

THE MOTOR VEHICLE: EMISSIONS AND THE ENVIRONMENT

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In a recent interview published in the magazine "Environmental Action", Sir Laurens van der Post, that towering moral and intellectual figure of our time, when asked whether ordinary business people are, in fact, equipped to address these large questions relating to our future on the planet, responded:-

"The business world now has an enormous importance in shaping our present and future world and it would be dangerous in the extreme to try to exempt business people from their growing responsibilities in this regard."

In looking at the South African situation, the evidence is there for all to see:

Firstly, a **Population Explosion** which is placing enormous strains on our land and other natural resources.

Secondly, **Water** requirements for our burgeoning population means that early in the 21st Century, South Africa will have to import water from our neighbouring states to meet our full requirements.

Thirdly, pollution of our **Oceans** through the deposit of sewage waste and abuse in fishing practices such as the use of gill nets by foreign trawlers.

And fourthly, the **Air** we breathe is being horribly polluted by sulphur from coal used in our power stations.

A 1989 Foundation for Research Development Report revealed that in parts of the Eastern Transvaal Highveld, 57,5 tons per square kilometre of sulphur dioxide were deposited in the form of acid rain. This rain has a pH level of 2,8 - similar to that of vinegar.

As a matter of shocking interest, 57,5 tons per square kilometre is four times more than in Britain; 8 times more than Western Germany and 50% more than Europe's most polluted area - as it was then known, Eastern Germany.

Clearly we need urgent solutions.

The Motor Industry is not exempt from criticism. Cars by their nature are not "Environment Friendly". They pollute the atmosphere; they use non-renewable fossil fuels, and wrecks litter the countryside.

Mr Chairman, I see from the programme that my presentation is titled "Problems and Financial Aspects of Emission Control of Motor Vehicles", therefore I should perhaps cover a broader aspect than just that of exhaust emission.

Emission from motor vehicles of course covers many areas of individual expertise each one employing its own specialists. Therefore Mr Chairman, I consider you may find it interesting to touch on these activities before we move on to the question of exhaust emission.

Elimination of CFC-R12

Without question the greatest activity at this time is in the field of emission control and the phasing out of the dangerous ozone depleting chlorofluorocarbon (CFC R12).

Due to the enormous environmental problems of this gas international agreements have been reached on a phasing out programme which is known as the Montreal Protocol, and I am sure you will know that South Africa signed this agreement on the 15th February 1990 and will participate as a First World country.

The programme as agreed to in Montreal is a minimum requirement, and in many instances has been improved upon.

- June 1989 not to exceed 1986 consumption
- June 1993 - 80% of 1986 consumption
- June 1998 - 50% of 1986 consumption
- January 2000 - Total deletion.

However many countries including South Africa have brought the deletion date forward and we can give examples from a recent publication dated February 1992 which includes:-

EEC Countries	-	Total phase out in	1997
Sweden	-	"	January 1993
Germany	-	"	January 1995
United Kingdom	-	"	during 1996
Australian	-	"	before 1998

South Africa - voluntarily at the end of 1995.

In the motor vehicle CFC R12 is used mainly as the refrigerant in air-conditioning systems. It is also used as a blowing agent in expanded foams, a release agent for demoulding plastics, and as a contact preserver in electronics.

The main problem area is that of the airconditioning system which has had to be redeveloped to operate off the CFC R12 replacement which is known as R134a.

This in itself is not without its problems. The R134a is known to be some 10-15% less efficient than the R12. It also creates corrosion of copper components, and as yet the health hazard level is not proven.

Due to these considerations it is doubtful if an airconditioning system designed for R12 will run for any time when filled or topped up with R134a. Therefore taking the normal life of a car in South Africa as ten years, and considering the non-availability of R12 after 1995, the only way one will be able to service an airconditioner in today's vehicle in future years will be through R12 which has been recycled from scrap products.

This solution will of course also apply to all airconditioning and refrigeration systems in both the industrial and domestic market.

