COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Hexachloro-1,3-butadiene; C_4Cl_6; [87-68-3]

ORIGINAL MEASUREMENTS:

Shevtsova, Z.N.; Korshunov, B.G.; Safonov, V.V.; Kogan, L.M.; Gudkova, V.I.

Zh. Neorg. Khim. 1968, *13*, 3096-9; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 1596-8

VARIABLES:

Temperature

PREPARED BY:

T. Mioduski and M. Salomon

EXPERIMENTAL VALUES:

Composition, densities, viscosities and refractive indices of saturated solutions.

$t/^{\circ}C$	solubility[a] mass %	 $mol\ kg^{-1}$	$d/g\ cm^{-3}$	η/P	n_D^{20}	nature of the solid phase
25	0.036	0.00146	1.679	0.0385	1.5563	$CeCl_3.4H_2O$
50	0.043	0.00175	1.645	0.0308	1.5556	"
75	0.062	0.00252	1.616	0.0247	1.5549	$CeCl_3.2H_2O$

[a] Molalities calculated by the compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. Equilibrium attained after 12 d at 25°C, 10 d at 50°C, and 7 d at 75°C.

Initial salt, liquid phases and solid phases analyzed for Ce by the oxalate method or by titration with Trilon B using Xylene Orange indicator, and for chloride by the Volhard method. Presumably water was found by difference. Solid phase compositions confirmed by X-ray analysis.

SOURCE AND PURITY OF MATERIALS:

$CeCl_3.7H_2O$ prepd by dissolving 99.8% Ce_2O_3 in HCl, evaporating and cooling, recrystallizing, and drying in a desiccator. The oxide contained oxide impurities of other rare earths and Fe (0.01%), Ca (0.01-0.05%), and Cu (0.01%). The product was analysed for metal and halide (mass %): Ce 37.45%, Cl 28.75%, H_2O 33.77%.

Purified solvent (method not specified) had the following properties:
$d_4^{20} = 1.6807\ g\ cm^{-3}$, and $n_D^{20} = 1.5543$.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: accuracy ± 0.1 K (authors).

REFERENCES:

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Ethanol; C_2H_6O; [64-17-5]

(3) Water: H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sakharova, N.N.; Sakharova, Yu.G.; Ezhova, T.A.; Izmailova, A.A.

Zh. Neorg. Khim. 1975, *20*, 1479-83; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1975, *20*, 830-2.

VARIABLES:

Temperature

PREPARED BY:

T. Mioduski and M. Salomon

EXPERIMENTAL VALUES:

solubility of $CeCl_3.6H_2O$ in 96.8 % $C_2H_5OH^a$

	sample 1	sample 2	sample 3	sample 4	mean solubilities	
t/°C	g/100 g^b	g/100 g	g/100 g	g/100 g	g/100 g	mol kg^{-1c}
20	43.97	44.10	44.36	44.15	44.15	1.245
30	48.91	48.89	48.90	48.92	48.9^d	1.379
40	55.20	54.98	54.87	54.93	54.99	1.551
50	68.41	68.55	68.66	68.38	68.50	1.932
60	84.53	84.61	84.47	84.51	84.53	2.384

[a] It is not clearly stated whether the mixture is 96.8 mass % or 96.8 volume % ethanol.

[b] Solubilities reported as grams of hexahydrate in 100 g of solvent.

[c] Molalities calculated by the compilers.

[d] Compilers calculated 48.91 g/100 g solvent. The molality for this solution was calculated from this value of the solubility.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method used. Equilibrium was reached after 3-4 h. Identical results obtained by approaching equilibrium from above and below. Two of the data points in the table obtained after 3 hours of equilibration, and the remaining two data points obtained after 4 h of equilibration.

The metal content of each aliquot taken for analysis was determined by complexometric titration with Trilon B.

Analyses of the solids withdrawn at 20°C, 40°C and 60°C showed the solid phase to be the hexahydrate: i.e. ethanol was not found in any of the solid phases.

The hexahydrate melted at 95.5 - 96.5°C.

