LOW-MELTING SALT MIXTURES DATA: ERRORS IN CONCENTRATION COORDINATES

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ABSTRACT

Different techniques for defining the low-melting salt mixture parameters have been compared. For a given phase diagram of two-dimensional vertical sections, it has been determined that the space equal to the concentration simplex is a region of possible errors in the invariant point coordinates and to characterize its extension and some other properties.

ISOBARIC DIAGRAMS OF TERNARY SYSTEMS

There is a great problem in determining the error in concentration coordinates of low-melting salt mixtures, which were derived by different thermal analysis techniques. For ternary systems, the earliest results have been received by the visual and differential thermal analysis methods, when the experimental points were either distributed in concentration triangle (Figure 1, b, c), or arranged in lines (Figure 1, a).

![Figure 1. Experiments design for the liquidus investigation by (1) – a), (2) – b), (3) – c)](image-url)

Later results were found by the investigation of special series of orthogonal to concentration simplex sections of a multidimensional phase diagram. This method is based on the regularities in structure and intersections of ruled (hyper)surfaces, produced by the horizontal simplexes of different dimensions, moving along directing curves, surfaces and hypersurfaces. One specific peculiarity of the molten salts diagrams differs from the metallic and ceramic ones: most of the salt mixtures may be considered as insoluble in solids. As a result, the only one directing element of any ruled (hyper)surface of any dimension is the real curve, surface or hypersurface. Other directing elements have been transformed into the straight lines that are orthogonal to the concentration simplex.
In the eutectic diagram these coincide with the temperature axes at the concentration simplex tops. In the peritectic diagrams new straight lines begin in the stoichiometrical points of incongruently melting compounds.

The isobaric diagram of the eutectical ternary salt system has only one type of ruled surface $I_{ee}E$. It is producing when a segment $I_{ee}$ of two-phase equilibrium in binary system (at the temperature of invariant point $e$) begins to scan a liquidus curve $eE$ and vertical line $I_{ee}E$ and stays parallel to the diagram’s base. The ruled surface, produced by $A_{e}e_{AB}=A_{e}e_{1}$ generating segment, may be designated as $q'_{AB}=A_{e}e_{1}A_{e}E=A_{e}e_{1}E=AB$. It has the same directing curve $e_{1}E$ with the ruled surface $q'_{BA}=B_{e}e_{1}B_{e}E=B_{e}e_{1}E=BA$. Other two pairs of ruled surfaces have been designated as $q'_{AC}=A_{e}e_{3}A_{e}E=A_{e}e_{3}E=AC$, $q'_{CA}=C_{e}e_{3}C_{e}E=C_{e}e_{3}E=CA$ and $q'_{BC}=B_{e}e_{3}B_{e}E=B_{e}e_{3}E=BC$, $q'_{CB}=C_{e}e_{3}C_{e}E=C_{e}e_{3}E=CB$. As a result T-x-y diagram in the trigonal prism has 19 points $3I+3ej-H)I_{ee}+3l_{ee}+3l_{0}$, 3 curves $e_{1}E$, 12 horizontal lines $3I_{ee}(or 6I_{ee})+3I_{e}E+3l_{e}E+3I_{0}E^{0}$, 3 vertical lines $l_{0}$, 2 horizontal planes $I_{0}B_{e}E_{0}(or E_{0})+1A_{0}B_{e}C_{0}$, 3 vertical planes $I_{0}I_{0}I_{0}$, 3 liquidus unruled surfaces $q_{I}=I_{e}e_{1}E=I$ and 6 already mentioned ruled surfaces $I_{ee}E$. All these geometrical elements must be used for the invariant points data evaluation.

Initially, an improved, special series of vertical sections was used to investigate the curvature of the liquidus polythermal lines $e_{1}E$ and liquidus surfaces isotherms in the ternary systems (4,5). D.Petrov (4) has proposed that only three vertical sections (Figure 2) are needed to derive 3 liquidus curves $e_{1}E$. Any point on the liquidus curve $e_{1}E$ was fixed by the cross-section of two generating segments with the same horizontal position (at the fixed temperature) of 2 ruled surfaces $I_{JJ}$ and $J_{II}$ (with the same directing curve). E.g. $Ap_{1}P_{1}$ and $B_{Q_{1}}Q_{1}$ segments with the equal temperature in points $Q_{1}$ and $P_{1}$ intersect in the point $e_{1}$ that belongs to the $e_{1}E$ liquidus curve. Unfortunately the Petrov' method does not give the information on the liquidus surfaces isotherms and it is not possible to check the liquidus curve position directly. As a result, some errors were possible when a real temperature of secondary crystallization was lowered in accordance with the bad heat transmission of primary crystals and an effect of the melt overcooling.

