

ON ROAD FUEL CONSUMPTION TEST

Toyota Corolla 1993-94

AIM OF STUDY

- 1/ To gain local testimony on the performance of Aquasolve.
- 2/ To determine what effect the use of Aquasolve in diesel fuel will have on engine performance.

METHOD

Quantitative study involving;

- A. On road fuel consumption testing.
- B. Dynamometer fuel testing.

STUDY SAMPLE

Toyota Corolla 1.7 litre diesel station wagon Kilometres travelled 129,000.

Compression test results lb/sq.in; NO 1/ 370, NO 2/ 355, NO 3/ 360, NO 4/ 370. These are average compression rates for this model engine at these kilometres, they are reasonably even. An optimum would be approx 420psi for all cylinders on a newly run-in vehicle.

A high kilometre vehicle was used to **ensure** running-in variables were avoided and to illustrate if any advantages were to be gained through cleaning effects on the injectors, pumps, combustion chambers etc.

INSTRUMENTS USED

Engineering department of Waikato Polytechnic Institute dynamometer.
Log book recording Kilometres travelled, fuel used, speedometer reading.
Readings were taken from vehicle speedometer and certified fuel pump meters.

EXPECTED FINDINGS

We expected that there would not be a great deal of change of performance or consumption, (it would be required to have a minimum change of + or - 3% for any margin of error).

Engine performance can vary due to temperature and humidity changes, given that we are starting the tests in early spring and that the bulk of the test will be over the thy summer period you might expect a slight reduction in performance under normal conditions.

STUDY FINDINGS

On road fuel consumption

As per the attached spread sheet and graphs, initial consumption tests carried out over 5,000 kilometres showed an average of 40.86 miles per gallon.

Testing with Aquasolve treated fuel showed a steady increase in performance over the first 4,000 - 5,000 kilometres then levelled out at approximately 46 miles per gallon or a 9 % improvement.

These figures would equate to a good percentage saving in fuel consumption, certainly more than enough to cover the costs of treatment,

STUDY VALIDITY

People reading this study should take into consideration the following points.

- A/ The study sample is small,
- B/ Variations may occur with different engine types i.e.; slow revving engines, direct injection engines, (this engine is a high speed indirect injection diesel).
- C/ Driver variation; We used this vehicle because it is driven daily by different people in different applications thus minimising the potential of driver awareness to effect test results.
- D/ Temperature variations during the course of this study may have had slight effects.
- E/ The condition of an engine could have considerable implications on performance improvements i.e.: new engines running-in, old engines carboned up etc.

FURTHER RESEARCH QUESTIONS ARISING FROM STUDY

What effects would higher or specific amounts of water added to fuel have.

High or low extremes of temperature implications.

Different engine types and or applications i.e. stationary engines, direct injection engines, petrol engines.

EVALUATION 01' STUDY

Although this is a small study and larger tests need to be undertaken for more specific results, Locally we were pleased with the results of both the on road study and the Dynamometer tests, both achieving similar results one helping to validate the other.

The study showed that not only did the use of Aquasolve not reduce engine performance, indeed it showed considerable benefits could be gained through its on-going use.

It needs to be noted that as can be seen by the graph, when the use of Aquasolve was started there was a period of gradual improvement in performance and when the use was stopped the fuel consumption rate did not increase straight back to the start point but stayed noticeable better. I would suggest that this is as a result of the cleaning effects of extended use of Aquasolve. As Aquasolve has a neutral effect on the octane and cetane ratings of diesel the direct improvement from the use of Aquasolve could be explained by its strong surfactant properties helping to optimise the atomisation of the fuel and thus giving a cleaner more complete fuel burn.

DYNAMOMETER TESTING

Venue

The Engineering Department Waikato Technical Institute

Equipment used

Water driven Dynamometer

Conditions

Fine low humidity

Full throttle

Speed 100 kilometres per hour

AIM OF TEST

A/ To run in conjunction with and act as a comparison for on road testing

B/ To have independent comparative testing

We were concerned that we may not be able to achieve consistent readings using the dynamometer but as can be seen in the accompanying data readings were very consistent at all stages.

