

## **All about Model Aircraft Fuel.**

*Fuel Facts by Don Nix former President, GBG Industries*

The following is the first in a series of articles exploring all facets of model engine fuel. The writer is Don Nix, former President of GBG Industries, Inc., manufacturers of POWERMASTER model fuel.

### **No. 1 - What's the Oil Content?**

Fact (A) - It's quite likely that no other single facet of modeling generates as many myths, misconceptions, misunderstandings, errors (and more than a few lies), or as much outlandish goofiness as model fuel....one of our absolutely necessary, non-optional items for powered flight.

Fact (B) - Of all the above, the one fact that rouses the most questions - and without doubt the most wrong answers - is the ongoing nonsense about the amount of oil required in model fuel.

Myth: Model Glow Fuel must contain XX% oil to operate properly, perform well and protect the engine.

Fact: There is no such fixed number....at least not a valid one.

Why not? Think about it: In order for this to be true, all oils used in model fuel - all of them - would have to be identical in every characteristic. Does anyone honestly believe they are? I doubt it.

While lubricants compounded for full-size engines - automotive, recreational vehicle or aircraft - are rarely, if ever, suitable for use in model engines (for many reasons), nevertheless, there are a number of base lubricants that are available for our highly specialized use. However, most of these must be modified slightly or extensively by the use of a variety of additives and modifiers.

While Klotz model oils are perhaps the most well-known to the average user, and are quite good, they are by no means the only lubricants available to model fuel blenders, and there are currently a number in use. Each has its own "personality" - its own set of technical specifications and characteristics.

At this point, we should point out that we're speaking of the so-called "synthetic oils" popularly used in modern model fuels. Castor oil...the oil of choice, and, indeed, the only suitable model engine oil for many years, is more of a common and known factor. Assuming a good grade, if a fuel uses only castor as its lubricant, then we could give you a fixed percentage, at least for the various engine groups and types.

However, few model fuels intended for R/C use today contain only castor oil as the lubricant. For the purposes of this discussion, we will only deal with fuels containing either straight synthetics, or a blend of castor and synthetics.

So what does all that mean?

Let's draw a little picture here: Suppose at some point in your life, you become concerned about living a long and healthy life, so you decide to consult a doctor for advice as to how to accomplish this. When you come to the subject of food, you say, "Well, tell me, Doctor....if I wanna still be healthy and virile at 90, how do I eat?" The good doctor replies, "M'boy, if you will eat two pounds of food a day, you'll be fine!"

My guess is your response would be something like, "well, what kind of food, Doc? After all, no two are exactly alike....is that two pounds of lettuce or two pounds of pork chops?" If he replied, "It doesn't matter. Just as long as you eat that two pounds every day, you'll probably outlive your kids." My bet is that you'd run, not walk, out of that quack's office!

Why, then do we blindly follow someone's Word From On High when they say (in words engraved on stone tablets), Thou shalt use no fuel that does not contain XX% oil." It makes absolutely no sense to me, nor do I think it will to you, if you just stop to think about it. All foods are different; so are oils.

If that's true, why do the instructions with my engine specify a fixed percentage of oil? Simple - to protect themselves. All engine manufacturers have been burned (figuratively and literally) in recent years by "bargain priced" fuels containing either inferior oils, or insufficient amounts of oils. Every one that I've talked to will admit off the record that they know that fuels containing good oils won't need as much as their instructions say. But they also say they know they have no control over that, so they are going to print a high number, in hopes that amount of even a cheap oil will be sufficient. Frequently, it isn't.

So why not just put a lot of oil - at least 20% or more - in fuel and not worry about it? A lot of reasons...all good ones. For example:

Too much oil - any more than is necessary - makes the engine run really crappy. Think about it: methanol burns; oil doesn't - or at least it shouldn't. (Some do, but that will be dealt with in another installment.) Common sense would tell us that the less oil (non-burnable) we can safely use (to an irreducible minimum point, of course), the more methanol (burnable) we will have in our combustion chamber. More burnable ingredients = more power.