![Figure 2. Petrov's scheme (4) of two ruled surfaces vertical sections to receive the liquidus curve as their mutual directing element: a) liquidus curves design; b)-d) vertical sections OP, QR and ST, parallel to BC, AC and AB binary systems](https://example.com/figure2.png)

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M. Malinovsky offered (5) two variants of more sophisticated scheme. His vertical sections pass via the triangle tops (Figure 3, a) or parallel to the triangle sides (Figure 3, b). In the first variant a fragment \( b_3E \) of curve \( e_1E \) is fixed as in Petrov’s method: from the section II data on \( c_2a_3 \) fragment and from the section III data on \( b_3c_3 \) fragment. After it a point \( b_3 \) of the section III is used to check the results of Petrov’s method. Then the liquidus curves in the binary systems and the liquidus surfaces vertical sections are used for the liquidus isotherms construction. When the vertical sections were parallel to the triangle sides (Figure 3, b) the results were even more accurate. Curve \( e_1E \) is constructed by the segments \( d_1c_1 \) and \( d_2c_2 \) intersection of the vertical sections I and II. Besides the \( b_3E \) fragment of this curve is corrected by the fragment \( b_1c_3 \) of the vertical section III (and the results of vertical section II) and point \( b_3 \) of this section is used as a control one. So the Malinovsky’s method is more valid and more accurate than Petrov’s.

**Figure 3.** Malinovsky’s scheme (5) of vertical sections to construct the liquidus curves and liquidus surfaces isotherms: a) sections pass via the triangle tops; b) sections are parallel with the triangle sides

Later, for many cases, only the invariant point coordinates were investigated by the vertical sections (6). In ternary systems, the eutectic coordinates were received when the vertical section cuts 2 liquidus I & J surfaces and 2 pairs of ruled surfaces BA, BC and CB, CA (Figure 4, a, b). In this case, the ruled surfaces intersection points B-E and C-E are at the same time the cuts of their common generating segments \( B_3E \) and \( C_3E \) (in the lowest position) that belong simultaneously to the horizontal solidus plane \( A_3E = E_3 \). A point \( I_3-E \) projection of such segment cut by the vertical plane \( ad \) gives a direction for a ray \( I(I-E) \) from the triangle top \( I \) to the ternary eutectic \( E \). An intersection of these two rays \( B(B-E) \) and \( C(C-E) \) fixes the concentration coordinates of ternary eutectic (Figure 4, c). Taking into account an error in the ray direction determination (7), we receive a rhombic area \( eggh \) for the possible position of eutectic point, where a distance \( eh \) reaches 10\% (in concentration) when an error in B-E and C-E points coordinates equals 1\%. Next scheme of the ternary eutectic determination consists of two steps. At first the vertical section \( be \) (Figure 4, a, d) cuts a liquidus surface A and a pair of ruled surfaces AB and AC with the same generating segment \( A_3E \) (in its lowest position). By the way, in the binary systems AB and AC this generating segment \( A_3E \) becomes the segments \( A_3I_1 \) and \( A_3I_3 \) of different binary invariant equilibria. As a result only one ray \( A(A-E) \) from the triangle top \( A \) to ternary eutectic \( E \) is fixed. Second vertical section \( A(A-E) \) is to coincide with this ray (Figure 4, e). It doesn’t cut any ruled surface, but cuts
the intersection of liquidus A surface with the horizontal plane $E_s$. This time a trapezoid $efgh$ (Figure 4, f) is an area for possible eutectic point position. In both these cases of ternary eutectic determination an area of errors may be used to construct its 3-dimensional quasi-diagram and to produce its vertical sections illustrating the real variants of the eutectic point dispersion. Actually even an accurate Petrov’s method gives 3 points ($a$, $b$ and $c$ on the Figure 4, g) as possible coordinates of ternary eutectic. The errors in A-E, B-E and C-E points produce more large area than $abc$ triangle as a possible place for ternary eutectic.

