A crime against oil analysis

By Jack Poley

"A little knowledge is dangerous," goes the old adage that applies to a lot of activities, including oil analysis. A lot of bad knowledge also can be dangerous.

Recently I watched an episode of the TV show CSI: Miami where a bad guy was caught based on oil analysis. To my knowledge, this is the first time that such analysis was ever used in a dramatic situation. It was rather amusing, if well intended, and despite several inaccuracies and exaggerations had some degree of validity in the overall sense and provided some instructive examples of what to do and what not to do, as well as reasoning processes, both plausible and questionable.

But, hey, it's entertainment and story telling, not the bottom line from a real oil analysis program.

In this episode, oil is found on the trigger of a gun used in a murder. After a round of testing (unspecified, other than viscosity), the conclusion is that the oil came from a motorcycle engine, narrowing the suspects down to a gang of bikers.

I'm thinking: Hmm, motorcycle oils do feature multigrade capability and a lot of shear stability because a wet clutch transmission usually shares the engine oil. But in order to establish that special shear-resistant qualities were prevalent from viscosity alone, two viscosities would have had to be determined in order to calculate the viscosity index. How can sufficient sample for one viscosity test, let alone two, be furnished by a trace amount of oil on a trigger? Perhaps a nanoviscometer (yet to be invented, to my knowledge) was used (twice).

The lead technician/investigator next advises his colleague that viscosity testing established the oil was from a motorcycle because motorcycles use "special oils" with unique viscosities.

I'm thinking: Well—that can be true, perhaps, for race course applications and high-tech bikes. Almost as often, however, a typical multigrade passenger car motor oil (PCMO) or a typical synthetic oil for high-performance passenger cars is used. Common stuff, nowadays.

Nevertheless, let's give the technician the benefit of the doubt, as we already did for the viscosity analyses that he likely could not have accomplished.

Subsequently, the bikes are gathered and staged at the CSI garage for oil sampling. One of the technicians is puzzled. He can't find the oil dipstick capæafter some mock chiding. The lead technician shows him where and how, using a large syringe with an extension tube (which demonstrates that he knows where and how to secure a good sample). But it appears the samples are being taken cold (i.e., the engines had not been warmed up, prior to sampling).

I'm thinking: Whoops, that's an OMA I violation. There goes some of the representative sample aspect, which is particularly important since the samples are about to be tested using ICP-Mass Spectrometry, a technique that is capable of analyzing at the parts-per-trillion level. Gee, I never got to use one of those!

A third investigator walks into the lab in the midst of the testing and hears the lead technician advise him that each oil has a unique additive package.

Well—yes and no. Each manufacturer may add a particular touch or preferred blending ratio to his product, but the preponderance of additizing is quite similar for similar applications, since there aren't high numbers of options when blending for specific properties and (confining) industry specifications. A few trace additives may help distinguish one oil from another, but it might prove difficult to determine their presence, assuming one knows they should be there in the first place.

Now the third investigator poses the (good) question: “What if several of the bikers are using the same oil?” Lead technician (sic): “Then we look at the bikes themselvesæeach bike will generate iron and zinc in a unique signature.” Subsequently, a video clip of an engine grinding its innards, like a metal lathe, is shown, spewing particles about an eighth of an inch and larger.

I’m thinking: It’s curious that the lead technician mentioned iron and zinc specifically. Only brass components would be likely to produce zinc and not much of it at that, compared to copper or even aluminum and lead, which are much more prevalent wear metals.

Also, our additive expert neglects to consider that zinc will likely be a masking agent in this test because zinc dithiophosphate is probably present as an additive. The concentration of the additive, perhaps 1,000 ppm or more for a motorcycle application in order to minimize wear, easily will overshadow a wear value that’s not likely to exceed 50 ppm. I’m also thinking that the sample from the trigger must have been at least a half ounce by now for all this testing it’s receiving. This much oil on his trigger would surely be daunting for a hit man.

The video clip of an engine tearing itself apart, while overdramatic, does get the point across that wear can be assessed via oil samples.

The fact that the particles pictured are too large for ICP-Mass Spectrometry analysis shouldn’t deter us, nor should the fact that those cold samples would all but guarantee that large particles such as those depicted would never find their way into the sampling syringe because they would be laying on the bottom of the engine case uncirculated.

When the analyses are finally completed, we see a set of spectra for each bike’s oil sample on a computer monitor, along with the bike’s picture. High-speed screen shuffling ensues, and a match is eventually made. Justice prevails. The killer is confronted and confesses.

I, too, confess thatæeven though I enjoy high-tech inclusion in movies—it embarrasses me to watch some of the hokey things perpetrated on us, the viewers, because no one does the appropriate research to provide a more credible scenario. (Don’t get me going about dumb car chases).

A fitting twist would be for the biker’s defense attorney to hire one of us “oil analysis people” to refute the quality of the data gathering, as well as point out the errors and invalid assumptions in the reasoning processes.

But, hey, it’s entertainment and story telling, not the bottom line from a real oil analysis program. Get over it, have a chuckle, and pay close attention to data quality and your reasoning processes.

This completes our first installment on data interpretation: Be sure the sample is trustworthy, know the test limitations and know the content and quality of your data. **<<**

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