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Performance Evaluation of Sustainable Flow Motor Systems Magnets on Fuel Consumption in IC Engines

Hallam Energy

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- This study does not intend to explain the science behind the functioning of the product. It simply states the results of the road tests carried out on one car.

- Lab tests with a fully controlled engine test rig and dynamometer were not possible due to the manufacturer’s requirement of driving for 1,000 miles after installation before the effects are observed. Thus, these tests were replaced by road tests.

Executive Summary

Sustainable Flow are the sole distributors in the UK & Spain for the American based company Magnetizer® who operate in 44 countries under the name of Mundimex, Inc.

Mundimex offer magnetic devices for automobiles and claim that these can enhance the vehicles' fuel efficiency and reduce pollution emissions from their engines.

Sustainable Flow Ltd., based in Rotherham, have re branded these devices under the name "Sustainable Flows Motor Systems". In the past, there have been many similar products on the market which have not delivered what they promised. Sustainable Flow have thus approached Hallam Energy (HE) at Sheffield Hallam University (SHU) to conduct an independent investigation to ascertain the impact of Magnetizer's® ceramic magnets on fuel consumption and pollutant emissions in IC engines of cars.

The manufacturer of the magnets requires that the magnets be installed on an automobile which should then be driven for around a thousand miles before the full effect on fuel savings can be seen. Due to this condition, fully controlled tests on an engine test rig with a dynamometer could not be conducted. Thus, the tests were replaced by a series of road tests.

The 7,500 Gauss magnets were provided by the company (Sustainable Flow). The car chosen for the tests was a 2009 Citroen Xsara Picasso, 1.6 L, belonging to university staff. During the course of the tests, the company had no access to the test vehicle and could thus, under no circumstances, interfere with the test procedure or the results. Five tests were conducted without the magnets. Then the magnets were installed and the car was driven around for more than a thousand miles. Then, another five tests were conducted with the magnets. The car's average fuel consumption without the magnets was 39.93 miles/gallon. With the magnets, this figure rose to 42.87 miles/gallon, suggesting 7.5% fuel savings.

In addition, tests were also performed on two other cars provided by Sustainable Flow: (i) 2001 Land Rover Discovery, 2.5 L, Diesel and (ii) 1997 Subaru Impreza GL Automatic, 2.0 L, Petrol. The Land Rover showed fuel saving of 9.3% and the Subaru, 7%. Unlike the Citroen, however, the university was in possession of these cars only during the tests and not in between. Also, much fewer tests were conducted on these two cars.

The three cars used in the tests were 8, 16 and 20 years old. The effect of magnets on newer cars has not been studied.

It is acknowledged that road tests are indeed, not the perfect way of measuring fuel efficiency. However, due to the constraints, they were the only option possible. Fully controlled tests in an engine test rig with a dynamometer may be performed to further prove the concept. However, the consistency in the evidence from road tests suggests that the magnets have had a positive impact on fuel efficiency of the vehicle.

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1. Introduction

Sustainable Flow Ltd. (SFL), a start-up company based in Rotherham, is the supplier of powerful permanent magnets (~7,500 Gauss) called "Sustainable Flows Motor Systems" for automobiles and claims that these magnets improve the fuel efficiency of the engine.

However, in order to gain credibility before marketing its products in the U.K., SFL need to independently verify the performance of these devices. In the past, there have been several similar products in the market which have failed to deliver what they promised.

SFL has thus approached Hallam Energy (HE) at Sheffield Hallam University (SHU), to conduct an *independent investigation* into the performance of these magnetic devices on reducing fuel consumption in automotive engines.

2. Aim and Objectives

2.1 Aim

The aim is to enable SFL to independently verify the performance of their product.

2.2 Objectives

1. Measure the fuel efficiency (miles per gallon) of a car without the magnets
2. Measure the fuel efficiency (miles per gallon) of a car with the magnets and compare with the first case
3. Suggest any improvements for the product

3. Research Method

The manufacturer of the magnets requires that the magnets be installed on an automobile which should then be driven for up to a thousand miles before the full fuel savings can be seen. Due to this requirement, fully controlled tests on an engine test rig with a dynamometer could not be conducted. Thus, the tests were replaced by a series of road tests.

All care was taken to minimise the effect of other factors so that the only difference would be the presence of magnets and the results could be compared.

