4IRSolutions

Crude Blending Advanced Efficiency Solutions

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Utilization of AI-60 NMR 3rd generation process analyzers is gaining momentum to engineer precise blends at much lower operating costs; Utilization of this technology gives refineries a large advantage in coping with changing costs of crude oils and distillates

Introduction:

Traditionally refineries were constructed to distill conventional light crude oils. Changing economic conditions, wide variations in the price of crude oils and shifting of distillates, as requested by the market, force refineries to optimize the cost of their distillation feedstock. This is achieved by blending high value light crude oils with heavy (unconventional) crude oils of varying qualities, or buying readymade blends. Lower quality crudes include heavy crudes from known source locations, as well as opportunity crudes that are brought to the market by traders worldwide. These crudes, of variable quality, can be purchased at lower costs than known proven stock. Blending these with standard more expensive grades of crude is the current best way to produce crude blends that bear optimal properties to be processed and at minimum refining cost.

Operating Refineries worldwide have been built and designed for handling very specific ranges of crudes and blends for optimal production and cost efficiency. Due to the wide expansion of drilling into unconventional energy plays as well as an expanding global footprint of pipelines and shipping the makeup of the crude supply has drastically changed and will continue to evolve...

The majority of distillation of crude oil has been targeted to produce gasoline components, such as light and middle distillate. During the past decade, especially in the most developed countries demand for fuels is shifting from gasoline towards diesel fuels. In the past predominately light crudes were distilled for gasoline, today refineries must be capable to efficiently distill heavier crude oils to increase the yield of middle and heavier distillates. Refining margins for most refineries, which were not able to adapt to this market demand shift find themselves running in the red. Technological limitations caused many refineries to buy expensive light crudes that do not to produce specifically those distillates that are most demanded in the market, and have the more profitable prices. Many refineries suffered large losses. A large number of refineries either, closed or changed their activities from distilling toward blending due to the new market conditions.

Currently crude blending is performed by blenders or refineries, who buy varying types and grades of crude oils. These locations upgrade the crude's chemical and physical properties to produce a synthetic crude oil at optimal cost, which can be easily processed in the equipment of refinery and will predominately yield high value distillates.

Characteristics of Crude Oils Worldwide

Physical and chemical properties of crude oils correlate directly with the chemical composition, and vary according to their place of origin, as can be seen in figure 1. Crude oils are characterized as light or heavy, sweet our sour.

Quality properties determine the market value of each type of crude individually. The most important quality characteristics are: density, the TAN and the sulfur content. The API (Density) ranges from light crudes (high API, low density) to heavy crude oils (low API, high density). Sulfur is present in crude oils as hydrogen sulfide and as polysulfide. Partially these sulfur containing molecules will decompose during the distillation process, while hydrogen sulfide evolves. The sulfur content and other acidic components in crude oil, such as naphthenic acids, are highly corrosive, and responsible for the crude oil to be characterized as sour or sweet. These characteristics determine the price paid to suppliers for ”raw” crude oils.

Refinery equipment

Crude oils with high acid numbers/value are heavy crude oils with high acidity or High TAN. High TAN crude oils are characterized by having:

High density and viscosity
High nitrogen content
High gel-asphalt content
High salts and high heavy metals
Fewer light components,
Low solidification point,
Low yield of light oil distillates
, , , . This type of crude causes water – oil separation by the De-Salter to be more difficult than in conventional crudes. These properties also cause these crudes to give low quality products that are very corrosive. Commonly, TAN crude is called “opportunity crude”. The price is about 70% of conventional crude oil. The additional cost of processing high TAN crude is within the range $3/bbl., but the savings compared to conventional crude processing can reach $20/bbl. **Utilizing opportunity crude is very attractive to refineries who have the technology to efficiently process it.**

Most refineries have been designed and constructed specifically based upon the crude oil availability and ease of purchase. This limits many refineries to purchasing only a few types of crude oil. Many refineries that are constructed to distill light and low sulfur crude oils are not currently capable to process heavy fuels efficiently or for a profit.

1. The distillation unit and its pipelines are not constructed from high TAN and hydrogen sulfide resisting metals. This causes increased corrosion which will increase the expenses of maintenance and risk of failure.

2. Critical differences between the physical and chemical properties make heavier crudes oils more difficult to distill than lighter crudes. Higher viscosities, fouling tendencies, and different flow streams, make it problematic to maintain stable crude charge rates. These are required for stable product yields, quality and reliability. Difference in boiling points between light and

heavy crudes require different temperature process conditions such as preheating and different distillation temperatures, overhead etc. Heavy fuels are rich in asphaltenes and metals and other contaminants, which cause poor desalting performance.

Oil refineries are custom designs based on the types/grades and supply of incoming crude supplies as well as the market demands for outputs. The most refineries are built and designed, for a limited number of crude oil types. Historically, refineries purchased their crude oil from specific locations and with specified chemical and physical properties. Many refineries were designed to refine light and sweet (low sulfur content) crude oils based on the regional availability of this type of oil.

The limitation for refineries to distill a broad range of crude oil types, forced many refineries to change their strategies. Dozens of refiners in the US and in Europe closed down and turned into terminals or put them up for sale to private companies. Other refineries decided to invest and upgrade their equipment and processing facilities to enable distillation of a wider range of crudes including heavy oils. These key refineries also increased production volumes of distillates that are highly demanded by the market driving growth and profitability.
Upgrading legacy distillation units, constructed to distill light sweet crude into units that distill heavy sour crude oils requires enormous investments in equipment and process planning. It is up to each refinery to consider whether the upgrade is going to drive revenue and profit growth.