**Figure 4.** Accuracy of the ternary eutectic $E$ found by vertical sections of ruled surfaces and liquidus surface: a) position of $bc$, $A(A-E)$ and $ad$ vertical sections; b) liquiduses B&C, ruled surfaces BA, BC+CB, CA and horizontal solidus plane $E_s$ section by the vertical plane $ad$; c) eutectic E determined as $B(B-E)$ and $C(C-E)$ rays intersection and the rhombic $efgh$ area of possible errors; d) liquidus A, ruled surfaces AB, AC & horizontal solidus plane $E_s$ section by the vertical plane $bs$ and error in the point A-E determination; e) liquidus A and horizontal solidus plane $E_s$ section by the vertical plane $A(A-E)$ and error of component A content in ternary eutectic; f) trapezoid $efgh$ area of possible errors in ternary eutectic coordinates determined by $bc$ and $A(A-E)$ vertical sections; g) $a$, $b$ & $c$ points as possible ternary eutectics on the I(I-E) and I(J-E) rays intersections
Figure 5. Unique variant for the quaternary eutectic position on the vertical $dD$ section of (A-B-C-D)=(LiF-BaF$_2$-MgF$_2$-ZrF$_4$) system: a) "eutectical" point $\varepsilon$ determination on the vertical $dD$ section started from the ternary eutectic (8); b) $dD$ curve projection coincides with $dD$ line; c) regular position of $pD$ section

BAD TECHNIQUE TO SEARCH EUTECTIC COORDINATES IN THE QUATERNARY SYSTEM Li,Ba,Mg,Zr//F (8)

No one has tried to search a ternary eutectic $E$ on the section $e,I$ connecting a binary eutectic projection with the triangle opposite top (Figure 2; 3; 4, a). Surely it is possible to image a point $E$ as belonging to the straight-line $e,I$, although this is not, in reality, possible. Nevertheless, according to this idea, a quaternary eutectic was investigated (Figure 5, a) in the system Li,Ba,Mg,Zr//F (8). At first the authors have checked the ternary eutectic Li,Ba,Mg//F coordinates (9) and changed them from 59.1% LiF, 15.9% BaF$_2$, 25.0% MgF$_2$, 911K for 52.8% LiF, 21.7% BaF$_2$, 25.5% MgF$_2$, 927K . Then a quaternary eutectic $\varepsilon$ with the coordinates 35.5% LiF, 9.5% BaF$_2$, 15.0% MgF$_2$, 40% ZrF$_4$, 777K was found on the section joining the ternary eutectic Li,Ba,Mg//F and ZrF$_4$ top of tetrahedron. The authors have shown only the liquidus cut, but it is obvious that a ternary eutectic temperature 927K doesn’t fit other 4 points of this section.
To make more accurate analysis of these results we need to describe a structure of T-x-y-z diagram with the quaternary eutectic ε, but without the solubility in solids (10). Let the binary eutectics εij written in the alphabetical order are designated by the Arab ciphers 1-6, and the ternary eutectics Eijk - by the small letters l of the opposite tetrahedron tops L (Figure 5, c). Then the liquidus hypersurfaces q_l are: q_A=123bcdε=A, q_B=145acde=B, q_C=246abcdε=C, q_D=356abcde=D. Only as an exclusion a section dD may be taken to search a quaternary eutectic ε (Figure 5, b). In this case a de polythermal curve projection is a straight line coinciding with dD section and L+A+B+C=LABC phase region is under the ds curve. In the regular case of pD section (Figure 5, c) a point s is absent and a liquidus surface 3bcs on the border of two unruled hypersurfaces (A and D) is cut in any point f3bce. Besides liquidus the pD section cuts the AεAεε ruled surface
in the point \( g \) and the horizontal AB\( e \) plane in the point \( h \) (all these points \( f, g \) and \( h \) belong the borders of ruled hypersurfaces).

Figure 7. \( pD \) section details when \( p=s \in 1d \) and \( p=r \in Ad \): a) liquidus A (and B) and ruled hypersurface AB have mutual point \( s_{1d} \) on \( sD \) section; b) ruled hypersurfaces AD and AB-C have mutual point \( r_{0} \) on \( rD \) section; c) points \( f, g \) and \( h \) origin on \( sD \) section, \( s \in 1d \); d) points \( f, g \) and \( h \) origin on \( rD \) section, \( r \in Ad \)