The following controls were observed during the tests:

- **Fuel Tank:** The test would start with a full fuel tank and at the end of the test, it would be filled again, giving an exact indication of the amount of fuel consumed in the test. The same petrol station and even the same pump was used for all tests for consistency.
- **Distance:** Each test involved driving the car over a long distance. This ensured that a large amount of fuel was consumed in each test and it thus minimised the errors caused by the small errors in refuelling. The shortest test involved driving for 182 miles but most tests involved driving for at least 300 miles.
- **Test Route:** Most of the test route was on the motorway M1. It is important to avoid driving inside cities where the start-stop traffic could make the tests uncontrolled. After filling the tank, the car was immediately driven to the motorway, avoiding the city traffic. About 99% of the test route was on the motorway.
- **Traffic Conditions:** The tests were scheduled to avoid the rush hour traffic.
- **Mileage:** The car's total mileage was recorded at the start and at the end of each test.
- **Driving Speed:** As far as possible, a steady driving speed of 65 to 70 mph was maintained for the duration of the test. Driving faster would have an adverse effect on the fuel economy as the drag force is proportionate to the square of the car's speed.
- **Car Condition:** The car used for the tests was a 2009 1.6 L Citroen Xsara Picasso. The car was in a good maintenance condition with a full service history. The car's air filter and oil had been changed prior to commencing the tests. The tyres were checked for the correct pressure.

Figure 1: The test vehicle

- **Air conditioning:** The same air-conditioning settings were used for all the tests.
- **Calculations:** After recording (i) the distance covered in the test and (ii) the amount of fuel consumed, the fuel economy for the test was calculated as (i) ÷ (ii).

Five tests were conducted without the magnets and then the magnets were fitted. These are powerful 7,500 Gauss permanent magnets. The fitted magnets inside the bonnet are shown below:

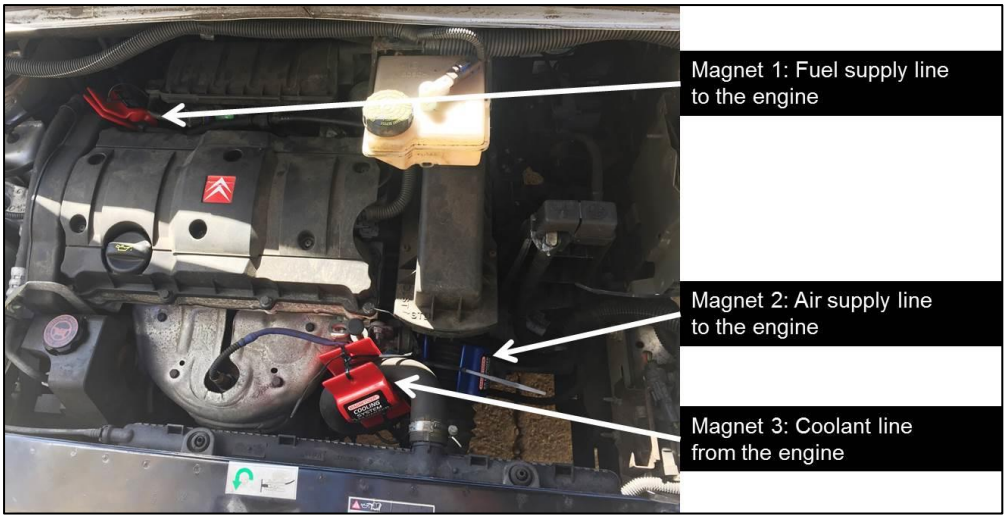

Figure 2: Magnets fitted in the car

Three sets of magnets were supplied by SFL which were fitted by qualified mechanics of Halfords Service Centre at Eyre Street, Sheffield on 12 August 2017.

The magnets were fitted on:

1. Fuel supply line to the engine
2. Air supply line to the engine
3. Coolant line from the engine

In addition, other tests were also performed on two other cars using the same test method:

1. Land Rover Discovery, 2001 Registration, Diesel, Manual, 2.5 L
2. Subaru Imperia GL, 1997 Registration, Petrol, Automatic, 2.0 L

Unlike the Citroen, however, the university was in possession of these cars only during the tests and not in between. In theory, it is possible to improve a car's fuel efficiency by tuning the engine to reduce its power although there is no evidence to suggest that there was any tampering with the engine.

4. Results and Discussion

4.1 Tests on Citroen Xsara Picasso

4.1.1 Sample Calculations

The following figures show the results of a sample test conducted on 11-08-2017:

Figure 3 : Car Mileage and fuel level at the start of the test

The car's total mileage at the start of the test was 38,293 miles. The test started with filling the fuel tank to its capacity as shown above.