Testing

The test involves running a warm engine at full throttle loaded to 100 kph with a set fuel quantity.

Pre Aquasolve testing		After Aquasolve treatment	
1st run	2.7 km/litre	1st run	2.9 km/litre
2nd run	2.6 km/litre	2nd run	2.9 km/litre
3rd run	2.7 km/litre	3rd run	2.9 km/litre

Results

We have achieved just under 9% improvement on the dynamometer tests after using Aquasolve for 27,000 kilometres, this is very close to on road testing.

Validity

- A/ The study sample is small.
- B/ Variations may occur with different engine types i.e.: slow revving engines, direct injection engines, This engine is a high speed indirect injection diesel.
- C/ Driver variation; We used a full throttle setting and governed engine speed using dynamometer to try to alleviate driver error, this appears to have worked well given the consistency of results.
- D/ Temperature and humidity variations during the course of this study may have had slight effects given the time between tests Humidity readings etc. were taken at the time and considered to very close 68% and 65%.
- E/ The condition of an engine could have considerable implications on performance improvements i.e.: new engines running-in, old engines carboned up etc. a new engine may not show the same level of performance but given that it is easier to keep injectors etc. clean it would follow that by using a detergent from new you should achieve better results although this would be very hard to quantify
- F/ It could have been expected to see higher results from the Dynamometer test than the on road test as the road testing takes into account the improvement period of approximately 5000 kilometres This was not shown, perhaps because of the extra stress incurred when running a diesel engine at full throttle and the fact that the injector pump is designed to over-fuel under these circumstances.

Overall this has been a successful test and we have been most impressed, these results may or may not duplicate themselves in other circumstances. It must be remembered that this vehicle was chosen because we felt that it had the potential given the kilometres travelled to show the best results.

Tests designed and managed by
Richard Jacobsen

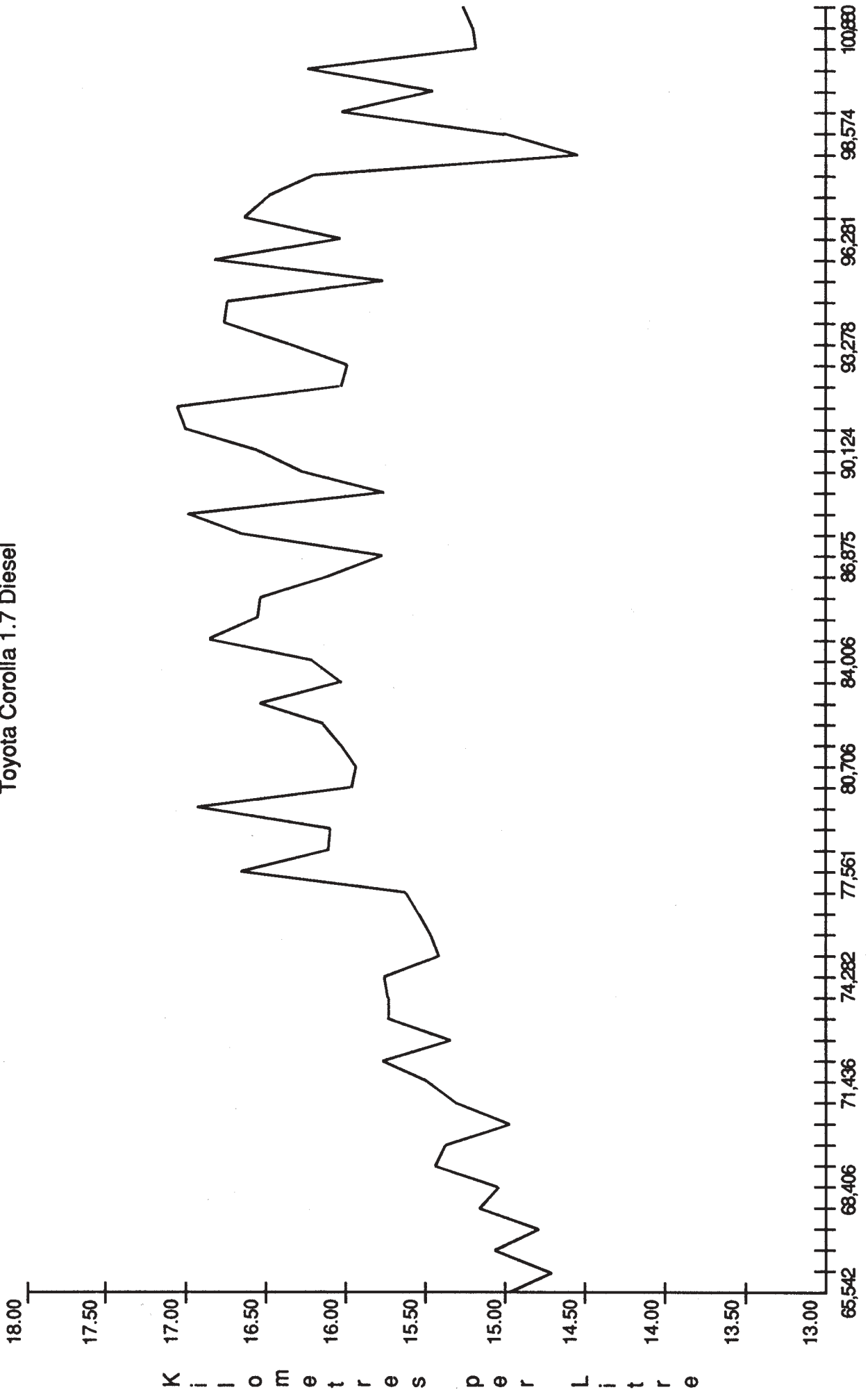
For Fuel Solutions, distributor of Aquasolve

