Progress in aluminium heat treatment – cooling technologies
- a cylinder head industrial application

BELTE AG

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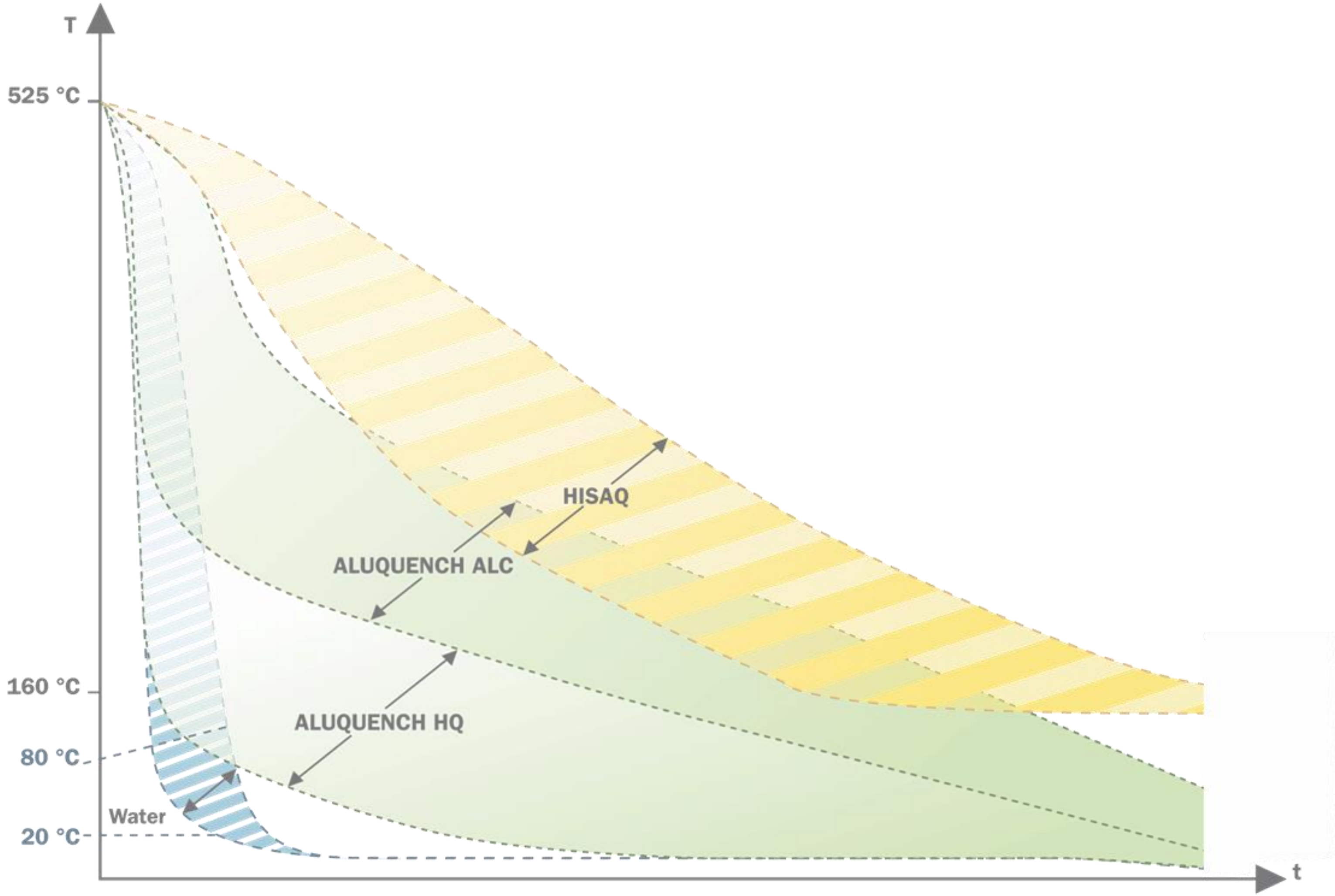
most commonly used heat transfer techniques by BELTE AG

- Water
- Polymer (ALUQUENCH®)
- Air (HISAQ®)



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most commonly used heat transfer techniques by BELTE AG

forced air cooling automatic equipment

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most commonly used heat transfer techniques by BELTE AG

water & polymer cooling automatic equipment

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most commonly used heat transfer techniques – SWOT Analysis

water cooling

Strengths
highest level of mechanical strength
lowest cost level
high packing density

