MODIFIED FORMULAS AND NOMOGRAM FOR DETERMINING CORRELATION INDEX OF CARBON-BLACK RAW MATERIAL

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For rating the degree of aromatization of hydrocarbon fractions, ever-increasing use is being made of the correlation index proposed by Smith [1]; this is a certain function of density and average boiling point of the product (sometimes the 50% point is used instead of the average boiling point).

Currently, in the petrochemical industry, the correlation index is used to rate the quality of feedstocks for carbon-black production. The higher the correlation index of the feedstock, the better it is considered to be in quality [2]. The correlation index is determined from Eq. (1)

$$\text{C.I.} = 473.7\rho_{15,6}^{15,6} - 456.8 + \frac{48\,640}{K}, \quad (1)$$

where $\rho_{15.6}^{15.6}$ is the relative density; K is the mean boiling point of the cut, °K.

In calculating the correlation index from Eq. (1), rather complex conversions are required. The usual method of converting the density ρ_4^{20} to $\rho_4^{15.5}$ involves average temperature corrections for the density of the petroleum products. Then the density $\rho_4^{15.6}$ is converted to density $\rho_{15.6}^{15.6}$. Since accurate corrections for converting the density from ρ_4^{20} to $\rho_4^{15.6}$ are not available for all hydrocarbons or cuts, errors will be introduced into the calculation of correlation index.

We are proposing to modify Eq. (1) so that the density value appearing in the formula will be ρ_4^{20}.

Smith, in calculating his formula, adopted a value of 100 for the correlation index of benzene, and a value of 0 for the correlation index of n-octane and n-hexane. For these hydrocarbons, a system consisting of three equations was set up:

$$\text{C.I.} = \rho_4^{20}iA - B + C/K_i. \quad (2)$$

Values of the density ρ_4^{20} and the boiling point K were taken from the data of [3]. After solving the system of equations, Eq. (1) for calculating the correlation index acquired the form

$$\text{C.I.} = 476.8\rho_4^{20} - 460.6 + \frac{49\,970}{K}. \quad (3)$$

The differences in numerical values in Eqs. (3) and (1) confirm the fact that, for various hydrocarbons, the difference $\rho_{15.6}^{15.6} - \rho_4^{20}$ depends not only on the density, but also on the boiling point of the hydrocarbon.

Equation (3) in S.I. units acquires the following form:

$$\text{C.I.} = 0.4768\rho_{20} - 460.6 + \frac{49\,970}{K}, \quad (4)$$

where ρ_{20} is the density at 20°C expressed in kg/m^3.

Values calculated for the correlation index by Eqs. (1) and (3) are listed in Table 1. It will be noted that the values do not differ by more than 0.2%, this error probably being due to the use of universal corrections in converting the densities.

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TABLE 1. Values of Correlation Index Calculated from Different Formulas

Hydrocarbon cuts	Average boiling point, °C	ρ_4^{20}	$\rho_{15,6}^{15,6}$	Correlation index calc. by		
				Eq. (1)	Eq. (3)	difference in value
Green oil* (150-360°C cut)	267	0,987	0,990	102,3	102,5	+0,2
Thermal gas oil 200-480°C cut	366	0,998	1,001	93,5	93,4	—0,1
200-460°C cut	366	0,980	0,983	85,6	85,6	0

*Aromatic distillate from naphtha pyrolysis tar – Translator.

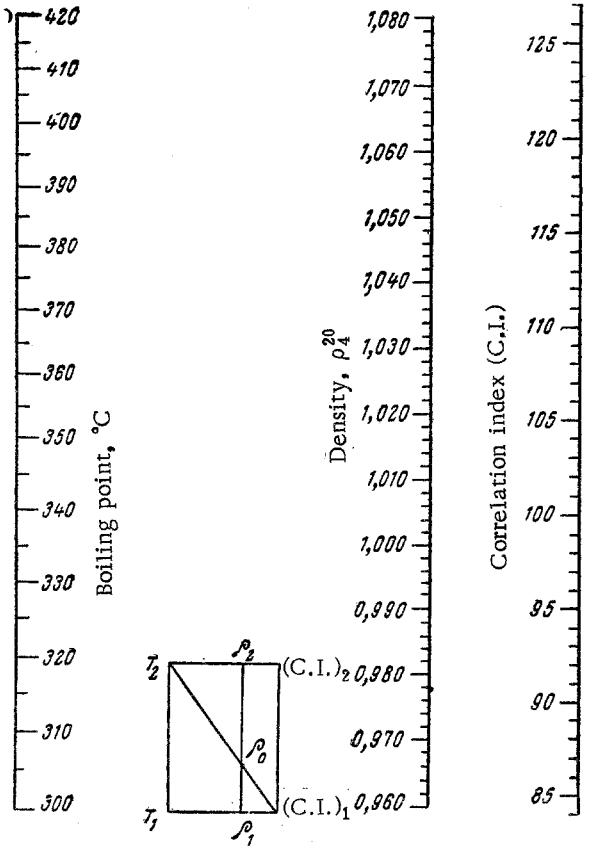

Fig. 1. Monogram for determining correlation index.

Equation (3) was used to construct a nomogram by which the correlation index can be determined rapidly from the density ρ_4^{20} and the average boiling point (Fig. 1).

If it is necessary to construct a nomogram for other ranges of variation in density and boiling point of the cuts, Eq. (3) is first used to find the correlation index $(C.I.)_1$ corresponding to the selected values T_1 and ρ_1, and analogously the value $(C.I.)_2$. Then, using the values T_2 and $(C.I.)_1$, the value ρ_0 is determined; and the distance from the temperature scale to the density scale $T_2\rho_2$ is calculated from the equation

$$T_2\rho_2 = T_2\,(C.I.)_2\,\frac{(\rho_1^{20})_2 - (\rho_1^{20})_0}{(\rho_4^{20})_2 - (\rho_4^{20})_1}.$$

LITERATURE CITED

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3. Handbook of Chemistry [in Russian], 2nd Ed., Goskhimizdat, Moscow (1963).