I am Automotive Engineer having passed all qualifications through to Advanced Trades Certificate including extension certificates in LPG and CNG gases.

I have 13 years experience in Automotive Engineering including Heavy Transport and Off Shore Oil Exploration and general Automotive work.

I am currently completing papers in Management and marketing at The University Of Waikato

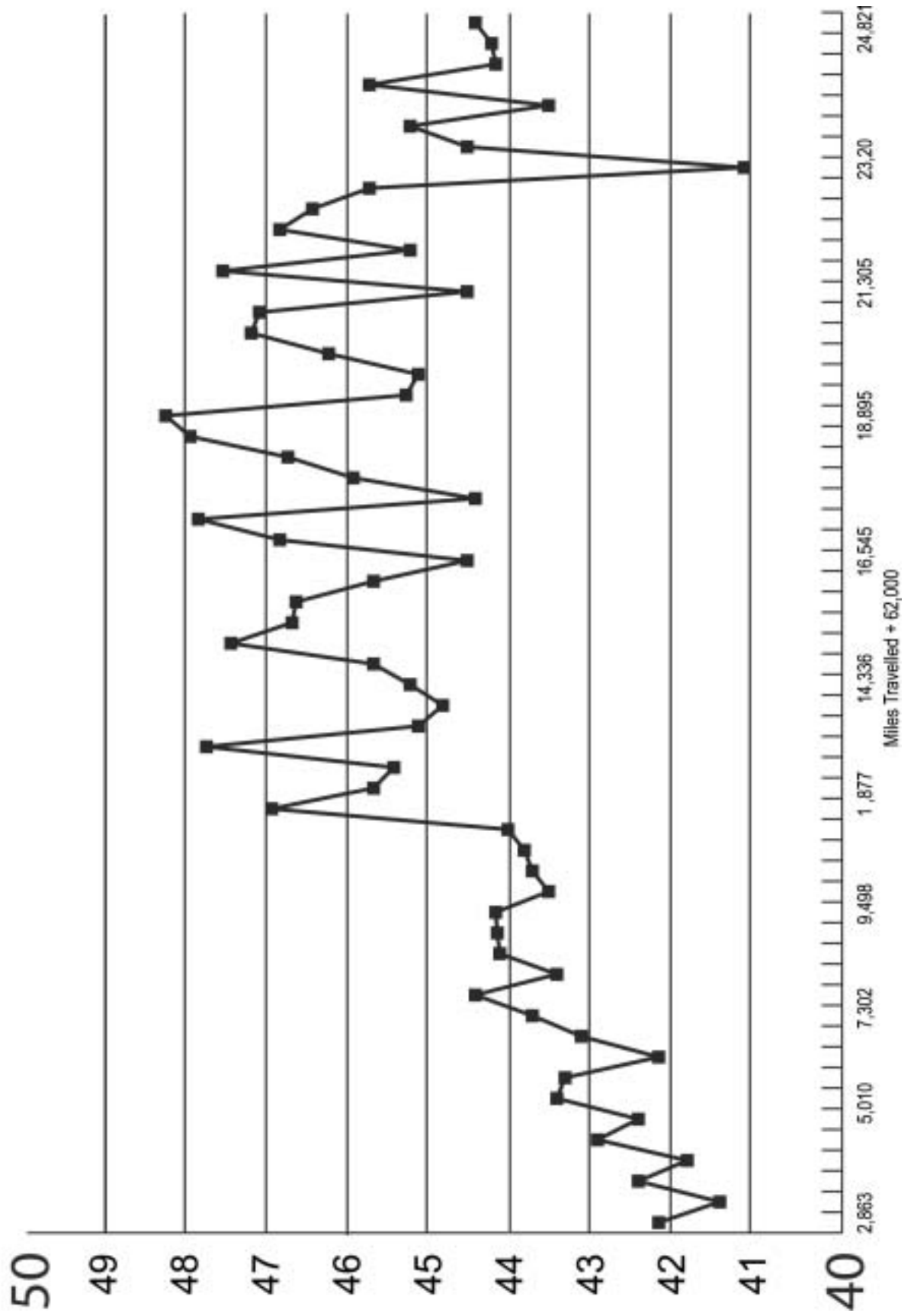
AQUASOLVE FUEL CONSUMPTION TEST
 Toyota Corolla 1.7 Diesel