Product shifting:

Demand continues to shift for certain distillates and refinery products. Global demand for diesel oil is replacing that of gasoline. It is expected that middle distillates will comprise 45% of global demand barrel by 2016, which is a rise of 10% as compared to 2005. It can be expected that the diesel gasoil in developing nations will increase by 10 M/M d/d from 2009 to 2030.

Currently the United States is the largest consumer of crude oil. While the US demands remains relatively stable, China is the second largest consumer of crude oil with an annual 4% yearly increase in demand. The latest generation of refineries constructed today, are designed so that they can process a wide range of crude oil grades and types from domestic and international markets.

The global consumption of heavy fuel oils is decreasing as environmental regulations restrict the emission of gasses originated from the use of “dirty” fuels. As a result of environmental restrictions, natural gas is the preferred “clean fuel” as opposed to conventional refinery fuels. This influences the properties of heavy fuel that can be blended, without producing and accumulating large quantities of heavy bottom fuels. To be profitable a refinery must adapt itself quickly to the supply and demand changes arising from regulatory and environmental drivers.

The major operational cost of the refinery is contributed by the price of the input crude oil. It is typically 80% to 90% of cash flow. Reducing the cost of the crude feedstock, without changing the range and volumes of high valued distillates, increases the refining margin significantly and by that the profit of the refinery. Refinery profits are a direct outcome of the strategy applied by the refinery to purchase low cost crudes and to produce distillates with a high market value. To increase the refining margins and be competitive with their competitors, refineries are obliged to minimize the cost of their crude feed, without affecting the capacity to produce of high valued distillates. Heavier crudes are typically more difficult to process based on legacy technologies, and the increase of consumption of diesel oil as compared to gasoline, light sweet crude oils are sold at a higher price than heavy crudes. Reducing the cost of the crude input, without changing the range and volumes of high valued distillates increases drastically the refining margins.

Potential Crude Blenders

To achieve increased refining margins, refineries have changed their feed stock from pure crude oils to synthetic crudes, by blending two or more different crudes of different market value. The resulting blend should still bear the required properties to process them efficiently in the refinery, without influencing the product range, product volumes and product qualities.

There are two major supplies of blended crude (synthetic crude):

1. ***Refinery industries:***
   Crude blending is done directly at the refineries to prepare low cost and compatible blends for internal consumption or for trading them in the global oil market

2. ***Blend producers and Trading companies:***
   Efficient crude blending open opportunities for oil blenders, oil trading companies and terminals to bring low cost blends on the market, which can be sold to the refineries with a high market value and with a marketable quality.

Crude mixing can be applied throughout the entire supply chain of crude oil, from its well (upstream) enabling transportation, through terminal blending (midstream) to the refineries (downstream users). The final supply to the distillation unit may be a combination of these applications.

Crude oil blending is a common practice to reduce the cost of the crude oil mixtures being distilled in refineries. Efficient blending of crude oils of different origins and of different qualities can result in the highest possible refining margins. Increasing the refining margins is achieved when blending of different low cost crude oils does not affect the production capacity of high value distillates. The Strategic value of crude oil blending includes several parameters. Each of them contributes to the overall final cost of the crude oil entering the crude distillation unit, and the refining margins.

1. Systems limitations of crude distillation units to refine any type of crude oil.
2. Cost differences of crude oils according to their location of origin, market demand their chemical and physical properties. An increased ability to process unconventional crudes leads to an improved refinery margins.
3. Demand shift in the major markets from gasoline towards diesel fuels. Throughout the last decade an increased demand of diesel fuels in the European market caused the refineries to increase the diesel yield and reducing the naphtha yield.
4. High viscosity, especially in heavier crude oils, affects the flow properties of the crude during transportation through pipe lines. Blending these types of crude oils

with diluents or conventional crudes may be required to reduce the viscosity and to increase its flow properties to reduce transportation cost.

Crude oil economics

Global political and economic changes forced refineries to change their sources of feedstock. Refineries used to distilled crude oil from single locations, today refinery profits are a direct result of the ability to create blends that compose minimal quantities of high value crude oils such as Brents, and maximize quantities of unconventional crudes, such as heavy and extra heavy crudes, sour crudes and bitumen extracted from oil sands. The final blends should still bear those physical and chemical properties that are required to enable a smooth and continuous operation of the distillation unit at the lowest possible operating cost.

Basically crude oils can be divided into 4 major groups:

1. Light Low sulfur crude oils (API 30-40°, S ≤ 0.5% mass) Cost 55 USD*
2. Light Sulfur crudes (API 30-40°, S=0.5-1.5% mass) Cost 53 USD*
3. Heavy, high sulfur (API 1-30°, S 1.5 – 3.1% mass) Cost 43 USD*
4. Extra Heavy high Sulfur (API = 15°, S ≥ 3% mass) Cost 35 USD *

* (Prices Are Given In Us $ / Barrel, Sources: Bloomberg, January 20 2017).

The numbers illustrate how the value of crude oil can be increased by blending higher grade crude with lower grades. The ratio of a component in the blend is actually limited by the physical properties required for production of the highest valued distillates to the largest extent, and by the refining infrastructure on location to process the blend.

Opportunity crudes, which are those heavy crudes with high TAN values, are the least expensive feedstock. Various crude oils, such as some Venezuelan crude and some Canadian crude (WCS) are very heavy, and are attractive for bitumen production. Its processing is very limited by their very low API. To produce other distillates from these crude oils, they must be upgraded by dilution with light crudes or kerosene.

