Distillation Process Analyser with ASTM D86 Compliance

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The redesigned BARTEC BENKE Distillation Process Analyser remains the benchmark for physical property analysers. The new DPA-4 model is still the only ASTM D86 compliant analyser available with respect to both, apparatus and procedure. For this reason, the analyser operates neither with calibration requirements nor with measurement corrections by means of correlation equations.

Refinery operator requirements have had a significant influence on the redesign of the new model. The result is the faster Rapid Analysis Method (RAM) beside the Standard Analysis Method (SAM) where the "recovered volume" and corresponding vapour temperature from the initial boiling point (IBP) to the final boiling point (FBP) of a vapourised and condensed liquid or vice versa is detected. Due to the identical measurement procedure and identical design of the measurement apparatus, the analyser is fully compliant with the ASTM D86 laboratory standard.

Description of the measurement procedure according to ASTM D86 standard

The ASTM D86 standard specifies, a sample with a volume of 100 ml is dosed into the distillation flask where it is heated up to the IBP. The sample will be evaporated by further heating and afterwards liquefied by means of running through the condenser unit. At a recovered volume of 5% detected, the heating is automatically regulated to a distillation rate of 4 to 5 ml/min until 5% residue of the total volume is left in the flask. The measuring cycle has finished once the FBP has been detected. After the measuring cycle, the system will be cooled and prepared for the next cycle by clearing and flushing with sample and purge gas.

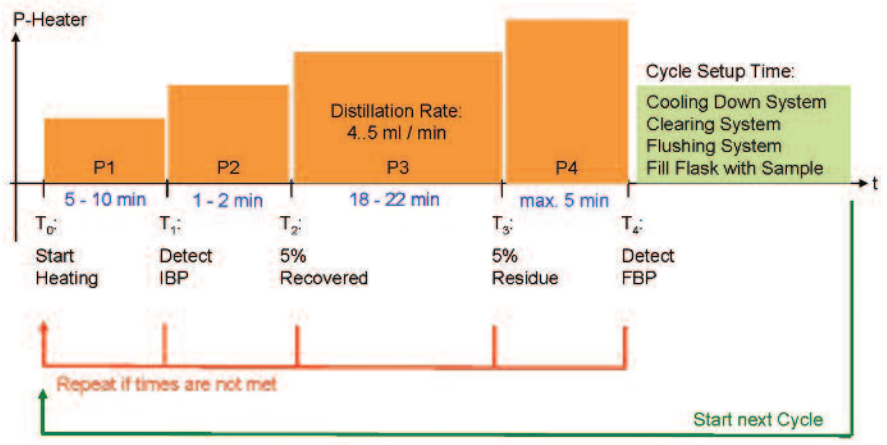

Figure 1: Distillation Cycle Time

Figure 1 shows a full distillation cycle in four defined sub-phases for Group 1 products according to the requirements of ASTM D86 (Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure). Phase 1 (P1) defines the time from first application of heat to initial boiling point temperature where the IBP has to be detected, between 5 and 10 minutes. The time spent for Phase 2 (P2) from the detection of the IBP to 5% recovered volume has to meet the range of 60 to 100 seconds. Furthermore heating has to be regulated so that a constant average distillation rate of 4 to 5 ml/min is reached and the 5% recovered to 5 ml residue in the flask is met between 18 to 22 minutes (P3). The recorded time from 5 ml residue to the FBP must not exceed 5 minutes (P4).

The complete cycle has to be repeated from the beginning, if any of these phases exceed the defined maximum times.

After the completion of the distillation cycle, the analyser system has to be cooled down, cleared, flushed and subsequently the flask will be filled with fresh sample to start a new measurement cycle.

A full distillation cycle according to ASTM D86 requirements takes 29 to 39 mins. But fast process control often requires faster response times.

According to the ASTM D86 standard, the distillation rate has to be between 4 and 5 ml/min. Figure 2 shows the interdependence of the distillation rates and the required time to reach different points on the distillation curve. It is clear to see that an additional 5 minutes are added to the analysis time to reach the IBP when a distillation rate of 4 ml/min has been used. It is also clear to see that, as the distillation process progresses, the difference in time it takes to reach the FBP for the two different distillation rates increase. As a matter of fact, once the FBP has been reached, the time difference is 10 minutes.

