IMPROVEMENTS IN CONTINUOUS PARTICULATE EMISSION MONITORING AS A RESULT OF THE INDEPENDENT VERIFICATION SCHEMES UBA/TUV AND MCERTS.

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1) ABSTRACT

Increasingly plant operators throughout the industrial world are required to continuously monitor particle emissions to atmosphere to satisfy regulatory requirements. Both in Germany and now in the UK, regulators specify the standard to which they expect this monitoring to be performed. Instruments must be independently validated according to the UBA/TUV type approval scheme and MCERTS product certification scheme respectively if used in certain industrial applications. While different in certain detail, both schemes require instruments to be both field tested over a 3-month period in a typical application and tested in a laboratory to evaluate their performance.

Of interest to plant operators in all countries, these schemes not only generally improve the performance and quality of monitoring, but somewhat surprisingly actually reduce the cost of monitoring as far as the user is concerned. This paper overviews the verification process as relevant to the various categories of UBA/TUV (BImSchV 13, 17 & 27) and MCERTS (Class 1 to 4) approvals. It then discusses the improvements (and limitations) in instrument performance resulting from these standards. Cost of ownership reductions can result from lower plant evaluation costs, reduced sampling costs (in the UK) and reduced purchase price in cases where instruments from different suppliers obtain similar approvals. This paper discusses these issues based on experiences with PCME's Electrodynamic (rod electrification) and light attenuation instruments.

2) INTRODUCTION (THE BACKGROUND TO VERIFICATION SCHEMES)

The use of continuous particulate emission monitors on industrial stack emissions is a common and growing regulatory approach around the world since it provides instantaneous feedback on changes in emissions. In combination with a periodic calibration procedure involving iso-kinetic samples, it provides the most cost effective measurement regime for assessing regulatory compliance and/or process control. A typical report from a continuous particulate emission monitor is shown in figure 1.

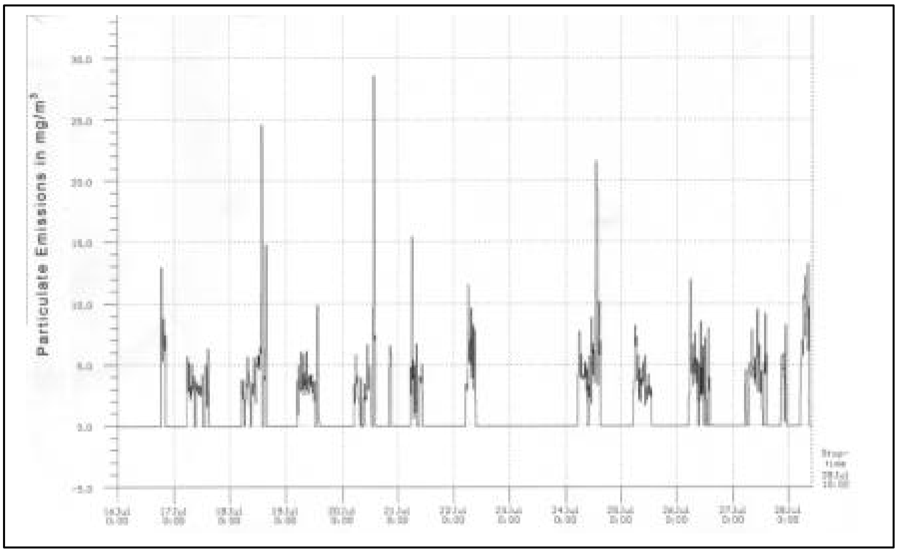

Figure 1. Typical report from a Continuous Particulate Emission Monitor

The performance of continuous particulate monitors is application specific and for optimum application of such instruments one balances the needs for accuracy, reliability, robustness and cost effectiveness. Since in practice, these needs tend to be difficult to combine in the same instrument design, verification schemes are introduced by regulators to help guide users to select instrumentation with the appropriate balance between these characteristics. Both the German UBA/TUV type approval scheme and the relatively new UK MCERTS certification scheme effect the type and performance of particulate monitors used to satisfy regulatory requirements. These verification schemes are also of relevance to regulators and users outside the UK and Germany, since there are no other European verification systems based on instrument performance and the American (US-EPA) requirements for certifying continuous particle monitors are still emerging (reference 1). This paper focuses on the nature of both the UBA/TUV and MCERTS verification schemes and details, with examples, the improvements in monitoring that has and is resulting from their adoption.