The high viscosity of heavy crude is another drawback. Blending with light crude oils, kerosene or other diluents, is required to give them flow properties that enable their transport through pipelines without heating.

To reach or grow profitability refineries are investing and upgrading so they can maximize the consumption of “opportunity crudes”, as these crudes are far less expensive than conventional crude oils and when done properly make the same outputs as previously done with the high feed cost of conventional crude.

Heavy oils are hydrogen deficient and have high levels of contaminants, such as sulfur, nitrogen, organic acids, vanadium, nickel, silica and asphaltenes. The method of upgrading heavy oils, considered as a low cost, is to dilute these with hydrogen rich higher-quality light crude oils or by using hydrogen rich diluents to increase the H/C ratio.

1. Blending of heavy crudes with lighter crudes or upgrading the API.

2. Blending heavy crudes with lighter crudes, upgrading by creating sweeter crudes oil with a higher API.
3. Diluting heavy crudes with light crudes or diluents to increase the pump ability through pipelines.

Prices of crude oils fluctuate on an hourly basis. Price differences between heavy and light, sweet and sour crude oils are variable. Crude oil prices are also influenced by the global demand, and the amount of crude oil offered by oil producing countries. Therefore, refineries are obliged to buy there feed-stocks as such, that blending will provide the lowest cost feed for the refinery and still make products that satisfy market demand.

Blending Processes

Crude oil blending is performed by two different methods:

1. ***In-tank blending (Batch Blending):***
   Specific volumes of different kinds of crude oils, which are stored in separated tanks, are loaded into a blending tank, where they are mixed until a homogenous composition is achieved. The tanks are mechanically stirred. Samples must be withdrawn to determine whether the blend is homogeneous and whether it conforms its predetermined specification. In any case of discrepancy, correction of the blend must be conducted. The process of in-tank blending is a very old practice, very time consuming and highly expensive technique.

2. ***In-line blending:***
   In contrast to "tank blending" in line blending is performed by simultaneously transferring different crude oils through an on line static mixing device to the final blend tank. The predetermined flow ratio between the different crudes will provide the blend of the required quality. In-line blending allows on-line correcting the quality of the blend, by changing the ratio between different feeds.

Main advantages of in line blending over in-tank blending are:

1. The blend is produced instantaneously.
2. No stirred "blending tanks" are required – all tanks are designated to final products saving footprint, time and complexity.

To efficiently and errorless operate the blending process, on-line process analyzers are required to instantaneously measure the blend downstream and to feed the blending operators with the required quality details of the blend in production. This enables real-time and on-line to automatically correct the feeds during the blending process, providing the blend of requested predetermined quality properties perfectly the first time. It eliminates the need of corrective re-blending of an entire tank, as well as unnecessary "giveaways" and losses.

Determination of the blending recipes

Simulation software, such as LP (Linear Programming) modeling is commonly used to predict the ratio between individual components, to prepare the blend. Based on

composition data of various crudes applied, and using the proper algorithm, this software is commonly applied to calculate and predict physical properties of blends to be produced.
This software calculates the ratio of different crudes to be blended, resulting in a crude blend with the desired properties, leading to the desired distillates at optimal yield. Incorporation of a large database, which covers a broad range of various crude oils is required to accurately predict a blend of predetermined physical properties and with the potential of maximized production capability of high valued distillates. Adequate blending simulation models should not only be restricted to the chemistry of the crude oil distillation, but also to its economics. It must be capable to calculate the composition of different crudes that provides the best economic blend of the lowest cost. Such blends, contain maximized volumes of those crude oils of lowest cost, but still bear the most attractive refining properties. This strategy will minimize the variable costs and maximize its profitability.

The LP is based on the assay of different crudes oils to be blended. Any changes in the assay will affect the LP predicted blend.

Fundamentals of effective crude blending simulation software should include the following features:

- Calculation of the blend components and their ratio.
- Ratio limits.
- Predicted fractions temperatures.
- Properties constraint of the blend.
- Properties of the fractions.
- Constraint limits.

Next to the chemical – physical properties of the blend, the software should also be focused on the potential economic profit of the blend. This requires software also to relate to:

- Cost of various crude oils and crude oil blends.
- Prices of final distillates and other refinery products.
- Volumes of final distillates required by the market.

Currently time consuming and costly laboratory analyses are required to verify the "real" physical properties of the output blends. Re-blending is required if these properties are not achieved after testing is completed.
To achieve maximum cost efficiency blending requires on-line monitoring of the blend properties throughout its entire production. Chemical compositions differ from crude to crude. Notwithstanding whether the crude oil is pure or a blend of crude oils, on-line corrections are continuously conducted to maintain a stable product quality. This requires real time collection and validation of physical properties from the blend throughout its entire production process. Among all analyzers available in the market, NMR process analyzers are most suitable for this purpose.

The first generation NMR process analyzers were launched in the late nineties to very limited success. Nuclear Magnetic Resonance is an effect whereby magnetic nuclei in a magnetic field absorb and re-emit electromagnetic (EM) energy at a specific resonance frequency. The basics of NMR process analyzers are the alignment of nuclei in a magnetic field. An external RF pulse is applied which distort the alignment of the nuclei in the magnetic field. The resonance frequency depends mainly on the strength of the magnetic field. When the RF pulse ends, protons relax and align back to their initial equilibrium position, which generates a decay signal: Free induction Decay Signal (FID).

Crude oil is a mixture of organic chemical compounds, mainly carbon and hydrogen atoms based molecules. Neighboring atoms, such as carbon, oxygen and sulfur, and neighboring chemical bonds, influence the strength of the energy absorption and emission of the hydrogen nuclei, in a magnetic field. According to that, the signal of each hydrogen atom shifts differently in the NMR spectrum. These well-defined chemical shifts represent the chemical structure of molecular species. Linear correlation between the intensity of the signal and the hydrogen concentration enables to quantify the different hydrogen nuclei.

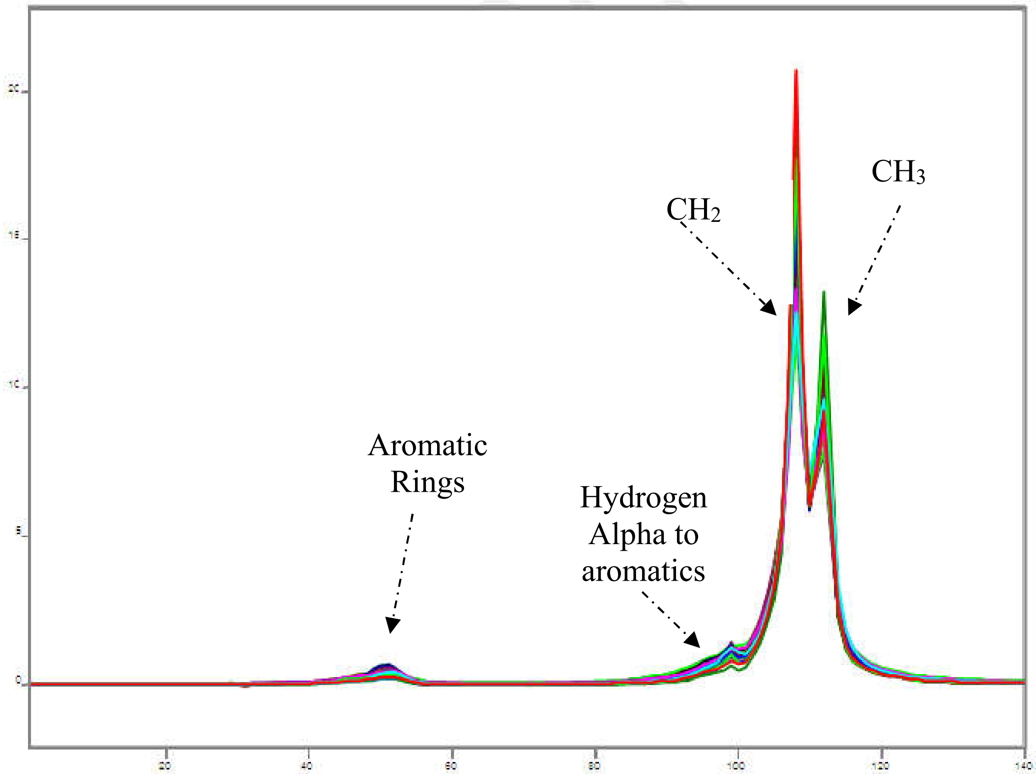


Figure 2: Typical NMR Spectra of Crude Oils:

Physical properties in crude oils and in distillates correlate with their chemical composition. This allows chemo-metrics methods to correlate between the measured spectral data and the physical – chemical properties of crude oil, or other distillates. In contrast to other chemometrics based spectral technologies, such as Raman and NIR spectrometry, which are based on fingerprints, due to its molecular specificity, and its linear quantitative correlation, the NMR technology requires far less reference samples to establish a chemometrics model.

NMR based on-line spectrometers are not limited to transparent fluids, but can be applied to opaque liquids as well. Crude oils contain water heteroatom molecules, which are easily distinguished by NMR spectrometry.

NMR on line spectrometry with appropriate chemo-metrics has the ability to determine the following properties in the crude oil, such as

- Specific Gravity
- TBP (True Boiling Point) yield
- Aromatic content %
- Olefin content %
- Pour Point
- Water %
- Sulfur %