Figure 2: Distillation Cycle Times According To ASTM D86

In comparison to Figure 2, Figure 3 shows two additional options to speed up the distillation cycle. Again the distillation rates according to the ASTM D86 standard are shown in green and red. The grey part here is defined as the Standard Analysis Method (SAM). Possibilities of speeding up the distillation cycle are often requested by users when faster response times of the analysers are needed. Two examples of faster procedures are shown in Figure 3 by using the same ASTM compliant design of the apparatus. The blue graph shows that the 95% point of recovered volume can be determined quicker by increasing the distillation rate to 9 ml/min. If the total sample volume which was originally 100 ml is reduced to 50 ml and a distillation rate of 9 ml/min is chosen, than an even faster determination of any point on the distillation curve is possible.

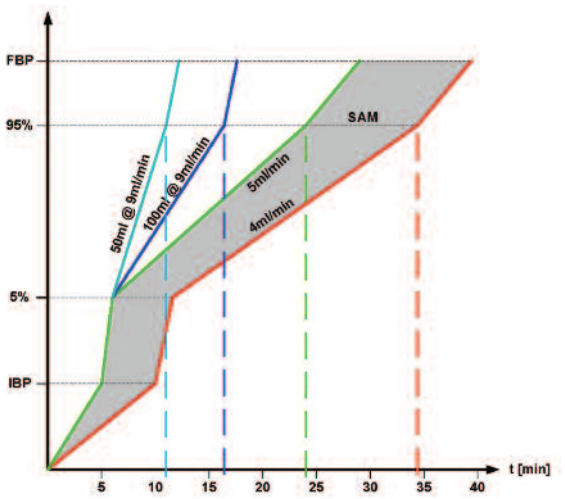

Figure 3: Distillation Cycle Times According To ASTM D86 And Additional Tuning Capabilities

State of the art Distillation Process Analyser

BARTEC BENKE satisfies the market requirements to achieve faster response times with the design to give continuous results to be fully compliant with the ASTM D86 standard but – if required – is capable of giving faster results at any time. The redesigned Distillation Process Analyser DPA-4 is suitable to determine each distillation point ranging from IBP to FBP.

Due to the new design, the analyser is capable of giving measurement results at reduced pressures which in effect reduces the measurement temperature. This allows handling samples which tend to coke.

New procedures have been developed to shorten the complete measuring cycle, including the preparation of the analyser after a distillation cycle has ended. The heat transfer between the sample and hot surfaces has been improved. Therefore, the time required to cool-down the analyser is reduced. Additionally, the implemented pressurised flushing ensures a fast evacuating procedure to get the analyser ready for the next measuring cycle and a "N2-stirrer" prevents the bumping and super-heating of the sample during heating of the sample within the flask. Reduced maintenance efforts are the result of the automatic de-coking and fast clearing procedure which minimises the risk of plugging. Due to the undertaken redesign the dimensions of the analyser are reduced and the Ex-protection gas group is by default IIB+H2.

By having the possibility of switching methods from Standard Analysis Method (SAM) to the new implemented Rapid Analysis Method (RAM), the user can obtain a faster response and reduced cycle times by approx. 40%, compared to SAM. The RAM procedure still uses the same apparatus specified according to the ASTM D86 standard, and therefore provides comparable results. The two tuning capabilities available result in a significant reduction of the cycle time. It is possible to switch between SAM and RAM methods at any time. To prove for reliability, several measuring cycles could be ran according to the RAM method and for validation purposes, the SAM method for a measuring cycle from time to time could be used.

The only ASTM D86 compliant Distillation Process Analyser

The DPA-4, based on an established standardised robust design, is suitable for installation in hazardous areas and is available with ATEX Zone I, CSA C/US Class I, Division 2, Zone I and GOST R certification. Other certifications are available on request. Optionally the analyser can be equipped with state of the art communication interfaces, customised sampling conditioning systems and closed loop chiller units.

In summary, refineries now have the opportunity to achieve faster response times for their process control tasks by implementing a state of the art distillation process analyser which offers the possibility to have shorter measuring cycle times. This will positively influence profit maximisation as the refineries are able to react faster to process fluctuations which cause produced fuels to be not within specifications. Depending on the specific needs a refinery might have, there is an analyser which is ASTM compliant for measuring the full distillation curve, with the added options to shorten cycle times, available.