When a generating segment \( l_{e} \) saves its horizontal position to \( A^0B^0C^0D^0 \) base of T-x-y-z hyperprism and moves along the directing surface \( l_{e}l_{e}E \) and vertical line \( l_{e}l_{e} \), it produces a ruled hypersurface designated as \( q_{ij} = l_{e}l_{e}E_{i+k}E_{j+k}E_{i+j} = l_{e}l_{e}E_{i+k}E_{j+k} = l_{e}l_{e} \). There are 12 hypersurfaces of this type (6 pairs with the same 6 directing surfaces):

- \( q_{AB}^{ri} = A_{0}A_{1}cde = A_{0}cde = AB \)
- \( q_{BA}^{ri} = B_{1}B_{2}cde = B_{1}cde = BA \)
- \( q_{AC}^{ri} = A_{2}A_{3}bde = A_{2}bde = AC \)
- \( q_{CA}^{ri} = C_{2}C_{3}bde = C_{2}bde = CA \)
- \( q_{AD}^{ri} = A_{3}A_{4}bce = A_{3}bce = AD \)
- \( q_{DA}^{ri} = D_{3}D_{4}bce = D_{3}bce = DA \)
- \( q_{BC}^{ri} = B_{4}B_{5}ade = B_{4}ade = BC \)
- \( q_{CB}^{ri} = C_{4}C_{5}ade = C_{4}ade = CB \)
- \( q_{BD}^{ri} = B_{5}B_{6}ace = B_{5}ace = BD \)
- \( q_{DB}^{ri} = D_{5}D_{6}ace = D_{5}ace = DB \)
- \( q_{CD}^{ri} = C_{6}C_{7}abc = C_{6}abc = CD \)
- \( q_{DC}^{ri} = D_{6}D_{7}abc = D_{6}abc = DC \)
Figure 8. Eutectic (A-B-C-D)=(LiVO₃-Li₂MoO₄-LiF-LiCl) determination (7): a) binary and ternary eutectics; b) gf and mr sections position; c) e “second projection” (7) on gf section; d) e “first projection” (7) on mr section; e) e on the ray started from the LiCl top; f) gf, mr & D(D-e) sections position within the tetrahedron of concentration.
Figure 9. g\textsuperscript{f} section details of system Li\textsubscript{1}/Cl\textsubscript{1}/F\textsubscript{1},MoO\textsubscript{4}, V\textsubscript{0} 3: a) cut of DC ruled hypersurface with D\textsubscript{6}b\textsubscript{6} generating segment (in its highest position), 6a6e directing surface and D\textsubscript{6}a\textsubscript{a} directing line; b) cut of DC-A ruled hypersurface with b\textsubscript{6}b\textsubscript{6}c\textsubscript{b} generating simplex (in its highest position), be directing liquidus curve and D\textsubscript{6}b\textsubscript{6}D\textsubscript{6}b\textsubscript{6} directing lines; c) rf section of DC-B ruled hypersurface; d) cuts of liquidus D, ruled hypersurfaces DC, DC-A, DC-B and horizontal \(\varepsilon\) \textsubscript{s} solidus hyperplane; e) cuts of L+D, L+C+D, \(L+\text{A}+\text{C}+\text{D}\), \(L+\text{B}+\text{C}+\text{D}\) and \(\text{A}+\text{B}+\text{C}+\text{D}\) phase regions