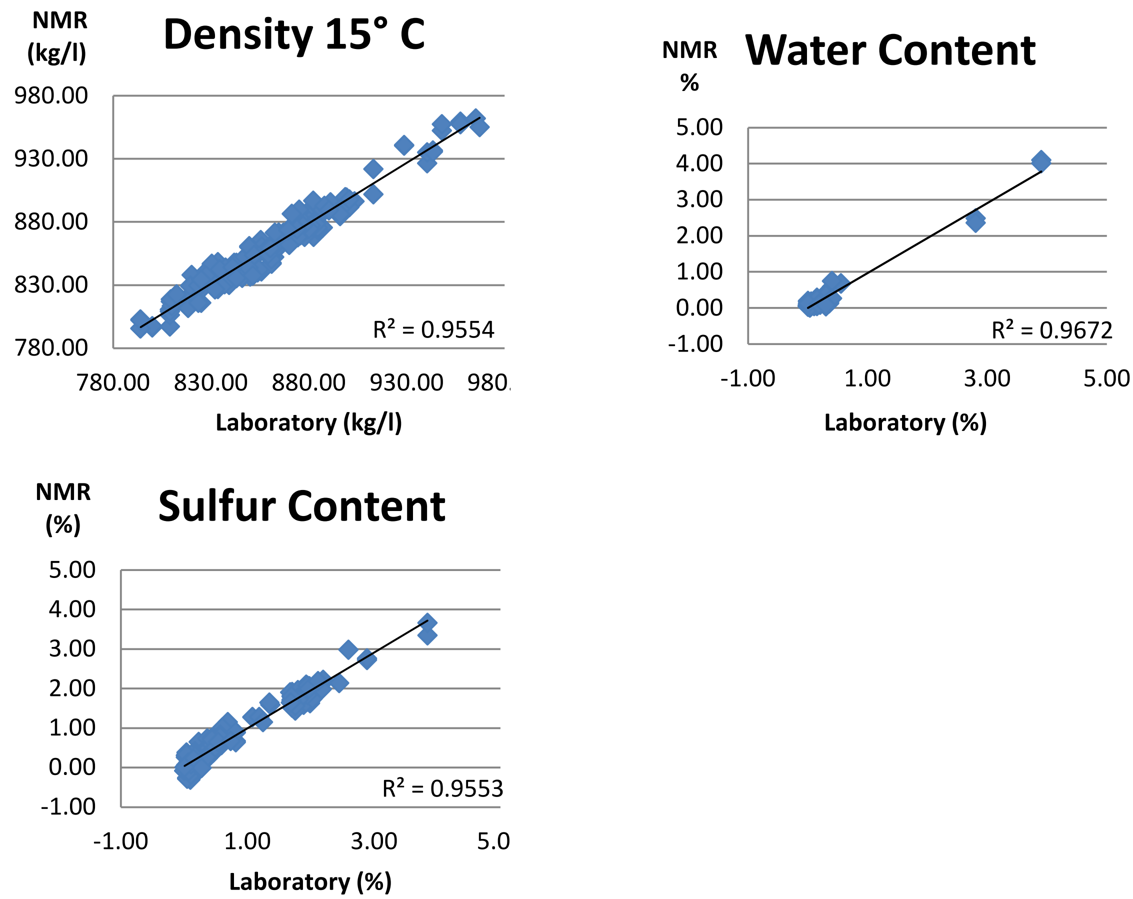
Follow up of these parameters are highly important during crude blending. On line measurement of these critical parameters allows to blend synthetic crude of predefined properties, either from a physical-chemical point of view or from an economic point of view.

Online monitoring of the blending process prevents the production of blends that are not compliant with the requirement of the refinery. A conservative 1% or 2% in blending error correction will save millions of dollars per year.

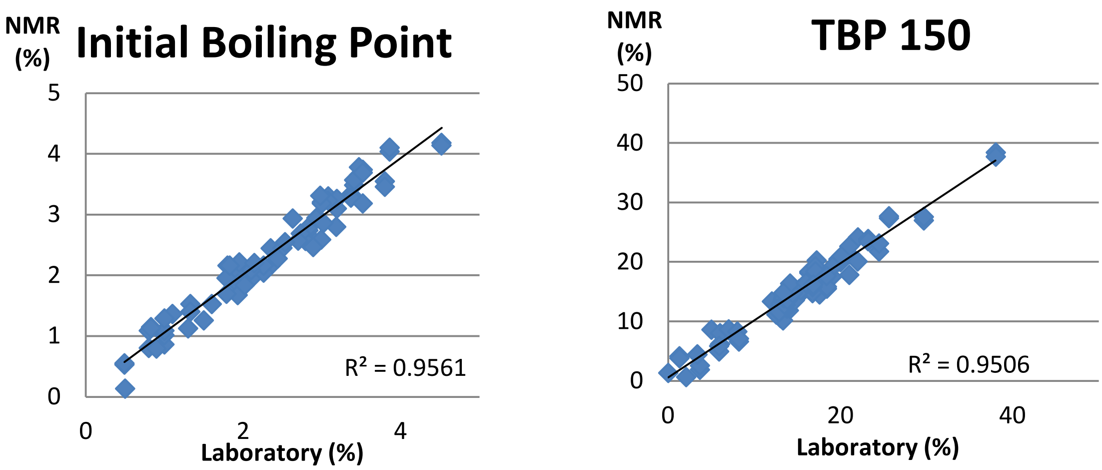
Precision of 3rd Generation NMR process analytics

