more than 42 per cent of the cracked oil. The results of the analyses are shown in Table 26.

TABLE 26.—*Results of analyses of cracked petroleum for benzene and toluene from tests performed independently in various laboratories.*

Analysis No.	Cracked oil.		Distillation cut.	
	Benzene.	Toluene.	Benzene.	Toluene.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
1	10.50	11.50	29.00	26.25
2	11.68	11.33	23.20	26.20
3	.....	.....	39.91	23.55
4	9.60	6.60	30.20	24.80
5	13.00	10.70	26.20	23.80
Average	11.19	10.03	29.70	24.92

COMMENTS ON ANALYSES.

Analysis 1.—The method employed was distillation, followed by deolefinization and redistillation with subsequent determination of aromatics by the sulphonation method. The results show one slight discrepancy in that they do not indicate the same ratio of benzene and toluene in the cracked oil and in the derived distillation cut.

Analysis 2.—The oils were distilled and redistilled, efficient fractionating columns being used, and subsequent determinations were made by both sulphonation and nitration methods. The latter were given the preference. Results were submitted with the statement that they were probably 1 to 2 per cent too high. Here again there is a discrepancy between the results for cracked oil and those for the distillation cut, and it is in the opposite direction to that noted in analysis 1. The results of both analyses 1 and 2 were probably as reliable as could be obtained by laboratories working in ignorance of the exact conditions under which the cracked oil had been produced and distilled.

Analysis 3.—The analysis was made with a single separation by distillation followed by duplicate determinations by the methods of sulphonation and freezing. The figure for toluene is near to that obtained by other laboratories. That for benzene is high, probably because reliance was placed on the results of the method of freezing.

Analysis 4.—The results were submitted without statement as to the method employed. The results are in general low, indicating a reliance on purely chemical methods.

Analysis 5.—The analysis was made by the method of distillation and specific gravity indicated above. The results are similar to those of analyses 1 and 2, but have the advantage of agreeing as to the ratio of benzene and toluene in the cracked oil and in the distillation cut.

CONCLUSIONS.

The following conclusions are based on the results obtained in this series of experiments which were performed with the degree of care and accuracy generally feasible in commercial laboratories:

Solubility methods for the separation and determination of aromatic compounds in cracked petroleum do not seem to be satisfactory.

Results approximating those of the best chemical methods may be obtained by the method of separating aromatic hydrocarbons with

three successive distillations and determining by specific gravity relations their percentage in distillation cuts.

The method of procedure that has seemed most satisfactory on the basis of present experience is as follows:

Seven hundred grams of cracked oil is distilled from a 1-liter distilling flask through a fractionating column whose efficiency is at least as great as that of a 5-inch Hempel column of aluminum beads. Two successive redistillations are conducted, likewise with efficient fractionating columns. For these a 200-gram part of the cut at 175° C. is taken. For the first redistillation, fractions are separated at temperatures of 105°, 130°, and 160° C. For the second the cuts are made at 95°, 120°, and 150° C.

Specific gravities are then determined by whatever method seems convenient. Measurements should be accurate to about one part in a thousand. The percentage of aromatic hydrocarbons is then calculated from these values on the basis of the following gravity relations in the various cuts:

Temperature of cut.	Specific gravity of aromatic hydrocarbon.	Specific gravity of nonaromatic hydrocarbon.
95° C.	0.880	0.720
120° C.	.871	.730
150° C.	.869	.760

The one assumption on which this method is based is the gravity value assigned to the nonaromatic constituents of each distillation cut, but this value need not be known with great accuracy. With present knowledge of the character of the cracking process, it is desirable occasionally to use chemical methods of determination for verifying results obtained on the basis of these specific gravities.

PRESENT APPLICATION OF SPECIFIC GRAVITY METHOD OF DETERMINING AROMATIC HYDROCARBONS.

For the products obtained in the laboratory runs with the small experimental furnace, the yields of recovered oil were too small to permit elaborate fractionation. Consequently, a simpler method was adopted, as follows:

The distillation cuts of the cracked or recovered oils up to 150° C. contain a mixture of the three aromatic hydrocarbons, benzene, toluene, and xylene, whose specific gravities are approximately equal. An average value of 0.875 represents them with sufficient accuracy. For the specific gravities of nonaromatic constituents found in the 150° C. distillation cut, use was made of figures obtained under identical conditions in another series of experiments for the determination of physical constants of crude petroleum and products from various fields. Following are the average specific gravities of 150° C. distillation cuts from the original oils designated: