TALAT Lecture 3804

Superplastic Alloys

5 pages, 5 figures

Basic Level

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Objectives:

- to review briefly the commercially available superplastic aluminium alloys and to give their processing and service properties

Prerequisites:

- General background in production engineering and material science

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3804 Superplastic Alloys

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Examples of commercially available superplastic aluminium alloys

Figure 3804.00.01 shows a collection of common, commercially available superplastic aluminium alloys together with material numbers according to AA, DIN designation, trade names, forming parameters and fields of application. The general behaviour of the superplastic alloys in service or during further manufacturing steps resembles closely the behaviour of the base alloys or of the alloy group to which these alloys belong (see e.g. TALAT lecture 1501). Nevertheless, potential users are referred to details in manufacturers' brochures.

Designation AA -No.	Designation DIN	Trade name	Parameter for superplastic forming: Process temp. T°C	Parameter for superplastic forming: Strain rate $\dot{\varphi}$ (s^{-1})	Remarks
AA 2004	AlCu6Zr0,4	Supral 100/150	450	10^{-3}	for uncritical parts in service
	AlCu6Mg0,35	Supral 220	450	10^{-3}	highest variant not qualified for primary structure
AA 5083	AlMg4,5Mn	Supral5083 Formall545 5083 SPF	350-450 490-530	10^{-3}	Used for facade elements, auto-mobile parts, uncritical parts, mass-produced sheets
AA 7475	AlZnMgCu1,5	Formall 700	500-515	10^{-4}	Use for primary structure possible, mass-produced sheets
AA 8090	AlLiCuMgZr	Lital	510-545	10^{-3}	Together with diffusion bonding

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Forming conditions

Figure 3804.00.02, Figure 3804.00.03, Figure 3804.00.04 and Figure 3804.00.05 show the forming temperature, logarithmic strain rate, elongation to fracture and mechanical properties for the alloys AA 2004 SPF, AA 5083 SPF, AA 7475 SPF and AA 8090 SPF.

Forming Conditions and Properties of AA 2004 SPF

Forming temperature:	450 - 480 °C
Logarithmic strain rate:	10^{-3} s^{-1}
Max. elongations:	ε = 700 % ($\dot{\varepsilon}$ = 10^{-3} s^{-1}) ε = 400 % ($\dot{\varepsilon}$ = 10^{-1} s^{-1})

Mechanical properties:	$R_{p0,2}$ N/mm²	R_m N/mm²	A_5 %
after forming in T6 condition	120	200	7
	300	420	5

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Forming Conditions and Properties of AA 5083 SPF

Forming temperature:	Formall 545	490 - 540 °C
	Suplastal 5083	350 - 450 °C
Logarithmic strain rate:	10^{-3} s^{-1}	
Max. elongations:	$\varepsilon = 300\ \%$ ($\dot{\varepsilon} = 10^{-3}$ s^{-1})	

Mechanical properties:	$R_{p0,2}$ N/mm²	R_m N/mm²	A_5 %
In as-formed condition	150	300	20

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Forming Conditions and Properties of AA 7475 SPF

Forming Temperature:	500 - 540°C
Logarithmic strain rate:	$5 \times 10^{-4}\ s^{-1}$
Max. elongation:	$\varepsilon = 450\%$ $(\dot{\varepsilon} = 5 \times 10^{-4}\ s^{-1})$

Mechanical properties:	$R_{p0.2}$ N/mm²	R_m N/mm²	A_5 %
In T6 condition	520	575	10

Forming Conditions and Properties of AA 8090 SPF

Forming Temperature:	510 - 545°C
Logarithmic strain rate:	5×10^{-3} - $10^{-2}\ s^{-1}$
Max. elongation:	$\varepsilon = 600\%$ $(\dot{\varepsilon} = 5 \times 10^{-3}\ s^{-1})$ $\varepsilon = 420\%$ $(\dot{\varepsilon} = 10^{-2}\ s^{-1})$

Mechanical properties:	$R_{p0.2}$ N/mm²	R_m N/mm²
In T6 condition	380	490

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