3) THE UBA/TUV AND MCERTS APPROVAL PROCESS

Both in Germany and the UK, national programs exist through which specific instruments are accredited. These are referred to as the UBA/TUV type-approval and MCERTS certification schemes respectively. In both cases instruments are subject to an independent evaluation in the laboratory and in a 3-month trial. The focus of both schemes is on the performance of the instrument in the field trial. Laboratory testing is only performed to evaluate performance that is difficult to ascertain from the field trial. In Germany it is mandatory to use 'type approved' instruments in certain emission applications while in the UK it is still permissible to use non-certified instruments reflecting that the scheme is only 2 years old and it is still being phased in.

The procedure used for approval in each country is similar although the types of processes and application for which approvals are available differ depending on specific national legislative requirements:

3.1) The verification process

Both the UBA/TUV and MCERTS verification schemes have different categories of certification/ approval depending on the application and purpose to which the particulate monitor is to be applied.

3.1.1) UBA/TUV

In Germany The Federal Environmental Agency (UBA) operate a type-approval scheme which matches regulatory requirements (reference 2). These regulatory requirements are detailed in the following legislative orders which require the installation of approved instruments for different processes. The standards are different for each order (BImSchV) reflecting different applications and measurement ranges (reference 3):

Legislative requirements		Continuous Monitoring for Particulate
BImSchV 13	(Order for power plant > 100MW)	Measurement over 0-150mg/m^3
BImSchV 17	(Incineration order)	Measurement over 0-30mg/m^3
BImSchV 27	(Order for other processes)	Qualitative monitoring over 0-50mg/m^3

Instruments are tested by technical institutes called the 'Technische Uberwachung Verein' (TUV) and hence instruments are often referred to as TUV approved. However, other organisations are also authorised to conduct such testing. The UBA's appointed technical committee (Air/monitoring subcommittee of the Immission Control Committee of the States) then reviews the test results to decide approvals and approved instruments are confirmed with a list of limitations in the Joint Ministerial Gazette twice annually. The UBA/TUV scheme is well known and respected in Germany and internationally.

3.1.2) MCERTS

MCERTS is the UK Environment Agency's certification scheme and it is administered on the agency's behalf by SIRA, an organisation specialising in international certifications. Test requirements, which are mainly based on international standards, are published by the Environment Agency (reference 4). Currently four categories of certification for particulate monitors are defined within the test requirements, to account for the different accuracy of iso-kinetic sampling at different measurement ranges and a category for qualitative (indicative) instruments. This reflects, like in Germany, that both measurement instruments (ie calibrated in mg/m^3) and indicative instruments are used to satisfy regulations.

Category 1 Measurement 0-10mg/m^3
Category 2 Measurement 0-50mg/m^3
Category 3 Measurement 0-500mg/m^3
Category 4 Qualitative monitoring 0–500mg/m^3

Testing is performed by certified laboratories (for example AEA for particulates) and the MCERTS technical committee assess results before publication of a multi-page test certificate confirming certification. This scheme is relatively new with the first instruments receiving approval in October 1999. The scheme is not yet widely adopted in UK industrial users although this will change when the scheme becomes mandatory shortly. Interest in it from outside the UK results from its use of international standards as its test standards and for example a power plant outside Europe (figure 2) have accepted MCERTS approved instruments as an acceptable level of approval.

Figure 2. International Power Plant requiring "an approved" particulate monitor

3.2.) Similarities between schemes:

The verification schemes in both Germany and UK are in the main similar in relation to test criteria against which instrument performance is evaluated.

The laboratory test includes assessment of

- Zero and calibration drift
- Detection limit
- Temperature response test

The field test involves installation of two instruments on the same source for three months and an assessment of:

- Reproducibility between two instruments
- Calibration function (linearity and drift over 3 months)
- Maintenance interval and availability

Table 1,below, shows part of the performance specifications required for MCERTS.

Performance characteristic	**Instrument category**		
	1	**2**	**3 & 4**
Analysis function/integral performance	*	C(1)/<20%	C(2)
Availability	>95%	>95%	>95%
Maintenance interval	*	*	*
Zero drift (per month)(3)	*	<2%	<2%
Span drift (per month) (3)	*	<2%	<2%
Reproducibility(4)	>30	>30(5)	>30(5)

* To be reported on the certificate.
(1) Compliance with an ISO 10155 confidence interval (95%) of ±10%.
(2) Compliance with the requirements of relevant EC Directives, for example, 89/369/EEC and 94/67/EEC.
(3) Percentage of the maximum of the certification range.
(4) Two identical instruments compared.
(5) Actual figure to be reported on the certificate.