Figure 4: Car Mileage and fuel level at the end of the test

The car's total mileage at the end of the test was 38,524 miles. The distance covered in the test was thus

38,524 - 38,293 = 231 miles

The fuel level indicator shows that approximately half the tank is empty at the end of the test. The exact amount of fuel consumed in the test was ascertained by refuelling the tank to its capacity again. Figure 6 shows the VAT receipt from the refuelling.

applegreen rewards

Applegreen Sheffield
Mega Service Station, 580 City Road,
Sheffield, S2 1GE
VAT No: 991256690,
01142393873
#5068-001 11/08/2017 19:28:48 5068 Donna
Inv#:00273152 Trs#:736703

P#2 27.32 litre @ £1.128/ 1 litre
Unleaded £30.82 T2

Net Sales	£25.68
Tax 2 [£25.68]	£5.14
TOTAL SALES	£30.82
SUB TOTAL	£30.82
MasterCard	£30.82
# **********7432	

VAT Summary

VAT Rate	Ex.VAT	VAT	Inc.VAT
20.00%	25.68	5.14	30.82
Totals	25.68	5.14	30.82

Item count 1

Applegreen Sheffield
Mega Service Station,580 City Road,Sheffie
ld

MID : ***80653 TID : ****7540

PLEASE KEEP THIS COPY FOR YOUR RECORDS

11/08/17 19:28 00179751
MASTERCARD (MasterCard)
APP ID: A0000000041010
PAN SEQ: 02
TC: 276B726694EE5DAB

Figure 5: Receipt for refuelling at the end of the test

27.32 litres of unleaded petrol were used in the test.

Thus, the car's fuel economy for the test was 231 miles ÷ 27.32 litres = 8.46 miles per litre or 38.47 miles per gallon.

4.1.2 Summary of test results

As per the manufacturer's recommendation, after fitting the magnets, the car was then driven for slightly more than 1,000 miles to complete the transition period. Then, another set of 5 tests were conducted with the magnets fitted using the same test method.

The results from all 10 tests are summarised below in Table 1. Tests 1 to 5 were performed without the magnets and tests 6 to 10 were with the magnets.

Table 1 : Summary of Test Results for Citroen Xsara Picasso

Test No	Date	Magnets	Starting Mileage	Ending Mileage	Distance Covered	Fuel Used	Fuel Efficiency	Fuel Efficiency
			mi	mi	mi	L	mi/L	mi/Gallon
1	20/07/2017	No	37,110	37,292	182	20.53	8.87	40.34
2	26/07/2017	No	37,354	37,655	301	34.50	8.72	39.67
3	29/07/2017	No	37,673	37,862	189	21.37	8.83	40.16
4	09/08/2017	No	37,975	38,283	308	34.10	9.02	41.03
5	11/08/2017	No	38,293	38,524	231	27.32	8.46	38.47
6	28/08/2017	Yes	39,678	39,978	301	32.15	9.36	42.60
7	30/08/2017	Yes	39,988	40,275	287	30.81	9.32	42.38
8	01/09/2017	Yes	40,287	40,593	306	33.29	9.20	41.85
9	03/09/2017	Yes	40,618	40,919	300	33.49	8.97	40.81
10	20/09/2017	Yes	41,548	41,859	311	32.35	9.60	43.67

The average fuel efficiency without the magnets was 8.78 miles/litre or 39.93 miles/gallon. With the magnets, this rose to 9.42 miles/litre or 42.87 miles/gallon, a gain of 7.35%.

Figure 7 shows a plot of the fuel efficiencies observed over these 10 tests.

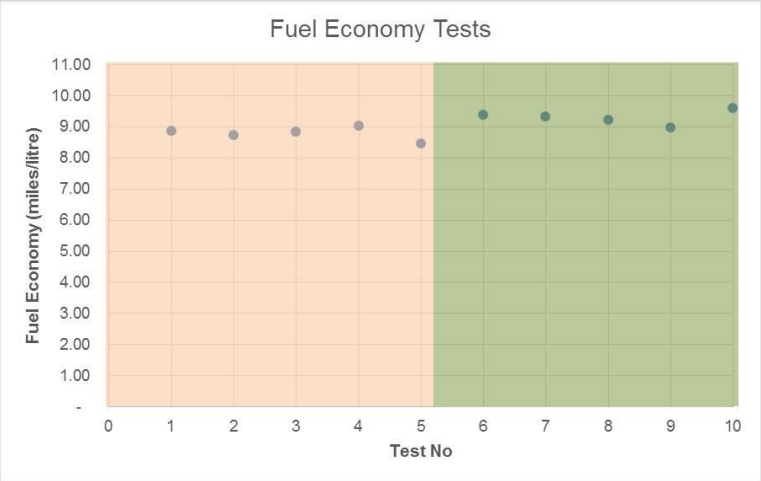

Figure 6 : Fuel efficiencies with and without the magnets

This shows that the efficiencies with the magnets were higher than those without the magnets in each case except in test 9.

