Fuel Oil Consistency is Imperative

By Jerome P. Sava

Fuel oil dealers are well versed in all aspects of oil pricing, supply, and transportation matters, but often tend to ignore learning more about another very critical part of their business: the attainment and interpretation of fuel oil specifications. In most areas of commerce, it is a given that the individual vendor would have a thorough knowledge of the product being sold, but this is not always so with fuel oil resellers. Although terms like gravity, Btu, and sediment are often cited, many oil dealers view these criteria to be primarily in the province of chemists and engineers. That is too bad because a "quick and dirty" means to fairly reliably evaluate any fuel oil does exist and is as easy to use as A-B-C, that is, **A**PI Gravity, **B**ottom Sediment and Water, and **C**olor.

The first step is, of course, to obtain representative samples. For this purpose, it is advisable to use a petroleum "bacon bomb" sampler that will permit the collection of oils at varying levels within the storage tank. Hydrometers and cylinders are needed to measure the gravity of the oil in much the same manner as antifreeze concentration is measured for your automobile. A centrifuge apparatus is useful to determine the presence, the nature, and the quantity of any contaminant. All this equipment can be readily purchased from any scientific supply house whose personnel are usually well familiar with the ASTM Standards that determine the proper equipment for each test.

A= API Gravity: Let's begin with a definition of gravity, as defined by the American Petroleum Institute (API). The term "API Gravity" is an arbitrary one empirically derived from the equation:

$$\text{API Gravity} = \frac{141.5 - 131.5}{\text{Specific Gravity @60°F}}$$

This equation reveals that API Gravity varies inversely to the specific gravity of the fuel, or weight per gallon, of the fuel. For example, heavy No. 6 bunker-C oil might have an API of 14.0, while a light No. 2 distillate oil might have an API of 34.0.

In general, home heating oil typically yields gravities within the 32 -36 range. As a fuel's gravity falls below 32, it suggests that the product may contain an inordinate amount of heavy hydrocarbon fractions that could lead to poor combustion and carbon deposition. Conversely, as the gravity rises above 36, then the product may be unusually volatile in nature and so laden with light ends that an unusually low Btu output can be anticipated. Very high API values, above 40, also are a strong indicator that the fuel has been diluted with significant percentages of kerosene, possibly to improve cold flow.

Referring to the heat of combustion, it is generally accepted that the Btu value of oil will decrease as the gravity increases, but remember that this is only a measure of the theoretical amount of heat liberated. The actual heat output is controlled by many variables. For example, excessive air/fuel ratios, heavy sludge formations, carbon deposits at nozzles, imperfect atomization, and the presence of insulating layers of soot, are all factors that will decrease ideal combustion efficiency. In other words, the cleaner the system, the better the efficiency and, accordingly, the greater the heat value supplied.

In order to provide homeowners with the most heating units for their money, many progressive oil dealers have adopted an intensive housekeeping review along with the adoption of a chemical treatment program. They have found that the routine chemical treatment of their fuel supply with effective multi-functional additives, such as **C & S Scientific's** oil conditioners, provide an effective tool in maintaining a constant flow of clean and stable fuel to the burner and thus ensuring optimum combustion efficiency.

TABLE 1

Relation of API Gravity to Pounds per Gallon and Btu per Gallon

Gravity, API	Pounds per Gallon	Btu per Gallon
15.0	8.056	149,030
20.0	7.784	145,880
25.0	7.541	142,820
30.0	7.296	139,660
35.0	7.084	136,720
40.0	6.877	133,760

B = BSW (bottom sediment and water): A very good indicator of overall fuel quality is the BSW test, whereby a small sample of representative oil is spun in a centrifuge for a prescribed time. During this test, most typical oil contaminants are forced to the bottom of the test vessel, and are clearly identifiable and quantifiable. Typical contaminants include any inorganic matter such as rust particles or dirt, any insoluble particles of precipitated hydrocarbons and sludge, any water, and any biological organisms.