SOURCE AND PURITY OF MATERIALS:

$CeCl_3.6H_2O$ prepd by dissolving c.p. grade oxide in dil (1:3) HCl followed by evapn and crystn. The crystals were dried in a desiccator over $CaCl_2$, P_2O_5 and NaOH. The crystals analysed for the metal by titrn with Trilon B, and for Cl by the Volhard method. Found (%) for Ce: 39.20, 39.34 (calcd 39.51). Found (%) for Cl: 30.10, 29.95 (calcd 30.04). 96.8% ethanol prepd by prolonged boiling of c.p. grade 93.5% ethanol with anhydr $CuSO_4$ followed by distn. Ethanol concn detd refractometrically and pycnometrically.

ESTIMATED ERROR:

Soly: results apparently precise to within ± 0.8% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) 2-Methoxyethanol; $C_3H_8O_2$; [109-86-4]

ORIGINAL MEASUREMENTS:

Kirmse, E.M.

Tr. II Vses. Konf. po Teor. Rastvorov 1971, 200-6.

VARIABLES:

T/K = 298

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

The solubility of $CeCl_3$ in 2-methoxyethanol at 25°C was reported to be

10.7 mass %

The corresponding molality calculated by the compiler is

0.486 mol kg^{-1}

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Nothing specified except that the solid phase was found to be $CeCl_3.nC_3H_8O_2$ where n = 2-3.

On the basis of previous papers by the author compiled elsewhere in this volume, it is assumed that the solutions were prepared isothermally and equilibrated for several days, and that Ce determined by complexometric titration.

SOURCE AND PURITY OF MATERIALS:

Nothing specified. Presumably, the anhydrous chloride was prepared by the method of Taylor and Carter (1).

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Taylor, M.D.; Carter, C.P. *J. Inorg. Nucl. Chem.* 1962, *24*, 387.

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) 1,1'-Oxybis-ethane (diethyl ether); $C_4H_{10}O$; [60-29-7]

ORIGINAL MEASUREMENTS:

Dzhuraev, Kh. Sh.; Mirsaidov, U.; Kurbanbekov, A.; Rakhimova, A.

Dokl. Akad. Nauk Tadzh. SSR 1976, *19*, 32-4.

VARIABLES:

T/K = 293

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

The solubility of $CeCl_3$ in diethyl ether at 20°C was reported to be

$$7.3 \times 10^{-3} \text{ mass \%}$$

The corresponding molality calculated by the compiler is

$$2.96 \times 10^{-4} \text{ mol kg}^{-1}.$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method employed. Equilibrium was attained within 24 h and was verified by constancy in the Ce concentration. Both the saturated solution and the equilibrated solid phase were analysed. Ce determined by complexometric titration using methylthymol blue indicator and urotropine buffer. Cl determined by titration with $AgNO_3$. The solid phase corresponded to $CeCl_3 \cdot 0.1C_4H_{10}O$ (the solvate was dried under vacuum at 40°C prior to analysis). The pyrolysis product obtained by heating to 500°C is CeOCl.

SOURCE AND PURITY OF MATERIALS:

Anhydrous $CeCl_3$ prepared by the ethanol solvate method (no details given). Diethyl ether was dried with Na and distilled from $LiAlH_4$.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Alkyl ethers

ORIGINAL MEASUREMENTS:

Kirmse, E.M.; Dressler, H.

Z. *Chem.* 1975, *15*, 239-40.

VARIABLES:

Room temperature T/K = 293-298

PREPARED BY:

T. Mioduski and M. Salomon

EXPERIMENTAL VALUES:

solvent			$CeCl_3$ solubility[a] mass %	mol kg^{-1}
1-methoxyheptane;	$C_8H_{18}O$;	[629-32-3]	0.1	4×10^{-3} [b]
1-methoxyoctane;	$C_9H_{20}O$;	[929-56-6]	0.1	4×10^{-3} [c]
1-methoxynonane;	$C_{10}H_{22}O$;	[7289-51-2]	0.12	4.9×10^{-3} [c]

[a] Molalities calculated by the compilers.

[b] Solid phase dried in a vacuum desiccator over P_2O_5 and analysed. The $C_8H_{18}O$:$CeCl_3$ ratio was less than 2

[c] Solid phases not specified.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solute-solvent mixtures were isothermally agitated at room temperature. Method of ascertaining equilibrium not specified.

The anhydrous reagents were handled in a dry box containing P_2O_5.

