for ground testing of new and overhauled engines.

CONFLICTS AMONG THE INTERESTED GROUPS

Grade 100/130 manufactured during the war was the cause of conflict between some of the engine manufacturers and

[1] U. S. Petroleum Administration for War, *A History of the Petroleum Administration for War, 1941-1945* (Washington, Government Printing Office, 1946), p. 463.

PAW. PAW controlled the oil industry, was mostly staffed with oil industry personnel, and understood the oil industry better than it did any other industry. It was charged with the very difficult job of producing steadily increasing quantities of petroleum products and of controlling quality. PAW could do nothing to aviation fuel quality without the sanction of the Army and the Navy and both were extremely performance conscious. However, both the Army and the Navy had to permit degradation of quality as a means of increasing supply. The conflict over aromatics, which has already been discussed, involved combat and operating units of the Military Services as well as the engine manufacturers. There was also conflict over the matter of volatility, and reduction of volatility during the war years appears to constitute the most serious degradation of quality which was permitted.

Volatility v. Supply

Before the war, Army and Navy specifications had required that 90% of the fuel (hereafter 90% point) should be distilled at a temperature not exceeding 275° F. Commercial fuel specifications permitted a 90% point of 257° F maximum. One hundred PN fuel supplied to the engine manufacturers for engine development and for production engine testing before 1941 had a 90% point not exceeding 245° F. The great majority of the 100 PN fuel supplied to the Military Services before Pearl Harbor was of the same volatility as that supplied to the engine manufacturers. Before the war, the engine manufacturers had objected to the 275° F 90% point in the military specifications and had demanded that it be changed to conform to the commercial specifications, but the Army and Navy refused on the grounds of potential supply. The Army and the Navy were on somewhat weak ground in permitting engines to be developed on a fuel superior to their specifications, but it is improbable that they could have promoted general supply of fuel with a 90% point close to 270° F, although one refiner was supplying such fuel to the Services and declared that reduction of the 90% point would sharply curtail his possible output. The Army had previously faced a similar problem with 68 PN which was permitted to contain 6 cc lead but which could be

and was being freely supplied with as little as 2 cc. The Army solved this problem by requiring that fuel used in type tests must contain 4 cc lead and must not exceed 70 PN.

With the advent of war and the requiring of a rich PN of 130 which resulted in increased use of cat cracked gasoline, the 90% point began to crowd 275° F. Use of cumene aggravated this situation and the 90% point was raised to 284° F for a time; further increase to 293° F was discussed. The British maintained that their engines operated just as well on a fuel of 300° F 90% point as on lower 90% point fuel.

The volatility conflict was unfortunate and the three interests concerned all were partly at fault. The engine manufacturer was being pushed for increased performance on what he regarded as an inferior fuel. He was glad to have controlled and increased rich mixture performance but did not want this accompanied by any disadvantages. Some engine manufacturers were demanding return to a non-aromatic fuel with a 257° F maximum 90% point and were deaf to suggestions that the available steel supply did not permit it. The Military Services had not taken all possible prewar steps to ensure that engines were developed on fuel which was marginal to the specifications (i.e., the lowest quality which would meet the specifications). Even before issuance of commercial specifications the oil industry had supplied 100 PN fuel with a 90% point of 245° F and 76 PN fuel with a 90% point of as low as 225° F to the engine manufacturers with the realization that it was being used for engine development. These fuels were supplied since they were then the most convenient and the lowest cost products for the oil industry.

After the issue of the commercial specifications which were adopted by the engine companies (in fact, written at their behest), the oil companies had good reason to adhere to these specifications since they could not be expected to produce and stock two grades for each PN. However, having educated the engine companies to the use of 100 PN fuel with 245° F 90% point, some sections of the oil industry were unable to understand why the 90% point should not be increased to 300° F to suit their convenience and regarded members of the engine industry as reactionary obstructionists for objecting. Some members of the oil industry loaned to PAW took the attitude

that anything not directly forbidden by the specification should be included in aviation fuel if it would increase supply. This view was supported even if it was known to its proponents that the addition would have very deleterious effects on engine performance. As the war progressed most PAW and oil industry personnel changed their views and became very conscious of the importance of engine performance.

The conflict between the engine and the oil industries in regard to quality was due to the fact that, in general, neither industry understood the other's problems. The engine industry knew nothing about the complexities of manufacturing high PN fuels. It bluntly told the oil industry what it wanted but did not presume to tell the oil industry how to manufacture it. The oil industry, on the other hand, knew almost nothing about the difficulties involved in design, development, and production of high performance aircraft engines. Nevertheless, some of the younger technical men of the oil industry were prone to advise the engine industry in respect to redesign of engines for better performance and particularly so in respect to better performance on some product which the self-appointed advisor was trying to sell.

The conflict in viewpoint between the engine and oil industries at times became acrimonious as a result of extremists on both sides. In the main, however, the controversy was good natured and accompanied by pleasant jeers. The necessary compromises were, in general, the best solutions to the difficult problem of balance between quality and quantity. The wartime solutions to the problems were, in general, highly creditable to the oil and engine industries and to the Armed Services. The oil and engine industries for the most part adjusted their products to meet the emergency possibilities of the two industries. PAW, the Armed Services of the United States, and the corresponding cooperating British authorities all contributed common sense (first and most important), highly skilled professional personnel, and diplomacy to the joint engine-fuel development and supply problem. While the result was not perfect, science, technology, industry, and government all contributed to a result which was a credit to the democratic system.