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IMMERSION OILS WITH INDICES OF REFRACTION FROM 1.292 TO 1.411

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The authors and coworkers at the Oak Ridge National Laboratory have found that mixtures of perfluorotributylamine $(C_4F_9)_3N$, and polymers of chlorotrifluoroethylene $Cl\text{-}[CF_2\text{-}CFCl]_n\text{-}Cl$, have properties which make them quite suitable for use as immersion oils for index of refraction measurements in the range 1.292 to 1.411. These commercially available end members are colorless, odorless, and are miscible in all proportions. Their mixtures maintain the same indices of refraction (within one part per thousand) over many months, and possess viscosities and vapor pressures such that they are easy to handle. They have been found not to etch microscope slides, coverglasses, container bottles, or refractometer prisms to any visible extent.

Pertinent physical properties for perfluorotributylamine, a mixture of the polymers of chlorotrifluoroethylene known as KEL-F(R) Polymer Oil No. 10, and the fifth member of the polymer series of chlorotrifluoroethylene $[Cl\text{-}(CF_2\text{-}CFCl)_5\text{-}Cl]$ are tabulated in Table 1. The last ma-

* Operated for the U. S. Atomic Energy Commission by the Union Carbide Corporation.

TABLE 1

Material	Refractive Indices[a,b,c] n_D at 25° C.	Temperature Coefficients[a]		Vapor Pressures[b,c] mm. of Hg at 25° C.
		$-dn/dt$ (° C.)	Temperature range (° C.)	
$(C_4F_9)_3N$	1.292±0.001	0.00041	19–25	0.3
KEL-F(R) Polymer Oil No. 10	1.411±0.001	0.00033	22–51	3×10^{-4}
$Cl\text{-}(CF_2\text{-}CFCl)_5\text{-}Cl$	1.406±0.001	0.00034	25–42	2×10^{-3}

[a] Measured at the Oak Ridge National Laboratory by the authors with an Abbe Refractometer.

[b] Technical Bulletin on Inert Liquid FC-43. Minnesota Mining and Manufacturing Company.

[c] Technical Bulletin on Halofluorocarbons, Oils, Waxes, Greases, and Alkanes. Minnesota Mining and Manufacturing Company.

terial has a lower viscosity than the mixture of polymers. Thus combinations of the labile perfluorotributylamine and the polymer mixture are somewhat more suitable for the lower part of the refractive index range while combinations of perfluorotributylamine and the pure Cl-$(CF_2$-$CFCl)_5$-Cl are better in the upper part of the refractive index range.

These oils have been used extensively at the Oak Ridge National Laboratory and at the Mound Laboratory for phase characterization and identification (1–4). The authors have observed no evidence of solubility or chemical reaction between these oils and the compounds described in the references.

No toxic or anesthetic effects for these materials have been observed (5–8) although they may cause skin irritation. Only at elevated temperatures (~315° C.) do the polymers of chlorotrifluoroethylene decompose with production of toxic products (6–8).

REFERENCES

1. C. J. BARTON, *et al.*, *J. Phys. Chem.*, **62,** 665–676 (1958).
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3. J. F. EICHELBERGER, C. R. HUDGENS, L. V. JONES, G. PISH, T. B. RHINEHAMMER, P. A. TUCKER AND J. L. WITTENBERG, "The System NaF-BeF_2-UF_4." Unpublished work, Mound Laboratory. A preliminary diagram for this system may be found in ORNL-2548.
4. R. E. THOMA, *et al.*, "Phase Equilibria in the Systems BeF_2-ThF_4 and LiF-BeF_2-ThF_4." Presented at the 136th National Meeting of the American Chemical Society. *J. Phys. Chem.*, in press.
5. *Technical Bulletin* on Inert Liquid FC-43. Minnesota Mining and Manufacturing Company.
6. *Technical Bulletin* on Halofluorocarbons, Oils, Waxes, Greases, and Alkanes, Minnesota Mining and Manufacturing Company.
7. *Technical Bulletin* on Polychlorotrifluoroethylene Oils, Greases, and Waxes. Halocarbon Products Corporation.
8. *Technical Bulletin No.* 30, Hooker Chemical Corporation.

Dr. Arthur L. Day, retired director of The Geophysical Laboratory, died March 3, 1960, at the age of 90.

Professor Ciro Andreatta, of the University of Bologna, died February 6, 1960. He was a fellow of the Mineralogical Society of America.

Following a stroke suffered on November 23, Burnham S. Colburn died on December 26 at the age of 87, at his home in Biltmore, North Carolina. A banker by profession, Mr. Colburn was well known as an amateur mineralogist. He joined the society in 1930 and was elected to fellowship in December 1936. A memorial will appear in a later issue.

Dr. Richard H. Jahns, professor of geology and executive officer of the Department of Geology at the California Institute of Technology, has been appointed Chairman of the Division of Earth Sciences at The Pennsylvania State University. Dr. Jahns succeeds Dr. O. Frank Tuttle, who has been made Dean of the College of Mineral Industries at that institution.

9TH ANNUAL CONFERENCE ON APPLICATIONS OF *X*-RAY ANALYSIS

This conference will be held August 10–12, 1960, at the Stanley Hotel, Estes Park, Colorado.

For information, write Wm. Mueller, Head,
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FIFTH IUCR CONGRESS AND GENERAL ASSEMBLY

The fifth general assembly and international congress of the International Union of Crystallography will be held in Cambridge, England, August 15–20, 1960. Following the congress two symposia will be held (August 22–24) as follows: I. Thermal Motion in Crystals and Molecules. II. Lattice Defects and the Mechanical Properties of Solids.

For information write Dr. R. E. Rundle, Chemistry Department, Iowa State University, Ames, Iowa, or Dr. W. H. Taylor, Cavendish Laboratory, Cambridge, England.