Section pD cuts 3 of them: \(AD, AB \text{ and DA (Figure 6, a-d, h)}\). It means, that \(p_{1}\text{dc}_{-}\text{e}=pD\cap AD, \quad g_{6}\text{c}_{-}e_{gbc}=pD\cap DA\) and \(p_{A}f_{bc}=pD\cap A, \quad f_{3}\text{bc}_{-}f_{D}=pD\cap D\). Besides \(q_{x}^{1/2}=ij\) ruled hypersurfaces a quaternary phase diagram has a new type of ruled hypersurface \(q_{y}^{1/2}=ijle_{le}je_{je}je_{je}=ij_{j}e_{j}e_{j}e_{j}e_{j}j\) with the generating simplex \(le_{le}je_{le}e\) (in its highest position), directing lines \(le_{le}, \quad je_{le}\) & curve \(E_{j}E_{j}E_{j}\). They are grouped as the triads around four \(E_{j}E_{j}\) liquidus curves: \(q_{AB-C}=A_{d}A_{e}B_{e}B_{e}d_{e}=ABd_{e}=AB-C, \quad q_{AC-B}=A_{d}A_{e}C_{d}C_{d}d_{e}=ACd_{e}=AC-B, \quad q_{BC-A}=B_{b}B_{b}C_{c}C_{c}d_{e}=BCd_{e}=BC-A\); \(q_{AB-D}=A_{a}A_{c}B_{c}B_{c}e_{c}=ABc_{e}=AB-D, \quad q\text{r}^{2}_{AB-B}=A_{d}A_{c}D_{d}D_{d}c_{e}=ADc_{e}=AD-B, \quad q\text{r}^{2}_{BB-B}=B_{b}B_{b}D_{b}D_{b}e_{b}=BDc_{e}=BD-A\); \(q\text{r}^{2}_{AC-D}=A_{a}A_{b}C_{b}C_{b}c_{b}=ACc_{b}=AC-D, \quad q\text{r}^{2}_{AD-C}=A_{a}A_{b}D_{b}D_{b}e_{b}=ADc_{b}=AD-C, \quad q\text{r}^{2}_{CD-A}=C_{b}C_{b}D_{b}D_{b}e_{b}=CDc_{b}=CD-A, \quad q\text{r}^{2}_{BC-D}=B_{b}B_{b}C_{c}C_{c}e_{c}=BCc_{c}=BC-D, \quad q\text{r}^{2}_{BD-C}=B_{b}B_{b}D_{d}D_{d}e_{d}=BDc_{d}=BD-A\). Section pD cuts 3 of them (Figure 6, a, e-h): \(p_{d}h_{c}=pD\cap AB-C, \quad h_{6}\text{g}_{-}e_{gbc}=pD\cap AB-D, \quad g_{6}\text{c}_{-}D_{c}_{e}=pD\cap AD-B\). If \(p\) coincides with \(d\) and if pD section cuts the same \(A, \quad AB, \quad AB-C\) hypersurfaces, then dD section (Figure 6, i)
resembles pD section (Fig 6, h) and differs only by the mutual point $d$ for A, AB and AB-C hypersurfaces. There are two particular cases when a point $d$ lays on the projections of eE curve and A_{E}E line. In the first case (Figure 7, a, c) A and AB hypersurfaces have a mutual point s_{1-d}, in the second (Figure 7, b, d) – AB and AB-C hypersurfaces have a mutual point r_{d}.

Figure 10. mr section details of system Li\textsubscript{1}/Cl,F,MoO_{4},V_{03}: a) $m_{6}(D_{e-e})$ section of DC ruled hypersurface; b) $h_{5-c}(D_{e-e})$ section of DB ruled hypersurface with $D_{55}$ generating segment (in its highest position), $5a_{c}$ directing surface and $D_{5}D_{e}$ directing line; c) $h_{b}(D_{e-e})$ section of BD-A ruled hypersurface with $cB_{c}D_{c}$ generating simplex (in its highest position), $c_{e}$ directing curve and $D_{c}D_{e}, B_{c}B_{e}$ directing lines; d) $h_{m}$ section of liquidus D, ruled hypersurfaces DB, DC, BD-A and horizontal e_{e} solidus hyperplane; e) $h_{m}$ section of L+D, L+B+D, L+C+D, L+A+B+D and A+B+C+D phase regions

GOOD TECHNIQUE TO SEARCH EUTECTIC COORDINATES IN THE QUATERNARY SYSTEM Li\textsubscript{1}/Cl,F,MoO_{4},V_{03} (11)

In this system a $k{mn}$ section was analyzed, that is parallel to Li\textsubscript{1}/VO_{3},F,MoO_{4} face of tetrahedron (Figure 8, a, b). At first on the $gf$ section (Figure 8, b, c) a point of so-called “quaternary eutectic second projection” (11) was fixed and then used to find a section from point $m$ on the edge Li\textsubscript{1}/Cl,F via the point e “second projection” (Figure 8, b, d). The coordinates of the point e “first projection” (Figure 8, d) were used to search the quaternary eutectic coordinates on the tetrahedron section from LiCl top via the e “first projection” (Figure 8, e). With these data it is very convenient to estimate an accuracy of the quaternary eutectic coordinates, if to interpret them as the ruled hypersurfaces sections. The points $g$ and $f$ of the first section is to be chosen an the “faces” borders of the same IJ (here DC) ruled hypersurface (Figure 8, f; 9, a). It means that $D_{g}$ and $D_{f}$ rays

