IT'S A GAS

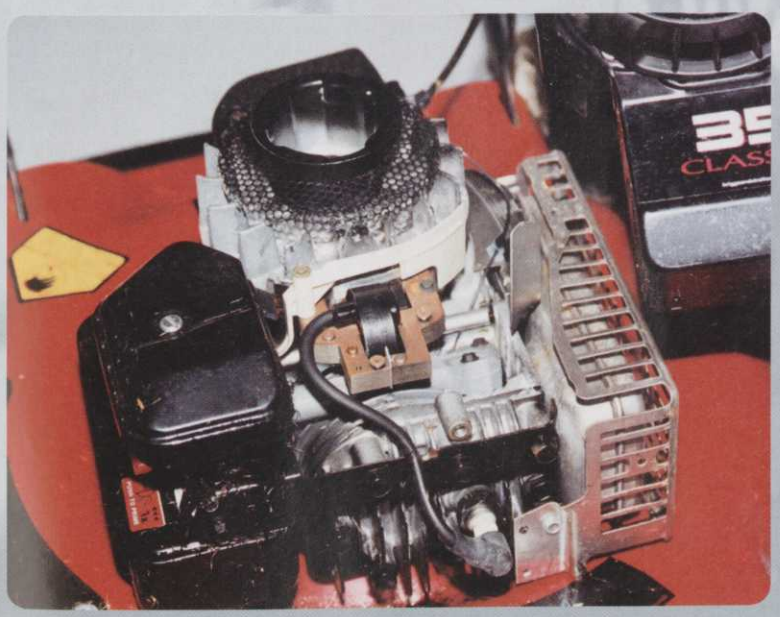
Roland Taylor takes a look at pollutants and how emission control is now such an important issue

No one would place a child a room full of toxic gases, yet every day we subject them, along with the rest of planet's population, to high levels of pollutants in the air that we breath.

In this article we are looking at the smaller engines found on all golf course equipment, although what is written, equally applies to all equipment and road vehicles that use combustion as a source of power.

It is a fact of life that there are a number of conditions and pollutants around which can cause serious health problems, not all, are the result of the internal combustion engines.

One of these is the 'greenhouse effect', there seems to some confusion as to what creates this phenomenon. If the earth's surface is to sustain a rich variety of growth it requires an average temperature to be maintained. Global warming occurs due to a cocktail of certain gases including, water vapour, carbon dioxide and methane, raising the temperature levels. The cause is largely due to man's intervention in nature, which results in excessive amounts these gases, being produced and released into in the atmosphere.



Damage to the ozone layer is another cause for concern. This is like a skin around the planet that protects the surface from the suns harmful ultra violet radiation. Here the culprit are CFCs (Chorofluorocarbons) which are commonly found in aerosol solvents and in the past refrigerators. These break down the layer so the earth and its population is exposed to the sun's rays. A very good reason to protect the skin on bright sunny days.

Combustion engine emissions play only a minor part in these two phenomena, their role is closer to home. Engine exhaust and fuel evaporation are two sources of pollution involved.

Petrol and diesel fuels are made up of hydrogen and carbon atoms. In a perfect combustion the fuel (hydrocarbons) is mixed with air (oxygen and nitrogen). When burnt this produces carbon dioxide, water and nitrogen, all three relatively harmless.

In an engine the results are different. A mixture of fuel and air creates unburned fuel (hydrocarbons), nitrogen oxides, carbon monoxide and carbon dioxide – a real witches brew.

Hydrocarbons

Basically this is unburnt fuel. This mixes with the nitrogen oxide and when exposed to sunlight produces ground level ozone – a major component of the smog, hence the reason for the continual shroud now over a number of large cities throughout the world. From a health point of view it can cause irritation to the eyes, damage the lungs and aggravate respiratory problems such as asthma. Exhaust hydrocarbons also have the potential to cause cancer.

Nitrogen Oxides

These are formed from the nitrogen and oxygen in the air being subjected to a high temperature plus pressure. Their role has already been mentioned in the formation of ozone, they also contribute to the production of acid rain.

IT'S A GAS

Carbon Monoxide

This is a real nasty. As the result of incomplete combustion the carbon in the fuel is only partially oxidised. As far as humans are concerned, oxygen levels in the bloodstream are greatly reduced and those with a heart condition are most at risk.

Carbon Dioxide

This is the stuff we exhale. In the normal ecosystem plants and trees take this in and convert it into oxygen. With the changes that man has bought about to the environment this natural cleaning system no longer works at a100% – the greenhouse effect is one of the results. Some environmental agencies now consider carbon dioxide is becoming a pollutant.

There are slight differences in emissions from diesel engines.

Particulates

These are made up of suspended carbon particles and the amount of these released will depend on the quality of fuel.

Soot (Carbon)

Most exhaust contaminates are carried in soot. Petrol units produce less soot, but more carbon monoxide.

Apart from exhaust emissions there is also another area associated with the engine that create atmospheric problems – evaporation.

