

Technical Report – Engine Test With Oilcom Fuel Catalyst (phase 1)

Preliminary Experimental Evaluation of Oilcom Fuel Catalyst on a Spark-Ignition Engine Test Bed

1. INTRODUCTION

This technical report presents the first-phase experimental results obtained from the evaluation of the Oilcom fuel catalyst on a commercially available spark-ignition engine operated on gasoline. The study was conducted in the Automotive Laboratory of Kırıkkale University using a fully instrumented engine test cell equipped with an eddy current dynamometer.

The fuel catalyst investigated in this study was provided to the research team by Viktor Gaspar (OILCOM TECHNOLOGIES FZE LLC) specifically for experimental evaluation under controlled laboratory conditions.

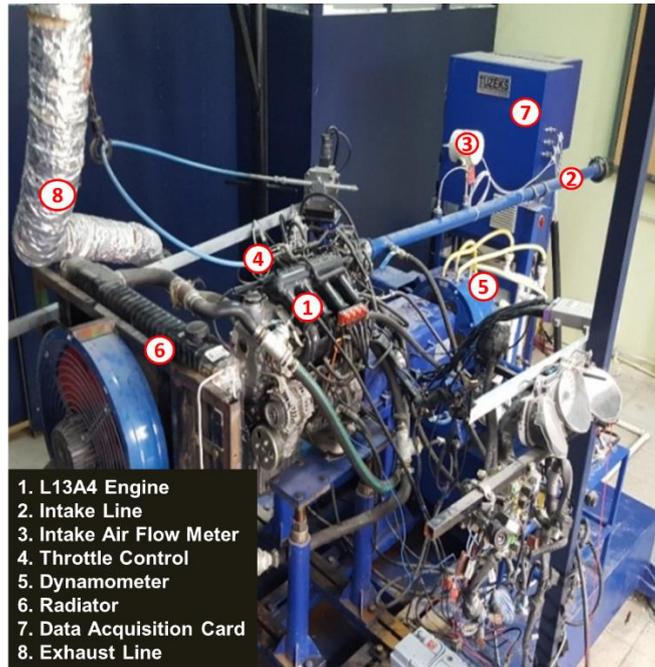
The motivation of this work is to experimentally investigate the potential of a non-intrusive, externally applied fuel catalyst to improve fuel economy without any mechanical or hardware modification of the engine. *The present document reports only the first measurement campaign, and the results should therefore be interpreted as preliminary but promising.* Further repetitions are already planned to strengthen the scientific reliability and reproducibility of the findings.