Cerium was determined by complexometric titration using Xylenol Orange indicator.

The reported solubilities are mean values based on four determinations.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) 1,3-Dioxolane; $C_3H_6O_2$; [646-06-0]

ORIGINAL MEASUREMENTS:

Kirmse, E.M.; Zwietasch, K.J.; Tirschmann, J.; Niedergesaess, U.

Z. Chem. 1968, *8*, 472-3;

Kirmse, E.M. *Tr. II Vses. Konf. po Teor. Rastvorov* 1971, 200-6

VARIABLES:

T/K = 298

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

The solubility of $CeCl_3$ in dioxolane at 25°C was reported to be

1.0 mass %.

The corresponding molality calculated by the compiler is

0.041 mol kg^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solute-solvent mixtures were isothermally agitated at 25°C or at room temperature: authors state that the difference found for the solubility was within experimental error limits.

Ce was determined by complexometric titration.

No other details given.

SOURCE AND PURITY OF MATERIALS:

The anhydrous chloride was prepared by the method of Taylor and Carter (1).

No other information given.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Taylor, M.D.; Carter, C.P.
J. Inorg. Nucl. Chem. 1962, *24*, 387.

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Tetrahydrofuran; C_4H_8O; [109-99-9]

ORIGINAL MEASUREMENTS:

Rossmanith, K.; Auer-Welsbach, C.

Monatsh. Chem. 1965, *96*, 602-5.

VARIABLES:

Room Temperature: T/K about 293

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

The solubility of $CeCl_3$ in tetrahydrofuran at 20°C (room temperature) was reported to be

0.593 g per 100 ml of solution

(0.024 mol dm^{-3}, compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method employed. The solution was equilibrated in an extractor with agitation for 60-80 hours at room temperature.

Cerium was determined by the oxalate method and by titration with EDTA using Xylenol Orange indicator. The solvent was determined by difference.

Anhydrous materials were handled in a dry box through which was passed a stream of nitrogen free of carbon dioxide.

The solid phase is $CeCl_3.1.46C_4H_8O$.

SOURCE AND PURITY OF MATERIALS:

Sources and purities of initial materials not specified. $CeCl_3$ was prepared by conversion of the oxide by high temperature reaction with an excess of NH_4Cl followed by heating the product in a stream of dry nitrogen, and then in vacuum to remove unreacted NH_4Cl.

Tetrahydrofuran was distilled from $LiAlH_4$.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Pyridine; C_5H_5N; [110-86-1]

ORIGINAL MEASUREMENTS:

Mueller, R.

Z. Anorg. Allg. Chem. 1925, *142*, 130-2.

VARIABLES:

T/K = 273

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

The solubility of $CeCl_3$ in pyridine at 0°C was reported to be

1.58 g of anhydrous salt per 100 ml of solution

(0.0641 mol dm^{-3}, compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method employed. The solute-solvent mixture was thermostated at 0°C for 48 h. No other information given.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Hexamethylphosphorotriamide; $C_6H_{18}N_3OP$; [680-31-9]

ORIGINAL MEASUREMENTS:

Mikheev, N.B.; Kamenskaya, A.N.; Konovalova, N.A.; Zhilina, T.A.

Zh. Neorg. Khim. 1977, *22*, 1761-6; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1977, *22*, 955-8.

VARIABLES:

Room temperature: T/K = 298 ± 3

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

The solubility of the anhydrous salt at 25 ± 3°C was given as

$$0.109 \pm 0.003 \text{ mol dm}^{-3}$$

Starting with the solvate $CeCl_3.3((CH_3)_2N)_3PO$, the solubility at 25 ± 3°C[a] was given as

$$0.107 \pm 0.003 \text{ mol dm}^{-3}$$

[a] Table 3 in the English translation of the source paper states the temperature to be 23 ± 3°C. This is probably a typographical error as the text clearly states that all measurements were carried out at rooom temperature (25 ± 3°C).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method used. Salt and solvent were placed in a test-tube in a dry box, and the tube agitated at room temperature (25 ± 3°C) until equilibrium was reached. Aliquots were withdrawn periodically and analysed for the metal content. Rare earth concentration was determined by complexometric titration, and by the radiometric method using the isotope Tm-170 ($t_{\frac{1}{2}}$ = 169 d). Authors state that results for both methods agreed. Although not clearly stated, it appears that equilibrium was reached in several weeks to several months.

