Annex B. Experimental and Simulation Results Obtained from Gaseous Fuel Tests

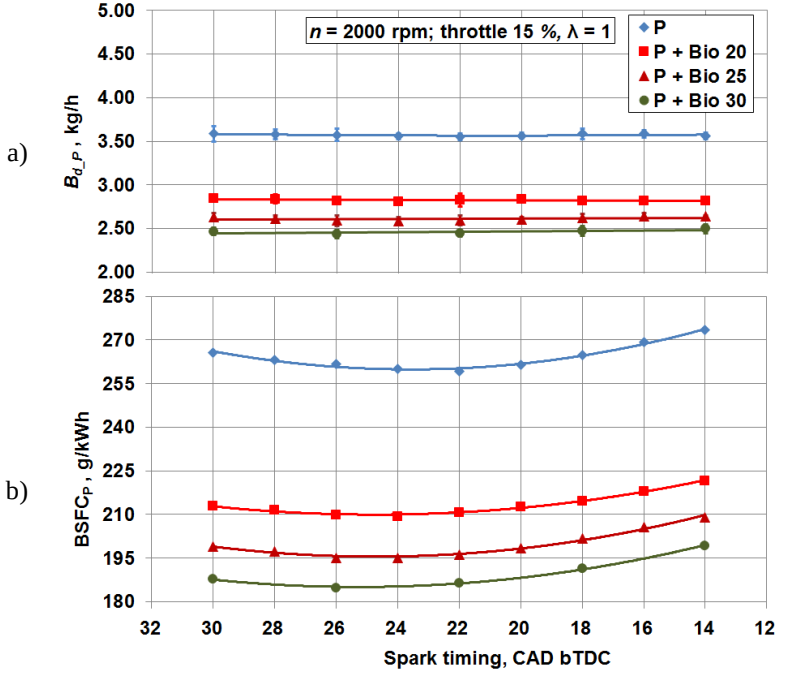

Fig. B.1. Dependence of petrol fuel consumption on the added biogas quantity and spark timing: a) petrol hourly fuel consumption, b) brake specific fuel consumption

