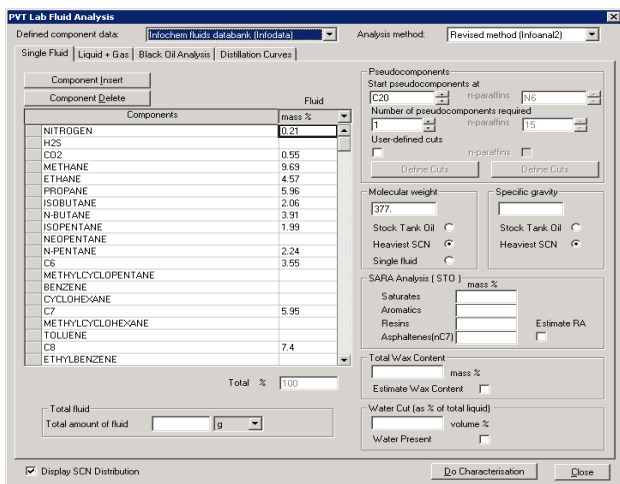


## Multiflash: Petroleum Fluid Characterisation

Modelling phase behaviour of petroleum fluids requires a knowledge of the physical properties of the components that make up the fluid and their composition. It is impractical to identify all the components of petroleum fluids because there are, typically, many thousands and the high molecular weight components are present in very small concentrations. The objective of the fluid characterisation procedure in Multiflash is to produce a simplified compositional model of the fluid taking into account the available experimental measurements in an optimal way.

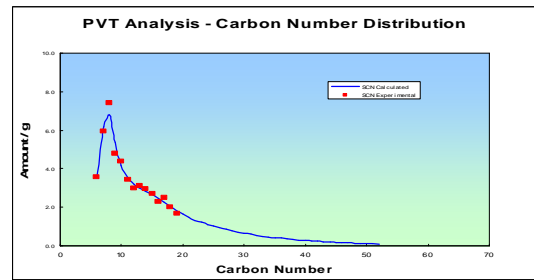
### Experimental information



A typical analysis from a PVT laboratory will identify the individual low molecular weight compounds such as methane, nitrogen etc. plus a series of single carbon number (SCN) cuts terminating with a plus fraction. The data may be provided as a total fluid analysis or as a separator gas and liquid, with different compositions, which are recombined at a given separator GOR. Multiflash also allows for a separate n-paraffin analysis, sometimes measured for use in wax studies. Additional information that can be taken into account are water cut, wax content and the SARA (Saturates, Aromatics, Resin, Asphaltene) analysis.

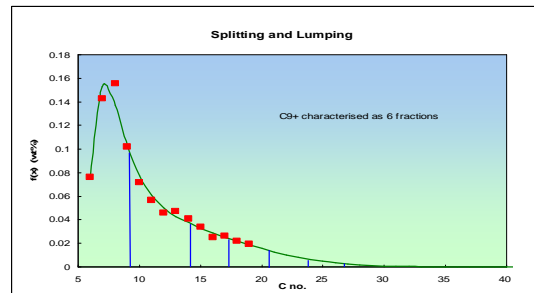
### Fitting a distribution function

The SCN weight fractions in the liquid, including the plus fraction, are correlated against carbon number using a distribution function. Multiflash fits the distribution using a proprietary method. The approach is flexible and can accurately reproduce SCN distributions that do not follow a standard exponential decay.



### Splitting and Lumping the Plus Fraction

Starting from any chosen SCN the remaining plus fraction can be grouped into a specified number of pseudocomponents. These can be generated automatically or chosen by the user. Each pseudocomponent will be allocated a name and an average molecular weight from which other physical properties of the cut will be derived. This process takes into account optional information, such as molecular weight or specific gravity of the total fluid or Stock Tank Oil (STO).



If the experimental composition is only reported to low SCN, e.g. C6+, the distribution function can be extended to higher SCN to obtain the more detailed heavy end analysis needed for certain calculations. The starting SCN and number of pseudocomponents has to be chosen to achieve a balance between the most accurate representation of the fluid for the purpose in question and the required speed and robustness.

### TBP and ASTM D86

Although not common in the upstream oil industry, analytical information is sometimes provided in the form of true boiling point (TBP) or ASTM D86 distillation data. Multiflash can produce a compositional model based on both types of data. Temperatures are entered against the cumulative amount distilled as a volume percent and, for TBP data, there is an option for entering molecular weights or specific gravities of each cut.

