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Entrance research on pressure distribution in combustion chamber of gasoline engine applied in electric generator, fueled by syngas, for different ignition timing.

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Synthetic gas (syngas) produced form waste organic matter may be used as a fuel for internal combustion engines. Possibilities of syngas application as an independent IC engine energy carrier are limited. Designed system of energy conversion from waste to electricity is expected to produce gas consists mainly carbon monoxide, methane, hydrogen and carbon dioxide. Based on theoretical study and own research, as the main factors which impact on floating syngas composition the quality of input substance, process temperature and gasifying medium application were identified. The fluctuation of syngas composition contributes important challenge in aspect of energetic efficiency and mechanical durability of generator system. The researches was provided on research test bed which enables pressure distribution measurement in the combustion chamber (for various mixture of synthetic gases) and correction of ignition timing. The results of the researches indicate that proper correction of the ignition advance allows syngas mixtures combustion in wide range of their composition.

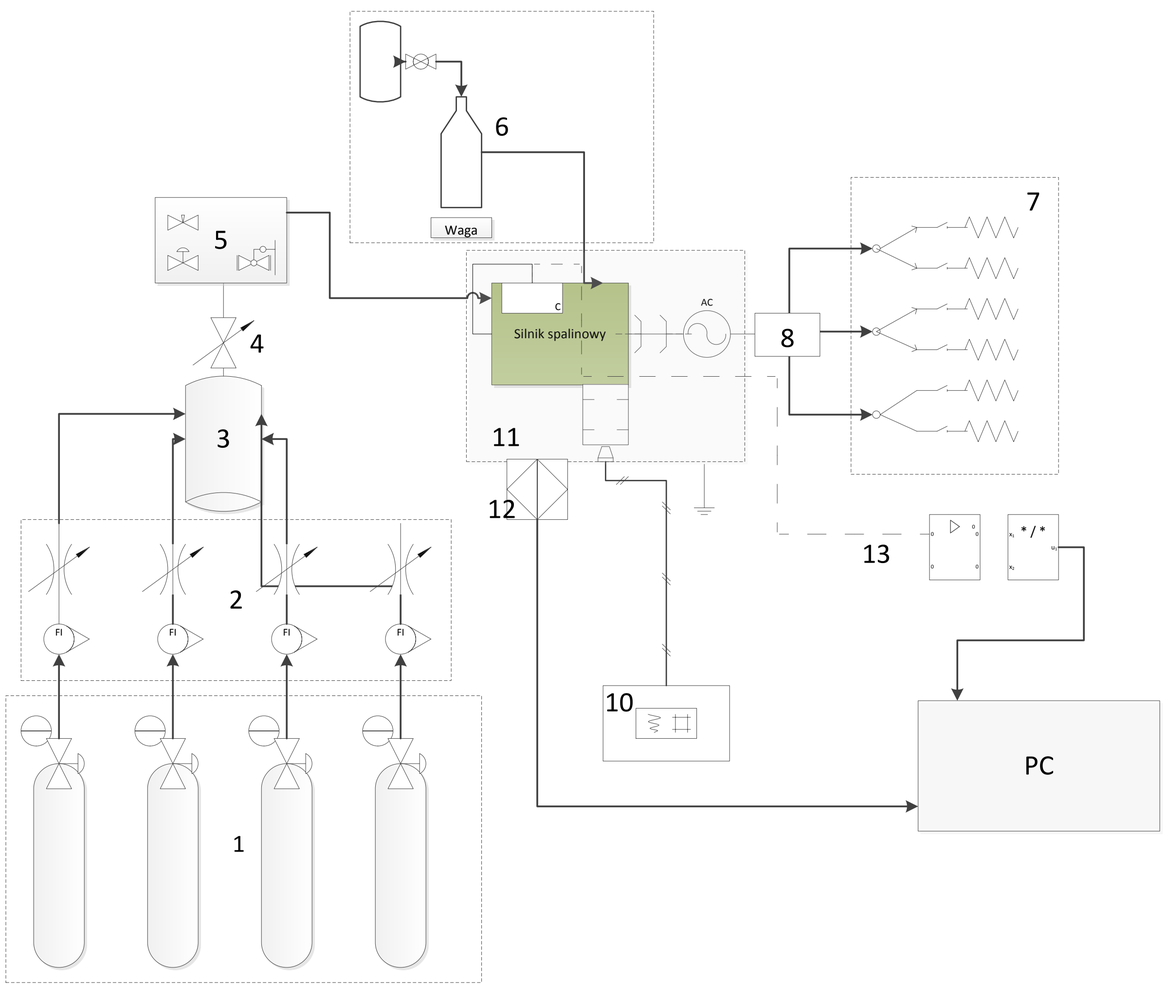

Fig. 1. Scheme of engine test stand

The engine test stand is equipped in IC engine connected with electricity generator (11). Fueling system was modified in a way which enable fuel consumption measurement. Gasoline consumption measurement system (6) is constructed by fuel reservoir, cut-off valve and measurement bulb mounted on RADWAG WPE 4000 weighing machine. The solution enable fuel consumption measurement by weighing method.

