DESKTOP STUDY

FUELSTAR COMBUSTION CATALYSTS

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Mr Ian Cornelius
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Dear Mr. Cornelius **DESKTOP STUDY**

Introduction and terms of reference

I refer to your letter dated 19th August 2001 asking me to complete a desk-top study in connection with the Fuelstar technology and product and, in particular,

1. the veracity of the Fuelstar technology from a scientific point of view, and
2. its effectiveness in actual use in meeting the claims made for it in
    a. reducing emissions in gasoline engines
    b. reducing black smoke in diesels by 30% and more
    c. reducing fuel consumption by 10% and more
    d. increasing power output by 10% and more
    e. enabling engines deigned for leaded petrol to operate on unleaded petrol without
        i. loss of performance
        ii. pinking
        iii. valve seat recession

The numerous reports and documents provided are listed at the end of this report.

Conclusions

1. In my opinion, the Fuelstar technology has complete scientific integrity. It is a common (though false) belief that products of this type bring about a chemical reaction on the fuel as it passes through the unit canister. This belief is ill-founded and incorrect. What actually occurs is that the Fuelstar product, with the aid of movement and vibration and possibly an electrolytic effect, releases minute particles of metallic tin and/or tin suboxide into the fuel stream.

2. These particles are less than 100 nanometres in size, are colloidal and are transported in the fuel stream into the combustion chambers of the engine. The tin particles act as a combustion catalyst, increasing the degree of oxidation of the fuel. As a result fuel economy is achieved as well as increased power availability from the engine. This applies to both gasoline and diesel engines.

3. The physical characteristics of these colloids are such that the Fuelstar unit must be installed strictly in accordance with the installation instructions. Lengthy experience has demonstrated that adequate movement (vibration) of the Fuelstar unit is essential for the generation of the tin particles in adequate number. It has been found that without adequate vibration the particles are not formed in sufficient number and the Fuelstar unit will not function properly.

4. Furthermore, since the actual catalyst material is particulate in nature (albeit of sub-micron size) there must be no physical impediment between the Fuelstar unit and the engine. Consequently there must not be a fuel filter in the line between the Fuelstar unit and the tubing carrying the fuel must be of a suitable chemical type. It may be thought the sub-micron particles would pass readily through typical fuel filters, but experience has shown that the flow of the particles is considerably impeded by certain types of filter. Also, being colloidal in nature, the particles carry an electric charge and this causes them to adhere to certain types of filter material. Likewise certain elastomer tubing attracts the charged particles, and this impedes the flow of the particles. In this latter instance however, the continued passage of the particles eventually saturates the adsorbent capacity of the tubing and the Fuelstar unit then operates normally. Filters do not self-correct in this manner.

Laboratory Tests

I am aware of laboratory tests which have been conducted on tin-based catalyst products of this type, and that the results of these tests have not been in conformity with outcomes achieved in commercial use. Failure by those conducting the tests to replicate actual operating conditions is the most likely reason for the anomalous results which have been reported based on laboratory testing.

Scientific tests on Fuelstar and other tin-based products of this type can only be designed to replicate on-road conditions after the precise mechanism of operation of the product is known and fully understood; but the exact scientifically-defined requirements for proper use of the products have not yet been fully elucidated. On-road conditions certainly provide the necessary environment for the units, but definition of this environment in sufficient detail to allow for laboratory replication has not yet been achieved.

From the dynamometer testing graphs supplied, and from the many hundreds of on-road tests and the many testimonials from users, there can be no doubt that the claims made for Fuelstar products are totally justified.

Definitive knowledge of operating parameters, in sufficient detail to permit scientific definition which is essential for laboratory testing, may be gained in due course; however this degree of knowledge has not yet been achieved by anyone in this field, so far as I am aware.

Valve Seat Recession

In relation to the ability of the product to prevent valve seat recession (VSR) in engines designed for leaded petrol when required to operate on unleaded petrol, again there can be no doubt that the product achieves this result. It acts in a similar fashion to tetra-ethyl lead (perhaps even better) but tin has the huge advantage of being non-toxic.