## Black Oil Data

In some circumstances you may have very limited compositional data for a fluid. A detailed analysis may not have been measured or the data may have originated from other applications such as reservoir simulations. The Multiflash Black Oil Analysis procedure can generate a compositional fluid model from minimal data. The minimum required information is: Gas gravity (relative to air), Stock Tank Oil specific gravity (relative to water) and Solution GOR. Additional data that may be provided are the Watson K factor and a Gas Analysis. The resulting compositional model can be used in all Multiflash calculations and can be tuned as described below.

## Properties of Pseudocomponents

The physical properties of the each pseudocomponent are calculated from the assigned molecular weight and specific gravity. In practice every pseudocomponent will be a mixture of several hydrocarbon compounds of different types. The properties of different component types, which may vary from paraffins to naphthenes and aromatics, may well be different even if they have the same carbon number. If sufficient compositional data, such as a PNA distribution, are available it is possible to calculate the physical properties for each type from different correlations and then combine them to define the whole pseudocomponent. Often, however, the differences are ignored and the properties of the whole pseudocomponent described by one correlation for each property. In Multiflash the hydrocarbon compound types that can be identified are Normal ("composite"), n-paraffins, non n-paraffin, resin and asphaltene. The correlations used for the thermodynamic properties are largely those recommended by Riazi and Al-Sahhaf. Certain properties can be adjusted to reproduce known values for the fluid, see Matching below

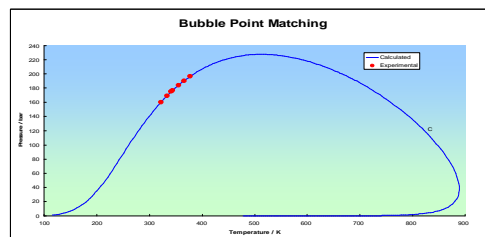
To superimpose specific property values for a cut the pseudocomponent name and basic properties can be entered directly. to the petroleum fraction correlation routines.

## Matching Fluid Properties

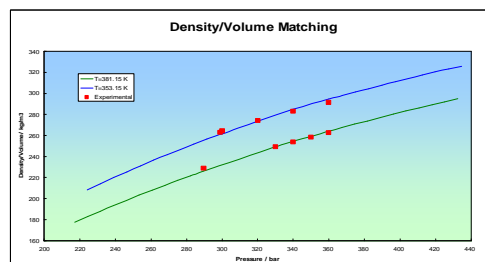
Sometimes the properties assigned to the pseudocomponents will not lead to agreement with a known or measured value for a property of the fluid. However, it is possible to adjust a property of the individual pseudocomponents in order to modify a property of the overall mixture.

One or more dew and bubble points can be matched. The pseudocomponent parameters that are adjusted will depend on the equation of state (EOS) model being used. For standard cubic EOS the acentric factor is adjusted; for more complex variants the vapour pressures of the pseudocomponents are adjusted using internal model parameters. The experimental data are compared to the calculated values using the adjusted properties, both numerically and graphically. Multiflash also

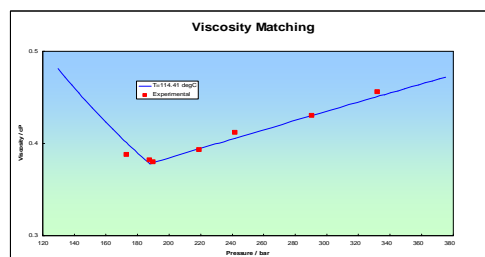
allows for simultaneous matching of the GOR (Gas/Oil ratio) and the saturation line.



The density or volume of the fluid may be matched by adjusting the coefficients for the Peneloux volume shift parameter

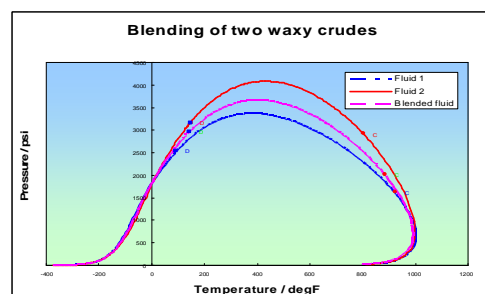


and the liquid viscosity of an oil can be matched by varying the reference viscosity of the pseudocomponents. This procedure cannot be used for other phases.



## Blending

A petroleum blending option allows mixing, or blending, of already characterised petroleum fluids to provide a new fluid characterisation. This may be necessary, for example, when two pipes intersect. Up to four separate fluids may be blended in relative amounts specified by the user (by mole, mass or volume) to produce a new fluid described by its own set of pseudo-components. The blend has a similar number of pseudo-components as any of the original fluids.



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