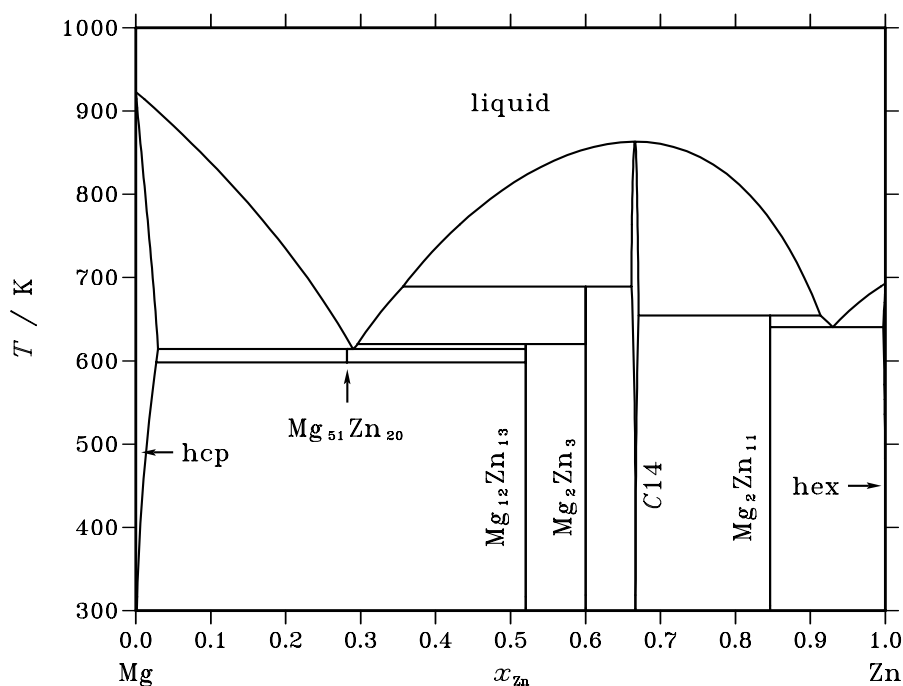


Mg – Zn (Magnesium – Zinc)**Fig. 1.** Calculated phase diagram for the system Mg-Zn.

The Mg-Zn system is of interest for the development of high strength aluminium-base alloys. A compilation of experimental data for the Mg-Zn system has been published by [88Cla]. The thermodynamic parameters of the Mg-Zn system have been first derived by [92Aga]. The subsequent update by [98Lia] is recommended since it reproduces various experimental data such as phase diagram, enthalpy of mixing, heat capacity and chemical potential very well and also takes into account the homogeneity range of the *C14* Laves phase (MgZn_2). The large positive deviation from Neumann-Kopp's rule derived by [92Aga] from the temperature dependence of the enthalpy of mixing of the liquid has been confirmed through the measurement of heat capacity [98Lia] and, very recently by calculations using a statistical thermodynamic theory [01Jha]. However, the description should not be used at temperatures above 3000 K, where an inverse miscibility gap in the liquid phase starts to develop.

The liquid, hcp, and hex-Zn phases are modelled as simple substitutional solutions, the *C14* Laves phase is described by a two-sublattice model whereas $\text{Mg}_{51}\text{Zn}_{20}$, $\text{Mg}_{12}\text{Zn}_{13}$, Mg_2Zn_3 , and $\text{Mg}_2\text{Zn}_{11}$ are treated as stoichiometric phases.

