Comments on Crude Oil Gravity Adjustments

Presented to
The Louisiana State Mineral Board
for the
Royalty Oil Task Force

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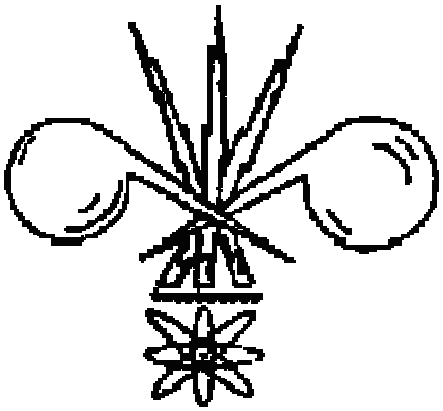
Presented by

T. Michael French
Director
Technology Assessment Division



Louisiana Department of Natural Resources
Raymond W. Stephens, Jr.
Secretary of Natural Resources

Comments on Crude Oil Gravity Adjustments

Considering that the price of crude in the 40 to 45 degree API gravity range is posted at a premium over crude above or below that range, the Mineral Board has posed two questions to the Royalty Oil Task Force concerning gravity adjustment deductions to state royalty oil.

Question A

Can the state increase royalty revenue by taking its crude in-kind and blending low gravity and high gravity crudes to produce blends in the 40 to 45 degree API range?

Simple Answer

The answer is almost always no because the mixture that has the desirable API gravity will not have the same chemical composition as that of a naturally occurring crude of the same API gravity. Refiners are ultimately paying for the composition of the crude rather than for its density as measured in degrees API.

Question B

Why is crude lighter than 45 degree API penalized with a gravity deduction similar to the gravity deduction for crude heavier than 40 degrees API?

Simple Answer

The answer lies in realizing that although light crude (i.e., 40-45 degree API) is good, lighter crude (i.e., 46 degree API and above) is not necessarily better for a typical refinery. Looking at the chemical composition of crude, as the crude gets lighter than 40-45 degrees API, it contains shorter molecules, or less of the desired compounds useful as high octane gasoline and diesel fuel, the production of which most refiners try to maximize. Likewise, as crude gets heavier than 40 degrees API, it contains more longer and bigger molecules that are not useful as high octane gasoline and diesel fuel. It is, thus, consistent from the perspective of a chemical engineer at a refinery to penalize these lighter and heavier crudes similarly.

Background

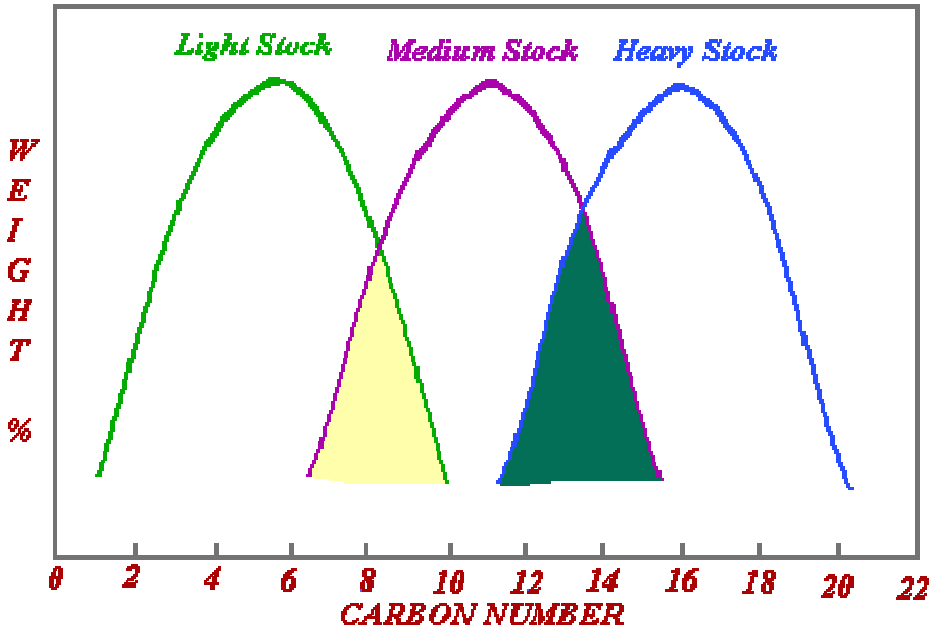
Crude Oil is a complex mixture consisting of up to 200 or more different organic compounds, mostly hydrocarbons. Different crudes contain different combinations and concentrations of these various compounds. The API gravity of a particular crude is merely a measure of its specific gravity, or density. The higher the API number, expressed as degrees API or degrees API, the less dense (lighter, thinner) is the crude. Conversely, the lower the degrees API, the more dense (heavier, thicker) is the crude. Crudes from different fields and from different formations within a field can be similar in

composition or be significantly different. These differences in composition are very important to chemical engineers running a refinery.

For crudes that have undergone detailed physical and chemical property analysis, the API gravity can be used as a rough index of the quality of the crudes of similar composition as they naturally occur (that is, without adulteration, mixing, blending, etc.). When crudes of different type and quality are mixed, or when different petroleum components are mixed, API gravity cannot be used meaningfully for anything other than a measure of the density of the fluid.

For example, consider a barrel of tar that is dissolved in 3 barrels of naphtha (lighter fluid) to produce 4 barrels of a 40 degree API mixture. When this 4-barrel mixture is fed to a distillation column at the inlet to a refinery, one barrel of tar plus 3 barrels of lighter fluid is all that will come out of the still. On the other hand, 4 barrels of a naturally occurring 40 degree API South Louisiana Sweet crude when fed to the distillation column at the refinery could come out of the still as 1.4 barrels of gasoline and naphtha, 0.6 barrels of kerosene (jet fuel), 0.7 barrels of diesel fuel, 0.5 barrels of heavy distillate, 0.3 barrels of lubricating stock, and 0.5 barrels of residuum (tar).

The figure below illustrates weight percent distributions of three different hypothetical petroleum stocks that could be fed to a refinery with catalytic cracking capacity. The chemical composition is generalized by the carbon number which is the number of carbon atoms in each molecule. The medium blend is desired because it has the composition that will yield the highest output of high octane gasoline and diesel fuel in the cracking refinery. Though the heavy stock and the light stock could be mixed to produce a blend with the same API gravity as the medium stock, the composition of the blend would be far different from the medium stock, as the figure indicates.



Conclusion

Crude oil is not a uniform or standardized material. It requires complex physical and chemical analyses to determine its quality, and hence value, to a refiner. The API gravity

measurement of a crude is at best only an approximate gross indicator of quality. The preceding discussion hopefully explains the technical reasons why blending heavy crude with very light crude will usually not produce a mixed crude with a higher royalty selling price and why very light crudes have a gravity price deduction similar to heavy crudes. This should not imply, however, that the state is necessarily receiving the best price for its royalty crude or that, through negotiation or other measures, the state could not affect lower gravity deductions for both light and heavy royalty crude.