As from 1994 it will become illegal to vent R12 into the air, and from that date all dealers in airconditioning units will have to be registered and meet with an SABS code of conduct. Whilst there are no emission controls in South Africa, Europe currently demand a loss factor of not more than 5g per year per joint; and considering the number of motor vehicle airconditioning units on Planet Earth will result in many tons of ozone depleting gas being released into the atmosphere just from passenger cars.

Emission - Plastics

Whilst CFC has become an emotional subject, fogging, a result of emission from plastics would seem to attract little if any public awareness.

What is Fogging?

It is the release of:

Toxic pollutants, odours and vapours from:

- * Plasticisers
- * Stabilising agents
- * Release agents

that are bonded into synthetic materials.

From fogging we can list the following identifiable condensate constituents:-

- * Phthalic Acid
- * Adipic Acid
- * Palmitic Acid
- * Stearic Acid
- * Myristic Acid
- * Fatty Acids
- * Stearyl Alcohol Tridecanol
- * C15 to 32-n-Paraffin-hydrocarbons
- * Sulphurous Compounds
- * Amines

Improvement of fogging behaviour of material for interior trim:-

Material F_R	F_R		MEASURES
(Use)	(Use) %	(Before) %	
PVC/ABS (Instr. Panel) Deep Drawing Foil	75-85	53	Change from Monomer-Softeners to Polymer-Modifiers
PVC (Sunvisor foils)	76-79	64	Improved Softeners
PVC (Imitation leather- seat covers)	81-88	41-43	Improved Softeners
PVC (Floor coverings)	85	24	Improved Softeners
Polyester-PUR-Polyamide- compounds (Seat covers)	73-87	32-86	Material optimisation of the Foam

$F_R = 100\%$ No Fogging
Transport / VW: R_R greater than 85%

Whilst local technology is not in pace with Europe we at Volkswagen S.A. will develop our future materials in line with VWAG standards and thus fall in line with the spirit of environmental protection.

Emissions - Batteries

Gas emission does occur but is so small as to be negligible.

Emissions - Brake Linings

Only in the case of new brake linings does gas emission occur under extreme braking conditions e.g. driving through a mountain pass. However the real problem with asbestos is in the manufacturing process, and this material will become obsolete in the very near future.

Emission - Fuel Vapour

Fuel vapour emission is considered one of the more environmental damaging properties from the motor vehicle and its servicing, since the emitted hydrocarbons that boil easily form radicals under the influence of UV-radiation which can disturb the $\text{NO} \leftrightarrow \text{NO}_2$ balance in the atmosphere and thereby indirectly contribute to the formation of ozone in the ground level area. This reaction-process pre-supposes strong solar radiation. The reaction products can then intensify the effects of the "Summer Smog".

Apart from these reactions with effects in the ground-level area, hydrocarbons as well as CO_2 and H_2O are said to increase the so-called greenhouse effect through their reaction to UV-radiation. It is, however, not yet clear just how great the influence of these anthropogenic emissions can become on a global temperature rise, since approx. 94% of HC-emissions are not of an anthropogenic origin (forests, swamps, animals, natural gas).

In 1987 pilot projects were already initiated at petrol stations in Berlin and Munich to reduce the fuel emissions that escape into the atmosphere during refuelling of vehicles by means of a gas displacement technique at the source of the problem.

The butane that occurs during the refining process (boiling point: $-0,5^\circ\text{C}$ or $-11,7^\circ\text{C}$ for i-butane), which, for "environmental reasons", is no longer "burned off" - as was previously the case - is now added to the Otto-fuel. During refuelling of the vehicle a large percentage of the butane - which was also registered on the meter - escapes from the liquid through the intense movement. When the vehicle is driven, the fuel is still moved and heated to a greater or lesser degree. At the same time the butane-parts as well as a considerable portion of the hydrocarbons that boil below 40°C are released, so that they cannot actually reach the engine and are not available for the production of energy.

Instead of burning them off, the mineral oil industry distributes these components in the environment over a wide area with the aid of motor vehicles and at the expense of the driver. By refraining from adding gaseous components and by increasing the boiling point of the Otto-fuels, fuel emissions from motor vehicles can be reduced by more than half.