Kilometres Travelled + 100,000

AQUASOLVE FUEL CONSUMPTION TEST

Toyota Corolla 1.7 Litre Diesel



General data for on road fuel consumption testing

Date	speedo 1.689	kilometres	litres	dollars	Kilo's/litre	MPG	cost / kilo	
05/08/93	164,990		32.51	16.39				
07/08/93	165,542	552	36.85	18.57	14.98	42.32	0.03	
09/08/93	166,090	548	37.25	18.77	14.71	41.56	0.03	
15/08/93	166,715	625	41.50	20.92	15.06	42.55	0.03	
21/08/93	167,269	554	37.34	20.50	14.84	41.92	0.04	
25/08/93	167,873	604	39.70	20.60	15.21	42.99	0.03	
28/08/93	168,406	533	35.40	19.08	15.06	42.54	0.04	
30/08/93	168,996	590	38.26	21.01	15.42	43.57	0.04	
07/09/93	169,585	589	38.29	21.40	15.38	43.46	0.04	
14/09/93	170,201	616	41.17	23.84	14.96	42.27	0.04	
21/09/93	170,820	619	40.46	20.03	15.30	43.23	0.03	
29/09/93	171,436	616	39.80	21.47	15.48	43.73	0.03	
02/10/93	172,057	621	39.44	20.47	15.75	44.49	0.03	
06/10/93	172,685	628	40.91	22.05	15.35	43.37	0.04	
09/10/93	173,027	342	21.87	12.44	15.84	44.18	0.04	
14/10/93	173,680	653	41.75	21.99	15.64	44.19	0.03	
20/10/93	174,282	602	38.40	20.69	15.68	44.29	0.03	
23/10/93	174,927	645	41.87	22.57	15.40	43.52	0.03	
27/10/93	175,565	638	41.26	21.83	15.46	43.89	0.03	
31/10/93	176,219	654	42.08	28.16	15.54	43.91	0.04	
05/11/93	176,832	613	39.28	20.77	15.61	44.11	0.03	
10/11/93	177,561	729	43.85	23.20	16.62	46.97	0.03	
12/11/93	178,184	623	38.54	20.77	16.17	45.67	0.03	
15/11/93	178,816	632	39.25		16.10	45.49	0.00	
19/11/93	179,450	634	37.52		16.90	47.74	0.00	
24/11/93	180,048	598	37.47		15.96	45.09	0.00	
27/11/93	180,706	658	41.45	22.50	15.87	44.85	0.03	
01/12/93	181,380	674	42.05	21.83	16.03	45.29	0.03	
08/12/93	182,082	702	43.41	24.38	16.17	45.69	0.03	
10/12/93	182,627	545	32.86		16.59	46.86	0.00	
14/12/93	183,303	676	42.18	24.00	16.03	45.28	0.04	
16/12/93	184,006	703	43.39	22.52	16.20	45.78	0.03	
22/12/93	184,589	583	34.70	18.00	16.80	47.47	0.03	