Solid phase samples washed three times with benzene or ether and dried on a steam bath in an argon atmosphere. The solid phase was analysed and found to be $CeCl_3.3C_6H_{18}N_3OP$.

The solvate was analysed for metal content by complexometric titrn, for chloride by the Volhard method, and the solvent was obtained by difference. IR spectra confirmed the absence of water. Structural studies of the solvate also carried out by X-ray analysis.

SOURCE AND PURITY OF MATERIALS:

Anhyd $CeCl_3$ prepd similarly to that in (1) by subliming NH_4Cl from a mixt of $CeCl_3$ and 6 moles of NN_4Cl in a stream of inert gas at 200-400°C (CeOCl content less than 3%). The solvent was purified as in (2).

$CeCl_3.3C_6H_{18}N_3OP$ prepd by dissolving the hydrate in $C_3H_{18}N_3OP$ and heating to 140-150° C for 5 m. The solvate was pptd by addition of abs ether, washing 7 times with ether, and drying over P_2O_5 in a stream of dry nitrogen. Yield was about 90 %.

ESTIMATED ERROR:

Soly: precision ± 0.003 mol dm^{-3} at a 95 % level of confidence (authors).

Temp: precision ± 3 K.

REFERENCES:

1. Taylor, M.D.; Carter, C.P. *J. Inorg. Nucl. Chem.* 1962, *24*, 387.
2. Fomicheva, M.G.; Kessler, Yu.M.; Zabusova, S.E.; Alpatova, N.M. *Elektrokhimiya* 1975, *11*, 163.

COMPONENTS:

(1) Cerium chloride; $CeCl_3$; [7790-86-5]

(2) Hydrazine; N_2H_4; [302-01-2]

ORIGINAL MEASUREMENTS:

Welsh, T.W.B.; Broderson, H.J.

J. Am. Chem. Soc. 1915, 37, 816-24.

VARIABLES:

Room temperature (not specified)

PREPARED BY:

T. Mioduski and M. Salomon

EXPERIMENTAL VALUES:

The solubility of $CeCl_3$ at room temperature was reported to be

0.03 g/cc

The compilers have not attempted to convert this value to mol kg^{-1} units for several reasons. First we do not know the temperature of the measurements and hence cannot obtain a value for the density of hydrazine. Second we do not know whether or not the initial salt was anhydrous or the heptahydrate as the authors did not provide this information. If the heptahydrate was used, then the results are meaningless for the obvious reasons. Third, the authors admit to problems with oxidation of the solvent and some contamination with water. Fourth, the experimental technique is so crude that in addition to the other sources of experimental error, it hardly seems justifiable to estimate the solubility in units of mol kg^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The soly was determined in small tubes which were loosely sealed with a cork covered with tin foil. Capillary tubing sealed to the bottom of the tube served for the passage of dry N_2. 1 cc of N_2H_4 was added to the tube and small weighed portions of powdered $CeCl_3$ added : N_2 was allowed to bubble through the sln to insure adequate mixing. $CeCl_3$ was added in this manner until no more solute would dissolve: the solubility was taken as the total weight of the added salt which dissolved up to this point. Weighings were made to a precision in the 10 mg range, and temperature was not controlled. Authors state that slight oxidation of N_2H_4 probably occurred, and that "slight amounts" of moisture probably were introduced into the solution. Gassing was noted upon introduction of the solid into the solvent.

SOURCE AND PURITY OF MATERIALS:

Commercial N_2H_5 was dehydrated and distilled as described in (1). Analysis for N_2H_4 yielded 99.7% purity. $CeCl_3$ was "an ordinary pure chemical of standard manufacture." It is not clearly stated whether or not the salt was dehydrated. Authors state "water of crystallization was removed wherever it was possible to do so without decomposition." Since many salts were studied in this work, the compilers cannot determine absolutely if the $CeCl_3$ starting material was anhydrous.

ESTIMATED ERROR:

Soly: precision no better than 50%. and accuracy may be much poorer (compilers).

Temp: unknown

REFERENCES:

1. Welsh, T.W.B. *J. Am. Chem. Soc.* 1915, 37, 497.