Slippery Stuff

About Oil Part II: Additives, consumption, levels, intervals, filters, and analysis

BY MIKE BUSCH

LAST MONTH, I WROTE about the types and properties of the various kinds of engine oil available. This month, the discussion continues with oil additives, oil consumption, oil levels, oil-change intervals, oil filter inspections, and oil analysis.

Aftermarket oil additives.

AFTERMARKET ADDITIVES

Pitchmen have long been promoting oil additives that eliminate friction and wear, increase fuel economy, improve your landings, raise your IQ, and rescue your marriage.

The granddaddy of these is Marvel Mystery Oil (MMO). Folks have been pouring this stuff into aircraft engines for more than 80 years. It was developed in 1923 by Burt Pierce, the inventor of the Marvel carburetor, and was intended as a fuel additive to clean carburetor jets. The name "mystery oil" came from the fact that Burt Pierce refused to divulge its formula.

As far as I can tell, MMO doesn't do any harm if used in moderation, but it doesn't seem to do much good, either. Its formula is no longer a mystery since regulations require the current manufacturer, Turtle Wax Inc., to publish the ingredients on a material safety data sheet. Turns out MMO has some interesting ingredients, including pig fat, perfume, and red food coloring in a base of petroleum distillate solvent. I don't use MMO.

Some aftermarket oil additives—notably Microlon and Slick 50—contain a slippery resin called PTFE, which is made and marketed by DuPont under the trade name Teflon. The Microlon and Slick 50 folks claim that the stuff bonds with metal surfaces in your engine and virtually eliminates friction. This is bunk. Manufacturers of nonstick cookware will tell you just how difficult it is to get Teflon to bond to anything. Users of nonstick cookware will tell you just how easy it is to ruin Teflon coating because it's so fragile. NASA did a study of Teflon oil additives a while back and concluded that they are ineffective as a friction reducer, and they can actually damage an engine by clogging oil filters and tiny oil passages in hydraulic lifters. DuPont specifically warns against using Teflon in internal combustion engines. Nevertheless, the promoters of Microlon somehow convinced the FAA to approve its use in aircraft engines. My advice: Just say no.

AvBlend has been around for two decades and is a repackaged automobile oil additive called Lenckite that has been around for even longer. Back in the '90s, my friend Howard Fenton of Engine Oil Analysis in Tulsa ran a test of AvBlend involving several piston twins that used AvBlend in one engine and not in the other. When we looked at the oil analysis results, we could not tell which engine had the AvBlend and which didn't. Like MMO, AvBlend appears to do no harm, but we didn't find any evidence of benefit either.

Given this dismal history of miracles-in-a-can, when ASL CamGuard hit the market about five years ago, I was understandably skeptical. But in July 2007, I ran into CamGuard developer Ed Kollin at AirVenture and discovered that Ed is a sharp and experienced lubrication chemist who ran Exxon's engine lab for many years, was heavily involved in the development of Exxon Elite, and seems to know more about aircraft oil and additives than anyone I've ever met.

I decided to run a test of CamGuard in my own airplane. I used it quietly for 18 months. My oil analysis results showed that

PHOTOGRAPHY BY MIKE BUSCH

the big spikes in iron (caused by rust) that I had always seen when the aircraft was idle for a month or more were eliminated. That got my attention. I also found a modest across-the-board reduction in other wear metals (about 10 to 20 percent). I examined the oil analysis history of several other airplanes using CamGuard and saw much the same thing. I've been using CamGuard in my engines for more than three years now, and I'm convinced the stuff works.

For most of the airplanes we manage, we recommend AeroShell W100 with a pint of CamGuard added at each oil change. That's what I use in my airplane, and my two engines are at nearly 200 percent of time between overhauls (TBO) and still going strong. For wintertime operations in cold climates, I recommend Phillips X/C 20W-50 multigrade with a pint of CamGuard.

OIL CONSUMPTION

Take any group of aircraft owners and it's not long before they're comparing notes on whose airspeed is the highest and whose oil consumption is the lowest. I'm here to tell you that low oil consumption is highly overrated.

Lots of factors affect oil consumption. Six-cylinder engines use more oil than four-cylinder engines. Big-displacement engines use more oil than smaller-displacement engines. Chrome-plated cylinders use more oil than steel cylinders. Nickel-carbide cylinders use less oil than steel. And so on.

Anything from a quart in 20 hours to a quart in four hours is normal. I've seen engines that burned a quart in four hours throughout their entire life and made it past TBO without any problem. I've also seen engines that used hardly any oil and then wound up needing a top overhaul after 500 hours.

TCM doesn't consider oil consumption to be a cause for concern until it exceeds a quart in three hours, and says that it isn't an airworthiness issue until it exceeds about a quart per hour. I don't think any of us w allow our horizontally opposed engines get to the point of burning a quart per h simply because it's embarrassing to run of oil before you run out of fuel.

