

The Truth about Steam Oil by Harry Wade



My participation in live steam began in the mid-1960s in large scale and over the years when trackside talk turned to locomotive lubrication I began to hear claims for all sorts of substitutes for steam oil, everything from crankcase oil to chain saw bar oil, and all of these were usually accompanied by declarations of "Aww, it's the same stuff". Some folks claimed to have success, or rather no adverse affects, with things such as transmission fluid or hypoid gear oil, claiming as usual "it's the same stuff". In addition, as outlandish as it might seem, there was the occasional nut-case who for whatever reason advocated using NO lubricant at all in a locomotive, which I thought was just plain contrariness and foolishness.

Since it was used without question by ALL the "old hands" it never occurred to me to use anything other than a genuine steam cylinder oil. It seemed to me to be false economy not to do so, and then there was the 150 years of steam technology which I considered sufficient time for more capable men than me to determine what worked best! In any case, as costly as our engines are in time or money and as cheap, relatively speaking, as the proper oil is, I could never see what possible benefit there could be in using anything besides a good steam cylinder oil (hereinafter abbreviated SCO.)

By about 1990 I found myself not only active in the garden gauges but supplying boilers, fittings, and supplies, including steam cylinder oil, to the US garden railway community. I soon discovered that because a large percentage of these folks were new to the world of live steam, and despite there being more miniature steam technology available in print now than at any time in the history of mankind, there existed many areas of misinformation, even among the otherwise well-informed. Steam lubricants were one of those areas and I encouraged the use of SCO whenever the question arose.

Occasionally I would be asked by the sceptical to justify my claim that a SCO would be a far better cylinder lubricant than something such as a motor oil or machine oil. Occasionally someone would actually preach against using what most of us recognized as the proper oil, so to better educate myself and to have factual evidence to offer beyond my own experience, I decided to learn more of the technology behind the product and the following is what I found.

Contrary to what some believe, SCO is not in danger of becoming extinct. It is in fact much in current demand for a variety of industrial applications, particularly where machinery operates in a steam environment, in food processing and brewing for instance, and is currently listed by all major petroleum refiners. It has also found modern applications, such as a lubricant for worm gear applications where it has been designated by the AWGM (American Gear Manufacturers Association) as their lubricant classes #7, #8, and #9.

To quote from the AWGM specification, "Due to the sliding interface of worm gears it is difficult to maintain a hydrodynamic oil wedge, which often results in worms operating under boundary lubrication conditions, and operating temperatures of 190°F or higher require oils which are thermally and oxidationally stable. It has been found that these requirements are met by mineral base oil containing oxidation inhibitors and 4%-6% acid-less tallow or synthetic fatty acid." - Precisely the attributes of our old friend steam oil! For that reason alone you may rest assured SCO will be with us for a long time to come.

In continuing my investigation, because it is probably the most often-mentioned substitute for SCO, I asked specifically about chain saw bar oil and I found that SCO and bar oil are actually on opposite ends of the performance spectrum. That is, the lubricating behaviour and characteristics of chain saw bar oil are diametrically opposite those for which SCO has been specifically formulated. More ominously, chain saw oil is often "the dregs", or what is left at the bottom of storage tanks, trucks, tankers, and pipelines after everything else has been taken off and typically receives no further processing and may contain impurities and suspended solids (also known as "grit"). Bar oil is intended for 100% loss lubricating systems, to lubricate for a few seconds and then be thrown off as waste, and according to the petroleum engineer I spoke with a poorer replacement for SCO you could not find.

Another popular notion is that SCO is a "stepchild" oil, that is, it's one of another type which has been re-labelled for service as steam oil. SCO is in fact a distinct oil and is in no way an orphan. Another misconception is that it is a rather low quality oil, which likewise it is not. It's actually highly refined with its key additive being animal tallow or tallow substitute. Before refined petroleum became widely available, common animal tallow was the standard lubricant for steam engine and it is the tallow which contributes much of the sticking qualities of steam oil and makes it behave like molasses when cold.

Some proposed substitute oils; hypoid gear oil for instance, may not only be inadequate lubricators but may indeed harm our locos. An oil company engineer had this to say, "Proper viscosity and the absence of "modern additive formulating" in an oil is all-important for us. Detergents, dispersants, antioxidants, anti-wear agents, anti-foaming compounds, and friction modifiers, plus other additives which we put into products for their intended application, i.e. crankcase and diesel oils, industrial oils, and even mildly formulated R&O turbine oils, should not be used. To emphasize - absolutely avoid hypoid gear oils, these contain aggressive sulphur and phosphorus compounds which work under extreme pressure conditions and heat." I cannot improve upon that description and caution, with the exception that in hypoid gear oil the sulphur content causes it to have an acrid, quickly recognizable, and (to me) repellent odour.

Practical Information and Application

SCO is intended to be introduced into the steam flow ahead of the cylinders where it is atomized and emulsified and is carried in the steam flow to all surfaces the steam touches. Because these surfaces are usually slightly cooler than the entering steam a tiny amount of condensation takes place and whatever oil is emulsified within the condensate is deposited on an exposed surface. Obviously some steam does not condense within the cylinders and finds its way to the atmosphere where additional

condensation and oil depositing takes place, typically as we all see from time to time, at or near the stack.

