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Brief 67-10184

AEC-NASA TECH BRIEF

New Class of Compounds Have Very Low Vapor Pressures

The problem:

To create a new class of compounds which are 50-volume-percent water and have a melting point of about 170°C, yet possess a low vapor pressure at 200°C.

The solution:

Magnesium Hexahydrate Tetrachlorometallates: $Mg(H_2O)_6MCl_4$, where M is a metal ion which can be either Zn, Fe, Cu, or Co. These compounds are relatively noncorrosive and thermally stable. They are water soluble but not hygroscopic. The Zn compound ($Mg(H_2O)_6ZnCl_4$) has a vapor pressure of only one atmosphere at 200°C, while water has a vapor pressure of 15 atmospheres at this temperature.

How it's done:

These compounds are created in the laboratory by melting together in a sealed tube equimolar quantities of $Mg(H_2O)_6Cl_2$ with anhydrous $ZnCl_2$, $CoCl_2$, $FeCl_2$, and $CuCl_2$, respectively. The crystallization temperatures of the 1:1 mixtures are below 200°C in all cases. The Zn compound is colorless; the Co and Fe compounds are deep blue and yellow, respectively; and the Cu compound is initially yellow, but changes to brown on standing.

Although the crystal structures of these compounds have not yet been precisely determined, some information about the 3d metal ions (M) can be deduced from the absorption spectra of the compounds. $ZnCl_4^{2-}$ and $CoCl_4^{2-}$ tetrahedra appear to be present in the Zn and Co salts. Spectral data also indicate that in the Fe and Cu salts the coordination about the Fe and Cu is octahedral, with four vertices occupied by Cl and two by H_2O molecules which are shared with Mg(II).

The data collected to this point seem to indicate that a delicate balance of forces determines whether the (MCl_4) groups in the crystalline state exist as isolated tetrahedral complex ion groups or whether they share an additional two H_2O molecules with the $Mg(6H_2O)^{++}$ groups to give octahedral coordination of the 3d ions.

Notes:

1. These compounds may have potential applications as cooling fluids or in the production of high temperature steam at low pressures.
2. These compounds were developed at Argonne National Laboratories as the byproduct of other research work. Thus little detailed experimentation has been done at this time and few concrete applications or properties data are available. This information is presented so that anyone interested in potential applications of the compounds may conduct the further research and development work necessary to adapt the compounds to specific needs.
3. Additional information is contained in: *Inorganic Nuclear Chemistry Letters,* vol. 2, p. 75-78 (1966).
4. Inquiries concerning this innovation may be directed to:

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(continued overleaf)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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