There are numerous reports, also based on widespread actual usage, which demonstrate the overwhelming success of the product in preventing VSR. It is futile to attempt to deny that this benefit is achieved. Prevention of VSR comes about because (as has been proved by analysis) Fuelstar causes a refractory coating containing tin oxide to form on the exhaust valve mating seats. (Lead behaves in the same manner.)

It has also been proved by experiment that the product has been proved to reduce exhaust gas temperatures, again duplicating the known benefit provided by lead-based additives.

Therefore, both scientific and practical bases exist for the product to perform as claimed.

My background

By profession I am an analytical and consulting chemist and I have spent over 50 years in this field. My whole post-university career was in the commercial world. As a result of this work in industry I have had extensive experience over many years in the fields of the chemistry of automotive fuels, combustion of hydrocarbon fuels, and combustion catalysts.

I am also knowledgeable on the free radical chemistry involved, and that of the oxides, silicates etc formed at high temperatures. I am also well informed on the science involved in the functioning of Fuelstar catalytic units, the laboratory testing which has been conducted, and the results achieved in actual usage of this product.

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The chemistry involved in more detail

Fuelstar manufactures the Fuelstar combustion catalyst, a device founded on many years' experience in several countries. This product is based on the known catalytic effect of tin (or more precisely the sub-oxide of tin) on the rapid oxidation of hydrocarbons under the high pressures achieved in modern internal combustion engines. The beneficial effects of the product apply to both spark-ignition (petrol) and compression-ignition (diesel) engines. Essentially the catalysis of the oxidation results in more complete or total fuel combustion, thus maximising the energy derived from the combustion of both fuels.

Furthermore, tin compounds, as with the compounds of lead formed by the combustion of lead tetra-ethyl, have another beneficial effect on internal combustion engines. The oxidised metal, either as the oxide or as a fusible compound formed by the interaction of the metallic oxide with silicate and (in some instances vanadate) in the fuel, forms a protective layer on the mating faces of the poppet valves used in all four-stroke engines. This coating protects the mating surfaces, especially the valve surfaces, from erosion and from bonding to the valve seat.

The usefulness of lead in this respect has been known for many years; and tin has the same or even better effect. Other metals also provide this benefit, but tin is unique in that it is non-toxic and the emission of toxic material in exhaust gases is avoided.

The Fuelstar Product

Fuelstar products are by no means the first of such catalytic units to be manufactured, and used, for these purposes; however Fuelstar has been developed, and its efficacy demonstrated, to a far higher degree than any other comparable product.

Fuelstar products have been installed since 1992 in more than 70,000 engines designed for leaded petrol, so as to enable such engines to operate on unleaded petrol. These installations have mostly been in New Zealand, Australia, France (more than 20,000 in each country) and in Switzerland, Spain and Denmark. The product is extremely well received by commercial operators of automotive engines, motorists, motor repair garages and specialist motoring magazines in all of those countries.

Fuelstar claims, with complete justification, that its product enables such engines to operate on unleaded petrol without loss of performance, without valve seat recession, without spark plug fouling and with pinking under load either eliminated or substantially reduced.

I have examined numerous reports and have satisfied myself of the overwhelming success of the product in actual usage. The product has been proved to reduce exhaust gas temperatures. It has also been proved (as outlined above) to deposit a refractory coating containing tin oxide on the exhaust valve seats. Therefore, both scientific and practical bases exist for the product to perform as claimed.

Test procedures

There are no established and satisfactory laboratory test procedures for products of this nature, either to test their capability to enable engines designed for leaded petrol to operate on unleaded petrol or to demonstrate the fuel savings which have been proved in practice. One test method, described in Standard AS4430.1, was developed in 1996. The sub-committee charged with the responsibility for that standard is not satisfied with it, and that the standard is under review. As currently specified, the test most certainly does not form the basis for a reliable test of Fuelstar or other products based on tin technology.

It is fundamental to any laboratory test procedure that is intended to replicate actual usage of a product or technique in practice, that the operating parameters of the test truly replicate the actual operating parameters in practice. Put another way, the laboratory parameters for a test on Fuelstar must duplicate the actual on-road conditions under which Fuelstar units are used. But this essential requirement has <u>never</u> been met in any laboratory engine tests carried out to date. Furthermore, this essential duplication may not even be possible given present knowledge of the operation of Fuelstar and related products. I would be pleased to elaborate on this point, on request.

