Table of contents Abstract i Kurzfassung ii Acknowledgements iii Table of contents \mathbf{v} Index of author's publications vii List of research papers in this dissertation ΧÌ Declaration of own contribution to the research papers xiii Declaration of authorship XVNomenclature xvii Part one: Synopsis 1 1 Introduction 3 1.1 Research background 3 1.2 State of the art 11 1.3 Research questions 14 1.4 Approach of the dissertation 15 2 Synthesis 21 2.1 Process development, simulation, and assessment 21 2.2 Carbonator modeling and design 30 2.3 Calciner modeling and design 36 2.4 Conclusion 39 2.5 Outlook 41 References 43 Part two: Research papers 57 Research Paper I 61 Research Paper II 75 Research Paper III 111



133

163

195

Research Paper IV

Research Paper V

Research Paper VI