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FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA

TEGNIESE MEMORANDUM NO. 36 OF 1974
TECHNICAL

THE DETERMINATION OF THE MEAN MOLECULAR MASS OF PETROL

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OPSOMMING

'n Gas-chromatografiese tegniek en 'n metode wat op die vriespuntverlaging van oplosmiddels deur opgeloste stowwe berus, is gebruik om 'n gemiddelde waarde van die molekulêre massa van petrol te bepaal.

Die resultate wat met die twee metodes verkry is, stem binne die perke van die eksperimentele foute met mekaar ooreen.

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INTRODUCTION

In investigations concerned with the reduction of exhaust smoke of diesel engines, it was required to calculate the volume of a given mass of petrol* at high temperatures. Assuming that the petrol at elevated temperature (approximately 500°C) behaves like an ideal gas, the volume can be calculated if the mean molecular mass is known.

Two different methods were used to determine the mean molecular mass of the petrol, viz. (i) Gas chromatography and (ii) Freezing Point Depression.

(i) GAS CHROMATOGRAPHY

A simulated micro distillation curve of the petrol was obtained, using an OV-1 column. With the aid of a similar curve of a mixture of normal hydrocarbons, the peaks in the curve of the petrol were divided into groups of compounds having the same number of carbon atoms per molecule. From the integrated values obtained for each peak area of the gas chromatogram, the relative amounts of each group were calculated.

By taking the molecular mass of each group to be equal to the molecular mass of the normal hydrocarbon with the same number of carbon atoms per molecule, the mean molecular mass of the petrol could be calculated.

The results are shown in table 1. The mean molecular mass obtained in this way was 100 mass units.

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*The effect of certain concentrations of petrol blended with dieseline was used in one series of tests.

/Table 1 .....

TABLE 1

THE CONSTITUENT GROUPS OF COMPOUNDS OF PETROL

Number of carbon atoms per molecule	Percentage	Molecular mass	Percentage x molecular mass
4	4,2	58	243,6
5	21,0	72	1512,0
6	23,4	86	2012,4
7	14,7	100	1470,0
8	15,6	114	1778,4
9	9,3	128	1190,4
10	7,3	142	1036,6
11	3,2	156	499,2
12	0,9	170	153,0
13	0,3	184	55,2
14	0,1	198	19,8
		Total	9970,6

Mean molecular mass = $\frac{9970,6}{100}$ = 99,7

(ii) FREEZING POINT DEPRESSION

When a substance is dissolved in a solvent, the freezing point of the solvent is lowered by an amount which is related to the molecular mass of the substance.

The molecular mass can be calculated with the following equation:

$$M = 1000\ Kf \frac{g}{G.AT} \qquad \text{---------- 1}$$

where

M = molecular mass of the solute,

Kf = molal freezing point constant of the solvent,

g = mass of the solute

G = mass of the solvent and

AT = freezing point depression of the solvent in degrees centigrade.

/The .....

The concentration of the petrol was plotted agains the calcu= lated value of the mean molecular mass. The correct value of the mean molecular mass is obtained by extrapolating the curve to zero petrol concentration and reading off the value of the mean molecular mass at that point. This was found to be 106, which compares well with the value of 100 arrived at with the gas chromatographic analysis.

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Pretoria
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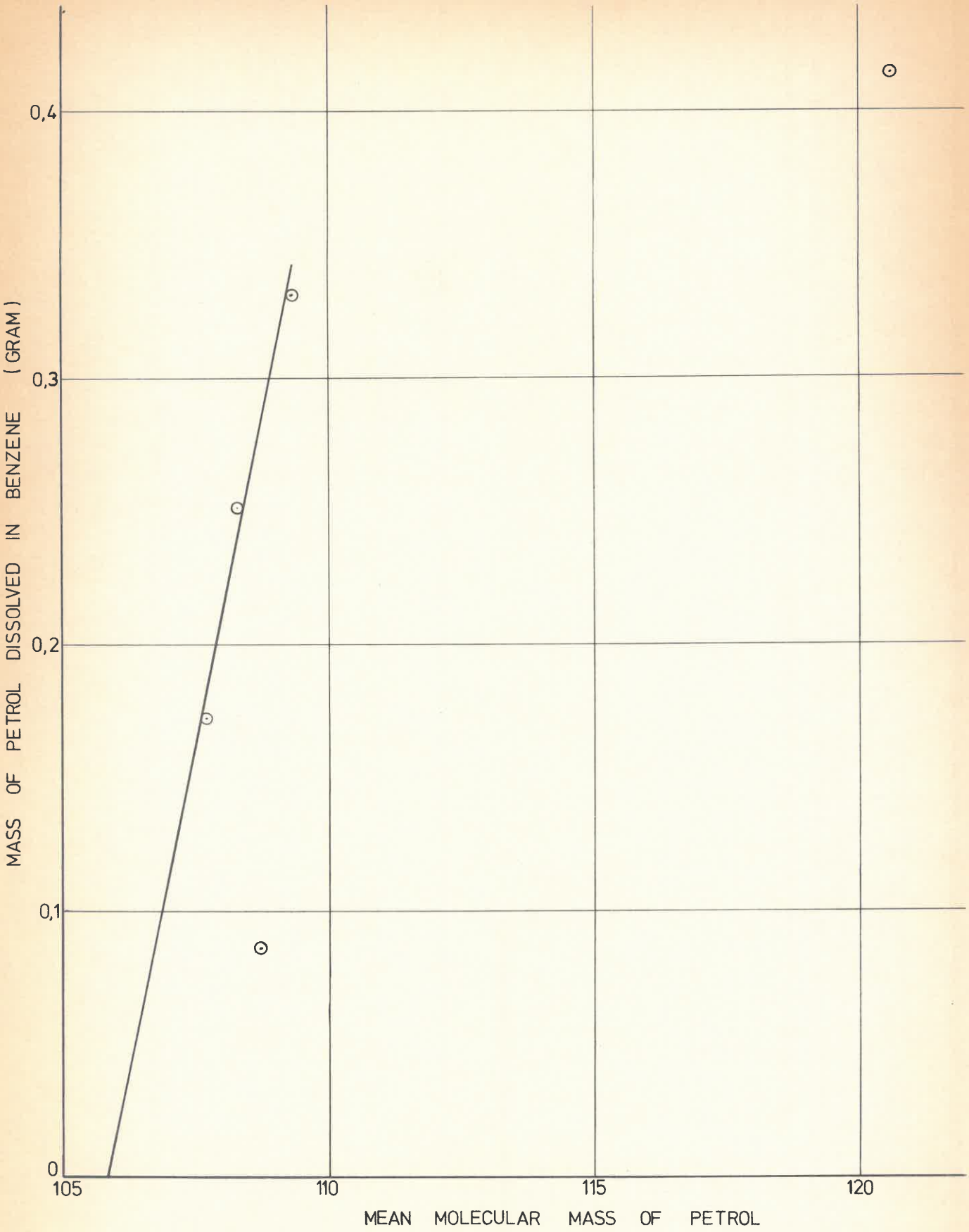

THE RELATION BETWEEN THE CONCENTRATION OF PETROL IN BENZENE AND THE MEAN MOLECULAR MASS OF THE PETROL CALCULATED FROM THE FREEZING POINT DEPRESSION OF THE BENZENE.