

Contents

Nomenclature and Abbreviations	iii
1 Introduction	1
2 State of the Art	5
2.1 Direct hot extrusion of aluminum	5
2.1.1 Fundamentals	5
2.1.2 Die design	10
2.1.3 Aluminum alloys	15
2.1.4 Microstructure of extruded aluminum alloys	18
2.1.5 Quality of longitudinal seam welds	20
2.2 Recycling of aluminum scrap	24
2.2.1 Material losses	25
2.2.2 Sources of scrap	25
2.2.3 Economics of scrap recycling	26
2.3 Reuse of aluminum chips by hot extrusion	27
2.3.1 Static mechanical properties of the extruded profiles from chips	30
2.3.2 Fatigue properties of the extruded profiles from chips	34
2.3.3 Formation of air blisters	36
2.3.4 Composites from aluminum chips	37
2.4 Severe deformation processes	38
2.5 Summary	41
3 Research aim and objectives	43
4 Experimental analysis of hot extrusion of chips	45
4.1 Experimental equipment	46
4.2 Effect of process parameters on extrudate's mechanical properties	50
4.2.1 Effect of chip type	50
4.2.2 Effect of extrusion ratio	57
4.2.3 Effect of die design	59
4.2.4 Effect of heat treatment	72
4.2.5 Effect of temperature	74
4.2.6 Effect of profile speed	77
4.2.7 Effect of contamination from machining fluids	80
4.3 Dynamic properties of profiles recycled from chips	81
5 Analytical approaches for mechanism of chip welding	87
5.1 Evolution of microstructure	87
5.2 Mechanism and quality of chip welding	91

6	Elimination of air blisters in newly developed hot extrusion process	101
7	Energy gain through recycling by hot extrusion	111
7.1	Energy requirement for primary aluminum	111
7.2	Energy requirement for secondary aluminum.....	113
7.3	Energy requirement for recycling by hot extrusion	114
7.4	Energy comparison for profiles from three different sources.....	117
8	Innovative new approaches in hot extrusion aluminum chips	119
8.1	Production of functionally graded profiles	119
8.2	Production of ferromagnetic aluminum.....	122
8.3	Increasing of thermal conductivity by design of a composite extrudate from aluminum and copper chips	124
8.4	Recycling other types of aluminum scrap	127
9	Conclusions	129
	References	131
	Curriculum Vitae	141