



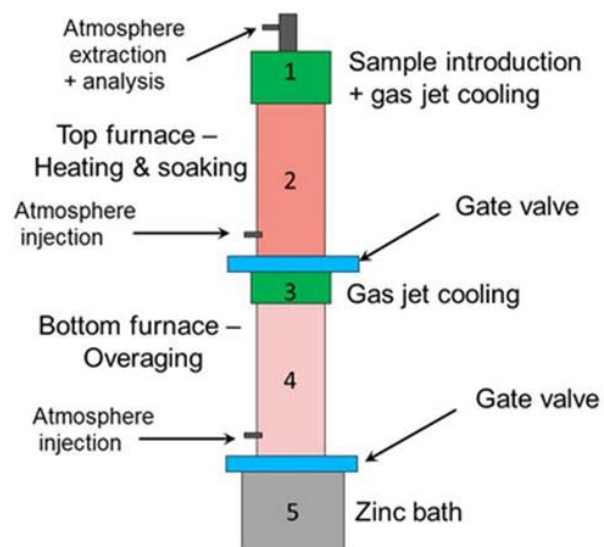
ZCO-76 : Hydrogen behaviour and effects in advanced HSS

May 11th – 12th – Nashville, USA
May 16th – 17th Rüsselsheim, Germany

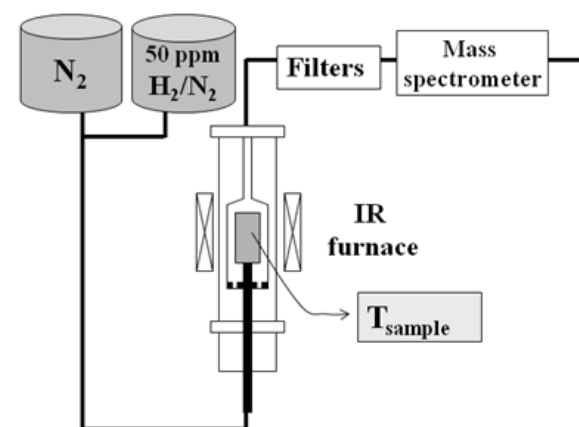
Working plan

- ⌘ Validation of the previous model
- ⌘ Steel selection
- ⌘ Effect of jet cooling on hydrogen pick-up
- ⌘ Galvannealing effects on hydrogen content
- ⌘ Effect of coating nature
- ⌘ Mechanical performance

Used equipments



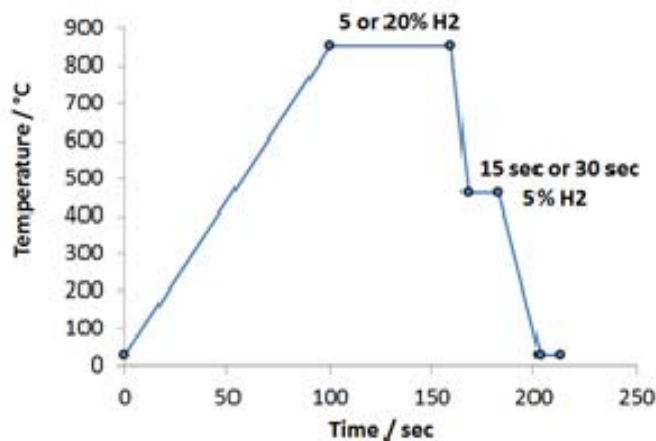
Multidip simulator



Hydrogen measurement

Task 1 validation of the previous model

⌘ Proposed work : one Rhesca campaign (multidip simulator of CRM Group) with a fully austenitic TWIP steel → comparison with results obtained on DP grades



