is kept constant, the amount of fuel dissolved in the crank-case increases rapidly at first, and then the curve gradually flattens off and approaches a fairly constant degree of dilution characteristic of the particular set of conditions. This behavior can only be explained on the assumption that a point is eventually reached where the rate at which fuel is dissolving in the oil is just balanced by its rate of reëvaporation. Different oils probably differ little in the rate at which they absorb fuel initially, but they would certainly be expected to differ in the amount they take up before the partial pressure of the dissolved fuel is sufficient for it to reëvaporate at the rate necessary to prevent further dilution.

The foregoing results show that for given engine conditions the amount of dilution will depend upon (a) the boiling point of the less volatile portion of the fuel (probably best measured by the 85 per cent point), (b) the molecular weight of the oil, (c) the magnitude and direction of the deviations from Raoult's law for the combination in question.

Of these the first factor is probably the most important, but for a given gasoline (containing largely paraffin hydrocarbons) an asphalt-base oil, or a vegetable oil, will dissolve somewhat less fuel than a paraffin-base oil of similar viscosity.[10] The difference is, however, not as large as might be expected, because the difference in molecular weight tends to counterbalance the deviations from Raoult's law.

To indicate the order of magnitude of the differences between different oils, it may be stated that if a given set of engine conditions diluted a paraffin-base oil until it contained at equilibrium 15 per cent of high-gasoline ends, under similar conditions an asphalt-base oil of similar viscosity would take up about 11 per cent, and castor oil (of much higher viscosity) also about 11 per cent. A similar difference in dilution could be produced by a difference of 7° to 10° C. in the 85 per cent point of the fuel, or in the temperature of the crank-case oil, so that the differences between different kinds of oil met with in practice are by no means as important as differences likely to be encountered in fuels, and particularly in engine conditions.

To be complete, from this standpoint, the experiments should show whether or not the reduction in viscosity of the different lubricants was a function only of the amount of dilution, or varied considerably with the different kinds of oil and fuel. Unfortunately, however, the available samples of oil were practically exhausted by the vapor pressure measurements, which were more comprehensive than at first contemplated, and only a few preliminary measurements could be made. For the samples tried, it appeared that the per cent dilution was much more important than the character of the diluent or of the kind of oil, provided the latter had the same initial viscosity. For oils which differed in initial viscosity, the per cent change on dilution was, of course, greater the more viscous the oil.

For the oils used in these experiments, 15 per cent dilution with hexane or benzene gave viscosities at 100° F. between 52 and 64 seconds Saybolt.

There seemed to be no simple relationship which would permit accurate calculation of the viscosity of mixtures. Bingham's approximation[11] that fluidities are additive was found to be far from true for these cases, oils containing 15 per cent diluent giving somewhat less than half the fluidity calculated on this assumption.[12]

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[10] In accordance with the observations of Garner as reported by Parish, *J. Am. Soc. Naval Eng.*, **32**, 57 (1920).

[11] "Fluidity and Plasticity," p. 92.

[12] Since the above was written a paper by J. L. Claydon has appeared in *Automotive Industries*, November 23, 1922, which gives some data on the effect of the amount of kerosene on the viscosity of oils. The reduction in viscosity at a given per cent dilution was considerably less than that observed with hexane and benzene, but has been checked up roughly by a few experiments with kerosene.

SOLVENT RECOVERY IN OIL SCRUBBERS—The foregoing data are also useful in calculating approximately the equilibria involved in oil-scrubbing systems for solvent for recovery. Here the desired property is exactly the opposite from that for use in a crank-case, and a paraffin-base oil would be better as an absorbent than an asphalt-base oil of similar viscosity. Better than either would be a fraction of the lowest possible molecular weight consistent with a high enough boiling point to prevent volatilization losses in the scrubber, or contamination of the recovered product if this should be important.

A very recent paper by Cantilo[13] brings out clearly how Raoult's law may be used to calculate quantities of importance in the design of scrubbers. These calculations will be correspondingly more valuable and reliable now that the foregoing data are available as to the deviations from Raoult's law for certain typical cases.

The important case of coal-gas scrubbers for the recovery of aromatic hydrocarbons is discussed in a subsequent article.

THE REMOVAL OF SOLVENT FROM SOLVENT-EXTRACTED OILS—For this purpose the important part of the data is the volatility of the last traces of solvent dissolved in the vegetable oils—in other words, the slope of the vapor pressure curve as it leaves the origin. The data obtained along these lines are as yet insufficient to permit generalizations, except that the assumption of the validity of Raoult's law in this region is quite unsafe—the two values for hexane and benzene in castor oil giving about half of the theoretical vapor pressure at low concentrations.

Vapor pressure data must also be supplemented by determinations of the least amount which can be detected or is harmful in the pure oil. Complete removal is obviously impossible in any system, but it is readily possible by countercurrent steam distillation in a suitable tower to bring it below any reasonable limit set by taste, odor, or toxicity.

ACKNOWLEDGMENT

[13] *Can. Chem. Met.*, **6**, 177, 196 (1922).

Dr. Svedberg Honored

In recognition of his leadership as an international authority on colloid chemistry and his success in the direction of research work at the University of Wisconsin during the past semester, this university conferred the honorary degree of doctor of science upon The Svedberg, of the University of Upsala, at its June commencement. On presentation of Dr. Svedberg to the president, Prof. F. L. Paxson, chairman of the Committee on Award of Honorary Degrees, said:

MR. PRESIDENT:

The Svedberg received his doctor's degree only sixteen years ago, yet to-day his laboratories in the ancient University of Upsala are recognized as the world's most active spot for the study of the formation and properties of colloids. Chemical science has advanced in those sixteen years. It has nearly revolutionized the arts of war; and the needs of war in turn have brought profound changes in the approach to chemistry. From the interactions of the two there is promise that the quiet life of mankind will forever be improved.

During the past semester, as a resident in the University of Wisconsin, Professor Svedberg has brought to his department a fresh scholarship and a new technic. He has continued here that peaceful conquest of his colleagues that has marked his career in Sweden. And the results of his inspiring teaching are already to be seen in a growing disposition to look to this university as a centre for the study of the special field that he has mastered and illuminated.