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(\text{Mg},\text{Zn})_1$
hcp	A3	Mg	<i>hP2</i>	$P6_3/mmc$	HCP_A3	$(\text{Mg},\text{Zn})_1$
$\text{Mg}_{51}\text{Zn}_{20}$	D7 _b	Ta ₃ B ₄	<i>oI14</i>	$Immm$	D7B_MG7ZN3	$\text{Mg}_{51}\text{Zn}_{20}$
$\text{Mg}_{12}\text{Zn}_{13}$	...	...	...	...	MGZN	$\text{Mg}_{12}\text{Zn}_{13}$
Mg_2Zn_3	...	...	<i>mC110</i>	$C2/m$	MG2ZN3	Mg_2Zn_3
<i>C14</i>	<i>C14</i>	MgZn_2	<i>hP12</i>	$P6_3/mmc$	C14_LAVES	$(\text{Mg},\text{Zn})_2(\text{Mg},\text{Zn})_1$
$\text{Mg}_2\text{Zn}_{11}$	D8 _c	$\text{Mg}_2\text{Zn}_{11}$	<i>cP39</i>	$Pm\bar{3}$	D8C_MG2ZN11	$\text{Mg}_2\text{Zn}_{11}$
hex	A3	Mg	<i>hP2</i>	$P6_3/mmc$	HCP_ZN	$(\text{Mg},\text{Zn})_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Zn}			$\Delta_{\text{r}}H / (\text{J/mol})$
liquid $\rightleftharpoons C14$	congruent	863.1	0.666	0.666		–13448
liquid + $C14 \rightleftharpoons \text{Mg}_2\text{Zn}_3$	peritectic	689.0	0.356	0.661	0.600	–1839
$C14$ + liquid $\rightleftharpoons \text{Mg}_2\text{Zn}_{11}$	peritectic	654.4	0.671	0.913	0.846	–5687
liquid $\rightleftharpoons \text{Mg}_2\text{Zn}_{11}$ + hex	eutectic	640.4	0.930	0.846	0.997	–7396
liquid + $\text{Mg}_2\text{Zn}_3 \rightleftharpoons \text{Mg}_{12}\text{Zn}_{13}$	peritectic	620.2	0.296	0.600	0.520	–1740
hcp + liquid $\rightleftharpoons \text{Mg}_{51}\text{Zn}_{20}$	peritectic	614.2	0.030	0.290	0.282	–5793
liquid $\rightleftharpoons \text{Mg}_{51}\text{Zn}_{20}$ + $\text{Mg}_{12}\text{Zn}_{13}$	eutectic	614.1	0.290	0.282	0.520	–5989
$\text{Mg}_{51}\text{Zn}_{20} \rightleftharpoons \text{hcp} + \text{Mg}_{12}\text{Zn}_{13}$	eutectoid	598.2	0.282	0.027	0.520	–204

Table IIIa. Integral quantities for the liquid phase at 973 K.

x_{Zn}	ΔG_{m} [J/mol]	ΔH_{m} [J/mol]	ΔS_{m} [J/(mol·K)]	G_{m}^{E} [J/mol]	S_{m}^{E} [J/(mol·K)]	ΔC_P [J/(mol·K)]
0.000	0	0	0.000	0	0.000	0.000
0.100	–3650	–1912	1.786	–1020	–0.916	1.544
0.200	–5926	–3445	2.550	–1877	–1.611	2.746
0.300	–7517	–4609	2.989	–2575	–2.090	3.604
0.400	–8545	–5398	3.234	–3100	–2.362	4.118
0.500	–9033	–5791	3.332	–3425	–2.432	4.290
0.600	–8951	–5751	3.289	–3506	–2.307	4.118
0.700	–8228	–5226	3.085	–3286	–1.995	3.604
0.800	–6738	–4150	2.659	–2690	–1.501	2.746
0.900	–4259	–2441	1.869	–1629	–0.834	1.544
1.000	0	0	0.000	0	0.000	0.000

Reference states: Mg(liquid), Zn(liquid)

Table IIIb. Partial quantities for Mg in the liquid phase at 973 K.