Table 1: MCERTS Performance standards for particulate monitoring instruments (field tests)

The performance evaluated is by definition application dependent, however in practise this aspect of the approval is sometimes not given appropriate visibility when being considered by potential users.

As a result of similarity between the schemes and perceived duplication, discussions have taken place between UBA and the Environment Agency regarding mutual recognition of each others schemes. In the future instruments approved this way will not be tested again for tests which are similar between the two schemes.

3.3) Differences between Schemes:

The features of each scheme which are different are as follows:

UBA/TUV

1. There are specific requirements for automatic self tests such as zero and span on measurement instruments to provide assurance of detecting any in-field failure.
2. Performance is evaluated totally in the field test and resulting cross-sensitivities are evaluated as much as possible as part of this. The calibration function (linearity assessment) is made to cover the full range of measurement inspite of the difficulties in creating these conditions in many applications. This test is very useful for giving a true assessment of actual field performance.
3. The UBA technical committee assess the results from the trial and make useful recommendations on the limitations of the instrument in the application rather than publish all the test data. An example list of limitations recommended and adopted by the technical committee is given in figure 3. This has great practical value to the user since few users have the time or experience to understand the relevance of all the test results without such a recommendation.

Dust Emissions alarm level monitoring, qualitative monitoring
DUSTALERT 60A

Manufacturer: PCME, St. Ives, UK

Distributor in Germany: Bühler Mess- und Regeltechnik GmbH. Ratingen

Approved: For plants with regulations according to TA Luft and 27 BImSchV

Minimum range
during the approval: Dust 0 to 30 mg/m³

Limitations:
The unit only works well if the velocity is above 5 m/s
The unit can only be used if it is sure that the gas will never fall below the dewpoint.

Guidance: After a filter failure with high dust concentration the sensor must be cleaned.
The unit has established to be calibrated in the range 0 to 30 mg/m³

Figure 3. Example TUV recommendation on limitations of instrument (DA60A)

MCERTS:

1. There is an additional set of wind tunnel tests to evaluate the instruments cross-sensitivity to changing particle size and velocity. In addition the linearity of instrument response to dust concentration is calculated over the full range of the instruments span, which is not always possible to perform in the field test.
2. There are strict controls on the design and manufacture of the instrument which has been certified. Only approved design changes (including those associated with microprocessor code) can be incorporated into the product. This reflects that the scheme certifies that a particular design is suitable.
3. The final test certificate reports performance in relation to a number of tests (eg particle size cross sensitivity) and states pass/fail in relation to others. Users must interpret these results to see whether an instrument is really suitable for their application.

4) EFFECT OF NO APPROVALS:

Before considering the impact of approvals on particulate monitors it is helpful to understand what happens when there are none. Between 1990 and 2000 many thousands of industrial users in the UK had to fit continuous particulate emission instruments to satisfy the Environmental Protection Act 1990, however this was before the adoption of MCERTS and there was little guidance on appropriate standards to which such instruments must perform.

On reflecting on the UK experience, the key issue that took place is that selection of instruments took place without the proper input of the regulator. Users, in making decisions without guidance from regulators, tend to give more weight to characteristics such as reliability, stability and low cost of ownership than those of absolute accuracy (which are difficult for the user to assess in any case). This meant that the particulate monitoring techniques that won out in the market were pragmatic and in many cases had the characteristics of good process control instruments.

Fortunately the results of this missing input from the regulator were not as catastrophic as might be expected, since in parallel the then UK legislation required the application of Best Available Techniques Not Encurring Excessive Cost (similar to the new approach of Best Available Technique (BAT)) which put a statutory burden on the user to apply due diligence on the selection of an instrument. In some ways uncertainty and the threat of prosecution of using inappropriate instruments stimulated the adoption of good practice.

A major benefit of users being responsible for selecting the instrument in a climate of uncertainty was that they tended to consider the application specific nature of a particulate monitor. Many users decided the only way to do this was to evaluate the instrument in their particular application and do a trial. The market was therefore inefficient in that trials are duplicated everywhere and those users not prepared to do trials faced the high possibility of owning instruments that didn't work properly in their application.