Disadvantages for the driver, such as starting problems or problems while driving, are not to be expected; on the contrary, problems as a result of excess lubrication during warm starting or vapour locks during driving, as they presently occur, e.g. shortly after refuelling, should rather decrease.

Mr Chairman, in the time available it is not possible to enter into detail discussion of the capture or control of fuel vapour emission into the atmosphere, however, we must mention that whilst there is little if in fact any control on vapour emission in South Africa, both Europe and America are addressing the subject in a positive and responsible manner.

Targets set for fuel-vapours control during the tank filling process have been set at 1000 grams per annum 80% Butane and less than 1% Benzol whilst emissions from the fuel tank system are proposed for both Europe and the USA at less than 2000 g/a. So when considering the current fuel system emission level at ± 7300 g/a the targets present a tremendous challenge to all motor vehicle manufacturers which include the following critical parameters.

- Material fuel resistance
- Permeability
- Aging = flexibility over lifespan
- Mechanical stability
- On-board vapour recovery system.

Whilst critical parameters for the serving stations include:

- Sealing of the dispensing nozzle, "liquid seal" is not operationally safe.
- The permissible variation for the back pressure at the dispensing nozzle.
- The permissible variation for the over-pressure in the tank.
- The optimisation of the storage-medium.

I am sure that with the introduction of lead free fuel and use of the catalytic converter we will also see certain manufacturers incorporate into their vehicle the "On board vapour recovery" system. This is one argument which is never addressed in the debate for unleaded fuel and yet it is a motivation which as you will see later is close to the top of the list for environmental protection.

Emission - Exhaust

Mr Chairman, like vapour emission, exhaust emission is another environmental subject which responsible people would seem to consider best left alone. It is true that the current debate is focused on lead free fuel, but it would seem to me that the argument is only addressing the dangers of lead and its effect on the population with specific focus on brain damage to small children. This as it may be, I think that we must include into this section on Exhaust Emission, the subject of lead free fuel as both are compatible and give a little bit of background, some history, and a comparison between the USA and Europe, and then move on to the real discussion, that of exhaust emission.

Background

Lead is added to petrol because it enables more kilometres to be travelled per barrel of crude oil. A reduction of lead compounds means that more crude oil has to be refined to provide the same quantity of petrol.

It is known that during the lifetime of a car about 70% of the lead added to the fuel as an antiknock agent is discharged as very fine particles of lead compounds such as oxide, sulphate, chloride, bromide, etc. The remaining approx. 30% is retained in the vehicle, mainly in the exhaust system but also in the oil and oil filter and in combustion chamber deposits.

Some of the lead particles emitted remain suspended in the air and can, therefore, be inhaled. The heavier particles fall to the ground and can contaminate roadside crops or food exposed in shops etc. Contaminated dust can be washed by rain into streams and rivers and then into the sea.

Many people are greatly worried about this contamination of the air, soil and water by a well recognised 'poison' that can have adverse effects on health. It is for this reason that during the last few years pressure has arisen in many parts of the world to reduce the lead content of petrol - or even to prohibit its use entirely.

A Bit of History

Until about 1970 lead was contained in almost all petrol used throughout the world but this was not a subject for public debate and concern. It is true that since 1923 (when lead was first added to petrol) from time to time in various places, doubts have been raised regarding the health aspects of the use of lead. Many committees and commissions studied the problem and in all cases reached the same conclusion - namely that there was no hazard to health due to the use of lead in petrol. For example in 1960 the Surgeon General of USA authorised an increase in the maximum allowable quantity of lead from 0.84 g/l to 1.12 g/l.

Since about 1970 however, a new situation has developed largely due to the interplay of many factors such, for example as:-

The realisation that human activity was causing massive (and as some feared, irreversible) pollution of land, water and air, has resulted in international co-operative efforts to control such pollution. Environmental Agencies, Departments, Societies, Committees etc. have sprung up like mushrooms all over the world and not surprisingly, lead, owing to its wide use, has been high on the list of priorities for study.

Germany, as part of comprehensive protection of the Environment legislation, passed the famous Lead Law in 1971. The Law required a reduction in the lead content of petrol from 0.64 g/l to 0.4 g/l as from January 1st, 1972 and to 0.15 g/l as from January 1st, 1976.