2. TEST ENGINE AND TEST CELL DESCRIPTION

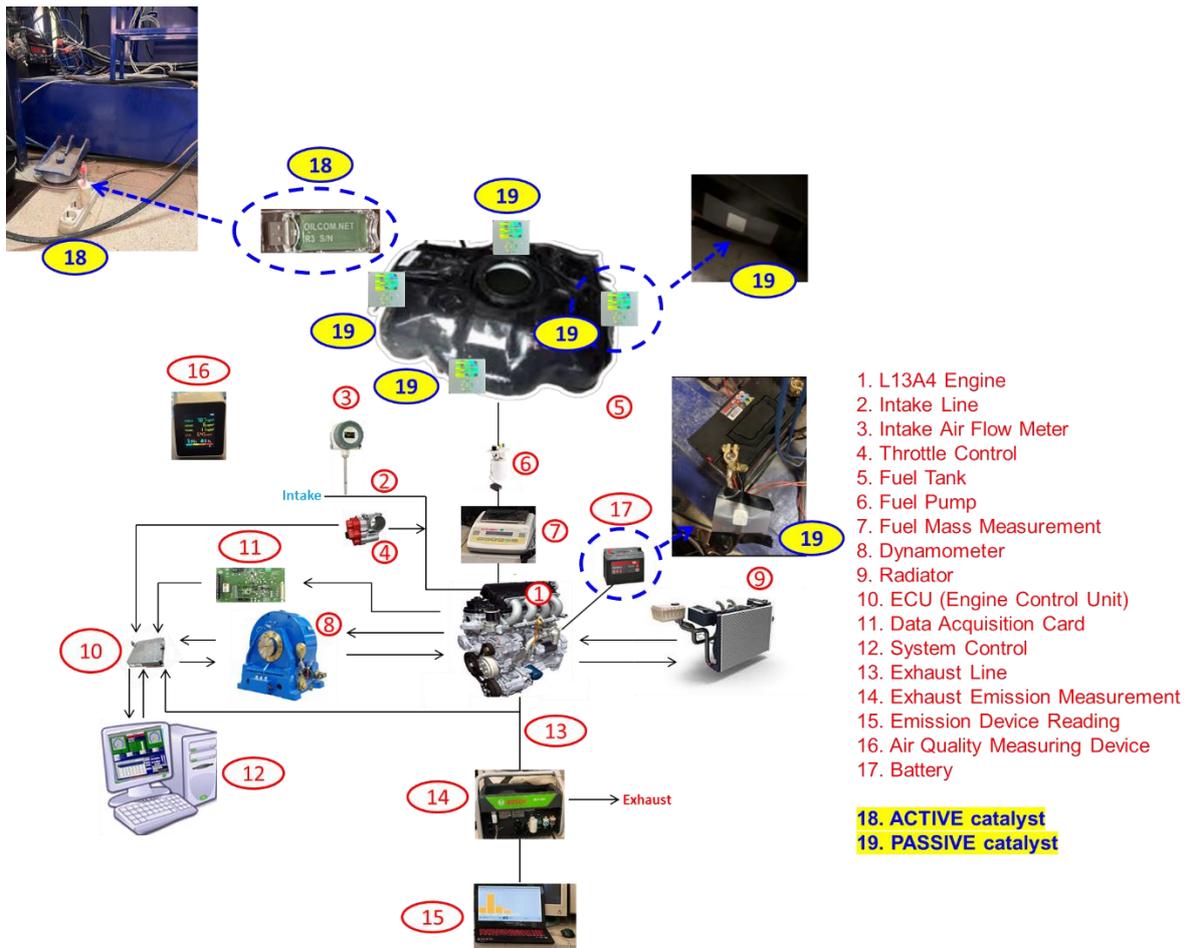
2.1 Engine and Test Cell Configuration

The experimental investigations were conducted in the Automotive Laboratory of Kırıkkale University using a fully instrumented engine test cell. A general view of the test system, including the engine, fuel tank, eddy-current dynamometer, and catalyst installation points, is presented in Figure 1.

Figure 1 combines schematic and photographic representations of the complete test setup. The locations of the passive and active catalysts, their mounting positions, and the distances between the engine, fuel tank, battery, and dynamometer are explicitly indicated to provide a clear understanding of the experimental configuration and installation geometry.



(a)



(b)

Figure 1. (a) Engine Test System, (b) Engine Test System Diagram

The test engine used in this study is a Honda L13A4, which is a naturally aspirated, spark-ignition engine commonly employed in production Honda Jazz vehicles. A detailed view of the engine installed on the test bench is shown in Figure 2.



Figure 2. Test Engine

Engine specifications are summarized as follows:

- Engine type: Honda L13A4, naturally aspirated, spark-ignition
- Displacement: 1.3 L
- Fuel system: Port fuel injection
- ECU: OEM production ECU with adaptive closed-loop control
- Maximum torque speed: 2800 rpm

All engine-related components, including the fuel tank, fuel lines, injectors, and sensors, are original commercial vehicle components transferred directly from a production Honda Jazz vehicle to the test bench. Consequently, the tested configuration closely represents real-world engine operating conditions.

2.2 Dynamometer and Measurement System

Engine load and speed control were achieved using an eddy-current dynamometer, shown in Figure 3. The dynamometer is coupled directly to the engine crankshaft, allowing precise measurement of engine torque and speed without the influence of vehicle drivetrain losses.



Figure 3. Test Dynamometer

The main characteristics of the dynamometer and measurement system are:

- Dynamometer type: Eddy-current dynamometer
- Control and data acquisition: Computer-based test automation system
- Torque and speed measurement accuracy: $\pm 0.25\%$

Fuel consumption was measured using a gravimetric method. Fuel mass flow was determined by continuously recording the fuel mass as a function of time using a high-precision electronic balance. Based on previous uncertainty analyses performed for this test system, the mass flow measurement uncertainty is approximately $\pm 0.26\%$.