Instrumentation suppliers with international presence used their approvals (UBA/TUV and US EPA) to provide confidence to their customers on the accuracy of their instruments. This did reduce the need for trials, however was not a total solution since these approvals were not always relevant to specific processes requiring monitoring under UK legislation.

Finally, it is most telling to reflect that many of those seriously involved in the UK market during these times agree that the absence of a verification scheme was unsustainable. Industry needed better guidance from regulators on what was acceptable and what was not.

5) IMPACT OF APPROVAL SCHEMES

The impact of approval schemes on particulate monitoring instruments can be divided into two distinct areas: changes to instrument performance (which are mainly improvements) and changes effecting the economics of buying and operating such instruments. Somewhat surprisingly the cost changes are generally favourable as far as the user is concerned.

5.1) Approved instruments referred to in examples

To provide increased incite to the impact of these changes, the author takes examples from supplying particulate monitoring instruments in both the UK in the early 1990's where approvals were irrelevant and today when approvals now play an increasing role.

Specific particulate instruments referred to in the examples are the DT-770 and DA-60 Electrodynamic (rod electrification type) particulate monitor and the SC-600 Dynamic Opacity instrument. The principle of operation and approvals history of each is briefly given below:

5.1.1) DT-770/DA-60

The principle of operation of these Electrodynamic rod based instruments is to monitor the electrical signature induced as naturally charged particles pass the rod inserted into a stack (reference 5). The signature can be correlated to the dust concentration in mg/m^3 in applications with constant particle charge characteristics (determined by particle type and process) and particle spatial distribution density. This rod may be completely insulated to provide operation in humid and conductive conditions.

Originally developed in 1992 with the assistance of a UK Government innovation award (ETIS) for lower dust concentration measurement, the DT-770 was first approved in Germany according to the TA- LUFT standards in 1996. This approval was upgraded to BImSchV 13 and 17 in 2000, and versions (DT-280/780) satisfying the UK MCERTS scheme in the range 0- 30mg/m^3 were approved in 1999. The instrument is used extensively for process control and emission measurement in bagfilter and drying applications throughout Europe. The DA-60 is approved according to BImSchV 27.

5.1.2) SC-600

The principle of operation of this optical instrument is to monitor the variation in light transmitted across the stack (caused by particle distributions) and then to make a ratio-metric measurement which overcomes problems of lens contamination and misalignment. Like other continuous particulate instruments the instrument is calibrated in mg/m^3 by comparison to results of an isokinetic sample.

Developed in 1993 this instrument was first submitted for approval in 1999 in the UK, although had been used in power stations and larger stacks (without approvals) in the UK, Japan, Australia and Canada dating back to 1996. The instrument now holds MCERTS approval for measurement in the range 0-150mg/m^3 and a BImSchV 13 approval is pending.

5.2) Improvements in instrument performance

Approvals, with few exceptions, result in a higher quality measurement of particulate emissions. These improvements are in a number of areas:

5.2.1) Accuracy of measurement.

The most significant impact of approval schemes is that the accuracy and reproducibility of the measurement satisfies a minimum level defined in the underlying test standards. Importantly, this accuracy has been validated in a real application over an extended period of time. This information has great value to the user, since in cases where the measurement is being done to solely satisfy a regulatory need (as opposed for process control or arrestment plant optimisation reasons), the user needs guidance on what quality of measurement the regulator is looking for. It is eminently sensible that the regulator defines the standard to which he requires the measurement to be made to stop a 'grudge' purchase by the user becoming a poor purchase. A correlation function similar to ISO 10155 is often used to define instrument accuracy (figure 4).

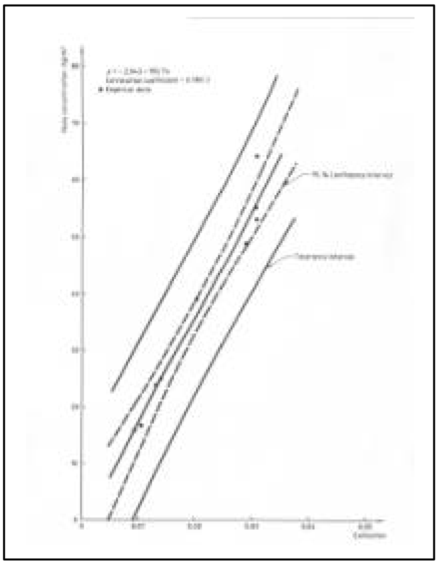

Figure 4. Correlation function defined in ISO-10155

An example of where this approval process has exposed limitations of what was otherwise seen to be a suitable instrument is as follows:

- In 1998 PCME developed a new Electrodynamic instrument, the DA-60 as a lower cost alternative to the DT-770. On submitting both for UBA/TUV approval the DA-60 unexpectedly exhibited a lower reproducibility figure in the field trial than the DT-770, due to limited auto ranging features (see figure 5). Reproducibility is a measure of how well two instrument track each other. Therefore the DA-60 was only approved to the lower standard of BImSchV 27, compared to the DT-770 which ultimately received the higher BImSchV 17 approval .