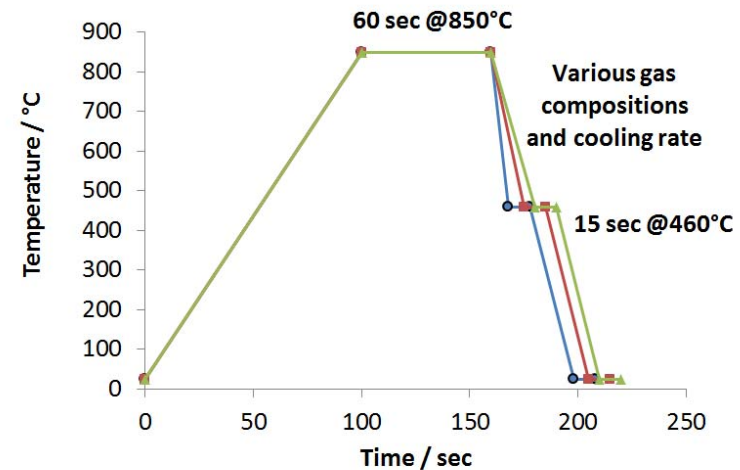
- No zinc due to wetting issues
- Which sponsor could provide the steel ?

Task 2 Steel selection

- ⌘ Proposal work on three grades
 - ⌘ DP980-1000
 - ⌘ DP >1000
 - ⌘ HSS with retained austenite : bainite or martensite based ? Q&P ? CFB ? Other ?
- ⌘ Thickness ~ 1mm → ideally similar for both grades
- ⌘ Which sponsor could provide?

Task 3 Effect of gas jet cooling on H pick-up

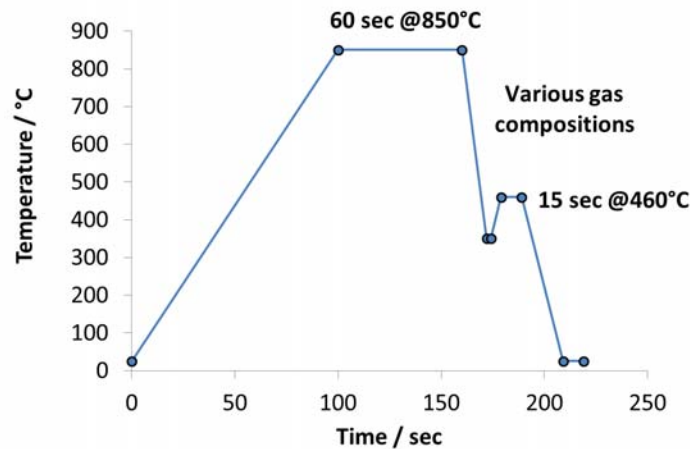
- ⌘ Annealing conditions could depend on the provided grades
- ⌘ 20 (pure H₂) to 50°C/sec (0 to 20% H₂ in N₂)
- ⌘ OA – 15sec ? 30 sec ?
- ⌘ Direct quench in Liq N₂
- ⌘ TDA measurements



Example of DP cycle

Task 3 Cycles could be different for other microstructure

- ⌘ Thermal cycle to be defined
- ⌘ Retained austenite determined by XRD



Example of 3G cycle

Role of oxides will also be studied : surface analyses, maybe special thermal treatment to generate oxides

Task 4 Galvannealing effect

- ⌘ Generation of GI, bare and GA samples under various conditions
- ⌘ Annealing under 20%H₂ to maximize the H₂
- ⌘ Measurements on coated samples after 24h – 3 days and 1 week

Flat or strained samples ?



Task 5 effect of the coating nature

- ⌘ Effect on the H absorption and after corrosion exposition
- ⌘ Comparison between GI, GE and ZnAlMg coating → which composition ?
- ⌘ Corrosion cycle ? SAE J2334 cycling test?

Stage	Description
1 - Humid	6 hours at 50° C under 100% of relative humidity
2 - salt dip	15 minutes at 25° C in a 0.5% NaCl + 0.1% CaCl ₂ + 0.075% NaHCO ₃
3 - Dry	17 hours 45 minuts at 60° C under 50% of relative humidity

Task 6 Mechanical tests

- ⌘ Tests after H2 introduction (annealing or corrosion)
- ⌘ Definition of the tests (punched hole (SEP1970), four points bending ?)



Scheduled timetable

Activity	Semester					
	1	2	3	4	5	6
Validation of the previous model	x	x				
Effect of Jet Cooling on Hydrogen Pickup + modelling	x	x	x	x		
Galvannealing Effects on Hydrogen Content		x	x	x	x	x
Effects of Coating Type				x	x	x
Mechanical performances				x	x	x
Reporting and travel	x	x	x	x	x	x