

Avgas - time to panic yet? Part II

Following up on our story about fuel supply in the October magazine, **Pat Malone** looks at the prospects for unleaded avgas



the West. "The communists weren't known for giving the capitalists a break," he says, "so I thought I should find out why."

He researched the market and approached the Russians to make avgas to the US ASTM D910 standard. They were willing to do so, but asked him why lead was required at all. The standard gives a maximum parameter for lead, but no minimum – it's not mandated. The Russians said they could reach the specified motor octane number without the lead, and they were able to do so.

Lars says: "You have to remember that in

Above: Hjelmc Oil supplies unleaded avgas to more than a hundred airfields; the red dots denote where it supplies 100LL
Below: one of the company's unleaded fuel bowlers in its bund



the early days, the 20s and 30s, avgas was all unleaded. And the fewer additives you put in it, the better it is. Lead damages valves, guides, heads and seats. Rotax engines flying on 100LL tend to break down every couple of hundred hours because of lead interfering with the valve system.

"But our original driver was cost rather than environmental concerns – the Russians were simply able to supply avgas more cheaply."

Hjelmc started marketing unleaded avgas in Sweden but there were a lot of logistical problems with the Russian suppliers. Their rail gauge is wider than the European measure so the tankers had to be offloaded and reloaded at the Polish border. Eventually Hjelmc ended up using a Czech refinery. The company's first product was 80/87 avgas. Lars says: "In the

In the last issue of *General Aviation* I wrote about the problems we've had with the avgas supply over the summer and looked at what the future holds for what is, in fact, the last leaded fuel being produced in any quantity. It's clear from the number of members who've asked questions about the article that there's more explaining to do.

I don't want to repeat anything from the last article – if you missed it you can download a PDF from the IAOPA-Europe website www.iaopa.eu – but we said the supply of tetraethyl lead (TEL) for avgas 100LL is assured, with key manufacturer Innospec saying it's a significant profit stream for them and they will keep producing it for as long as there's a market.

Unfortunately, TEL is not the only avgas additive that has few friends. The deposits left when TEL is burned are corrosive and damaging and must be scavenged, and the agent that does the job is ethylene dibromide (see sidebar). This was banned in the Montreal Protocol of 1987, signed by every EU country, largely because of its effect on the ozone layer. It's open to some bureaucrat somewhere to decide to take against it at any time; no legislation would be required, and it's a weak point in the avgas supply system.

But there is one country in the world – Sweden – where unleaded avgas is on sale, and gaining an increasing share of the market. It won't do for all GA piston engines, but it does suit most of them, and in fact has some advantages over 100LL in terms of production, transport and engine maintenance.

Unleaded avgas is produced and marketed by Swedish aviation fuel company Hjelmc Oil and has been approved since 1995 for use in a majority of Textron-Lycoming engines up to 180 hp, and also the 235 and 260hp

Lycoming O-540s as well as all Continental 100 and 145hp engines, without any modification. (See Lycoming Service Instruction 1070) In August this year Hjelmc 91/96 UL avgas was certificated for use in all Rotax engines. (See Rotax Service Instructions 912-016 and 914-019). While that means the 200hp Lycoming O-360 in the Arrow 200 is excluded, it covers the familiar Cherokee, Warrior, 172 and 150 types and some twins, such as the Piper Aztec, Twin Comanche and many more – and of course, anything with a Rotax. In Sweden, Hjelmc Oil has 70 percent of the general aviation fuel market and serves about 150 airports.

Hjelmc is owned by Lars Hjelmcberg, a general aviation pilot who also happens to be Chairman of AOPA-Sweden. It produces an aviation grade fuel which can meet the specifications for avgas without resorting to TEL, mainly by being extraordinarily picky about the quality of the ingredients and using the most stringent quality control methods. Engines using unleaded avgas need an oil additive which is sold by Lycoming and added at every oil change, and helps the oil stick to the metalwork.

Unleaded avgas is much easier to transport and store than its leaded counterpart, but the reason it hasn't spread across Europe is that it would require duplication of fuel facilities at many airfields – separate tanks and nozzles, separate delivery tankers. And that won't happen in the UK until it has to, although it already has at many Swedish GA airfields.

Lars started Hjelmc Oil some 25 years ago, when as an administrative research director for a Swedish pharmaceutical company he often flew himself around the former Eastern Bloc countries on business. He knew that avgas in places like Prague was half the price it was in



Top: company owner (and AOPA-Sweden chairman) Lars Hjelmberg, and (above) at the controls of his Piper Cherokee
Below: one of Hjelmc's research aircraft; the four-bladed prop reduces noise and improves performance
Right: it could be more economical to scrap rather than re-engine vintage twins like the Cessna 421
Far right: aircraft like the piston-engined Malibu could be difficult to re-engine



early 1980s the big oil companies wanted to abandon the 80/87 market and have a single unified fuel, 100LL. I was taking a market they wanted to leave, so they didn't mind. But engines suitable for 80/87 were not particularly popular, so we set about creating a 91/96 grade avgas without lead, and this superseded the 80/87 in 1991. With 91/96 we can power 70 percent of the general aviation fleet. We do also sell 100LL in some places, but many Swedish airfields now stock only 91/96."