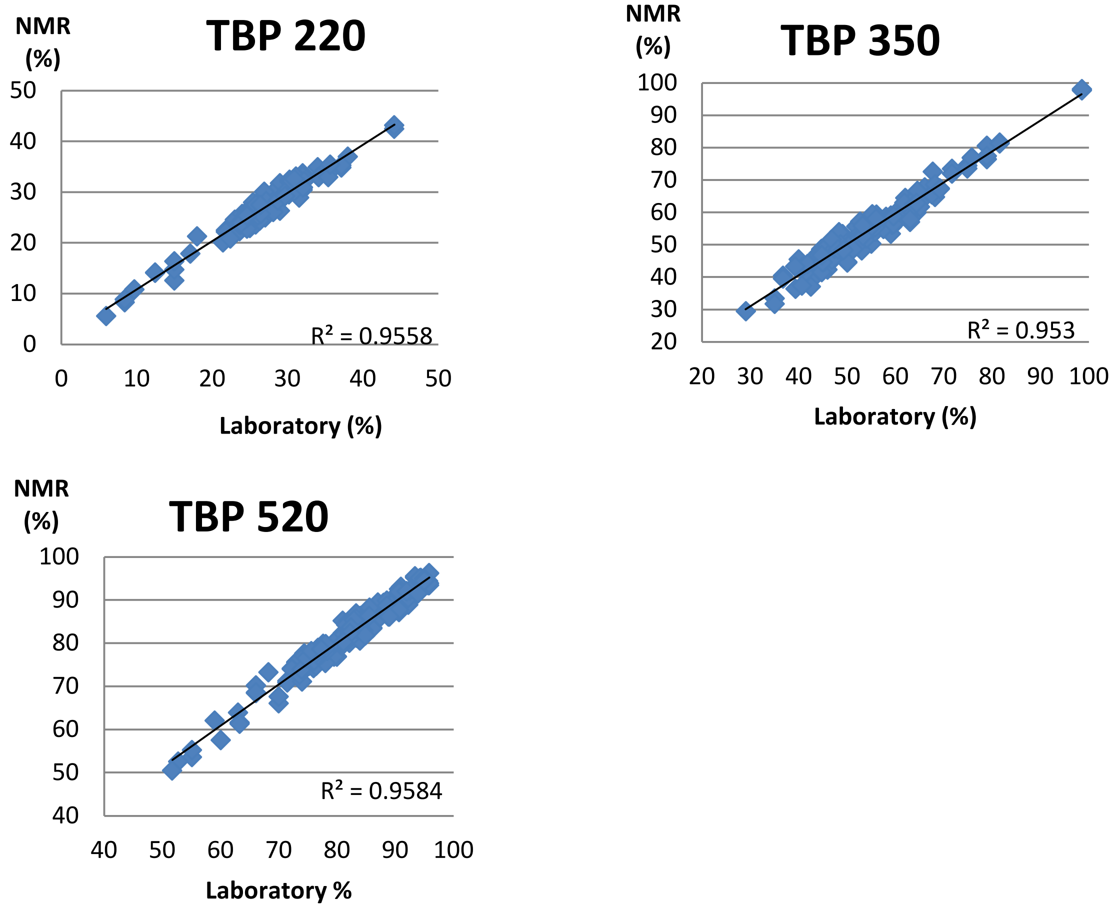
The concern when investing in on-line process analyzers is the credibility of the analytical data provided by the analyzer. When the accuracy of predicted results lacks, the instrument loses its credibility to rely on its analytical data. The occurrence of such events does not only cause financial losses to the customer, but in many cases also to the developer, manufacturer and the service provider.
High accuracy in the correlation between NMR process analyzer obtained results and laboratory results, characterizes the latest developed production of NMR process analyzers.. Early generations of NMR process analyzers were sensitive to temperature differences, due to the accumulation of too much heat by electronics and a heat conducting measuring probe. This made it difficult for early generation systems to make the move from the lab environment into a hostile production environment. This latest generation of NMR process analyzers the overall design excludes any accumulation of heat in the magnet or in its surroundings by uncontrollable fluctuations, such as heat transformation by electronics, the magnet itself and by the material, which is measured. Not only did this increase its stability to heat fluctuation by some eight degrees in also allowed for the system to be installed in more hostile environments for in line processing. This means that any required heating of the crude oil prior to blending, or after the de-Salter is possible, without affecting the analytical results, as long as by the end a temperature deviation of 10 °C is maintained.

The figures 3-5, show the correlation between NMR results and laboratory analyses of different crude oils.

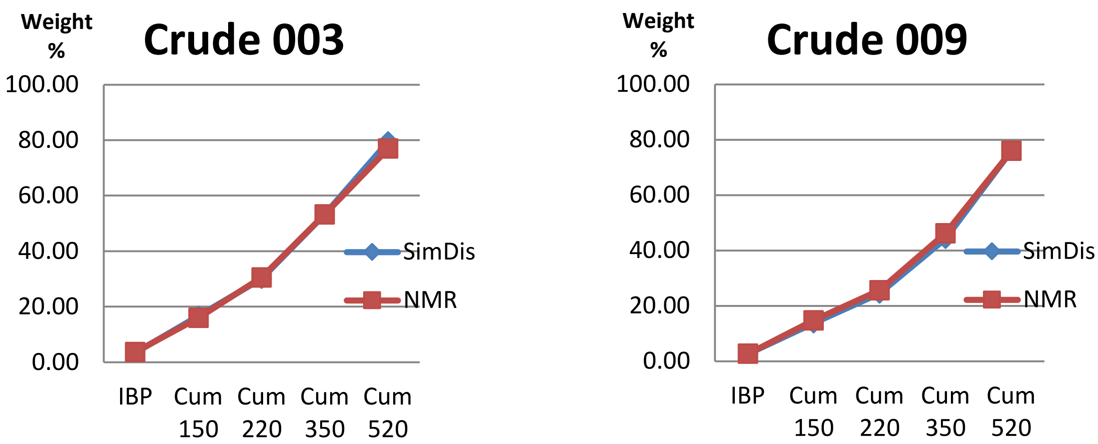


Figures 3: Correlation between NMR Results and traditional Laboratory Measurements.





Figures 4: Correlation between NMR Predicted Boiling Points and Laboratory Measured Boiling Points



Figures 5: Overlapping NMR and SimDis Predicted Distillation Curves.

The figures demonstrate the high accuracy in correlation between NMR results and traditional laboratory measurements. Partially these measurements relate to chemical matter such as water and sulfur, and partially to physical properties such as the distillation curve, and an excellent overlap between SimDis and NMR analytical results. Without any doubt, taking into account the time required for laboratory analyses, the cost to perform crude oil assays or the purchase and maintenance of SimDis, more than justify the incorporation of new generation NMR process analyzers in for crude blending processes, especially in cases of in-line blending. It enables precisely to monitor the quality of the blend in production, and if required to change the ratio between different crude oil feeds to establish and maintain the requested quality of the final blend.

Optimized crude oil blending station setup.

Crude Blending Station consists of a blending skid, which is available to receive liquid or gas streams, optimization software and analytical equipment. Analytical equipment should be able to provide online measured data of a component and product streams involved in a blending. This data is transferred to optimization software whose target is to optimize produce a blended product with minimum product cost, minimal quality giveaway, and minimal individual raw material formula deviation. In order to achieve this objective, the optimization system continuously receives quality feedback of the finished product using on-line analyzers.