It was later discovered that the plastic fastener (Figure 7) used to fit the magnet on the air supply line had been tightened excessively. Since the air supply pipe was also made of plastic, it became constricted, reducing the free air flow to the engine. This had caused the reduction in performance.

(a)

(b)

Figure 7 (a): Plastic fasteners used on plastic pipe supplying air to the engine and (b) Air supply pipe was constricted by the weight of the magnets

Once this problem was rectified, the engine performance picked up again as seen in test 10 (Figure 6).

It is thus recommended that SFL replace the plastic fasteners with rigid metallic fasteners in order to avoid this problem in the future.

4.2 Tests on Land Rover Discovery TD5 XS

Figure 8 : The test car: Land Rover Discovery TD5 XS

The diesel car used in the tests is shown above.

A summary of test results is shown in Table 2.

Table 2 : Summary of Test Results for Land Rover Discovery

Test No	Date	Magnets	Starting Mileage	Ending Mileage	Distance Covered	Fuel Used	Fuel Efficiency	Fuel Efficiency
			mi	mi	mi	L	mi/L	mi/Gallon
1	24/04/2017	No	115,092	115,398	306	47.81	6.40	29.12
2	25/04/2017	No	115,435	115,741	306	46.37	6.60	30.03
3	18/05/2017	No	116,245	116,422	177	27.74	6.38	29.03
4	21/05/2017	No	116,422	116,753	331	50.49	6.56	29.83
5	22/05/2017	No	116,753	117,136	383	62.20	6.16	28.02
6	25/05/2017	Yes	117,412	117,611	199	27.59	7.21	32.82
7	14/06/2017	Yes	117,867	118,067	200	28.52	7.01	31.91
8	27/06/2017	Yes	118,113	118,312	199	28.28	7.05	32.07

The average fuel efficiency of the car was:

- Without magnets: 6.48 miles/litre or 29.50 miles/gallon
- With magnets: 7.09 miles/litre or 32.26 miles/gallon

In other words, a saving of 9.36% was apparent. On a full tank, this would translate into an extra 45 miles.

4.3 Tests on Subaru Impereza GL 4WD Auto

Figure 9 : The test car: Subaru Impereza GL 4WD Auto

The petrol car used in the tests is shown above.

A summary of test results is shown in Table 3.

Table 3 : Summary of Test Results for Subaru

Test No	Date	Magnets	Starting Mileage	Ending Mileage	Distance Covered	Fuel Used	Fuel Efficiency	Fuel Efficiency
			mi	mi	mi	L	mi/L	mi/Gallon
1	25/05/2017	No	71,187	71,335	148	18.31	8.08	36.78
2	14/06/2017	Yes	73,764	73,912	148	16.81	8.80	40.06
3	27/06/2017	Yes	73,970	74,169	199	23.40	8.50	38.69

The average fuel efficiency of the car was:

- Without magnets: 6.48 miles/litre or 29.50 miles/gallon
- With magnets: 7.09 miles/litre or 32.26 miles/gallon

In other words, a saving of 7.07% was apparent. On a full tank, this would translate into an extra 25 miles.

5. Conclusion

Acknowledging that road tests are indeed, not the ideal way of measuring fuel efficiency, all due care was take to minimise the impact of other factors such as traffic conditions, driving speed, route, car condition, air conditioning, etc. Fully controlled tests in an engine test rig with a dynamometer may be performed to further prove the concept. However, the consistency in the evidence from road tests suggests that the magnets have had a positive impact on fuel efficiency of the vehicle.

The magnets used were powerful 7,500 Gauss permanent ceramic magnets.

The first car's average fuel consumption without the magnets was 39.93 miles/gallon. With the magnets, this figure rose to 42.87 miles/gallon, suggesting 7.5% fuel savings. These tests were the better controlled and were more reliable.

The second and the third cars showed savings of 9.3% and 7% respectively. The tests on these cars, however, were not fully controlled as the university was in possession of these vehicles only during the tests and not between them.

The three cars used in the tests were 8, 16 and 20 years old. The effect of magnets on new cars has not been studied.

Also, SFL should replace the plastic fasteners with rigid metallic fasteners used for fitting the magnets. Customers should not try to fit the magnets themselves. Instead, they should have them fitted by professional auto mechanics.