Fuelstar has sought, with total justification, to have this standard drawn in such manner to provide Fuelstar (and others) with a means of having their products tested in a fair and proper manner.

I am aware of the test conducted by the University of Melbourne on the Fuelstar product on behalf of the New Zealand Automobile Association (NZAA) in 1997. That test was totally flawed for no fewer than four reasons:

1. The test was conducted with a filter between the Fuelstar unit and the engine. This is in total contravention of Fuelstar's stated instructions. Fuelstar International has known for years that such filters effectively remove the tin particles from the fuel, and so the NZAA test was completely invalid. The presence of the filter denied passage of the catalyst to the engine.

2. The test was an accelerated one; that is, it sought to derive data by means of extreme and artificial parameters. The test thus violated the fundamental basis of any such test (see above). The engine was operated continuously at wide-open throttle and under full load, conditions that would never be encountered in actual usage. Again the test violated the first and essential requirement for a reliable laboratory test.

3. The Fuelstar was not installed in accordance with published installation instructions, which fact alone would have ensured a fail result. Yet again, in the third respect, the parameters used in the NZAA test did not replicate on-road usage.

4. Under instruction from NZAA, the operators conducting the test departed from the test standard by ignoring the need to condition the engine (which had freshly cut valve seats) by operating it for a period of 50 hours on leaded petrol. Again the requirement for true replication was flouted; a total of four departures from essential requirements.

The NZAA test was flawed from the outset, and it is no surprise that the test gave erroneous results.

There is a second fundamental requirement for laboratory testing of practical techniques or products that have proved successful in widespread use over a lengthy period. If the laboratory test appears to contradict the lengthy observations, the test method itself must be regarded as suspect. The method must be re-visited; the opinions of experts in the field in question must be obtained; and above all there must be no publication of information that would, or even might, have adverse commercial consequences. Those who, like myself, have spent many years in the field of practical science are all too well aware of the damage which can arise from laboratory "tests" which fail to replicate practice.

The Fuelstar product is clearly the best available for enabling engines designed for leaded petrol to operate on unleaded petrol. The alternatives, lead replacement petrol and liquid additives may (possibly) prevent VSR but are highly toxic and promote spark plug fouling, pinking and detonation, and a consequential deterioration in engine performance. Fuelstar prevents valve seat recession, improves performance and eliminates or substantially overcomes pinking and detonation.

Further, by providing a more complete fuel oxidation, it improves fuel economy (10% and more) and reduces undesirable emissions (by 30% and more).

The scientific basis for these claims is well founded and the comprehensive results in actual usage over almost a decade of use are ample proof of the efficacy of the product.

The Fuelstar product is so effective it should be installed in all original equipment engines, from new, in the interests of conserving the world's dwindling reserves of non-renewable fuels, and reducing gaseous emissions, in particular carbon dioxide, believed to be a major contributor to "greenhouse gases" and global warming.

It is most regrettable that all of this success should be jeopardized, and the operators of internal combustion engines who could benefit from Fuelstar products misled, by an ill-conceived test conducted by people who clearly did not understand the technicalities of the product they were attempting to test, and who failed even to follow the simple directions for installing the Fuelstar unit in the first place.

Yours faithfully

T J Sprott OBE MSc PhD FNZIC

List of documents provided

1. Yellow plastic covered booklet containing a variety of brochures, detailed installation instructions and other information and data that Fuelstar sends out to its distributors, including 12 recently generated dynamometer graphs.

2. Report dated 17th January 1998 by Ron Wilkinson, Chartered Chemist of McCrae in Australia, elucidating the means of operation of the product.

3. A booklet containing some 25 further formal and semi formal scientific reports.

4. A report by you on the Effectiveness of Fuelstar in NZ during the period 1996 - 1998 in enabling engines designed for leaded petrol to operate on unleaded petrol.

5. A booklet containing a quantity of testimonials and press articles. You advised that this dossier is quite incomplete, as many testimonials have been misplaced. However, it is representative.

6. Document dated 24th September 2001 styled "Fuelstar Tin-based Catalysts"