In addition to fuel consumption, the following parameters were continuously monitored and recorded during the experiments:

- Engine speed
- Throttle position
- Intake air temperature
- Coolant temperature
- Engine oil temperature
- Ambient conditions

This comprehensive instrumentation ensured stable operating conditions, repeatable measurements, and high confidence in the recorded experimental data.

3. CATALYST DESCRIPTION AND INSTALLATION

3.1 Passive Catalyst

The passive catalyst consists of a plastic plate with an aluminum layer, functioning as a passive electromagnetic antenna. According to the manufacturer, the catalyst is pre-conditioned in specific electromagnetic fields, enabling it to re-radiate ambient fields in a manner that influences fuel structure and combustion.

Installation during this study:

- One passive catalyst installed on the negative battery cable
- Four passive catalysts installed on the external surface of the fuel tank, facing outward

No insulation was removed from electrical cables, and no metallic adhesive tape was used.

3.2 Active Catalyst (USB Device)

An additional active catalyst (USB-type) was installed near the engine and fuel tank.

- Supply voltage: 5 V
- Current: below 20 mA
- Operating frequency: ~40 Hz

The active catalyst remained continuously powered during the entire activation period.

Photographs of the active and passive catalysts, together with dimensional size comparisons, are presented in Figure 4 to illustrate their compact structure.



Figure 4. Active and passive catalysts

4. EXPERIMENTAL PROCEDURE

4.1 Baseline Measurements (Without Catalyst)

Before installing the catalyst, baseline fuel consumption tests were performed under identical operating conditions to establish reference data.

4.2 Catalyst Activation Phase

Following installation, the engine was operated according to the manufacturer's recommendation:

- Activation duration: 7 consecutive days
- Daily operation time: approximately 2 hours per day
- Purpose: allow fuel and ECU adaptation to modified fuel characteristics

During this period, no catalyst on/off cycling was performed.

4.3 Test Matrix

All measurements were conducted under identical ambient and operating conditions, every day between 15:00–17:00 (local time).

Test points:

- Engine speeds: 2500 rpm, 2800 rpm, 3500 rpm
- Throttle openings: 40% and 60%
- Measurement duration per point: ~30 minutes

Total daily measurement time: ~2 hours.

The detailed test matrix is given in Table 1.

Table 1. Test Matrix

Test matrix				
Test No	Test Name	Fuel	Throttle Opening	Engine Speed, rpm
1	Base Test	Gasoline	40	2500-2800 (max.Torque speed)-3500
2	Base Test	Gasoline	60	2500-2800 (max.Torque speed)-3500
3	ACTIVE-PASSIVE Catalyst Test	Gasoline	40	2500-2800 (max.Torque speed)-3500
4	ACTIVE-PASSIVE Catalyst Test	Gasoline	60	2500-2800 (max.Torque speed)-3500

5. RESULTS AND OBSERVATIONS

A preliminary analysis of the experimental data indicates that the engine operated in a stable and repeatable manner throughout the entire test campaign. The following general observations were made:

Stable engine operation and repeatable throttle response were observed at all test points.

Torque and engine speed signals showed consistent behavior across different test days, indicating good repeatability of the experimental setup.

No abnormal combustion phenomena, misfire, knock, or operational instability were detected during either baseline or catalyst-assisted operation.

Figure 5 illustrates the evolution of normalized brake specific fuel consumption (BSFC) as a function of test day for different engine speeds and throttle openings (40% and 60%), where the baseline gasoline operation is taken as 100% reference. The catalyst-assisted measurements, including intermediate activation days and the final measurement, are presented to highlight the progressive fuel economy improvement during the catalyst activation period.

At 2800 rpm, corresponding to the maximum torque speed of the engine, the catalyst-assisted operation resulted in a fuel consumption reduction ranging from approximately 9.7% to 17% compared to the baseline gasoline operation, depending on throttle opening and activation progress.

The reduction in BSFC is most pronounced at 2800 rpm, which suggests that the catalyst effect is strongly coupled with operating conditions near the optimal torque region of the engine. Additionally, the results indicate that higher throttle openings (60%) tend to amplify the observable fuel economy benefit.