I get concerned about any sudden increase in oil consumption. If an engir has been using a quart in 12 hours for n of its life and suddenly starts using a qu in six hours, something has changed an that's a red flag. Until we figure out *whc* changed, we can't be sure whether it's s ous or benign.

I also get concerned if the oil starts t turn black and opaque quickly after an c change—say, within 10 hours or so. Tha indicates excessive blowby, and some te and troubleshooting is needed to deterr why this is happening and which cylind the culprit.

Many owners install aftermarket air separators to reduce oil consumption aı keep the belly clean. I don't like air-oil s rators because they return all sorts of u

OIL ANALYSIS REPORT

ELEMENTS IN PARTS PER MILLION		UNIT / LOCATION AVERAGES						UNIVERSAL AVERAGES
MI/HR on Oil	44		33	44	50	50	55	
MI/HR on Unit	2,608		2,564	2,531	2,485	2,435	2,385	
Sample Date	08/02/10		05/02/10	12/28/09	06/28/09	04/05/09	08/25/08	
Make Up Oil Added	4 qts.		3 qts.	4 qts.	6 qts.	4 qts.	4 qts.	
ALUMINUM	5	7	5	7	8	7	7	8
CHROMIUM	10	8	11	13	12	12	8	8
IRON	46	38	44	52	58	47	45	40
COPPER	4	3	5	5	7	4	4	4
LEAD	6113	5840	4778	5238	5049	6515	6122	5511
TIN	2	1	0	0	2	2	3	1
MOLYBDENUM	3	3	3	3	4	4	4	3
NICKEL	27	16	35	27	25	34	21	14
MANGANESE	1	1	1	1	1	1	1	1
SILVER	0	0	0	0	0	0	0	0
TITANIUM	1	0	1	1	1	1	1	0
POTASSIUM	0	0	0	1	1	2	0	0
BORON	0	0	0	1	1	0	1	0
SILICON	5	5	5	6	7	5	6	6
SODIUM	1	1	0	0	5	1	0	1
CALCIUM	75	20	59	11	48	67	63	15
MAGNESIUM	2	1	1	1	2	2	1	1
PHOSPHORUS	58	46	65	6	36	68	46	214
ZINC	1	2	0	1	3	3	2	3
BARIUM	0	0	0	0	0	0	0	0

Here is an excerpt of an oil analysis report from Blackstoı Laboratories in Fort Wayne, Indiana, on the right engine Cessna 310. (I fly a twin, so I get two reports at each oil cl The report for my left engine was unremarkable.

The column on the left is the most recent sample, ta August 2, 2010. The engine was then at 2,608 hours sinc overhaul (more than 1,200 hours beyond TCM's recomme TBO of 1,400 hours). Aluminum, chromium, and iron all great—those would be from pistons, rings, and cylinder l respectively. Copper is fine as well—that would be from l ings or thrust washers. Lead is low, indicating that the eı does not have excessive blowby. Silicon is also low, so th filter is doing its job nicely.

The one red flag on this report is nickel, which is mc than twice what it has been historically. The only source nickel in my engines is exhaust valve guides, so there mu be a valve guide that is experiencing accelerated wear. Tl elevated nickel has been present for at least two years, b gradually increasing. Sooner or later, there will be a burn exhaust valve in my future.

I did a compression test and borescoped all the cylin so I know that none of the exhaust valves are leaking or s ing any abnormal heat signatures...yet. But the oil analys telling me that an exhaust valve problem is inevitable, so watching closely. Of course, the oil analysis can't tell me v cylinder is having the problem, but that's something I'll k in time by means of continued borescope inspections anc keeping a close eye on my digital engine monitor. Eventu a distressed exhaust valve will become evident, and the c sponding cylinder will need to come off for repair.