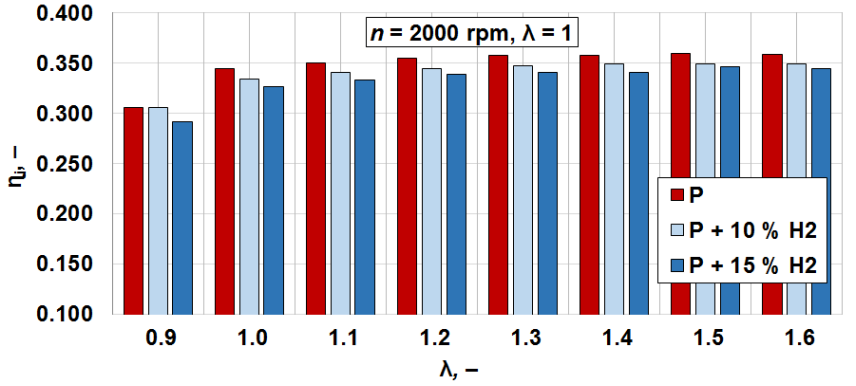

Fig. B.2. Dependence of indicated efficiency on H_2 concentration and A/F ratio

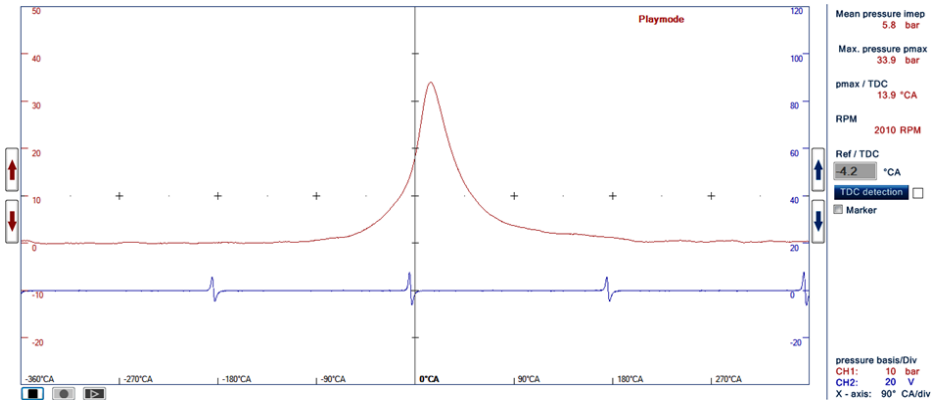

Fig. B.3. Pressure in cylinder determined by stand experiments for *P* fuel

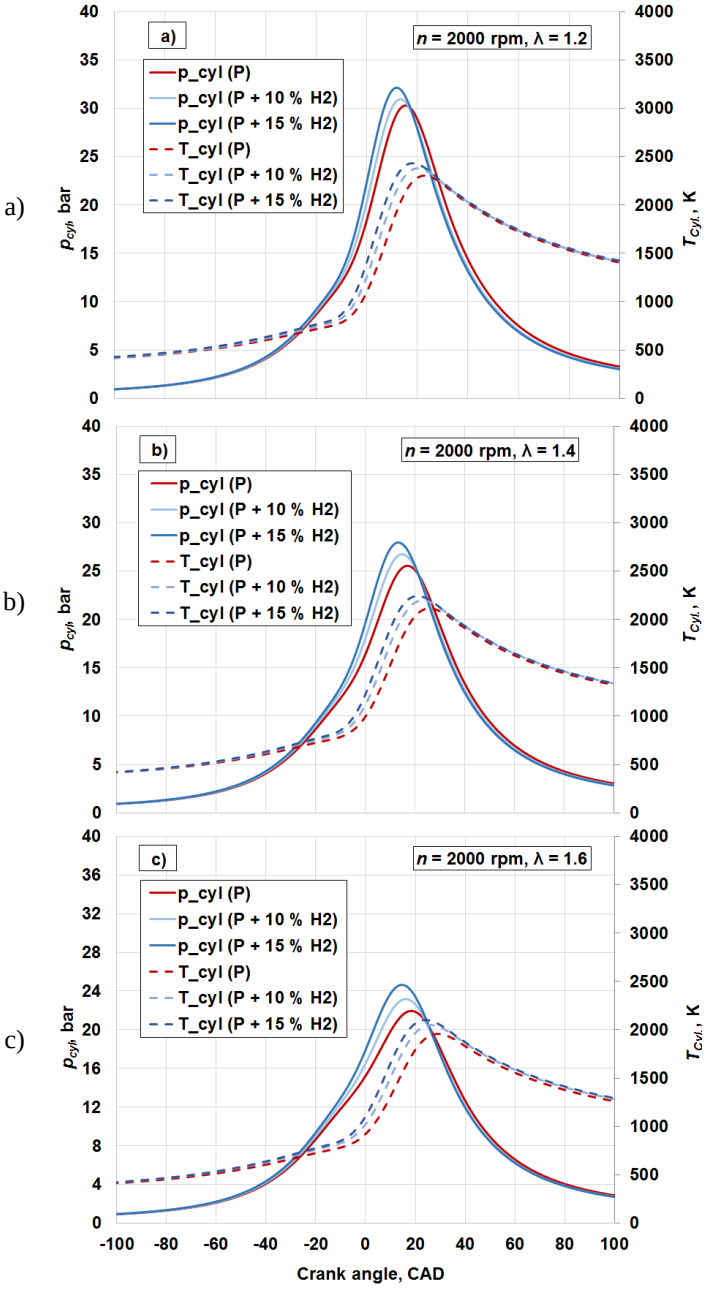

Fig. B.4. Dependence of in-cylinder pressure and temperature in cylinder on H_2 concentration and air / fuel ratio: a) λ = 1.2; b) λ = 1.4; c) λ = 1.6