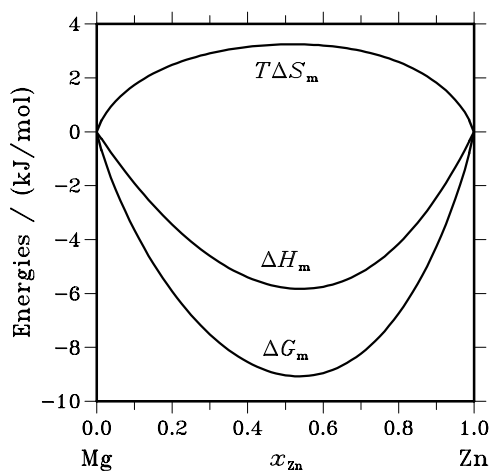
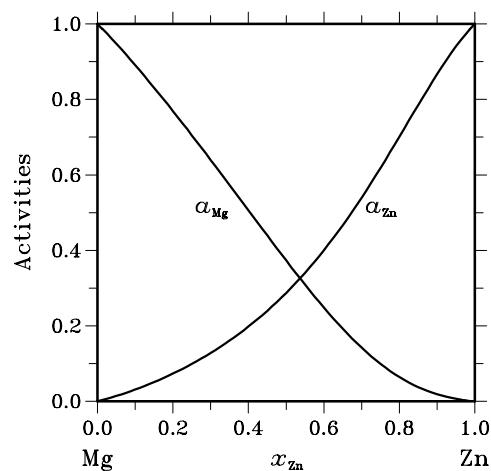
x_{Mg}	ΔG_{Mg} [J/mol]	ΔH_{Mg} [J/mol]	ΔS_{Mg} [J/(mol·K)]	G_{Mg}^{E} [J/mol]	S_{Mg}^{E} [J/(mol·K)]	a_{Mg}	γ_{Mg}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	–935	–192	0.764	–83	–0.112	0.891	0.990
0.800	–2126	–748	1.416	–321	–0.439	0.769	0.961
0.700	–3616	–1672	1.998	–731	–0.968	0.640	0.914
0.600	–5509	–3015	2.563	–1376	–1.684	0.506	0.844
0.500	–7975	–4872	3.189	–2367	–2.574	0.373	0.746
0.400	–11271	–7385	3.994	–3858	–3.625	0.248	0.621
0.300	–15790	–10741	5.189	–6049	–4.822	0.142	0.473
0.200	–22208	–15173	7.230	–9187	–6.152	0.064	0.321
0.100	–32193	–20960	11.544	–13565	–7.601	0.019	0.187
0.000	– ∞	–28426	∞	–19519	–9.155	0.000	0.090

Reference state: Mg(liquid)

Table IIIc. Partial quantities for Zn in the liquid phase at 973 K.

x_{Zn}	ΔG_{Zn} [J/mol]	ΔH_{Zn} [J/mol]	ΔS_{Zn} [J/(mol·K)]	G_{Zn}^{E} [J/mol]	S_{Zn}^{E} [J/(mol·K)]	a_{Zn}	γ_{Zn}
0.000	$-\infty$	−21077	∞	−11057	−10.298	0.000	0.255
0.100	−28080	−17388	10.989	−9452	−8.156	0.031	0.311
0.200	−21125	−14232	7.084	−8104	−6.298	0.073	0.367
0.300	−16619	−11461	5.301	−6879	−4.710	0.128	0.427
0.400	−13099	−8972	4.241	−5686	−3.378	0.198	0.495
0.500	−10090	−6710	3.474	−4483	−2.289	0.287	0.575
0.600	−7404	−4661	2.819	−3272	−1.428	0.400	0.667
0.700	−4987	−2863	2.183	−2101	−0.783	0.540	0.771
0.800	−2870	−1395	1.517	−1065	−0.339	0.701	0.877
0.900	−1155	−383	0.794	−303	−0.082	0.867	0.963
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Zn(liquid)

**Fig. 2.** Integral quantities of the liquid phase at $T=973$ K.**Fig. 3.** Activities in the liquid phase at $T=973$ K.**Table IV.** Standard reaction quantities at 298.15 K for the compounds per mole of atoms.

Compound	x_{Zn}	$\Delta_f G^\circ$ / (J/mol)	$\Delta_f H^\circ$ / (J/mol)	$\Delta_f S^\circ$ / (J/(mol·K))	$\Delta_f C_P^\circ$ / (J/(mol·K))
Mg ₅₁ Zn ₂₀	0.282	−4580	−4729	−0.500	0.000
Mg ₁₂ Zn ₁₃	0.520	−8773	−9479	−2.370	0.000
Mg ₂ Zn ₃	0.600	−10070	−10881	−2.720	0.000
C14	0.667	−10906	−11784	−2.944	0.036
Mg ₂ Zn ₁₁	0.846	−5255	−5678	−1.420	0.000

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