In Europe

One of the aims of the European Economic Community (EEC or Common Market) is to 'harmonise' regulations and legislation - that is, to make sure that standards applicable in one member country do not conflict with those in other member countries. Following, the introduction of the German Lead Law the Commission of the EEC, after many months of discussion and debate, proposed a Directive to control the lead content of petrol. This, as would be expected, was a compromise, calling for a reduction of 0.4 g/l in premium petrol and a maximum of 1.15 g/l in regular petrol. The European Parliament agreed to the 0.4 g/l limitation, and a proposal for 0.15 g/l to be implemented at a later date. Since Germany already had a 0.15 g/l law and certain of the other member countries had strong reservations about making

any reductions then, it was unlikely that the proposed Directive would become Community Law.

In the USA

In 1970, in the USA a law was passed which required, by January 1975, very stringent control of certain components of vehicle exhaust gas, i.e. carbon monoxide and unburned fuel, resulting from incomplete combustion in the engine cylinder. The motor manufacturers decided that the only way open to them to comply with the requirement of the law was to fit 'catalytic' devices in the exhaust systems of their vehicles, the purpose of which is to convert such pollutants to harmless carbon dioxide and water. Such catalysts are de-activated by lead and it was necessary, therefore, to ensure that only lead-free petrol was used. Further legislation required petrol refiners to supply such lead-free petrol - not to protect the health of the population but to protect the exhaust system catalysts. Unfortunately, owing to a lack of understanding of the complexities of the problems, many people in the USA began to think that "Getting the lead out" was itself the answer to all their air pollution problems.

Lead in Blood

Regarding the emotional subject of leaded petrol, and its affect on humans particularly children I would like to quote from a study the British Department of the Environment, HMSO 1990:-

"This study is following acceptance by the British Government to reduce the maximum lead content of petrol from 0.4 g/l to 0.15 g/l on 31 December 1985.

There has been an overall downward trend of 4.5% per year in mean blood lead concentrations of both adults and children since the early 1970's.

This has been due to reductions in lead levels in food, water, cooking and eating utensils, point sources of lead and other adventitious sources. On the other hand the DoE report shows that lead emissions from motor vehicles have remained substantially the same since the early 1970's until the reduction in lead levels in December 1985. This long term downward trend in blood lead concentrations must therefore be assessed against a fairly constant level of lead emissions from exhausts of motor vehicles.

In 1985, prior to the reductions in petrol lead levels, average blood lead concentrations in adults and children living in close proximity to heavily-trafficked roads fell by more than the overall downward trend although there was no change in lead emissions.

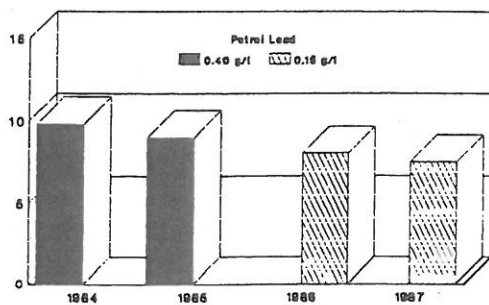
In 1986, one year after the reduction in petrol lead levels, the fall in blood lead concentration in adults living close to major roads was the same as in 1985. For children the fall was slightly larger by around 0.5 - 1.0 μ /100 ml.

In 1987 all the falls were the same as the long term downward trend. The report comes to the following conclusion on the effect on blood lead concentrations of the reduction in petrol lead levels:-

- For adults the fall in blood lead concentrations in 1986 and 1987 two years after the reduction in lead levels were of the same order as the long term downward trend.
- Petrol lead makes only a relatively small contribution to the body burden.
- The contribution made to the body burden of children was slightly larger.
- All the effects of the reduction in petrol lead have been observed.
- No further monitoring is required.

These conclusions complement another recently published study on lead intake and blood lead concentrations in urban children which estimated that of the total daily lead uptake only 3% was from inhalation.