(The two numbers are firstly, the lean octane rating, and secondly, the rich rating.)

Unleaded avgas is more difficult to make, but is sold at the same price as 100LL. It needs cleaner component products than conventional avgas, better production

equipment and more stringent quality control. In market terms it's a niche within a niche, and it would put Big Oil to a lot of trouble to make it, for a little return. "This is a pharmaceutical product in terms of production values and volumes," Lars says. "100LL is less than one tenth of one percent of the car gas market, and unleaded avgas is a part of that. Major oil companies may say they can make this product, but we have a 25-year track record of research and production, and none of them can match that. We are light years ahead with this product.

"Certain refineries produce special components for us, and we blend the fuel ourselves. We produce our 100LL the same way, simply adding TEL to achieve the motor octane number. Because of the quality of the products we use, our 100LL is far better, too – mostly a 115/145 octane avgas but still with the lead content of a 100LL fuel, which makes it especially suitable for war-birds and other demanding aircraft."

Being unleaded, of course, the transport of Hjelmc's 91/96 is straightforward. Importing 100LL into the UK is difficult. You're not allowed to use the Channel Tunnel or conventional ferries. Any tanker you use can't be used for anything else because leaded fuel is deemed to contaminate everything it touches. Unleaded avgas can be carried by road and rail in standard containers – but there remains the problem of dual provision. You can't use 100LL facilities for anything but 100LL.

"Many airfields have fleets where 100LL is required, and two tanks complicates things," Lars says. "Of course, we entered the market at a time when there were two products, the 100LL and the 80/87, so it was not a problem



back then and we have just maintained the old infrastructure."

In-service experience with unleaded 91/96 has been good. Typically, a Lycoming with a 2000-hour TBO will go to 3000 hours (in Sweden they're allowed to extend by 50 percent on condition) using 91/96. This, says Lars, is largely because you don't get the lead

fouling problems that bedevil 100LL users.

Sweden has no tax or VAT on avgas, partly in recognition of the fact that Hjelmc is at the forefront of fuel technology, using the cleanest possible fuel with the lowest emissions. Punitive taxes would only hamper their research efforts. Lars says the fuel is thirty times more pure than the standard car petrol Eurosuper 95 and has far less of an environmental effect.

One fly in the ointment is a mandatory requirement imposed by the EU to add ethanol to fuel for road vehicles and boats. Mogas is already three percent ethanol in some places and will go to five and even ten percent soon. Ethanol is not suitable for aviation use, so Hjelmc is researching with ETBE, an ether derived from ethanol, and testing it with the Swiss and German aviation authorities.

Leaded avgas, Lars believes, will fade away. "It will die by itself because of cost. You need dedicated production facilities, distribution systems, pipelines, ships, storage tanks, road tankers, just for avgas. The price will continue to increase every year regardless of the price of oil, and people will just move away from these engines.

"New alternatives are there. Thielert has a 300hp diesel, and we see new jet engines coming. If I'm buying a new aircraft with a TBO of 2000 hours and I fly 100 hours a year I'm looking at a 20-year investment. Will 100LL be on the market in 20 years? I doubt it. Will it be available in ten years? I don't know. Will it be available in two years? Probably. But if you're buying such an aircraft you need to be aware that it might have a write-off period of five years.

"For many aircraft, it will be more



economical to scrap than to go to diesel. Vintage twins like the Navajo, the Cessna 421 and the 310 will be affected. More modern aircraft like the piston-engined Piper Malibu would be difficult to re-engine. My advice to anyone buying an aircraft is to look at the octane rating requirement on the engine plate, and if it says 91/96 you're okay." ■

Your friend, ethylene dibromide

When it is burned in an engine, tetraethyl lead – now called avtel by makers Innospec – can leave a deposit which has a corrosive effect, particularly on valve heads and stems. This is called lead fouling. The lead oxides must be scavenged as far as possible, and for this purpose ethylene dibromide is added to avgas.

Ethylene dibromide reacts with the lead oxides to form lead bromide, a gas (at high temperatures) which is exhausted from the cylinders. It doesn't work very well at low temperatures, which is why lead fouling is at its worst during operations at low power settings such as taxiing and hanging around waiting for take-off clearance.

Because of its effects on the environment, ethylene dibromide was banned by international treaty 20 years ago. We're still using it, but they could pull the plug at any time.

It's worth running the engine up before shut-down, especially if you've had a long taxi at relatively low power, to get rid of lead oxides. Increase power from the ground idle range to around 1800 rpm for 15 or 20 seconds. This should raise the temperature enough to let the ethylene dibromide do its work.

When you've gone back to ground idle, check the magnetos. Lead fouling also affects plugs – temperatures are lower around the plug, before the flame really gets going. Some pilots also lean the mixture off as much as possible when faced with a long taxi, to reduce the amount of fuel and increase the temperature in the pot.