

1.	INTRODUCTION.....	26
1.1.	Motivation.....	26
1.2.	Introduction on metal hydride cooling systems.....	28
1.3.	Literature review and background.....	30
1.3.1.	State of the art of the technology.....	30
1.3.2.	Mathematical models.....	31
1.4.	Objectives.....	33
1.5.	Structure.....	34
2.	EXPERIMENTAL SET-UP.....	37
2.1.	P-C-T equilibrium measurements.....	38
2.1.1.	Description of the P-C-T set-up.....	38
2.1.1.	Measurement procedure.....	39
2.1.1.	Uncertainty of the measurements.....	42
2.2.	Thermally driven system.....	43
2.2.1.	Description and technical specifications.....	43
2.2.1.	Operation of the system.....	46
2.2.2.	Uncertainty of the measurements.....	48
3.	PROPERTIES OF METAL HYDRIDES.....	54
3.1.	Brief description of the sorption reaction.....	54
3.2.	Classification of metal hydrides and properties.....	55
3.3.	Ideal phase diagrams.....	59
3.4.	Thermodynamics of sorption reactions.....	61
3.5.	Hysteresis.....	63
3.6.	Specific heat.....	65
3.7.	Effective thermal conductivity.....	66
3.8.	Mechanical and chemical treatment	70

4.	EQUILIBRIUM P-C-T CHARACTERIZATION.....	76
4.1.	Theoretical background.....	76
4.1.1.	Plateau region.....	78
4.1.1.	Overall P-C-T models.....	79
4.1.1.1.	Smoothed Zhou model.....	79
4.1.1.2.	Lacher-Lototsky model.....	81
4.1.1.3.	Polynomial fitting method.....	82
4.2.	Experimental results.....	83
4.3.	Model adjustment.....	85
4.3.1.	Plateau region.....	85
4.3.1.	Overall P-C-T models.....	86
4.3.1.1.	Smoothed Zhou model.....	87
4.3.1.2.	Lacher-Lototsky model.....	89
4.3.1.3.	Polynomial fitting method.....	91
4.4.	Conclusions on the P-C-T models.....	93
5.	INTRINSIC REACTION KINETICS.....	97
5.1.	Introduction.....	97
5.2.	Experimental campaign.....	99
5.3.	Intrinsic kinetic model.....	101
5.4.	Results.....	101
5.4.1.	Alloy B3.....	102
5.4.2.	Alloy A3.....	105
5.5.	Conclusions on the intrinsic reaction kinetics.....	108
6.	DESCRIPTION OF THE DYNAMIC MODEL.....	112
6.1.	Introduction.....	112
6.2.	Governing equations.....	114

6.2.1.	Heat and mass transfer equations.....	115
6.2.2.	P-C-T equilibrium correlation.....	122
6.2.3.	Hysteresis.....	124
6.3.	Solver.....	126
7.	VALIDATION OF THE DYNAMIC MODEL.....	131
7.1.	Introduction.....	131
7.2.	Validation of the model with experimental tests.....	133
7.2.1.	Reactors A1-B1.....	133
7.2.2.	Reactors A2-B2.....	135
7.2.3.	Reactors A3-B3.....	137
7.2.3.1.	Maximum cooling power tests.....	137
7.2.3.2.	Dynamic cooling tests.....	142
7.3.	Conclusions on the model validation.....	147
8.	OPTIMIZATION AND DESIGN OF THE MHCS.....	151
8.1.	Introduction.....	151
8.2.	Reference case.....	152
8.3.	Sensitivity analysis.....	154
8.3.1.	Regeneration temperature.....	154
8.3.2.	Chilled water temperature.....	157
8.3.3.	Cycle duration.....	159
8.3.4.	Initial hydrogen charge.....	162
8.3.5.	Water heat transfer.....	164
8.3.6.	Intrinsic reaction kinetics.....	165
8.3.7.	Effective thermal conductivity.....	166
8.3.8.	Reaction enthalpy.....	167
8.4.	Optimised metal hydride cooling system.....	169

8.4.1. Optimal operating conditions.....	170
8.4.2. Modification of the alloy properties.....	172
8.5. Conclusions on the optimization results.....	174
9. CONCLUSIONS.....	178
REFERENCES.....	183