Weaknesses
highest level of residual stress

Opportunities
universal available

Threats
high level of distortion especially for thin walled structure parts

Polymer cooling

Strengths
high level of mechanical strength
high packing density
low level of residual stress

Weaknesses
subsequent washing necessary

Opportunities
reduction of distortion by a high level of mechanical strength

Threats

forced air cooling (High Speed Air Cooling)

Strengths
reduction of distortion
highest reduction of the level of residual stress

Weaknesses
low packing density

Opportunities
for parts requiring very low level of residual stress or for large parts having an intricate geometry

Threats
the mechanical strength is much lower in comparison with a similar HT
with water or polymer cooling

practical results – cylinder head

Tabelle 1: Mechanische Eigenschaften der AlSi10Mg-Bauteile in Abhängigkeit vom Abschreckverfahren

Abschreckmedium	*Dehngrenze $Rp_{0,2}$ in MPa*	*Zugfestigkeit R_m in MPa*	*Dehnung A in %*
Wasser	225-235	280-295	>5
Polymer	225-235	280-295	>5
Luft	160-180	240-250	>6

Source: Belte, Dragulin a.o; Giesserei 12/2009

$$\sigma_A = \frac{1 - M * R}{8 * M(1 + M)} * R_m$$

Beleg nach (Stroppe 2009)

σ_A - Schwingfestigkeit
M - Mittelspannungsempfindlichkeit aller Al-Legierungen $\approx 0{,}25 + 8 * 10^{-4} * R_m$ [MPa]
R - Spannungsverhältnis (Unter- und Oberspannung)

Source: literature

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practical results – cylinder head

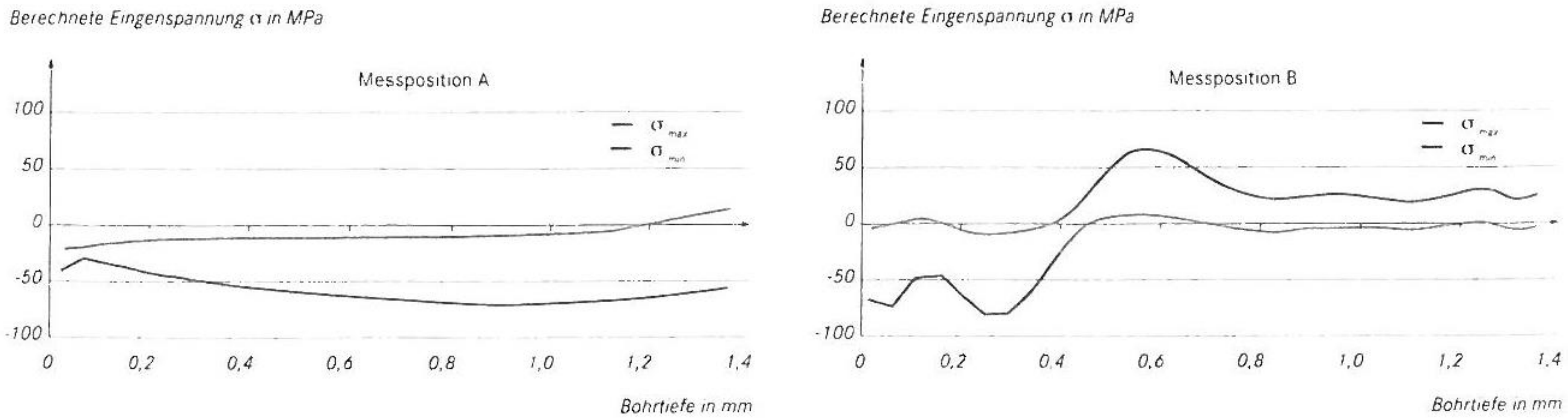

Bild 3: Eigenspannungen des AlSi10Mg-Bauteils in Abhängigkeit von der Messposition und der Bohrtiefe bei Wasserabschreckung

