

Smart technologies for waste processing from the automotive industry, Scientific Monograph of UNIVNET 2021

Contents

Smart technologies for waste processing from the automotive industry, Scientific Monograph of UNIVNET 2021	i
Introduction	v
1 Analysis of the quantities and processing capacities of waste generated in the automotive industry	2
1.1 Introduction.....	2
1.2 Main objectives of the study and methods.....	2
1.3 Needs of industry	3
1.3.1 Results of the first contact with producers.....	4
1.3.2 Identification of the groups of waste types and results of the second contact with producers	4
1.4 Processing capacities	12
1.4.1 Data analysis from the form Report on the processing of old vehicles	12
1.5 Conclusions and recommendations	14
1.6 Bibliography	16
2 Trends of structural effects of electromobility on the economy of the Slovak Republic and the potential of waste for the circular economy	18
2.1 Introduction.....	18
2.2 Specific features of circular economy in the automotive industry, main factors and consequences of technological changes for the economy of the SR	19
2.3 Circular economy in the automotive industry.....	21
2.4 Electromobility challenges for Europe and SR.....	22
2.5 LCC and emissions	26
2.6 Analysis of trends in the development of inputs and production multipliers in the Slovak automotive industry	29
2.6.1 Intensity of inputs in an international context.....	30
2.6.2 Trends in the development of input coefficients and production multipliers in the automotive industry through 2025.....	33
2.7 Research and development as the source of innovation potential of the sub-contractors in the Slovak automotive industry	37
2.7.1 Global value chains in the automotive industry.....	37
2.7.2 Research methodology	41
2.8 Bibliography	43

3 SmartWaste III. – Integrated information and innovation platform of recycling technologies	48
3.1 Introduction.....	48
3.2 The concept of “preparation for re-use” and re-use in the policy and legal acts of the EU	49
3.3 Preparing for re-use and re-use in the conditions of the Slovak Republic.....	53
3.4 Conclusion	58
3.5 Bibliography.....	59
4 Recycling of laminated glass – Construction of line modules for the decomposition of multilayer laminated glass.....	62
4.1 Introduction.....	62
4.2 Design of laminated glass recovery technology.....	63
4.3 Structural design of individual modules	63
4.3.1 Receiving module.....	63
4.3.2 Breaking module	65
4.3.3 Vibration module.....	66
4.3.4 Stripping module.....	67
4.4 Production of individual modules	68
4.4.1 Receiving module.....	68
4.4.2 Breaking module	69
4.4.3 Vibration module.....	70
4.4.4 Stripping module.....	70
4.5 Variant solution of the line.....	73
4.5.1 Minimum configuration of the line	73
4.5.2 Line configuration with feeder module.....	76
4.5.3 Line configuration with two vibrations – shaking modules.....	77
4.5.4 Vertical arrangement of the line.....	79
4.5.5 Extended arrangement of the line.....	81
4.6 Conclusion	81
4.7 Bibliography.....	83
5 Extraction of valuable components from the discarded lithium accumulators from electric vehicles.....	86
5.1 Introduction.....	86
5.2 Work progress design.....	86
5.3 Experimental part.....	90
5.4 Conclusion and proposal of further action.....	100
5.5 Bibliography.....	102
6 Development of materials and products with sound and thermal insulating and other properties on the basis of waste from the automotive industry	106
6.1 Introduction.....	106

6.2	The selection of components and their materials which would be suitable for our needs	106
6.2.1	Tires and rubber and the resulting recycled rubber granulate.....	106
6.2.1.1	Properties of the rubber granulate	108
6.2.1.2	Rubber materials used for experimental purposes	109
6.2.1.3	Textile material.....	110
6.2.1.4	Materials used for experimental purposes.....	113
6.2.2	Glass.....	115
6.3	The research of bulk materials of various fractions for the development of sound and heat insulating products	118
6.4	Development and production of test cartridges for the purpose of testing of the selected acoustic properties of bulk materials	121
6.4.1	Design and production of test cartridges for the extension of measurement possibilities of bulk materials from the end-of-life vehicles with the use of 3D printing and CNC technology	121
6.4.2	Practical application of the cartridges.....	124
6.5	Development and production of the device for the filling of test cartridges.....	124
6.6	Results of the acoustic properties measurements of bulk materials and comparison with the same material composition.....	127
6.6.1	Results of the measurement of reference samples	127
6.6.2	Measurement results of materials on the basis of recycled rubber granulates	129
6.6.3	Measurement results of recycled textile materials.....	137
6.7	Development and manufacture of the product based on bulk materials.....	140
6.8	Research activities of the authors	142
6.9	Conclusion	143
6.10	Bibliography	144
7	Research of the properties or new wooden composites containing waste polymers from cars	148
7.1	Introduction.....	148
7.2	Evaluation of the waste tire eco-toxicity	150
7.3	Evaluation of the safety of waste polymers in terms of the effect on water and soil with the use of biotests	151
7.4	Preparation of composites.....	152
7.5	Properties of the composites – fire performance	153
7.6	Properties of the composites – heat insulation.....	155
7.7	Business plan concept for the production of wood-plastic boards in the context of circular economy	157
7.8	Bibliography	166
8	Implementation of the pyrolysis reactor for energy recovery of waste from the automotive industry	172

8.1	Introduction	172
8.2	Pyrolysis.....	172
8.3	Conceptual design of a device for energy recovery of waste from the automotive industry	175
8.3.1	Technologies necessary for gasification and pyrolysis	177
8.3.2	Crushing, transportation, and dosing equipment.....	178
8.3.3	Gasification and pyrolysis equipment	179
8.3.4	Devices for the treatment and use of the synthesis gas	179
8.3.5	Conceptual design of a small complex device for the energy recovery of plastic waste	180
8.4	Laboratory experimental device.....	182
8.4.1	Location of the experimental device	182
8.4.2	Experimental reactor - original design	184
8.4.3	Condensation exchanger	187
8.4.4	Experimental reactor – implementation	194
8.4.5	Material preparation for pyrolysis – shredding device.....	197
8.5	Conclusion	198
8.6	Bibliography.....	199
	Smart technologies for waste processing from the automotive industry, Scientific Monograph of UNIVNET 2021	203
	List of Figures	203
	List of Tables.....	207
	List of Charts	208