

A COMPARISON OF THE CHEMICAL CHARACTERISTICS OF CRUDE OILS PRODUCED IN THE OLD AND NEW ILLINOIS FIELDS

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Through the discovery and development of new fields, the annual production of crude oil in Illinois has increased rapidly in the last few years until it now approaches the 1908 peak of 33,000,000 barrels, with the result that Illinois now ranks fifth as a major producer. Because of this increased activity, it will be of interest to compare some of the chemical characteristics of the new crudes with those obtained from the older fields.

The comparisons presented herein are based on analyses made in the University of Illinois analytical laboratory and the State Geological Survey laboratories. For the most part these analyses were made according to standard procedures of the American Society for Testing materials¹ and the U. S. Bureau of Mines.² Due to incomplete analyses particularly in regard to the crudes from older fields, it has been necessary to estimate some of the characteristics of the oils. In making these estimations the characterization factor developed by members of the staff of the Universal Oil Products Company⁴ has been employed wherever it was possible. Although this method is not to be considered infallible, it provides a very satisfactory means of obtaining some of these characteristics for purposes of approximate comparison. In conjunction with the "characterization factor" it has been necessary to obtain approximate average boiling points of some of the crudes from true boiling point curves of typical Mid-Continent crudes based on yields of 410-425° F. end point gasoline according to Nelson.³

It may be of interest to discuss briefly the "characterization factor." Mathematically, it is defined as the ratio between the cube root of the average boiling point and specific gravity at 60° F. Its utility lies in the fact that it serves as a means of evaluating the properties of an oil from a minimum of analytical data. For example, by determining specific gravity at 60° F. and viscosity

at 100° F. we may estimate the average boiling point, average molecular weight, and the nature of the base of the crude. Numerically, a "characterization factor" value of 12.5-13.0 indicates a paraffin base oil, while values of 10 or below indicate an aromatic or naphthenic base. Intermediate values between 10 and 12 correspond to mixed bases.

Members of the staff of Universal Oil Products Company^{4, 5, 6} have correlated kinematic viscosity and gravity data with "characterization factors" and cubic average boiling points. The latter is defined as the cube of the summation of the product of the cube root of the average boiling point of each fraction constituting the crude and the volume per cent. In addition, they have correlated A.P.I. gravity and average molecular weights with characterization factors and with the mean average boiling point, which is the arithmetic mean between the cubic average boiling point of the oil and molal average boiling point. All these boiling points are determined from the volumetric average boiling point by adding a correction factor which is a function of the slope of the true boiling point curve from an Engler distillation.

There are no viscosities or true boiling point curves available on oils from the old fields. However, gravities, gasoline, kerosene, and fuel oil yields are available. From data obtained from Nelson³ it was possible to plot a series of true boiling-point curves corresponding to various gasoline yields of the crudes. By graphical integration, volumetric average boiling points were obtained. In this manner the necessary characteristics were determined for evaluating the crudes. The method was checked on new field crudes where viscosity-gravity data were available and it was found to give satisfactory results (table 1).

Another factor influencing the estimated and actual results obtained from old field data is sampling. In cases where ab-

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TABLE 1—SUMMARY COMPARISON OF CHEMICAL CHARACTERISTICS OF CRUDES FROM OLD AND NEW FIELDS

	Old		New	
	Range	Average	Range	Average
A. P. I. Gravity	28.7-40.3	33.5	33.8-46.9	38.3
Kinematic Viscosity (Centistokes)	3.9-13.3	6.6	4.1-7.4	5.0
Viscosity (Saybolt seconds)	39-71	47.5	40-50	42.5
Gasoline Yield—per cent (425° F.—end point)	16.5-40.3	26.8	24.7-38.5	33.1
Volumetric Average Boiling Point °F	586-172	657	606-676	638
Cubic Average Boiling Point °F	546-672	617	566-656	598
Characterization Factor	11.79-12.24	11.94	11.9-12.9	12.22
Average Molecular Weight	187-243	219	200-240	216
Sulfur Per Cent	0.15-0.35	0.24	0.18-0.40	0.32

normally low gasoline yields were obtained along with correspondingly low A.P.I. gravities and high viscosities, there is reason to believe that a fresh sample was not taken. The crude was apparently taken from a reservoir in which it had been standing for some time instead of from a flowing well. However, where a sufficient number of samples have been taken in any one locality the effect of this factor is immediately apparent and the sample is not considered to be representative of that locality.

Results.—Data for samples produced in old fields located in Clark, Crawford, Jackson and Wabash counties show crudes ranging in A.P.I. gravities from 28.7 to 40.3, Saybolt viscosities from 39 to 74, gasoline yields from 16.8 to 41.6 per cent, volumetric average boiling points from 580° F. to 707° F. and average molecular weights ranging from 190 to 265 (table 1).

Data for samples from new developments show crudes ranging in A.P.I. gravities from 33.8 to 46.9, Saybolt viscosities from 41 to 50, gasoline yields from 29.2 to 38.2 per cent, volumetric average boiling points from 593° F. to 660° F. and average molecular weights ranging from 200 to 240 (table 1).

If we now compare the characteristics of the crudes from the older and newer fields (table 1) the following general comparisons are apparent.

Crudes from the new fields in general show higher A.P.I. gravity values, lower Saybolt viscosities, higher gasoline yields, lower average volumetric boiling points and lower average molecular weights than those from the older fields. Sulfur values for the newer oils, on the basis of the few values available, appear to be somewhat higher, in general, than those for the oils from the older fields. Characterization factors for the crudes of the new fields are appreciably higher, indicating that these oils are more paraffinic than those from the older productions.

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