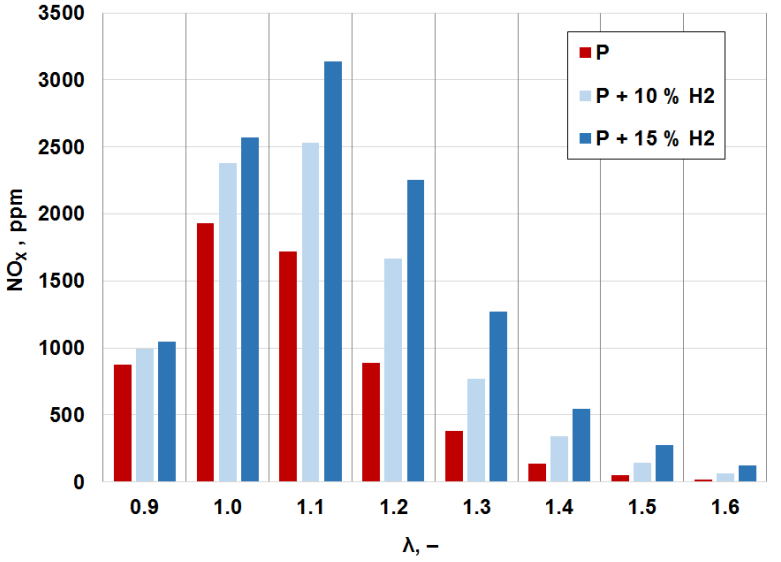

Fig. B.5. Dependence of nitrous oxide concentration in combustion products on hydrogen concentration and A/F ratio

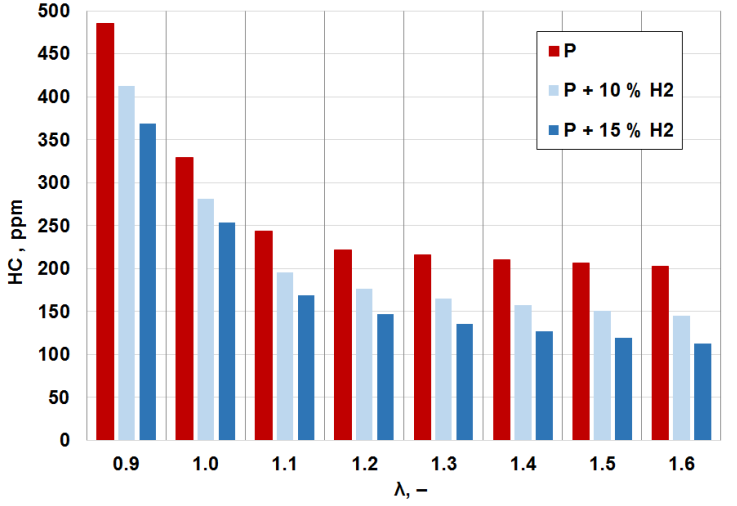

Fig. B.6. Dependence of hydrocarbon concentration in combustion products on hydrogen concentration and A/F ratio

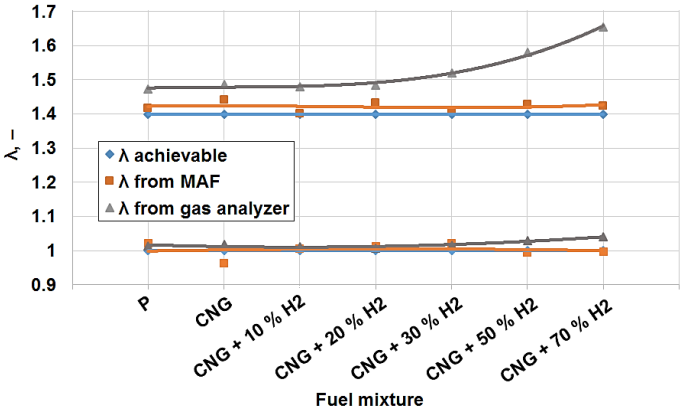

Fig. B.7. Dependence of λ value on different measurement ways and different tested fuel mixtures

a)

b)