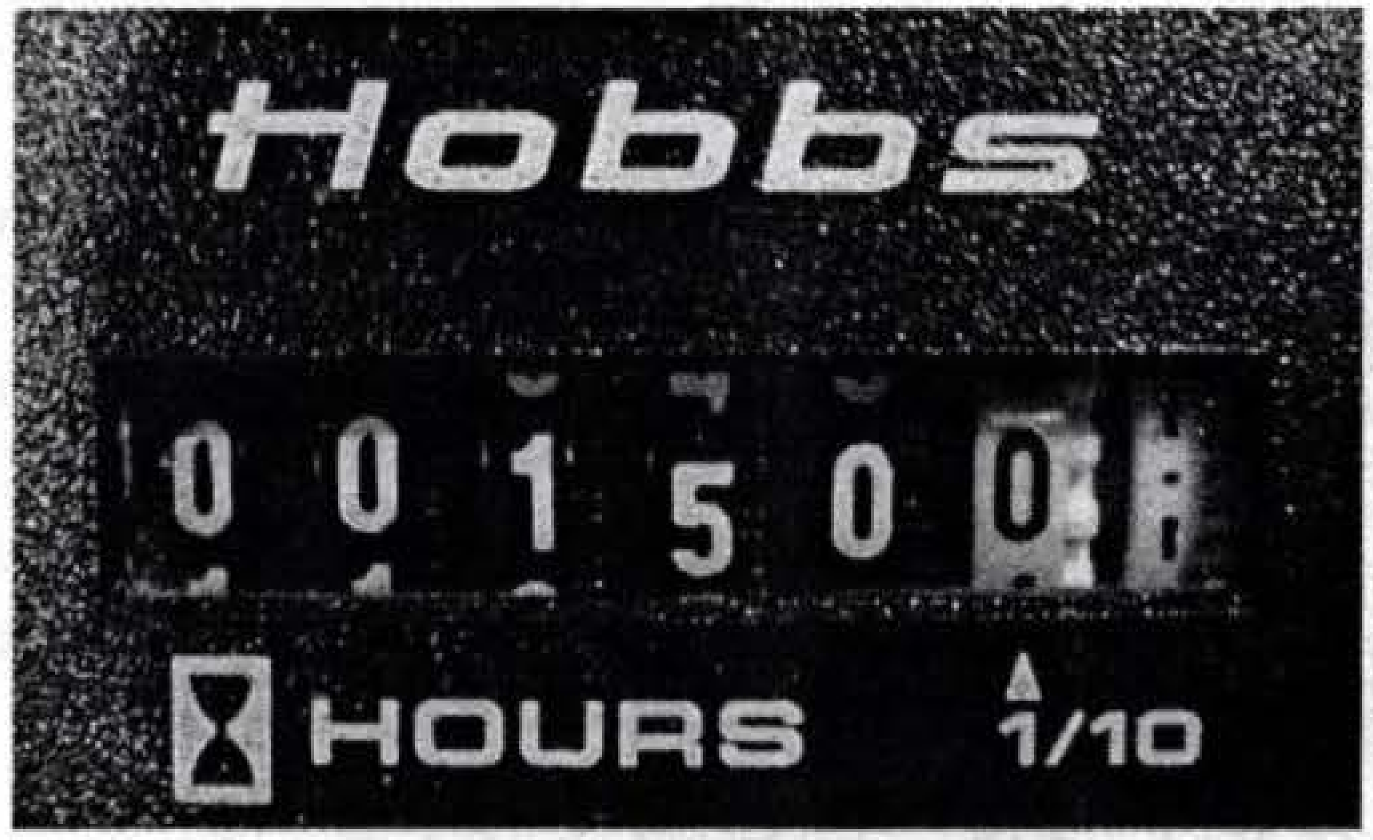
your engine uses a lot of oil, you might want to add one more quart to those figures for a little extra cushion.

OIL-CHANGE INTERVAL

Because piston aircraft engines get oil so filthy, regular oil and filter changes are an absolute must. Never go more than 50 hours or four months between changes, whichever comes first. Some experts recommend changing the oil every 25-30 hours or three months. If you have an older plane that has only an oil screen rather than a full-flow filter, you should not exceed 25 hours between oil changes.

If appreciable metal is found in the oil filter, or if the oil analysis report comes back with any red flags, we normally put the engine on a reduced oil-change interval until the source of the metal is identified or the problem resolves itself.

If you're approaching an oil change and you know the airplane will go unflown for several weeks, it's best to change the oil



Never go more than 50 hours or four months between oil changes. (Some experts recommend 25-30 hours or three months.)