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intersect 6b and 6a ternary liquidus curves (not be or ae liquidus curves within the tetrahedron). In this case two ruled hypersurfaces DC-A and DC-B (Figure 9, b, c) have on the gf section a mutual point r that belongs to their mutual generating simplex DC e (in its lowest position). Next section mr may begin at any point m on the generating segment D66 projection of DC ruled hypersurface (Figure 10, a). Within the space of DC hypersurface it doesn’t cut neither DC-A, nor DC-B hypersurfaces and permits to fix a point Dc-e on the horizontal line Dc-e as an intersection of DC ruled hypersurface with the horizontal hyperplane e (Figure 10, a, d). As a result of gf and mr sections an accuracy in Dc-e point coordinates may be estimated in the same way as for the ternary eutectic E determination by the bc and A(A-E) sections (Figure 4, d, f). On the D(Dc-e) section (Figure 11, a) a quaternary eutectic ε is fixed as the liquidus D and horizontal e hyperplane intersection. Its accuracy may be given as a 3-dimensional hexahedron with the two faces of efgh type (Figure 4, f).

**Figure 11.** Dε section details of system Li//Cl,F,MoO₄,VO₃: a) p_dε section of AC-B ruled hypersurface with dAdCa generating simplex (in its highest position), de directing curve and A_dA_e, C_dC_e directing lines; b) p_2_dε section of CA ruled hypersurface with C_2 generating segment (in its highest position), 2bdc directing surface and C_2C_e directing line; c) liquidus C hypersurface and liquidus 2bde surface & de curve as the directing elements for CA and AC-B ruled hypersurfaces; d) Dp section of liquidus D, C hypersurfaces, ruled CA, AC-B hypersurfaces and horizontal e_e solidus hyperplane; e) Dp section of L+D, L+C, L+A+C, L+A+B+C, A+B+C+D phase regions
CONCLUSIONS

Before to use in practice or to place in the data bank the information on the low-melting salt mixture coordinates one needs to evaluate the accuracy of these experimental results. A lot of invariant points coordinates in the multicomponent salt systems have been got with the help of the so-called projection method of the thermal analysis. It means to use the specially chosen vertical section of the multidimensional phase diagrams and to fix there a direction for the next polythermal section or to find an invariant point projection as the cross-section of two generating simplexes of the ruled (hyper)surfaces. As a result a data evaluation means to estimate every time the errors of the used point concentration coordinates.

Besides the invariant points coordinates evaluation as a polyhedron (hyper)volume of the same dimension as the concentration simplex, the additional recommendations have been formulated to get the more accurate data. An idea to standardize this procedure for data determined by polythermal sections of isobaric diagrams of the melting has been discussed. For the first time it was formulated for the ternary diagrams (7). In the quaternary diagrams a similar technique based on the same schemes has been used to evaluate a space of possible errors for the invariant points. Some ideas have been elaborated to simulate model diagrams and to analyze their vertical sections before the investigation of real multicomponent systems (10).

In many cases all hypersurfaces of the multidimensional phase diagram may be depicted by one-dimensional linear (additive) contour and simulated as the skewed hyperplanes of different types. When it is a diagram's ruled hypersurface, its generating simplex is parallel with the diagram's base. When liquidus, solidus and solvus hypersurfaces were approximated, then generating simplex of skewed hyperplane wasn't horizontal. In T-x-y-z diagrams two types of the skewed hyperplanes are used: with one-dimensional and with two-dimensional generating simplexes. For the unruled hypersurfaces (like liquidus etc.) it is a six-power equation derived when one-dimensional simplex slides along two skewed planes of the four-dimensional space. The same equation (but with some zero coefficients) simulates the ruled hypersurface, generated by a horizontal segment of three-phase equilibrium in binary system. An equation of third power for skewed hyperplane with two-dimensional generating simplex and three directing lines simulates other type of ruled hypersurface produced by four-phase equilibrium in ternary system. Its x-y-z projection resembles a trigonal prism or truncated pyramid with five faces.

Concentration coordinates of invariant points in salt systems have been determined by different technique of thermal analysis. For each technique, these data may be evaluated by the vertical sections of the model phase diagram, across the invariant point neighborhood. As main results in the T-x-y-z diagrams have been received by the standard method, when the first vertical section fixes a cut of two ruled hypersurfaces generating plane (in its lowest position I6) and next sections determine the intersections of the horizontal solidus hyperplane with the ruled hypersurface (with one-dimensional generating segment) and liquidus hypersurface, they may be easily standardize.
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