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Source: Belte, dragulin a.o; Giesserei 12/2009

practical results – cylinder head

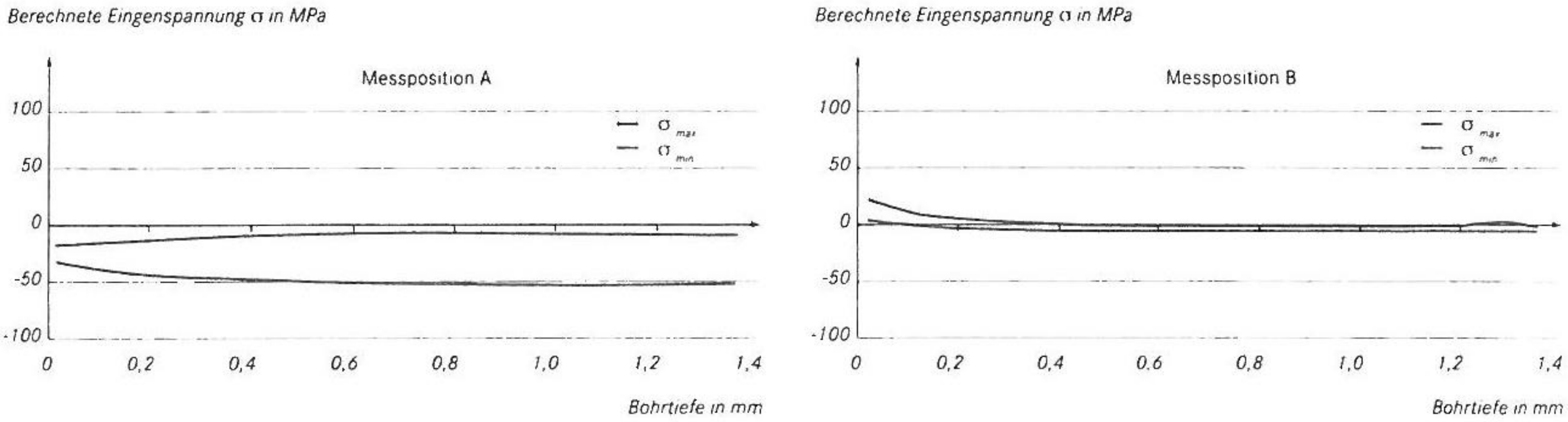

Bild 4: Eigenspannungen des AlSi10Mg-Bauteils in Abhängigkeit von der Messposition und der Bohrtiefe bei Polymerabschreckung

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Source: Belte, dragulin a.o; Giesserei 12/2009

practical results – cylinder head

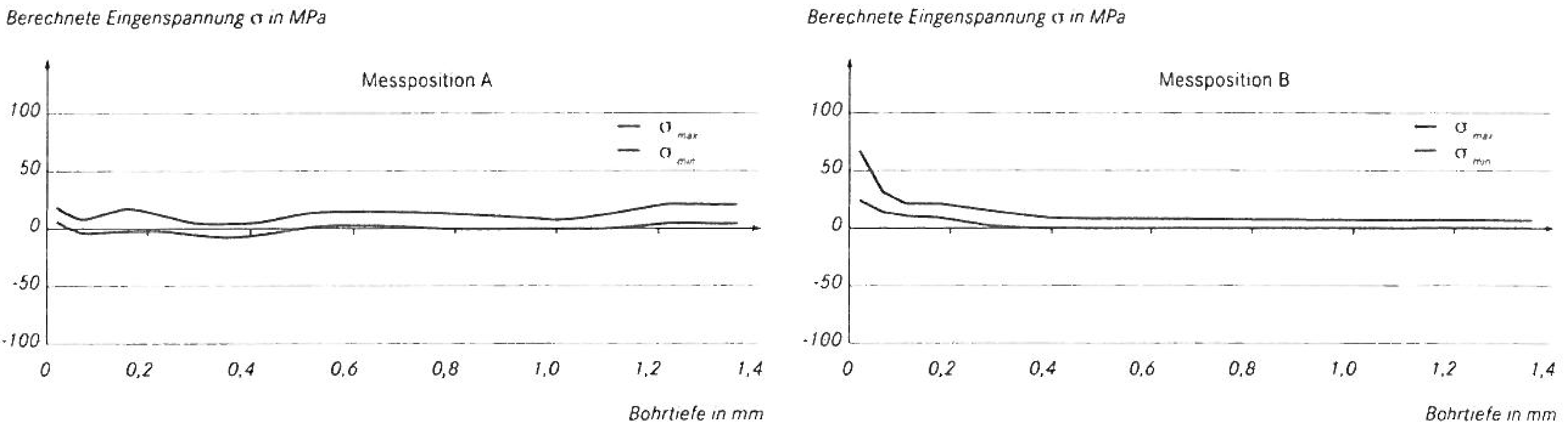

Bild 5: Eigenspannungen des AlSi10Mg-Bauteils in Abhängigkeit von der Messposition und der Bohrtiefe bei Luftabschreckung

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Source: Belte, dragulin a.o; Giesserei 12/2009

Thank you