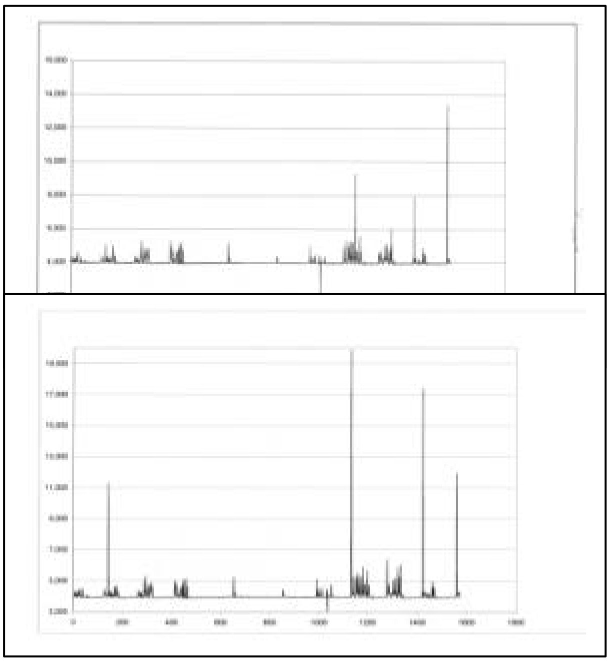

Figure 5. Results from reproducibility test of 2 DA60's

5.2.2) Suitability for application.

Approvals provide some guidance on the suitability of instruments for particular applications. In both the MCERTS and UBA schemes the instruments are approved for a specific measurement range meaning that the instrument's accuracy, resolution and repeatability has been tested in the range in question. In addition, guidance on limitations is given in the UBA official announcement and details of cross-sensitivities are given in the MCERTS certificate. The approved measurement range has great practical value since many emission levels have fallen below the minimum detection levels of older techniques such as Opacity. This, therefore, discourages the use of instruments that are completely unsuitable for the application.

Over the past 7 years the DT-770 has replaced many Opacity instruments mis-applied to low dust concentration applications. Representative examples where the lack of presence of approvals have been relevant are:

- At a vehicle catalyst plant in the UK, emissions from a platinum recovery process are controlled by a bagfilter. In 1990 the local regulatory inspector (HMIP) had required a continuous monitor to be fitted. With no UK approval scheme in existence and with vacuum of proper information on the limited measurement range of Opacity instruments, a common UK Opacity instrument was agreed upon and fitted to the stack (figure 6). The resulting minimum detection level of the instrument in the 500mm stack was unsurprisingly 100mg/m^3, however the prescribed emission limit was 1mg/m^3!, Since a response is needed from an instrument when it is calibrated in mg/m^3 with an isokinetic test, the instrument was deemed unsuitable. Unfortunately for the user not only did the opacity instrument need to be replaced, but money had to be spent evaluating the DT-770 (which was ultimately fitted to the stack) since at that time no public 3rd party evaluation (or approval) of this instrument existed.

- At a pharmaceutical company's clinical waste incinerator in the UK, a ceramic filter is used to control particulate emissions from the high temperature furnace. A respected opacity brand was fitted to the stack, but again due to low emissions (2mg/m^3) and small optical path length (500mm stack diameter) instrument had no response at normal operating levels. On making replacement decision, user prioritised regaining regulators confidence that appropriate instrumentation was being fitted. An MCERTS certified instrument (DT-780) was selected with measurement range appropriate to typical emissions in the application.

Figure 6. Typical small stack application on which small path length limits resolution of opacity instrument

5.2.3) Improved functionality

A feature inherent in the German UBA scheme is the need for automatic zero and span checks on instruments used to satisfy measurement requirements (BImSchV 13 and 17). These automatic tests provide an instantaneous warning (alarm output) should a failure in the instrument's functionality be detected by these internal tests. This permits the operator to rectify the situation as soon as it occurs rather than when it is too late (by assessment of suspect data) and therefore, increase instrument reliability (availability).