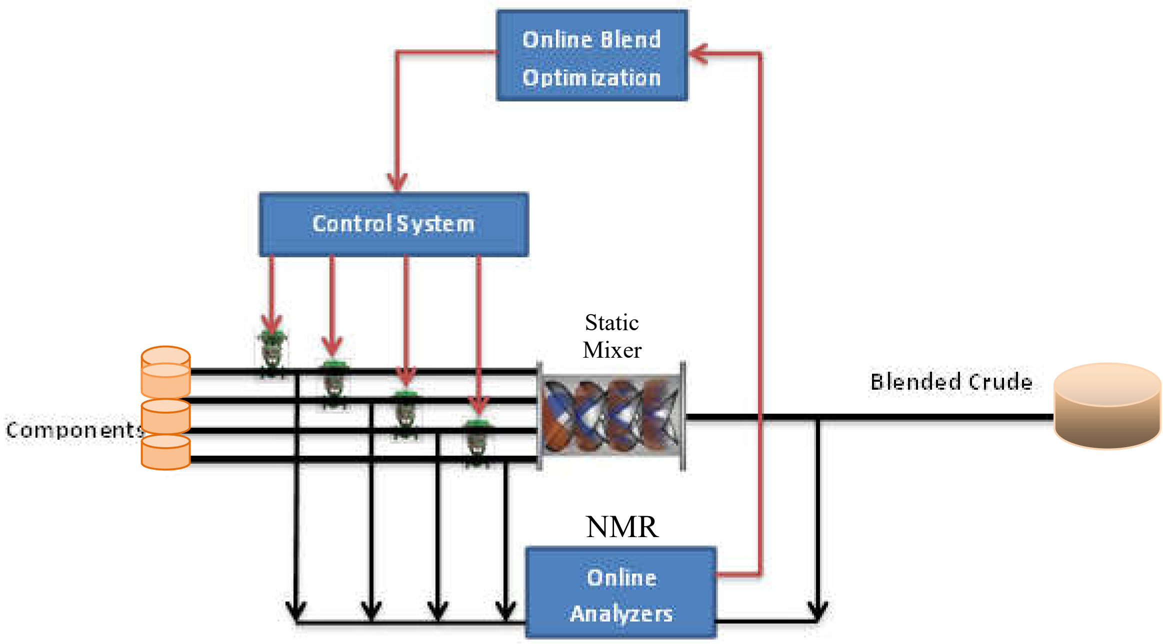


Figure 6: Set Up Of A Blending Station With Incorporated next generation NMR Process Analyzer, Simulation Modeling and Blending Control. (Components can be high and low quality crude oils, diluents and/or gasses (NLG).

Using the inputs from online analyzers, the optimization system performs either a feed forward or feedback control of raw materials based on the quality of instantaneous product samples obtained from the blend header.

Both technologies LP simulation and NMR process analyzers can operate "stand alone". However, to enhance the optimization of the crude blending process, it is essential to integrate between both technologies.

Efficient blending optimization is a dynamic process of mixing, continuous blend analyses, simulation model adjustment and process control. All influencing elements should be taken into account, as shown in figure 8. Any missing step in this chain will have its impact on the efficiency of the entire process and reduce its revenue.