It is also evident from the figures that the fuel consumption improvement evolves progressively over the activation period, supporting the hypothesis that both fuel conditioning and ECU adaptation contribute to the observed efficiency gains.

Importantly, all improvements reported in this section were achieved without any ECU recalibration, software modification, or hardware changes to the engine, highlighting the non-intrusive nature of the applied catalyst.

In addition to the graphical results, Table 2 summarizes the averaged brake specific fuel consumption values obtained under baseline and catalyst-assisted conditions at different engine speeds and throttle openings, clearly confirming the observed fuel economy improvements discussed above.

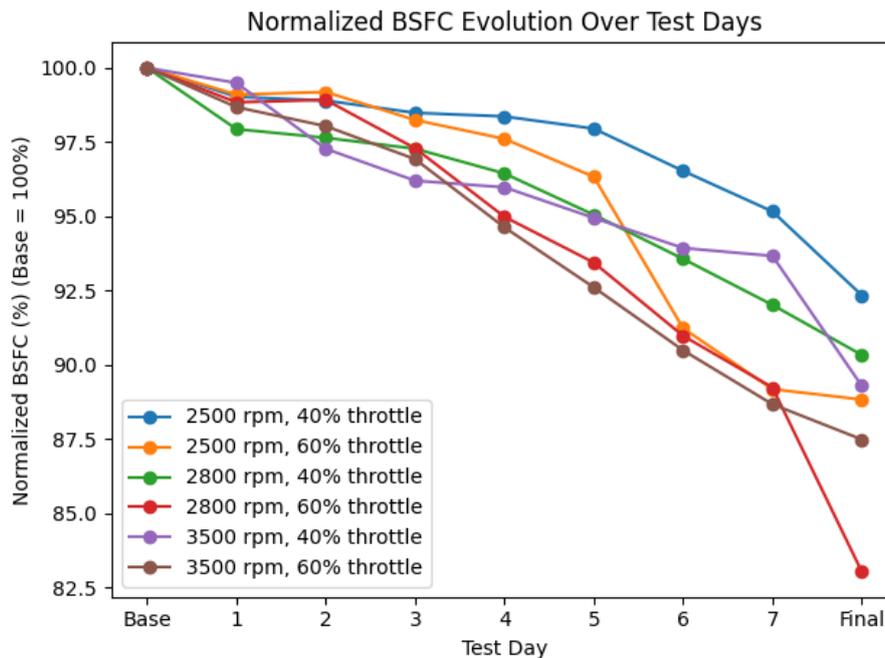


Figure 5. Normalized brake specific fuel consumption (BSFC) variation over test days (Base = 100%) for different engine speeds and throttle openings during catalyst activation period.

Table 2. Performance values obtained under baseline and catalyst-assisted conditions