It should be noted that instrument zero and span checks are not capable of detecting shifts in calibration (caused, for example, by particle size changes) but provides a basic level of confidence that the instrument is working correctly and accurately measuring what it monitors as a surrogate for particulate (eg light attenuation)

An example of how these requirements have improved instruments is seen in the evolution of the PCME Electrodynamic range of particulate monitors.

- In early versions of the Electrodynamic instruments (DT-200) there were no self checks built into the instrument since the technology was in its infancy. In submitting an instrument to UBA/TUV approval this feature had to be added. TUV accepted that the specific nature of this test was different to tests performed in optical instruments due to the nature of the technology. This feature is now standard on the DT-770, benefiting both regulatory and process customers. An additional test has been added latterly which detects the other failure mode of the instrument; insulator contamination. This is a key self check for this type of instrument.

5.3) Changes in cost of ownership

The UBA and MCERTS schemes, while costly to the manufacturer in the short term, do in most circumstances reduce the cost of monitoring as far as the user is concerned. Cost savings can be in up to 3 areas: Instrument selection, purchase price and, in the UK, sampling costs.

5.3.1) Instrument selection

Evaluating the suitability of an instrument for an application can be expensive if it is necessary to test and challenge the instrument in the application. This is due to the time of managing a trial against pre-defined objectives and the costs of taking reference iso-kinetic samples against which the instruments output is compared over a number of months (typically costing £1000 a time).
Of course it is precisely these issues that both the UBA and MCERTS schemes evaluate and, therefore, with intelligence a user can modify the evaluation program in light of approvals data and considerably reduce the evaluation costs. Rather than duplicate the approvals test, the evaluation can be focussed on special issues related to the application. (ie reliability with a particularly sticky dust (eg Wood pulp) , interference from steam or suitability with a particularly reflective dust (TiO2).

It is interesting to note that the field trial component of a TUV and MCERTS test costs a similar amount of £10,000 to £15,000 for a particulate monitor. Savings in not having to duplicate such testing can, therefore, be considerable.

An example where a user spent considerable expense evaluating an instrument is :

- A large aluminium smelting plant in the UK needed to fit 8 continuous particulate monitors in 1994 to satisfy regulatory requirements. The applications points were highly abated emissions after bagfilters on furnace emissions and due to the fact they had a poor experience with Opacity instruments in the past decided to evaluate three different instruments. In light of competing claims from different manufacturers decided to make their own evaluation program. Over a three month period the cost of this evaluation (excluding instruments) was £12k. At the end of this, an eight channel DT-770 networked system was purchased for less than £20,000. The evaluation costs had been over 40% of the purchase price.

5.3.2) Purchase Price

Provided there are sufficient instruments approved, the cost of approved instruments are lower than non-approved instruments. This somewhat surprising fact reflects that approvals provide better transparency on instrument performance and makes it difficult for manufacturers to create some mystical image of top performance of their instrument for which the customer must pay! The contrary exists if there are few approvals for a particular type of instrument. In this case monopolistic behaviour by manufacturers is always a temptation and prices can rise.

A current example where approvals affect the price paid by customers is:

- With the advent of MCERTS in the UK, users have become less concerned about the application suitability of an instrument rather whether it is approved or not. And with a choice of approved instruments from 3 suppliers, price has been the secondary purchasing criteria. For example prices for the MCERTS approved DT-280 have now fallen by 25% compared to its not approved relation (DT-270) due to increased competitive pressures. Features included in the DT-270 for process control benefits (such as broken bag diagnostics and trend memory) have been removed in the DT-280 and the benefit to the user only concerned with regulation compliance is that he doesn't need to pay for features he may not be interested in.

An example of how a limited choice of approved instruments can allow prices to remain artificially high is as follows:

- A coal fired power plant in Northern Ireland which had historically used standard Opacity instruments with UBA/TUV and US EPA approval recently started looking for an alternative due to the £5k annual instrument service costs. They evaluated the SC-600 as an alternative due it is reduced maintenance requirements. In the process of the evaluation they found it to have additional benefits since the calibration was less effected by particle size and particle colour than the standard Opacity instrument. In spite of their desire to purchase the SC-600 they were unable to, since the regulator in Northern Ireland required an approved instrument to be purchased. Fortunately the SC-620 received regulatory approval in 2000 and the customer was permitted to purchase the SC-620 with a cost saving of 25% over the original Opacity device and an 80% reduction of service costs.