Distributions of Blood Lead Concentrations in Children 1984-1987



Blood Lead Concentration (g/100ml)

Many Governments are considering reducing lead in petrol levels or introducing lead-free petrol because of anticipated health benefits and to reduce blood lead concentrations in the population particularly in children.

This valuable new evidence shows that despite a 60% reduction in lead emissions from motor cars and a rapid decline of 53% in lead in air levels there was no effect on blood lead concentrations of adults and a minimal effect of less than 1.0 pg/100 ml on blood lead concentrations in children; which is of no clinical significance.

Mr Chairman, it would seem that this report must surely end the discussions and uncertainties on the adverse health risk from leaded petrol driven vehicles.

Exhaust Gas Emission Control

As we have heard the real reason for eliminating lead from petrol is so as not to damage the vehicles catalytic converter so fitted as to reduce the toxic exhaust gas composition. However to understand why it is necessary to phase in unleaded fuel thus enabling motor manufacturers to fit catalytic converters it may be important to have a brief understanding of properties of exhaust gas constituents.

Carbon dioxide CO₂: non-poisonous.

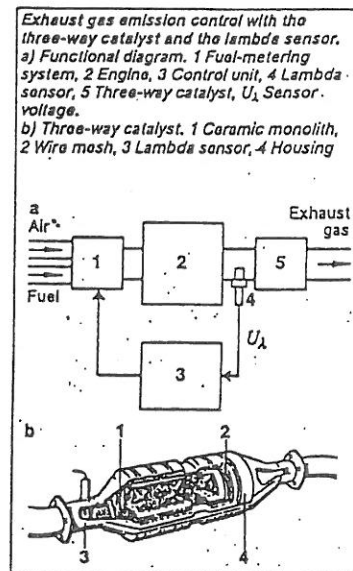
Carbon monoxide: a colourless, odourless and tasteless gas. Inhalation of 0.3% by volume of CO can cause death within 30 minutes. At idle, the exhaust gas from spark-ignition engines has a high CO content. For this reason, never allow the engine to run in closed garages!

Oxides of nitrogen NO_x: Nitrogen monoxide NO: a colourless, odourless and tasteless gas. NO is rapidly converted to nitrogen dioxide NO₂ in the presence of oxygen. NO₂ is a reddish brown, poisonous gas with the penetrating odour which destroys lung tissue. NO and NO₂ are customarily treated together and referred to as oxides of nitrogen NO_x.

Hydrocarbons of many different types are present in exhaust gas. In the presence of nitrogen oxide and sunlight, they form oxidants which irritate the mucous membranes. Some hydrocarbons are considered carcinogenic.

Particulate matter, in accordance with American legislation, includes all substances (with the exception of unbound water) which under normal conditions are present as solids (ash, carbon) or liquids in exhaust gas.

Whilst all responsible countries in the World have or are introducing tougher regulations for all vehicles, South Africa still squabble about some futuristic date just to eliminate the lead. The ECE has recommended that in 1993 all engines less than 1,4ℓ must comply with more stringent requirements whilst America will require for 1994 that all engine capacities must comply. This requirement will most probably result in every new European car being fitted with a 3-way catalytic converter by 1st January 1993.



Three way catalytic converter

It is also interesting to know that the improved emission levels must be met after 80 000 km and also include a duration of high speed testing.