Syngas consumption measurement system (1) is constructed by four gas containers .

As the generator loading (7) system of electric heaters was applied. The heaters were connected to generator by parameters net measure system Eastron 630 (8) which enables to read real load of electric generator. The loading system (heaters) was configured for full range of unit work with 1kW resolution.

For ignition timing set EMU controller (ECU Master) was applied instead basic ignition system.

The system for pressure measurement inside of the combustion chamber (13) 6117BFD16 Kistler in-chamber pressure sensor which is integrated with spark plug

The testing stand was also equipped with exhaust analyzer MEXA 584L (10).

Tab. 1 Maximum pressures of the combustion for various ignition timing

Mixture number	Ignition timing	Avarage maximum pressure [bar]	SD	deg.CA	SD
1	8,5	42,37	3,83	22,27	5,48
	11,5	48,35	3,26	17,88	4,74
	14,5	50,63	2,86	16,48	4,62
	17,5	55,74	2,72	12,27	2,35
	20,5	59,47	2,14	10,45	2,22
2	8,5	34,88	1,9	10,72	12,56
	11,5	31,89	2,56	16,23	12,11
	14,5	36,87	4,93	20,44	9,8
	17,5	37,33	4,75	17,9	9,6
	20,5	43,65	4,23	14,89	6,36
3	8,5	27,06	2,47	24,81	5,1
	11,5	28,8	2,28	22,92	5,6
	14,5	33	2,4	21,82	3,59
	17,5	30,75	2,34	20,24	5,64
	20,5	33,23	2,36	18,5	3,44
4	8,5	26,16	2,11	24,74	10,9
	11,5	28,79	2,54	23,56	8,34
	14,5	30,92	2,98	24,58	7,11
	17,5	33,92	2,73	21,65	4,4
	20,5	35,68	3,29	17,4	5,68

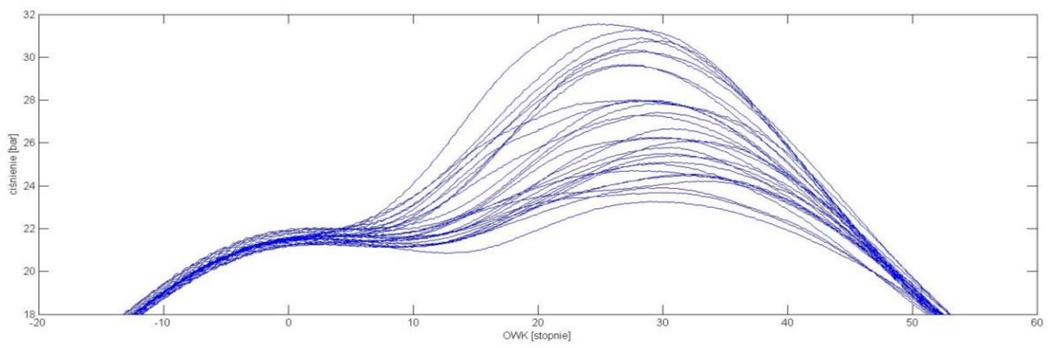

Fig 2 pressure displacement chart for 30 cycles (mixture no. 21)

Conclusions

Application of syngas as an engine fuel needs ignition timing correction (in relation to basic sets) for adjustment to a syngas composition. This fact indicates that future investigation requires also measurements in aspect of noise and vibrations emission.

According to the researches, for most prospective ignition timing, the maximum pressure of the combustion, was observed near 20 deg of crank angle.

This fact causes hydrogen generation in vales covers what effect uncontrolled gas explosion in crank-case. When hydrogen share in the mixture was above 20%, the phenomena wasn't observed.

The researches indicates that it is possible to combust over 50% CO-consisting mixture (as so as over 50% H_2-consisting) applying fuel direct injection into inlet collector.

Near optimum ignition timing, pressure distribution diagram is characterized by inflexion point placement close to TDC. This fact as so as relatively late ignition timing indicates on significant higher combustion rate in comparison to conventional fuel.

Increasing CO share in the syngas mixture limit maximum pressure value in the combustion chamber.

Dual-fuel system may be consider as a solution with conventional fuel mode during a cold-engine start. This solution will be also prospective for increasing of generator work stabilization in extreme situations (high fluctuation of syngas composition)

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