24/12/93	184,987	398	24.08	15.00	16.53	46.70	0.04	
30/12/93	185,648	661	40.03	20.17	16.51	46.65	0.03	
11/01/94	186,251	603	37.31	19.36	16.16	45.66	0.03	
14/01/94	186,875	624	39.51	19.72	15.79	44.62	0.03	
24/01/94	187,561	686	41.31	21.48	16.61	46.92	0.03	
28/01/94	188,231	670	39.49	20.50	16.97	47.94	0.03	
05/02/94	188,822	591	37.50	20.21	15.76	44.53	0.03	
06/02/94	189,512	690	42.38	21.15	16.28	46.00	0.03	
11/02/94	190,124	612	37.00	21.50	16.54	46.73	0.04	
14/02/94	190,703	579	34.10	17.02	16.98	47.97	0.03	
17/02/94	191,342	639	37.41	18.29	17.08	48.26	0.03	
22/02/94	191,921	579	36.02	18.79	16.07	45.42	0.03	
03/03/94	192,613	692	43.31	21.61	15.98	45.14	0.03	
14/03/94	193,278	665	40.61	20.67	16.38	46.27	0.03	
25/03/94	193,957	679	40.58	20.25	16.73	47.27	0.03	
31/03/94	194,579	622	37.29	20.47	16.68	47.13	0.03	
07/04/94	195,221	642	40.69	24.21	15.78	44.58	0.04	
14/04/94	195,698	477	28.35	15.00	16.83	47.54	0.03	
19/04/94	196,281	583	36.32	21.03	16.05	45.35	0.04	
28/04/94	196,436	155	9.33	5.00	16.61	46.94	0.03	
03/05/94	197,137	701	42.65	21.28	16.44	46.44	0.03	
07/05/94	197,755	618	38.08	19.00	16.23	45.85	0.03	
18/05/94	198,275	520	35.71	18.89	14.56	41.14	0.04	dyno test
25/05/94	198,574	290	10.02	10.00	15.80	44.65	0.03	No Aquasolve
30/05/94	199,119	545	34.03	18.00	16.02	45.25	0.03	
02/06/94	199,707	588	38.11	19.02	15.43	43.59	0.03	
13/06/94	199,788	81	5.00	9.82	16.20	45.77	0.12	
13/06/94	200,336	548	35.00	18.60	15.66	44.24	0.03	
21/06/94	200,880	544	34.72	18.37	15.67	44.27	0.03	
30/06/94	201,459	579	36.78	19.69	15.74	44.48	0.03	

26,935.00

Green data is for treated fuel

Black data is for untreated fuel

Average fuel consumption before treatment - 42.58 MPG

Average fuel consumption during treatment - 46.70 MPG - 9% Improvement

average fuel consumption after treatment stopped - 44.61 MPG - 4.5% reduction