5.3.3) Reduced sampling costs

Over the past 10 years we have seen customers increase costs by not purchasing approved instruments. By implication purchase of approved instruments would have saved the customers money. Use of continuous instruments from which the results the regulator has little confidence can result in increased surveillance costs for isokinetic sampling for which the user must pay.

- For example a large plasterboard plant in the UK purchased 10 non- Electrodynamic Triboelectric instruments 8 years ago which had never worked properly due to the high levels of humidity after the kettles and driers. As a result the local authority required increased sampling at the site to provide at least some data on the sites performance in controlling emissions. In 1997 a decision was made by the user to fit appropriate continuous particulate monitors that worked and requested reduced sampling intervals from the regulators. The regulator approved this approach provided instruments were shown to work properly. Ten DT-770's were fitted due to their TUV approval and after 6 months of continuous operation, the regulator permitted sampling requirements to be halved to an annual test. Purchase of the correct instrument in the first place would not only have saved the user the costs of increased sampling and a second set of instrumentation but avoided the undesirable exposure to being non-compliant with regulatory requirements.

Recently in the UK the Environment Agency has formalised the policy of providing economic incentives to encourage the adoption of MCERTS approved instruments. External sampling audits are less likely on sites using approved instruments as opposed to non –approved instruments.

5.4) Limitations of approvals

Unfortunately one of the undesired effects of approvals is that inappropriate instruments can still be selected for a particular application. This arises when users are cushioned from the fact that particulate monitors are still application dependent devices and that approvals only give limited guidance on the applicability of instruments. It is important to understand that most approvals emanate from field trials performed on incineration and combustion facilities (where regulations were first enacted) and that conditions in chemical, mineral and metal applications can be quite different. Monitoring carbon black, for example, is a more difficult application than monitoring the limestone injected into an incinerator to reduce HCL, because of carbon black's physical properties (Untypical effect on light (due to particle size), highly conductive and coats surfaces very easily). For practical reasons approval schemes cannot be designed to cover all applications and a user must still consider whether approvals are transferable or even relevant to a particular application and monitoring requirement. Probably the largest problem with approval schemes are that results and the scope of an approval are too often taken out of context.

An example where the mis-application of approvals led to poor choice of instruments is:

- At a number of an asphalt producer's roadstone drying plant in southern Britain, Opacity instruments with BImSchV 13 approvals were fitted to the rotary drier emission stacks as standard in 1990, since the regulator perceived this would provide appropriate measurement. Use of these instruments was problematic due to particulate accumulation on lenses causing regular service needs, and poor measurement accuracy due to interference from steam in the flue stack. Of course these issues are not necessarily relevant to a BImSchV 13 approval where use in a combustion process with non accumulating dust and low humidity conditions are more prevalent. It is likely that the regulator was unaware of the details of the German approval process and wrongly assumed that the approval was transferable onto this process. It is interesting to note that these instruments were replaced in 1995 by a then non-approved instrument, the DT-770, with insulated probe since it was proven to provide more reliable and accurate performance than the 'approved' Opacity device.

A criticism that is sometimes levelled against verification schemes is that they discourage innovation. While this is no doubt true in cases, where standards are prescriptive about measurement technology and instrument design (for example US EPA), the approach of performance standards used in MCERTS and the UBA/TUV schemes still permits and encourages innovation.

6) A FUTURE EUROPEAN VERIFICATION SCHEME?

Verification schemes provide a vital role in defining the standards to which regulators expect and require continuous particulate emission monitoring systems to perform. Currently this is being done on a country by country basis, however, the rational for a pan-European verification scheme may already exist. EU Directives are driving environmental legislation in European countries on a converging basis and therefore monitoring needs are likely to become more and more similar. Certainly a centralised (and hence larger) verification scheme, valid across Europe, would encourage more instruments to be approved and in doing so would promote better quality measurement and lower monitoring costs. For users, this would further extend the benefits of more cost effective continuous monitoring and for regulators it would provide good quality data comparable between EU member states. It is for these reasons among others that an Adhoc CEN working party has recently been created to look further at a European verification scheme.

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8) AUTHORS BIBLIOGRAPHY

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