Test_number	Day	Method	Fuel	Speed (rpm)	Throttle opening (%)	Brake_torque (Nm)	Brake_power (kW)	Brake_mean_effective_pressure (kPa)	Fuel_flow (g/s)	Brake specific fuel consumption (g/kWh)	Difference for BSFC (%)	Thermal efficiency	Exhaust Temp. (°C)
1	Base Test	Test	Gasoline	2500	40	102.779	26.907	964.568	2.370	317.087		26.330	647.001
2	1. Day	Test_catalyst	Gasoline	2500	40	103.878	27.195	974.887	2.372	313.996		26.589	663.400
3	2. Day	Test_catalyst	Gasoline	2500	40	103.927	27.208	975.344	2.370	313.584		26.624	668.700
4	3. Day	Test_catalyst	Gasoline	2500	40	104.140	27.264	977.344	2.365	312.282		26.735	665.200
5	4. Day	Test_catalyst	Gasoline	2500	40	104.138	27.263	977.325	2.362	311.892		26.768	664.452
6	5. Day	Test_catalyst	Gasoline	2500	40	104.396	27.331	979.741	2.358	310.596		26.880	668.750
7	6. Day	Test_catalyst	Gasoline	2500	40	104.948	27.475	984.922	2.336	306.079		27.277	674.727
8	7. Day	Test_catalyst	Gasoline	2500	40	105.769	27.690	992.626	2.321	301.754		27.668	683.411
9	Final Test	Test_catalyst	Gasoline	2500	40	106.651	27.921	1000.909	2.271	292.810	-7.656	28.513	682.780
10	Base Test	Test	Gasoline	2500	60	109.965	28.789	1032.009	2.426	303.368		27.520	742.765
11	1. Day	Test_catalyst	Gasoline	2500	60	109.410	28.644	1026.803	2.392	300.633		27.771	744.092
12	2. Day	Test_catalyst	Gasoline	2500	60	109.772	28.738	1030.201	2.402	300.894		27.747	742.988
13	3. Day	Test_catalyst	Gasoline	2500	60	110.410	28.905	1036.184	2.393	298.036		28.013	745.469
14	4. Day	Test_catalyst	Gasoline	2500	60	110.616	28.959	1038.120	2.382	296.113		28.195	748.304
15	5. Day	Test_catalyst	Gasoline	2500	60	111.093	29.084	1042.599	2.361	292.241		28.568	748.956
16	6. Day	Test_catalyst	Gasoline	2500	60	112.880	29.552	1059.369	2.272	276.773		30.165	749.913
17	7. Day	Test_catalyst	Gasoline	2500	60	113.951	29.832	1069.420	2.242	270.552		30.858	751.381
18	Final Test	Test_catalyst	Gasoline	2500	60	114.090	29.869	1070.725	2.236	269.499	-11.164	30.979	752.904
19	Base Test	Test	Gasoline	2800	40	109.077	31.983	1023.673	2.239	252.022		33.127	702.547
20	1. Day	Test_catalyst	Gasoline	2800	40	109.983	32.249	1032.174	2.211	246.820		33.825	703.665
21	2. Day	Test_catalyst	Gasoline	2800	40	110.013	32.257	1032.456	2.205	246.083		33.927	700.699
22	3. Day	Test_catalyst	Gasoline	2800	40	110.227	32.320	1034.473	2.201	245.158		34.055	709.336
23	4. Day	Test_catalyst	Gasoline	2800	40	110.472	32.392	1036.771	2.187	243.059		34.349	705.714
24	5. Day	Test_catalyst	Gasoline	2800	40	110.961	32.535	1041.353	2.165	239.555		34.851	708.223
25	6. Day	Test_catalyst	Gasoline	2800	40	112.305	32.929	1053.969	2.157	235.813		35.404	708.236
26	7. Day	Test_catalyst	Gasoline	2800	40	113.401	33.251	1064.259	2.142	231.909		36.000	710.874
27	Final Test	Test_catalyst	Gasoline	2800	40	113.897	33.396	1068.914	2.112	227.665	-9.665	36.671	711.669
28	Base Test	Test	Gasoline	2800	60	114.806	33.663	1077.445	2.299	245.861		33.662	765.589
29	1. Day	Test_catalyst	Gasoline	2800	60	114.714	33.636	1076.580	2.271	243.008		34.356	762.478
30	2. Day	Test_catalyst	Gasoline	2800	60	115.101	33.749	1080.209	2.280	243.205		34.328	765.596
31	3. Day	Test_catalyst	Gasoline	2800	60	116.541	34.171	1093.721	2.271	239.199		34.903	765.369
32	4. Day	Test_catalyst	Gasoline	2800	60	116.871	34.268	1096.821	2.223	233.533		35.750	765.801
33	5. Day	Test_catalyst	Gasoline	2800	60	117.275	34.387	1100.616	2.195	229.744		36.340	768.247
34	6. Day	Test_catalyst	Gasoline	2800	60	118.341	34.699	1110.617	2.156	223.681		37.325	768.256
35	7. Day	Test_catalyst	Gasoline	2800	60	119.051	35.077	1117.278	2.128	219.409		38.051	770.285
36	Final Test	Test_catalyst	Gasoline	2800	60	119.609	34.901	1122.519	1.989	204.167	-16.958	41.048	775.289
37	Base Test	Test	Gasoline	3000	40	107.915	33.903	1012.772	2.428	257.821		31.782	715.023
38	1. Day	Test_catalyst	Gasoline	3000	40	108.333	34.034	1016.692	2.425	256.510		32.548	712.587
39	2. Day	Test_catalyst	Gasoline	3000	40	108.472	34.078	1018.002	2.374	250.792		33.290	710.208
40	3. Day	Test_catalyst	Gasoline	3000	40	108.574	34.110	1018.956	2.350	248.024		33.661	716.554
41	4. Day	Test_catalyst	Gasoline	3000	40	108.594	34.116	1019.146	2.345	247.451		33.739	718.268
42	5. Day	Test_catalyst	Gasoline	3000	40	109.632	34.442	1028.883	2.342	244.795		33.483	720.253
43	6. Day	Test_catalyst	Gasoline	3000	40	110.059	34.576	1032.889	2.326	242.180		34.474	722.158
44	7. Day	Test_catalyst	Gasoline	3000	40	110.133	34.599	1033.589	2.321	241.496		34.885	728.582
45	Final Test	Test_catalyst	Gasoline	3000	40	110.748	34.793	1039.361	2.225	230.221	-10.705	36.919	726.659
46	Base Test	Test	Gasoline	3000	60	109.457	34.387	1027.247	2.420	253.351		32.652	826.256
47	1. Day	Test_catalyst	Gasoline	3000	60	109.552	34.417	1028.134	2.390	249.994		33.396	830.211
48	2. Day	Test_catalyst	Gasoline	3000	60	110.727	34.786	1039.161	2.400	248.376		33.613	832.743
49	3. Day	Test_catalyst	Gasoline	3000	60	111.529	35.038	1046.691	2.390	245.562		33.999	830.695
50	4. Day	Test_catalyst	Gasoline	3000	60	111.845	35.137	1049.658	2.340	239.745		34.824	835.403
51	5. Day	Test_catalyst	Gasoline	3000	60	112.819	35.443	1058.793	2.310	234.630		35.583	845.669
52	6. Day	Test_catalyst	Gasoline	3000	60	113.962	35.802	1069.524	2.280	229.259		36.416	850.258
53	7. Day	Test_catalyst	Gasoline	3000	60	114.765	36.054	1077.056	2.250	224.660		37.162	855.478
54	Final Test	Test_catalyst	Gasoline	3000	60	115.388	36.250	1082.902	2.232	221.660	-12.509	37.665	859.456

