



## Content

<b>1</b>	<b>Introduction .....</b>	<b>1</b>
1.1	Motivation	2
1.2	Water containing fuels	5
1.3	Task description	7
<b>2</b>	<b>Fundamentals .....</b>	<b>9</b>
2.1	Microemulsions	9
2.1.1	Phase behaviour	10
2.1.2	Phase prism	11
2.1.3	$T(\gamma)$ -section	12
2.1.4	Efficiency	15
2.1.5	Technical grade surfactant	17
2.1.6	Temperature invariance	18
2.1.7	High pressure phase behaviour	19
2.1.8	Trajectory of the middle phase	20
2.1.9	Additives	21
2.1.10	Amphiphilic film	22
2.1.11	Compounds	25
2.2	Emulsions	28
2.2.1	Types of emulsions	29
2.2.2	Emulsification methods	30
2.2.3	Compounds	34
2.3	Microstructure and formation kinetics	37
2.3.1	Dynamic light scattering	37
2.3.2	Small angle neutron scattering	39
2.3.3	Formation kinetics	40
2.4	Combustion parameters	42
2.4.1	Diesel injection	46
2.4.2	Diesel spray atomisation	49
2.4.3	Internal combustion emissions	50
2.4.4	Aftertreatment	56

---

<b>3 Water Containing Fuels.....</b>	<b>61</b>
3.1 Water fuel microemulsions	61
3.1.1 Influence of $n$ -variation on the phase behaviour	62
3.1.2 Influence of $\delta$ -variation on the phase behaviour	64
3.1.3 Influence of $\varepsilon$ -variation on the phase behaviour	66
3.1.4 Influence of $\psi$ -variation on the phase behaviour	69
3.1.5 Influence of $\alpha$ -variation on the phase behaviour	71
3.1.6 Optimised systems	74
3.2 Physical properties	80
3.3 Microstructure	90
3.3.1 DLS-measurements	90
3.3.2 SANS-measurements	92
3.4 Stopped-flow measurement	95
3.5 Water fuel nanoemulsions	100
3.5.1 Aqueous phase	100
3.5.2 Dynamic light scattering	103
<b>4 Combustion Results .....</b>	<b>109</b>
4.1 On injector-blending	109
4.2 Microemulsion combustion experiments	112
4.2.1 NO <sub>x</sub> -emissions	113
4.2.2 Filter smoke number (FSN) and opacity	114
4.2.3 Particulate mass	116
4.2.4 Number of particle	117
4.2.5 Particulate matter composition	119
4.2.6 Unburnt hydrocarbons	120
4.2.7 Carbon monoxide and carbon dioxide	121
4.2.8 Spray behaviour	122
4.3 Nanoemulsion combustion experiments	127
4.3.1 NO <sub>x</sub> -emissions	127
4.3.2 Filter smoke number (FSN) and opacity	129
4.3.3 Unburnt hydrocarbons	130

---

4.3.4	Carbon monoxide and carbon dioxide	131
4.3.5	Scanning electron microscope (SEM)	132
4.4	Comparison of microemulsions and nanoemulsions	143
4.4.1	NO <sub>x</sub> -emissions	143
4.4.2	Filter smoke number (FSN) and opacity	144
<b>5</b>	<b>Summary .....</b>	<b>147</b>
<b>6</b>	<b>Experimental Section .....</b>	<b>151</b>
6.1	Chemicals	151
6.2	Measuring methods	152
<b>7</b>	<b>Appendix .....</b>	<b>169</b>
7.1	X-points and utilisable efficiency	169
7.1.1	Diesel fuel microemulsion	169
7.2	Physical properties	172
7.3	DLS-measurements	173
7.4	Combustion measurements	175
7.5	Corrosion-test	178
7.6	Scanning electron microscopy	179
7.7	Abbreviations and Symbols	181
7.8	Literature	186