This is one of the major factors for hydrocarbon pollution, especially on hot days and it can occur in a number of ways:–

- If a fuel tank becomes hot then fumes escapes through the vent in the cap.
- Engine and exhaust heat will vaporise fuel, this continues for relatively long period after the unit has been switched off.
- Vapour is always present in fuel tanks and this is forced out during refuelling – the shimmering haze that can be seen on all garage forecourts.
- There are other indicators that signal a power unit is producing excess fumes or something sinister might be going on inside.

White smoke

Mainly evident when an engine is started up, it usually disappears when the unit warms up. Water droplets (condensation) plus unburnt fuel in the cylinder cause this. In the worst scenario it could indicate that water from the cooling system has gaining access to the combustion chamber.

Blue Smoke

Burning oil plus unburnt fuel generally causes this. May be the result of excessive wear, broken oil ring or more likely a poorly tuned and maintained engine.

Black smoke

A combination of soot, oil and or unburnt fuel, this could also herald a mechanical failure. In the case of the last two, some action to rectify symptoms is needed fairly quickly, if a major problem is to be avoided.

As has already been shown, the combustion process, although now highly refined, is still relatively inefficient and this can be escalated by other contributory factors:–

- The quality of the fuel used
- Type of engine, whether it is a standard model, turbo charged or has fuel injector.
- Incorrectly tuned engine
- Fuel pump or carburettor settings
- The workload it is subjected too.
- Engine running temperature
- Lack of maintenance.

Stringent legislation in some countries has meant that that engine manufacturers have made considerable strides in reducing emission levels with models now on the market 70% cleaner than a decade ago.

This is the result of changes in the cylinder and valve configurations, finer tolerance throughout, and more sophisticated fuel/air supply systems. Power units are more compact having greater fuel and oil economy and less vibration, plus the lowering of another emission – noise.

On some models the catalytic converter has been introduction. These use very high temperatures to burn off the unused fuel before it is emitted from the exhaust, but they are a highly sensitive components that are likely to be damaged if an engine is not properly maintained.

Another reason why problems can occur is that some of the contaminates from an incomplete combustion remain inside the engine. These eventually find their way into the sump where they mix with the oil to form lacquer and a thick sludge. This then passes into oil ways and adheres to components causing a reduction in an engine's efficiency as the power output drops and fuel consumption and emissions increase.

Out of all this there is a clear message regard controlling the level of emissions. While, engine manufacturers now produce power units that comply with present and future legislation once these are out in the field, it is the responsibility of the users to maintain these standards. The fact is modern engines require very little maintenance, so by look after them regularly and correctly this can be achieved.