Because the amount and location of each of these contaminants can provide important clues as to the overall quality of the fuel, the sampling point is critical. Generally, most contaminants will gradually settle to the bottom of the storage tanks and so that is obviously where the first sampling point should be. However, realizing that water will float above the oil, that heavy sludge will sink below the oil layer, and that fungal organisms will float at the oil/water interface, it becomes obvious that additional samplings are required. For that reason, the ideal test procedure involves a "bomb" sampler that ultimately provides a cross-sectional view of just what is occurring at various tank levels.

Once centrifuged data is established, then an overall evaluation of the product's quality may be made. As a rule of thumb, any contaminant of less than 0.3% should not cause any handling or combustion problem, especially if present only along the very floor of the tank. However, if significant quantities (generally above 1%) are identified at one or two inches off bottom, then a potential problem exists. High water content will create problems at the burner as well as providing an environment for the acceleration of sludge deposits. High fungi content will cause serious clogging of filters, strainers and lines. High hydrocarbon sediment content will cause poor atomization and carbon formations. On the basis of these findings, consideration can then be given to whether the oil product is acceptable for use as is, or whether its off-spec qualities can be somehow overcome. Any full-service chemical company should have the capability to obtain, analyze, and recommend an effective remedial approach, if available. At **C&S Scientific**, this service is routinely performed at no cost or obligation.

Please note that the percentage guidelines expressed above involve the condition of the oil in storage tanks, either at the dealer's terminal or at the customer's site. The same type of evaluation, however, would apply to specifications provided through loading specs from majors' terminals or pipeline services. In these cases, however, the presence of any contamination whatsoever should signal a serious alarm since it would then be a significant indication of a far less than ideal oil supply. This is because most of the problems normally tend to develop downstream of the refinery level, and are created during the subsequent storage and transportation procedures. To have evidence of any contamination at these key points of origin would be very unusual and should necessitate concern and dose scrutiny.

C= Color: In recent years, the use of color as a criterion for quality has declined in applicability because of the regulations requiring that all home heating oils be dyed red.

Contrary to popular belief, however, the color of the oil per se was never an accurate indicator of its quality. Many factors, such as the effectiveness of metal deactivators incorporated during the refining process, prior exposure to varying temperatures, duration of storage, compatibility of commingled oils, and even the inherent nature of the crude from which the oil was derived, may affect color. All these factors, however, do not have either a positive or a negative effect on oil performance and, in fact, it would be quite usual for an amber-colored product to outperform a water-white product.

Nevertheless, even recognizing these factors, the color (and appearance) of a fuel can give some important dues as to its overall quality, especially when combined with API and BSW results. For example, oil that is black and opaque can certainly be suspected of coming from a site where high sludge contents exist. Oil that is cloudy in appearance can be suspected of carrying low but significant levels of entrained water, while oil revealing a separate bottom layer of water can be suspected of containing excessive water. Oil that has a foamy, milky-like emulsion can be suspected of being exposed to active microorganisms**.** Despite the red in the oil, these general characteristics will clearly show through when any contaminant is at a serious level. The ease of collecting and evaluating oil samples should allow any interested oil dealer to always have a handle on the product that he is receiving from his supplier and ultimately resupplying to the homeowner. Through a series of relatively straightforward procedures, coupled with a limited but sound understanding of the chemistry involved, the dealer should then be able to knowledgeably assess the quality of any fuel oil.

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Many companies are available for consultation and review to help familiarize the oil dealer with the technical aspects of his trade. Obviously, it is important to seek such information from a company that would present an unbiased and non-self-serving view of he facts. For example, although **C&S Scientific Corp**. is a prime researcher and manufacturer of fuel oil conditioners, it has also assumed a role as a key resource in helping to make dealers more aware of the overall subject of fuel oil chemistry and its implications. Armed with this technical knowledge, together with the specific results of his API, BSW, and Color analyses, the oil dealer can be truly confident of his ability to knowledgeably assess the quality of any fuel oil.