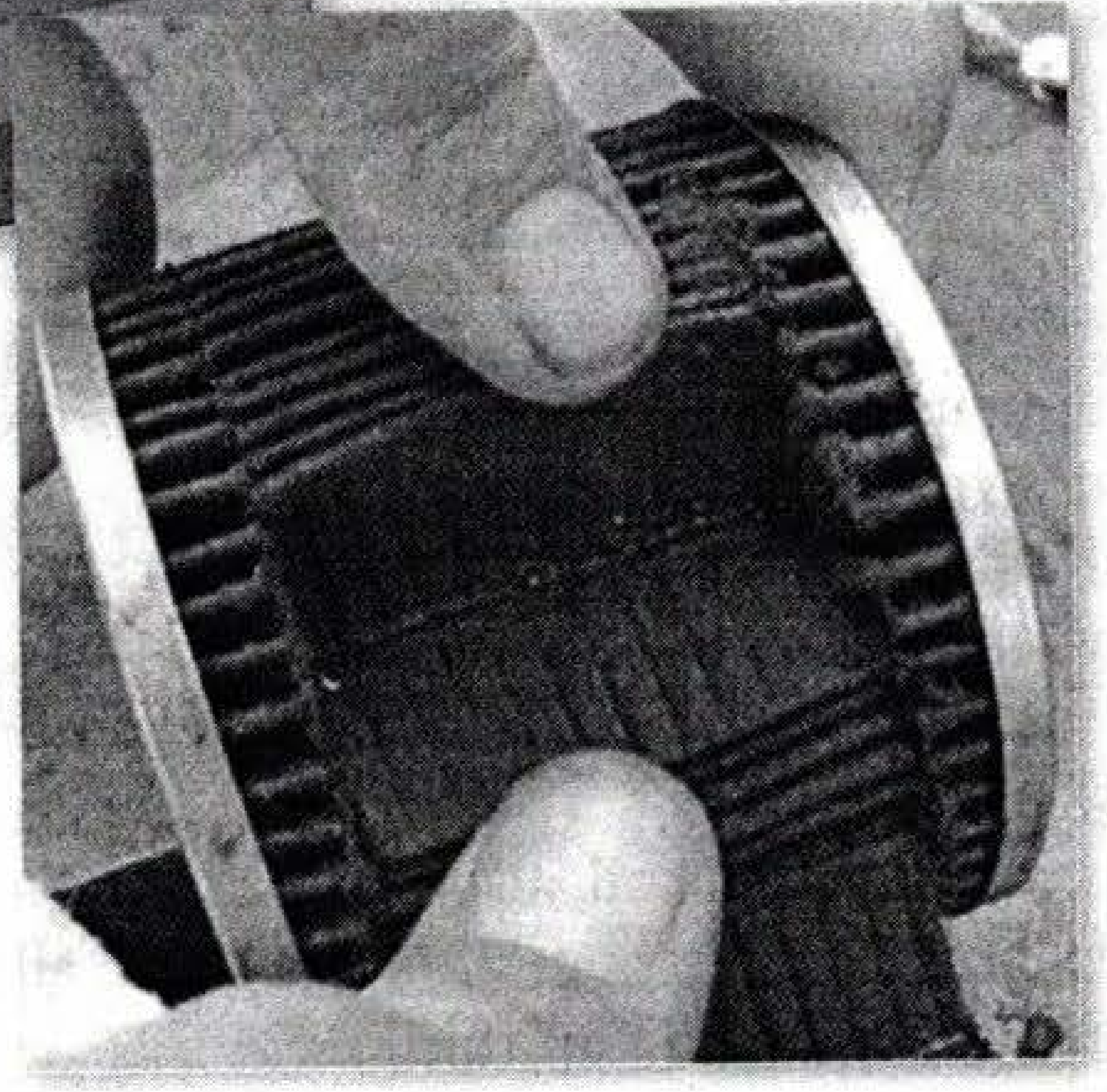
before the downtime. Dirty oil tends to be corrosive, and you don't want your expensive crankshaft and camshaft bathed in that stuff for any longer than necessary.

OIL FILTER INSPECTION

Every time you change the oil, also replace the oil filter. Cut the old one open and carefully inspect the filter media for the presence of metal. Don't get too excited about a few flecks of metal, particularly if it's non-ferrous metal such as aluminum, copper, or bronze.

If there's a significant amount of metal, investigate to determine what kind it is and where in the engine it's coming from. For example, metal whiskers (as opposed to flakes or particles) that are ferrous (attracted by a magnet) are typically associated with a failing lifter or cam lobe.

Of course, the source of the metal isn't always so obvious. If you're still not sure where the metal is coming from after examining it with a magnifying glass and checking it with a magnet, the next step is to send it out to a lab for analysis under a scanning electron microscope. This isn't nearly as scary as it sounds. It typically costs less than $100, and the results come back within a few days. The report will identify the exact quantity, shape, and type of metal and usually the exact alloy. This is often sufficient to determine where in the engine the metal is coming from.



At every oil change, the oil filter should be cut open and inspected for metal.

OIL ANALYSIS

In addition to filter inspection, take an oil sample at every oil change and send it out for spectrographic oil analysis. This is not a substitute for filter inspection but a complement. Inspecting the filter allows us to detect metal that is big enough to be caught and visible to the naked eye. Oil analysis detects microscopic metal particles that are small enough to pass through the filter and would be too small to see anyway.

Oil analysis is superb at detecting slow wear events that never throw off metal particles big enough to see. It's also good at providing early warning of accelerating wear events that would eventually show up in the filter or some other way, but not until significant damage is done. EAA

Mike Busch, EAA 740170, 2008 National Aviation Maintenance Technician of the Year, has been a pilot for 44 years, logging more than 7,000 hours. He's a certificated flight instructor and an airframe and powerplant mechanic with inspection authorization. E-mail questions to Mike at *mike.busch@savvyaviator.com*. Mike also hosts free maintenance webinars on the first Wednesday of each month at 8 p.m. (Central). To sign up or access the archives, visit *www.SavvyMX.com*.