One well-known magazine writer, with more than 50 years engine experience, tells me that in his experience, for every 1% oil removed from model fuel, the effect is about the same as adding 1% nitro methane. And it costs a lot less!

By the same logic, the less oil we use (to the predetermined minimum, of course), the less the oil is going to be dousing the glow plug element, and we should be able to achieve a lower, smoother idle.

Next to nitro methane, oil is the most expensive ingredient in model fuel. By not using an unnecessary amount of oil...especially if it's just to satisfy some Great Guru's edict...the manufacturer can keep the cost of the fuel down, which puts a smile on all modelers' faces. Remember that even an additional 25 cents in manufacturing cost translates to an additional dollar....or more....at the retail level.

So, what is the right amount?

It all depends...on what kind of oils, in what combinations, with what additives, etc. And for what use? Sport airplanes... Racing... Helicopters... Boats... Cars... Ducted Fan? What size engines? (As engine size increases, they need progressively less oil. Why? Simple mathematics. Surface area of the combustion chamber increases at about half the rate as the displacement increases.) Most people know that the big T.O.C. and Unlimited racing engines use oil in the 4% to 5% range.

Ducted fan and helicopter engines typically need more oil, 4-strokers less. It might be surprising to most airplane flyers to know that top competition model car engines use fuel with oil contents in the single digits, even though they are turning in the 40,000 - 50,000 rpm range, and have no fan in front to cool them! As matter of fact, they will hardly run on regular airplane fuel.

## **No. 2 - Which Oil is Better - Synthetic or Castor?**

(The following is the second in a series of articles exploring all facets of model engine fuel. The writer is Don Nix, former President of GBG Industries, Inc., manufacturers of POWERMASTER model fuel.)

Before we get started on the subject heading, I'd like to offer a couple more thoughts on last month's subject, "What's the Oil Content?" - thoughts that have been remembered since writing the original column:

Many modelers who have been involved in the hobby for a long time, including those who've been away for years and recently returned, are very stubbornly remembering when model fuel just about had to contain something in the order of 25% oil - usually all-castor - and have a hard time dealing with the idea that virtually no one runs that much any more in modern engines.

The operative word here, of course, is "modern." The metallurgy in today's engines barely resembles that of a generation ago. The end result, as far as model engines are concerned, is that the engines today simply don't require as much lubricant - not nearly as much. I will be quick to add that those running antique engines in Old Timer events should certainly continue to use the old-time formulas - no doubt about it.

In addition to vastly improved metallurgy, we must remember that manufacturing techniques barely resemble those from years ago, in many ways. Modern CNC machinery has made it possible to routinely and cheaply make 1 or 1 million parts all exactly alike.

Those of you who have come along in later years may be shocked to know that up until the advent of this new technology, every piston was hand fitted to every liner. There was no such thing as simply machining 1,000 pistons and 1,000 sleeves, picking one from each batch and having them fit.

The belief in those days that some engines of the same size and make were markedly hotter than others was no doubt true. We've read that in those days, a .29 for example, might vary from as low as an actual .26 to a .32 - some 23% more displacement! More closely controlled tolerances have resulted in the ability to use much different fuels than a generation ago.

The second thought on the subject of total oil content came from reading the operating instructions included with a new imported 4-stroke engine - the DAMO FS 218 twin. It recommends a fuel containing 94% methanol, 5% nitro and 1% Castor Oil! Clearly, this reinforces my point that "there ain't no such thing as a fixed percentage of oil content." Now....on to this month's subject:

Before we depart the subject of oil in model fuel, let's talk about a point that's argued vehemently all over the land - Which kind of oil is better - synthetic or castor?

Each side has its very strong proponents, and each side is right....to a point. "Old-timers" tend to still favor an all-castor fuel, or at least one containing a liberal amount of castor oil. Modelers who have come to the hobby in the last 15 or 20 years have a strong affection to synthetic oils, or at least want their fuel to have mostly synthetics. Let's take a look at both types statistically:

### SYNTHETIC OILS

Strong Points - Weak Points

Good Lubricity (It's "slick") Most tend to cause corrosion if adequate inhibitors aren't added.