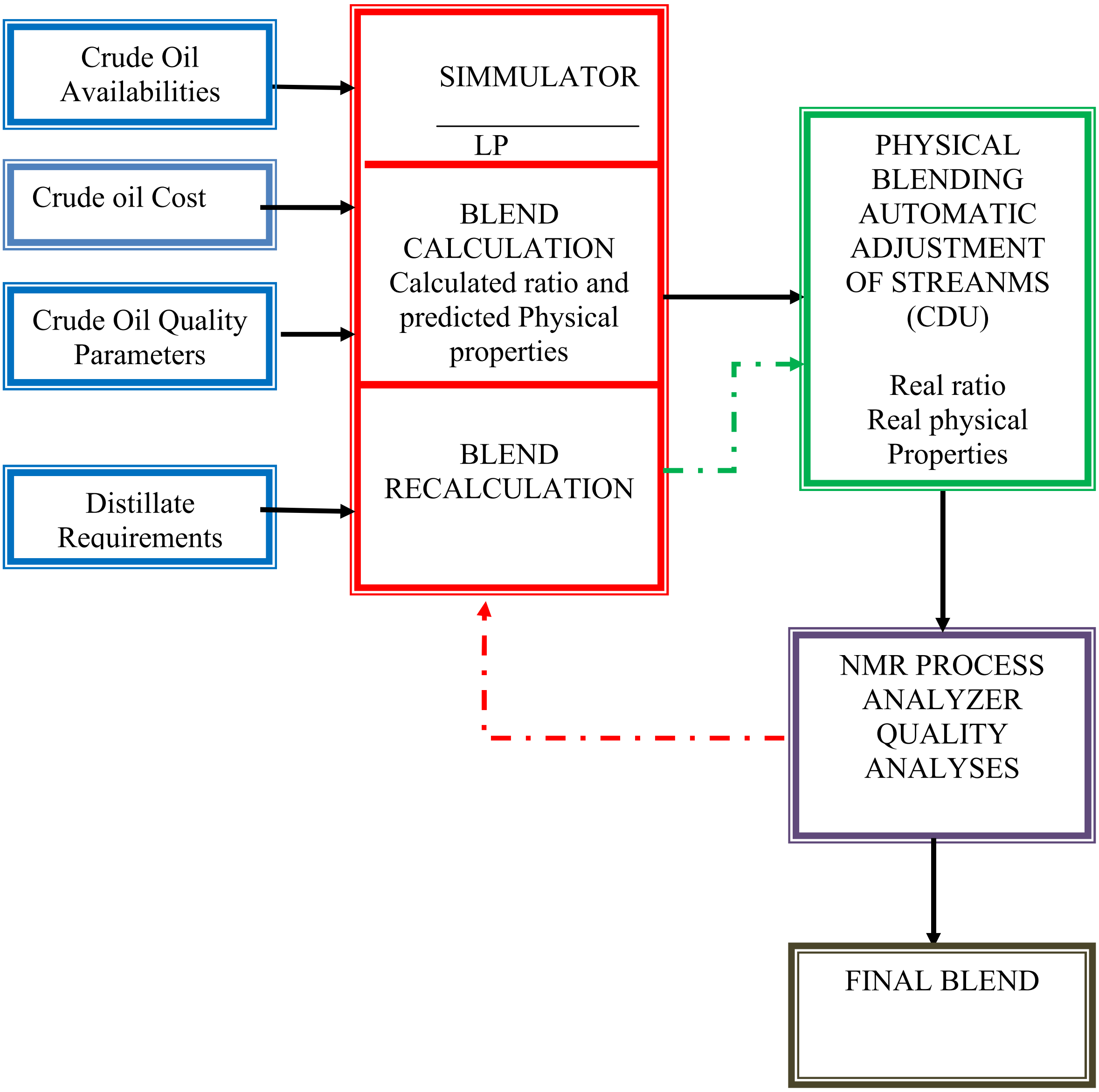


Figure 7: Dynamic Process of Mixing, Continuous Blend Analyses, Simulation Model Adjustment and Process Control.

Additional applications for on line process NMR process analytics.

Additional applications for NMR on-line process analytics are of interest in the application of NMR process analyzers for blending of different crude oils achieving a crude oil suitable for production at the highest refining margin, in equipment available at a refinery,

1. Crude oil compatibility during blending:

Blending different crudes, especially those which involve unconventional crudes, may cause precipitation of asphaltenes, which causes fouling in the pipes and process units. Asphaltenes are soluble in polar aromatics, such as toluene, but insoluble in paraffinic non polar solvents. On line analyses of the SARA content (Saturates, resins, aromatics and asphaltenes) can be a potential tool for on line determination of quantitate ratio between different crudes to be blended, or between crude oils and polar solvents, without causing asphaltenes to precipitate. This will reduce operational and repair costs.

2. Natural gas application in crude oil blending.

NLG's are produced via refrigeration and distillation processes that take place in gas plants and refineries. NLGs are considered "by-products" in the oil and gas industry. Gas plants extract NLGs for profit and/or to ensure production of pipeline quality natural gas. Liquid condensate of natural gas contains carbohydrates heavier that methane: ethane (33-55%), Propane (20-30%) normal butane (10-15%), isobutene (4-8%) and compounds with a carbon content higher than pentane, "pentane plus"$^{+}$, also called natural gasoline.

NLG prices are relatively low. NLG and other off spec grade materials from the natural gas production industries are applied by refineries and blending companies to upgrade heavy crude oils. Another option for its application is to lower the viscosity of heavy crudes, to make them easier to flow through pipe lines. Implementation of on-line NMR process analyzers provides an effective tool for efficient blending of NLG and crude oil to such a blend that has the required physical properties and at lowest cost.

Conclusions:

Crude oil blending is a major way to increase the refining margin. This can be achieved either by the increase of those distillates that have a high demand on the market or by decreasing the cost of the crude feed and efficiency of the process. Physical properties of crudes oils limit the process ability of crude oils in refineries. Further to that, many crude oils are either too expensive or result in economically less attractive distillates. Crude blending is a common strategy applied by refineries to overcome these drawbacks, either by in-house blending or buying crude oil blends.

Different blending options exist to upgrade unconventional crude oil into synthetic crudes of higher values. A proposed automatic crude blending station integrates between LP in combination with on-line NMR process analytics. It can be used either by traders who offer blending services, or proposed directly to traditional refineries. Some crude traders are integrated with refineries, while others produce material that meets certain minimum quality requirements to be sold. Cost, market value, availability and technology decisions are the main factors, to be considered in planning the configuration to be used for upgrading unconventional raw crude oil.

Two major principles for are required for the success of efficient and optimized crude blending:

- Accurate On-line process analytics – knowing the crude oil and blend quality properties at any time and at any stage.
- Dynamic Simulation modeling - blending simulation models are commonly used to determine the required blend composition. Highest blending optimization can only be achieved by updating the simulation program with real time analytical data of the crude oil and blending quality properties.

Incorporation of appropriate process analyzers is highly efficient tool for on-line monitoring of blended crudes qualities, such as NMR spectroscopy based process analyzer, which is efficiently used to determine chemical composition and physical properties in dark and opaque streams. The benefit of NMR spectrometry lies in its linear correlation between hydrogen atoms of the molecules present in the crude oil, and the distinguished chemical shifts representing the chemical nature of its components. Chemo-metrics transforms the spectrometric measurements into physical properties which are characteristic for the crude oils and blends.

This technology provides real-time data and information about the physical and chemical properties of the blend in process. On-line adjustments and changes between blend components can be performed accordingly, until the proper required physical properties are achieved.

Incorporation of the latest generation of Process NMR analyzer enables to increase the blending efficiency and accuracy of crude oils of different prices and qualities, and to reduce unnecessary giveaways. Efficient blending reduces the cost of the feedstock. It will significantly contribute to improve the refining margins, and the profitability of the entire refinery.