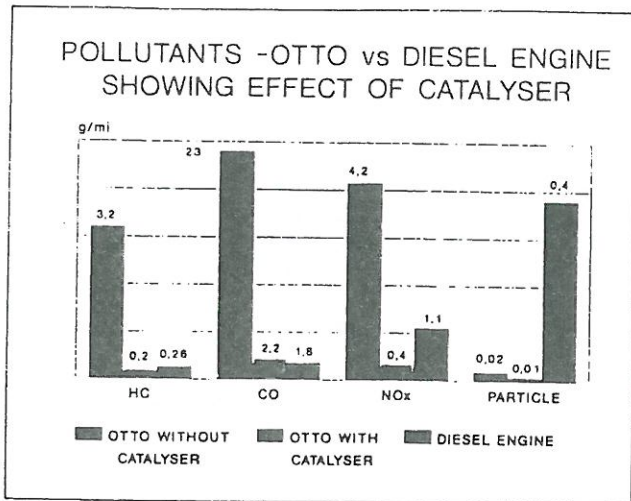
Emissions - Exhaust 1993 Requirements

1,4-2,0 litre ECE TEST	more than 2 litre ECE TEST	US-TEST
Anlage 25	Anlage 25	Anlage 23
CO 8,9g/km	CO 7,4g/km	CO 2,1g/km
HC + NO _x 2,5g/km	NO _x 1,08g/km	NO _x 0,62g/km
	HC + NO _x 2,0g/km	HC 0,25g/km

MAXIMUM EMISSION LEVELS AFTER 80 000km PLUS HIGH SPEED REQUIREMENTS:

1993 ECE: Recommended all engines less than 1,4ℓ must comply
 1994 USA: All engine capacities must comply.

From the following chart we can see a comparison between the diesel engine and the petrol motor both with and without catalytic converters, and from this I would consider there to be little doubt that if we are serious about the environment we must move into the direction set by responsible countries.



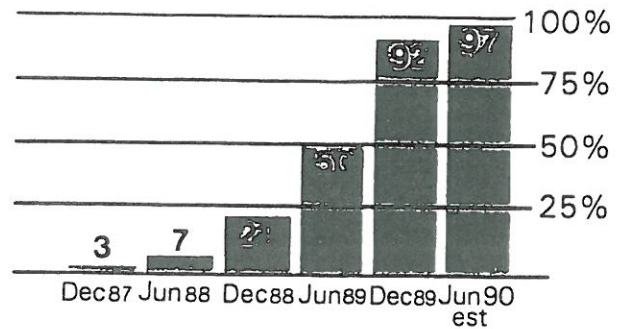
South African Motor Industry

Whilst I can not speak on behalf of the South African Motor Industry I can say that as far as Volkswagen is concerned, the situation regarding lead free fuel is quite simple. Obviously lead, together with the other exhaust pollutants such as unburnt hydrocarbons, carbon monoxide, oxides of nitrogen etc., are undesirable and the world would be a better place without them. For this reason Volkswagen totally supports whatever measures the government decide to implement regarding emission control. However, there is no doubt that lead free fuel will cost more to produce than the current leaded fuel (unofficial estimate is 7%) and should the government also decide to enforce the fitting of catalytic convertors to all cars, then the cost of the cheaper cars such as the Citi Golf, could increase by tween 10 and 15%.

To us it does not make sense to take from Germany a highly sophisticated clean engine and re-develop it into a dirty one. This not only absorbs a great deal of design and testing capacity, it also limits our choice of engines and affects our export programme.

It is obvious that all things can not happen at once and whilst we now seem to be committed to introduction of unleaded fuel in 1995 one must ask why do we wait so long, and point out the gradual phase in programme undertaken by the oil companies in the United Kingdom during the eighties.

Percentage of filling stations with unleaded pumps



Conclusion

Considering the responsible actions of Governments and motor manufacturers towards environmental protection and human health standards I must say that I find it unbelievable that South Africa has shown such an irresponsible attitude towards the development and introduction of lead free fuel. No matter what the politics we are now light years behind European countries in our responsibilities towards global environmental protection.

We have seen the positive actions brought about by legislation covering the phase out of of CFC R12, however I am of the opinion that there are even greater rewards awaiting us with the introduction of unleaded fuel. Certain motor manufacturers want to be seen to be clean and will not wait for legislation to dictate their actions.

There is little doubt that with the availability of lead free fuel some manufacturers will fit catalytic converters. They will also include on-board vapour recovery systems. This will all be the start of bringing South Africa more into line with First World countries.

Some will argue that we are Third World.

In addition some will argue that the motor vehicle only produces 3% of the pollution problem.

Mr Chairman I will leave such discussions for question time, but end by saying:-

The Motor Industry wants to get going.

The Motor Industry wants to do its part in protecting the atmosphere and the people that live in our country and on our planet.

The Motor Industry therefore asks that all industries hold hands and come to the party in achieving what must be one common goal.