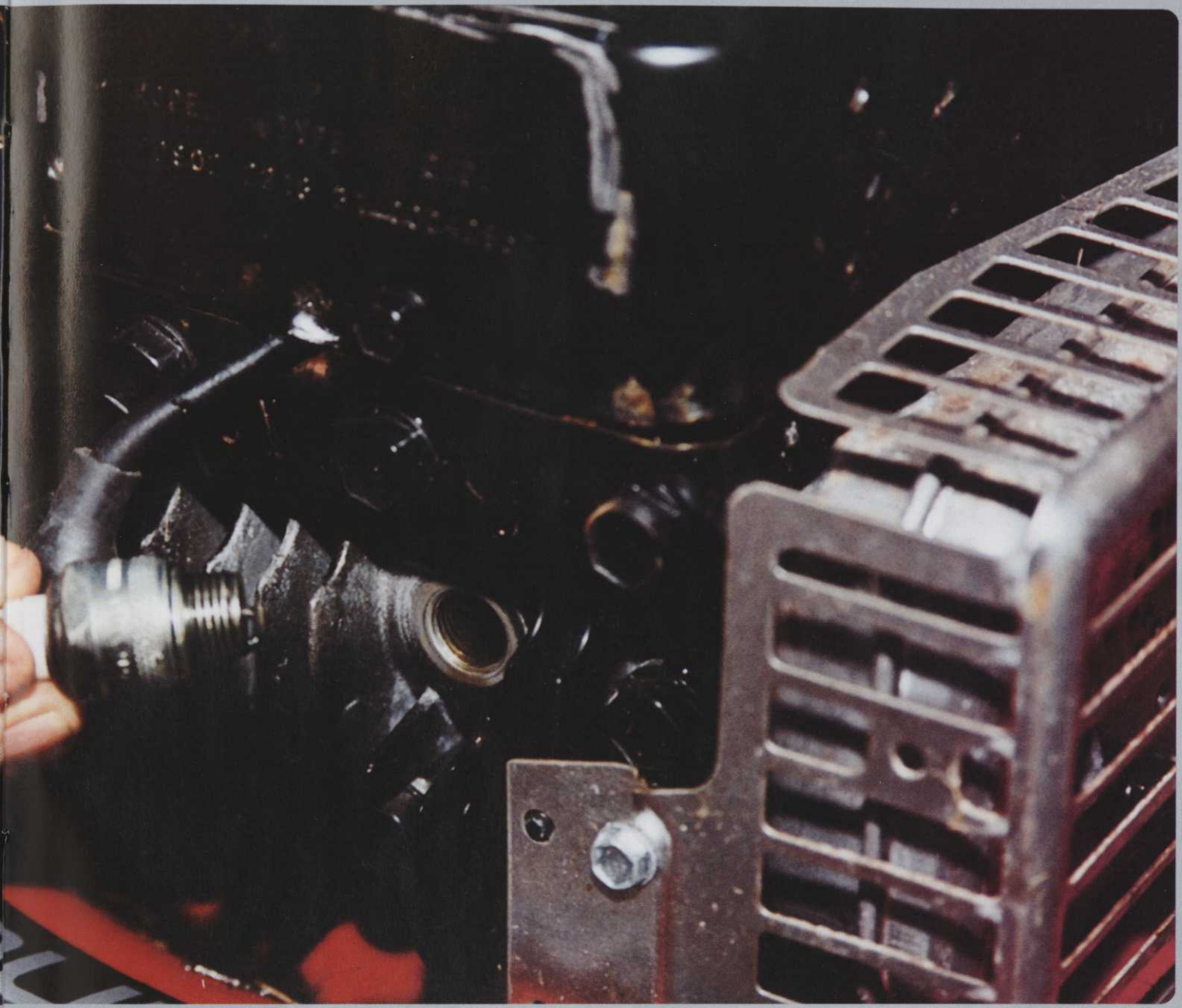
Oil

This has two main jobs, to reduce friction and to help dissipate heat. If it is in short supply or contaminated, serious damage to the engine can occur. The message is, check the levels are correct every time the equipment is used. This not only applies to the engine, but also to any other components that uses oil, such as hydrostatic drives and gearboxes.

Change the oil as outlined in the instruction manual using top quality recommended lubricants.

Airfilters

If these are dirty they alter the



fuel/air ratio entering the combustion chamber and as already explained this has an effect on the amount of pollutants the engine emits. It will also increase fuel consumption as well as effect the performance. Starting may also become a problem. In extreme case dirt can enter the engine and cause a great deal of damage.

Regularly clean the air filter, more often in dry dusty conditions. If a filter is badly contaminated or damage it will require replacing.

Cooling systems

These are designed to ensure the engine constantly runs at the right temperature.

Where the airflow becomes blocked or restricted, heat builds up very fast, and in some case the unit catches fire. It is time to start running because a bomb in the form of an exploding fuel tank can make a nasty mess.

Clean dried grass and dirt out of the fins of air–cooled areas such as around the engine cylinder blocks and hydrostatic drives also from radiator grills on water–cooled systems.

Ignition

In the case of the petrol engines, make sure the spark plug is the correct one with the right size gap, if it is badly contaminated fit a new one. Fuel injectors will require specialist attention.

There are other parts of the machinery that will effect emissions and performance

- Blunt blade or poorly adjusted cutting cylinder requires more power so an engine has to work harder with all the already mentioned results.
- Badly adjusted drives such as belts and chains have the same effect.
- The unit should also be operated at the correct speed and to meet the prevailing conditions.

Not only will all these benefit the environment they also increase the life of equipment and reduce the risk of a breakdown.

It is also necessary to have a fuel management programme in place that ensures the minimum of evaporation.

Petrol or diesel should be stored in a cool place in an approved container. If a spillage occurs it will need to be cleaned up immediately.

Gas power

Over recent months there has been a lot of media coverage regard using liquid propane gas (LPG) or natural gas (NG). Some engines are now being manufactured specifically designed to operate on these alternative fuels, but as far as is known no one at present is fitting these in the UK. There are companies' here, now offering conversion kits. Apart from reducing emissions these units also show considerable savings in fuel costs, as the example below illustrates.

A 16hp Briggs & Stratton Vanguard engine was used for the purpcses of this study.
Fuel consumption: 3.5litres per hour
Fuel costs: Petrol 75p per litre
LPG 25p per litre
Operating period: 6 hours per day
5 days a week
30 weeks per year
Fuel costs for this cutting period
Petrol: 3150 litres at .75p litre = £2362.50
3780 litres at 25p litre = £945.00
Other items: One-off cost of conversion approximately £650.00
Bulk fuel storage tank £150
Rental of tank and pump approximately £96 per year
The total costs in first year including fuel is £1841.00
This is a saving of £521.50

In the second and subsequent years the savings are higher, in the region of £1300 per annum based on these fuel costs.

This example is more in line with contract grass cutting, the savings on a golf course could be pro rata.

Regarding diesel, because there is doubt that red fuel will continue to be available to the turf machinery sector, a comparison is not given.

Pollution of our planet is not going to go away and the damage already inflicted cannot be redressed. The only course of action left is to ensure wherever possible we minimise some of the effects we have on the atmosphere, by maintaining the equipment in a tip–top condition and good running order.