When a Gauge 1 steam loco is properly lubricated during operation there should be just the merest wisp of oilish goo the color of well creamed coffee visible at the stack. When a working steam engine has been properly maintained and lubricated, steam oil, heat, pressure, metal oxides, and time combine to form a dark, protective skin on the internal cylinder parts. This is especially true of cast iron. If you ever get the chance to peek inside the cylinders of an older, well cared for steam engine you will see that the bore is a deep matte black. Steam is actually quite an abrasive fluid and the combined flow and temperature of steam will scrub other less tenacious oils off the moving parts very quickly leaving exposed wearing surfaces vulnerable to damage.

SCO is offered by most refiners in various ISO viscosity weights from around ISO380 to ISO1500 and the higher the ISO number the higher steam pressure and superheat it is suited for. The ISO viscosity preferred and most often sold for small scale live steam operations, and indeed for all steam applications where steam pressure does not exceed 150psi and where there is little or no superheat, is ISO460 or thereabouts. The steam oil I offered for a time (as do many others now) was an ISO460 which proved to be an excellent weight for all scales.

In most things I am a proponent (within reason) of going with what works for YOU, so I only find it necessary to speak about oil when a question arises, as it has often, or if someone is misleading the uninformed, as occasionally happens among live steamers. Some folks use ISO600 oil, and while not prohibitively heavy, it is in my opinion a bit too heavy for our small scale locos. But if, as some people I know have said, a heavier viscosity works for you then I'd see no reason to change on my account.

Since it had been some time since the research for my original article published in Steam in the Garden magazine, I took the time to make a few further inquiries and the table below lists the SCO product names for a number of refiners. As you can see virtually all major refiners produce steam oil in the grades we use with the exception of Exxon 1500 which is clearly outside our service range. Unfortunately, since SCO is an industrial product, it's typically only available from industrial stockists in 5 gallon pails or 55 gallon drums and although most local petroleum distributors will sell to anyone, differences in local demand may mean that all viscosities may not be available at all stockists in all areas.

Product Name	ISO Grade	V.I. ¹	F.P. ²
Mobile 600W	375	95	282
Mobile 600W Super	460	95	282
Mobile Hecla SSO*	680	85	282
Mobile Hecla SSO*Mineral	1000	80	285
Exxon Cyclesstic 460	460	99	271
Exxon Cyclesstic 680	680	97	279
Exxon Cyclesstic 1000	1000	93	288
Exxon Cyclesstic 1500	1500	92	313
Chevron W-220	220	98	288
Chevron W-460	460	99	308
Chevron W-680	680	99	316
Phillips 66 Hector	460	93	315
Shell Valvata	680/1000	n.a.	n.a.
Shell Valvata J	460/680/1000	n.a.	n.a.
Texaco Vanguard 460	460	99	308
Texaco Vanguard 600	680	99	316
Texaco Vanguard 1000	1000	100	322
¹ Viscosity Index			
² Flash Point in °F			
(*) "Super Steam Oil"			

A few random thoughts:

Cold Running - Steam oil requires steam and heat to do its job. If no heat is present it's not much more liquid than molasses and is probably as much a hindrance as a help. For cold running, such as testing on compressed air, a conventional machine oil of some kind should be used.

Additives/Thinning - It seems to me that if an oil which has a very specific set of attributes (such as does SCO) is thinned with something other than a less viscous form of itself the resulting admixture may not have the qualities we trusted the original to provide so the question becomes why not use a less viscous SCO to begin with? A good genuine ISO-rated steam oil comes blended from the refinery to do its job and doesn't need additives and in fact will suffer from additives. Adding anything other than a lighter viscosity steam oil of the same rating is wasting money and reducing if not neutralizing its ability to do what it was created to do.

Proprietary "Blended" Oils - The only one that I know of currently is about three times the price of standard SCO and does nothing stock oil won't. Use it if you have nothing better to do with your money.

Spoilage - I've occasionally been asked about shelf life, if steam oil will spoil if kept too long. I don't know about this, but I once had a bottle of steam oil which had been "lost" for a very long time, for at least 20 years, and when found it appeared to me to have the same appearance and odour as the day I got it. There may very well be conditions under which steam oil might spoil, or sour - if it contained organic fats, but I don't think spoilage should be of too much concern to small quantity users such as us.

Machine oils

During the original internet discussion the question of lubricants for workshop machine tools was raised by one of our members. Unfortunately this very broad subject is one with which I am not nearly so familiar as I am with SCO so I'd best leave that for more capable hands. However the general consensus is that if one follows the recommendations of the designers or manufacturer, or substitute only a genuine equivalent to what has been specified, one cannot go far wrong.

As a case in point, I've owned a well-known brand of British lathe for some years and the maker's lubrication chart called for a Shell oil called "Tellus 68" for the majority of applications on the machine. I was unfamiliar with this name so I telephoned my local Shell stockist and found that Tellus 68 was essentially a common 20W (now ISO60) "hydraulic oil". This is the oil used in hydraulic drive and cylinder-actuated machine power systems and is one of the most widely used oils in the world. I gave this a try and found it to be an excellent all-round machine lubricant. I also found it to have a consistency and chemical formulation, including rust inhibitors, which is difficult to improve upon for general machine tool and workshop use.

I hope these few notes on steam oils and lubricants will be of use to some of you and dispel some of the questions which from time to time seem to spring up. I will say that all considerations of cost and convenience aside, in my opinion the most compelling reason for using a good steam cylinder oil is that not only does it protect our investment, but the unmistakable sweet, rich, aroma of hot steam oil adds measurably to my live steam experience. That alone is worth the price.

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