6. DISCUSSION

The observed fuel economy improvement is consistent with the hypothesis that modifying fuel structure and combustion characteristics can enhance overall efficiency. However, it is important to emphasize that:

- These results represent the first measurement campaign
- Scientific rigor requires repeated experiments under identical conditions

Additionally, although the eddy-current dynamometer generates electromagnetic fields, no negative interaction with the catalyst was observed during this phase.

7. PLANNED FUTURE WORK

To ensure scientific robustness, the following steps are planned:

1. **Deactivation period**
 - The catalyst has been removed
 - A deactivation period of approximately one month will be observed
2. **Repetition of tests**
 - The full 1 + 7 + 1 day test cycle will be repeated two additional times
 - Statistical consistency will be evaluated
3. **Testing on other engines**
 - Discussions are ongoing with other institutions and engine facilities in Turkey
 - Including university and industrial test cells
4. **Extended studies**
 - Investigation of ECU adaptation limits
 - Evaluation of combined catalyst use on different combustion parameters

8. NOTES ON CATALYST PROPERTIES (MANUFACTURER INFORMATION)

According to information provided directly by Oilcom (Manufacturer):

- Catalyst lifetime: Unlimited, no degradation observed (samples operating >10 years)
- Safety: Passive catalyst is safe for human handling, no certification required
- Active USB device: Requires EMC certification, expected to pass due to very low emissions
- Economic target: Cost recovery within approximately one year for end users

9. CONCLUSIONS

The first phase experimental results demonstrate a significant and promising fuel economy improvement using the Oilcom fuel catalyst on a commercial spark-ignition engine. *Catalyst-assisted operation resulted in a fuel consumption reduction ranging from approximately 9.7% to 17% compared to the baseline gasoline operation, depending on throttle opening and activation progress.*

While the results are encouraging, they are intentionally reported as preliminary. The planned repetitions and extended studies will be essential to establish full scientific confidence and to explore the catalyst's complete potential.

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