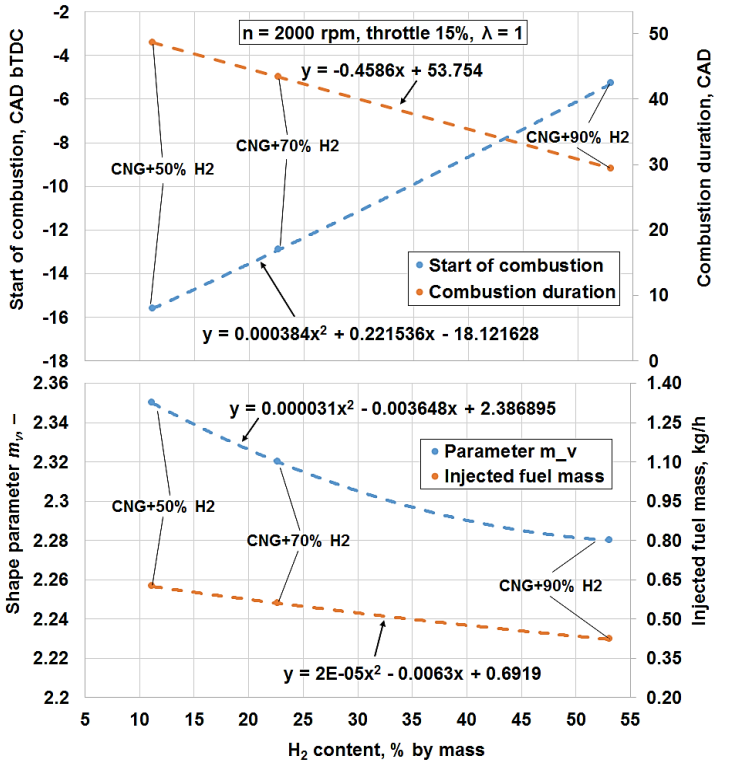

Fig. B.8. Dependence of combustion characteristics and injected fuel mass on different natural gas and hydrogen fuel mixtures: a) start of combustion and combustion duration, b) m_v factor and injected fuel mass

Table B.1. Parameters for engine tests with different combustions at different engine speeds and loads

Speed, rpm	Combustion type	Injection duration, ms	Intake press, kPa	Compression pressure, bar	SOI, CAD	Spark timing, CAD	λ	IMEP, bar
1000	Homogeneous stoichiometric	0.96	58	10.2	–280	–32	1	2.45
		1.42	72	12.37	–280	–30	1	3.53
		2.4	90	15.37	–280	–30	1	5
	Homogeneous lean burn	0.85	71	12.05	–220	–34	1.4	2.59
		1.07	84	14.15	–220	–34	1.4	3.45
		1.37	100	16.4	–220	–34	1.4	4.18
	Stratified lean burn	1.7	97.7	16.5	–36	–28	2.79	2.68
		2.3	97.7	16.6	–36	–28	2.23	3.54
		3.1	97.7	16.62	–46	–38	1.37	4.88
1500	Homogeneous stoichiometric	0.9	54	10.04	–280	–38	1	2.44
		1.3	68	12.5	–280	–32	1	3.62
		2.1	84	15.26	–280	–32	1	5.1
	Homogeneous lean burn	0.82	65	12	–220	–38	1.4	2.65
		1.02	80	14.2	–220	–38	1.41	3.54
		1.6	100	17.4	–220	–34	1.4	4.76
	Stratified lean burn	1.59	97.7	17.17	–42	–36	2.9	2.69
		2	97.7	17.17	–48	–38	2.2	3.48
		3	97.7	17.17	–61	–46	1.4	5.04
2000	Homogeneous stoichiometric	0.9	50	9.92	–280	–40	1	2.53
		1.2	62	11.98	–280	–34	1	3.61
		1.8	75	14.61	–280	–32	1	4.84
	Homogeneous lean burn	0.83	62	12.25	–220	–38	1.42	2.45
		1	75	14.46	–220	–36	1.38	3.61
		1.57	94.7	17.77	–220	–36	1.39	4.82
	Stratified lean burn	1.47	94.6	17.5	–53	–40	2.5	2.65
		2.3	94.6	17.5	–58	–40	1.87	3.59
		2.8	94.6	17.66	–65	–45	1.45	4.34