4.5 Processing and property links

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS heat treatment • solidification

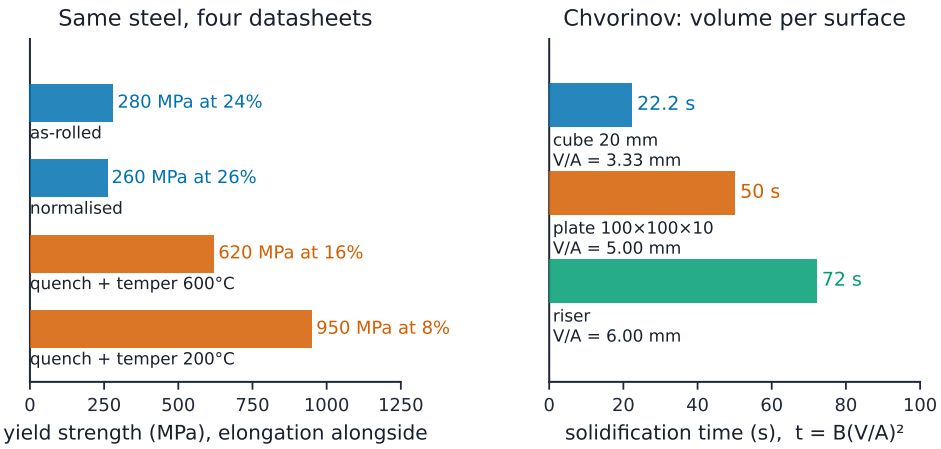
Objective

Predict property changes from processing: the heat-treatment menu, Chvorinov's freezing clock, and riser sizing by V/A.

1 Key knowledge and worked examples

■ The process map

Routes (MPa / %): 280/24, 260/26, 620/16, 950/8. Chvorinov $t = B(V/A)^2$ - volume over cooling surface, squared.



*The furnace writes the datasheet

■ Worked example. The clock

$B = 2.0 \times 10^6$: 20 mm cube 22.2 s; 100×100×10 plate 50.0 s - the $(V/A)^2$ ratio 2.25 exactly ✓; a $V/A = 6$ mm riser holds 72.0 s ✓.

2 Practice

A foundry runs $B = 1.8 \times 10^6$ s/m^2.

2.1 A cylinder 30 mm diameter × 60 mm long: V/A (mm, one decimal) and freezing time (one decimal, s). [4]

2.2 A bar 40×40×160 mm: V/A (three decimals, mm) and freezing time (one decimal, s). [4]

2.3 Which solidifies last, and what does that imply for placing the riser? [2]

2.4 For the impact-loaded mount bracket, choose as-rolled (280 MPa / 24%) or quenched + tempered 600°C (620 / 16%) with one sentence of reasoning. [4]