Little to no carbon or varnish buildup inside Burns off surfaces at about 100 degrees lower temperatures than castor oil

Leave less oily mess on models Many types and qualities, making it hard to choose the best one

Available in a variety of viscosities

Expensive - good ones cost almost twice as much as castor oil, increasing the cost of the fuel.

Totally soluble in nitro methane When used as the sole lubricant, a greater quantity is required, which increases the cost of the fuel.

## CASTOR OIL

### Strong Points - Weak Points

Great Lubricity Tends to cause carbon and varnish buildup in engine if cheap grade and/or too much is used. Reduces the amount required, resulting in more power and better idle. Messier on model than synthetics

Will tolerate internal temperatures about 100 degrees higher than any synthetic Somewhat sensitive to extremely cold temperatures - mild separation in solution, residue on model becomes almost "buttery" in consistency.

Almost 50% cheaper than good synthetics - reduces cost of fuel. Insoluble in nitromethane. In solutions above 40% - 50% nitro, will separate unless some sort of co-solvent is used.

Great natural rust and corrosion inhibitor Generally available in only one viscosity

I'd like to insert here that there is a "Chicken Little....The Sky Is Falling" rumor making the rounds of the Internet these days that the manufacturers of castor oil have recently changed their methods of making the product, and the castor oil we are getting now is either wholly or partially incompatible with methanol.

I have talked at some length with the "Head Techie" of one of the largest castor oil importers in the U.S., and I want to go on record as saying that, according to the best information I can find, This is total B.S. The Head Techie actually laughed out loud when I told him what was going around. He said, "You know, there isn't much we do to the stuff. We press the oil out, filter it, grade it and package it.

As far as I know, nothing has changed." It apparently started with one of the fuel manufacturers. For what reason, I have no idea, unless it's to help them promote their proprietary synthetics. (Incidentally, I have read a response on the 'net from SIG, agreeing with the fact that it's nonsense.)

So, there you have it. "You pays your money and takes your choice." Actually, it's a little better than that, and the obvious answer is - use a combination of the two, in proportions that will come nearest to enjoying the benefits of each, while minimizing the adverse characteristics.

A few years back, the modeling community was in a "synthetic oil frenzy," and the swing was toward all-synthetic fuels. Happily - at least in this writer's opinion, we've seen a very noticeable swing back toward the center, with the majority seeming to prefer a synthetic/castor blend. We think this makes sense, and many years experience proves it.

The most frequent comment I hear from lovers of all-synthetic fuels is, "Brand XX leaves a lot less oil on my model." My response to that is, "Doesn't that bother you? If you don't see much oil on your model after flying, that tells you one of two things - or both:

Either there wasn't enough oil in there in the first place, or the oil is burning off with the methanol. Neither is good. There's no way oil can burn off and properly lubricate at the same time." This is usually met with a puzzled look, then one of the light dawning, having just realized something they never thought of before.

Oil residue in model engines is a natural as barking is to a dog. We have to learn to live with it.

As an aside, not long back a friend sent me a copy of an article published in a European model magazine. In one part, the writer stated, "The Americans are the only ones rich enough and dumb enough to use synthetic oils." Perhaps overstated just a bit, but it has some validity.

There a couple of types of engines that do require an all-castor fuel, or at least one with a considerably

higher castor content than most others. One would be the Fox ringed iron piston type, and the other would be the small Cox engines, because of their rather unique ball-and-socket connecting rod-to-piston design.

Pattern flyers traditionally prefer an all-synthetic fuel, for a couple of reasons, I think. One is the fact that pattern flyers practice a lot - hour after hour after hour. That much use, plus the tuned pipe setup that is almost universal with them probably, tends to cause a greater problem with varnish and carbon buildup than in sport types. (At the risk of being bombarded, I also think it's largely a state of mind. "Joe Champion uses all-synthetic, so that's what I'm going to use.")

The other area where we have seen all-synthetic fuels gain in popularity in recent years has been with model helicopters, probably for the same reasons. Also, the trend toward 30% nitro fuel for serious competition has led to using a lower viscosity lubricant, and, as shown in the comparison charts above, this necessarily dictates using synthetics.

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