

Contents

	Page
List of Tables	ix
List of Figures	xi
Abbreviations	xv
Symbols	xv
1 Introduction	1
1.1 Antibiotics in the environment.....	1
1.2 Objectives and Experimental approach	2
1.3 Thesis outline	4
2 Transport and transformation of sulfadiazine in soil columns packed with a silty loam and a loamy sand	5
2.1 Objectives.....	5
2.2 Introduction.....	5
2.3 Materials & Methods	7
2.3.1 Experimental set-up	7
2.3.2 Analytics of sulfadiazine and transformation products	9
2.3.3 Theory of solute transport.....	14
2.4 Results & Discussion	17
2.5 Conclusions.....	27
3 Transport of sulfadiazine in undisturbed soil columns: the effect of flow rate and applied mass	29
3.1 Objectives.....	29
3.2 Introduction.....	29
3.3 Material & Methods	32
3.3.1 Soil.....	32
3.3.2 Analytics of sulfadiazine and transformation products	34
3.3.3 Theory of solute transport.....	35
3.4 Results & Discussion	40
3.4.1 Chloride Breakthrough Curves.....	40
3.4.2 ¹⁴ C Breakthrough Curves.....	41
3.4.3 Transformation of Sulfadiazine	44
3.4.4 Modeling Results	45
3.4.5 Fitting the BTCs of SDZ and its transformation products for experiment C	50

3.4.6	Simultaneous fitting of the steady-state flow experiments	51
3.5	Conclusions	56
4	Transport of manure-based applied sulfadiazine and its main transformation products in soil columns	57
4.1	Objectives	57
4.2	Introduction	57
4.3	Materials & Methods	60
4.3.1	Experimental set-up	60
4.3.2	Analytics of sulfadiazine and transformation products	64
4.3.3	Theory of solute transport	66
4.4	Results and Discussion	69
4.4.1	Chloride breakthrough curves	69
4.4.2	¹⁴ C breakthrough curves and concentration profiles	71
4.4.3	Breakthrough curves of SDZ and its transformation products	74
4.4.4	BTC of the organic material	76
4.4.5	Modeling Results	78
4.5	Conclusions	85
5	Final Remarks	87
5.1	General discussion	87
5.2	The influence of soil properties	89
5.3	Description of profile data	90
5.4	Transport behavior of the transformation products	91
5.5	Comparison of the transport model for SDZ and its main transformation products with other existing models	92
5.6	General Conclusions	93
5.7	Outlook	94
6	References	95
7	Appendixes	105
7.1	Appendix A: Sulfadiazine and its transformation products	105
7.2	Appendix B: Soil Properties	108
7.3	Appendix C: Experimental Setup	109
7.4	Appendix D: Analysis of ¹⁴ C and the transformation products in liquid samples	111
7.5	Appendix E: Chemicals and Instruments	114