FIT-FOR-PURPOSE CERTIFICATION OF NON-TRADITIONAL ROAD ADDITIVES

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ABSTRACT

Demands for improved infrastructure in urban and rural areas are increasing and will continue to do so for the foreseeable future. At the same time, demands on resources, both financial and natural, are also increasing and more attention will need to be given to using marginal materials and innovative construction techniques in order to cost-effectively provide the best possible service. The use of appropriate additives is one option that can be considered to reduce dust, improve all-weather passability, minimise maintenance requirements or to improve local materials to the point that they can be used in upgrading unsealed roads to a low-volume sealed standard. However, suppliers of these road additives can seldom provide sufficient information for road authorities and engineers to make an informed decision on the appropriate use of the additives as an alternative to using traditional stabilizers in a conventional design. The use of non-traditional additives is not covered in any of the guideline or specification documents used by the roads industry. The research undertaken by many manufacturers on the performance of their products is often insufficient to prepare appropriate guidelines, to predict performance over time or to carry out a detailed pavement design. A fit-for-purpose certification system for road additives would ensure that appropriate research on additives is undertaken by additive suppliers and would provide a measure of confidence in their use to road authorities and consulting engineers. A procedure for certification has been developed under the guidance of a steering committee with representation from road authorities, consulting engineers, product suppliers and academia. This entails assessment of information provided by the applicant in terms of a questionnaire, control testing and certificate issue. This paper summarizes the recommended certification procedure and provides recommendations for implementation.

1. INTRODUCTION

There are over 500 000 km of unsealed roads in South Africa managed by a number of different authorities. Unacceptable levels of dust, poor riding quality and/or impassability in wet weather are experienced on much of this road network, the implications of which have been described elsewhere in the literature[1].

Over the last 25 years, numerous soil additives in the form of chemical dust palliatives, compaction aids and stabilizers have been introduced to the road industry, which manufacturers claim will reduce both dust and maintenance on unsealed roads or improve the material properties to a point that the road can be sealed. The level of research and usefulness of the findings differs from additive category to additive category - numerous small ad hoc studies have been undertaken on calcium and magnesium chlorides, lignosulfonates, tars, bitumens and sulfonated oils. Very little work has been carried out on

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other potentially useful and cost-effective additives such as waxes, synthetic polymer emulsions, enzymes and other biological agents. In all of these investigations, including those undertaken by the South African road authorities, the methodology mostly entails an ad hoc laboratory investigation, usually on one material type using standard laboratory tests (which were not developed for treated materials), followed by a field trial. This is usually done on one road, which is subjectively monitored until the effects of the additive are no longer apparent (eg dust suppression). Rejuvenation requirements and techniques are usually not considered. Reporting is based on the observations made, the recommendations and conclusions are usually applicable only to the material and road on which the experiment was conducted, and very little, if any, scientific interpretation of the results is provided (ie what attribute caused failure or led to success). In many instances, failures that could have been related to incorrect application techniques or to application on unsuitable materials were unfairly attributed to poor performance of the additive. No effort has been made to quantify the benefits and cost-effectiveness of additives over longer periods of time (eg five years) and only limited attempts have been made to compare the performance of treated roads with untreated roads. Only limited information on material requirements and application techniques is available, while there is little performance related information on rejuvenation. Most of the international research has been carried out in the northern United States, Canada and Europe, all of which experience short dry seasons and low winter temperatures. The results are thus not particularly suited to South African conditions.

This lack of understanding has resulted in general scepticism among the roads industry regarding the use of road additives. The situation is aggravated by poor marketing, with many sales representatives having no engineering background, little understanding of the roads industry and insufficient knowledge to provide adequate technical backup. In attempting to overcome some of the problems detailed above, discussions with road authorities and consulting engineers indicated that “fit-for-purpose” certificates for additives, issued by an independent certification body would contribute to confidence in their use. A certification system would also encourage suppliers to conduct appropriate research. Agrément South Africa was identified as an appropriate organisation to manage such a certification process and the development of a system was initiated. The procedure documented in this paper is the culmination of the study undertaken by CSIR, Transportek on behalf of Agrément South Africa under the guidance of a steering committee consisting of representatives from road authorities, consulting engineers, academia and suppliers of road additives. The fit-for-purpose certification system was developed in four phases:

- Phase I: Background to the use of additives on unsealed roads, a listing and discussion of the various additive categories and an introduction to unsealed road additive certification[2]
- Phase II: Development and validation of control tests for certification and setting of tentative limits for abrasion and erosion loss and strength improvement[2]
- Phase III: Comparison of control test results with field performance, refinement of the limits for abrasion and erosion loss and strength improvement[3]
- Phase IV: Preparation of a detailed procedure for certification[4]

2. AGREMENT SOUTH AFRICA

The Board of Agrément South Africa was established in 1969 by the Minister of Public Works as an objective, independent agency to serve the building and engineering communities in providing assurance to specifiers and users via technical approvals for the fitness for purpose of non-standardised and/or unconventional construction products. The word Agrément means consent in French. Agrément South Africa is a member of the

World Federation of Technical Assessment Organisations (WFTAO), to which 23 countries belong.

2.1 Roles of Certification and Standards Bodies

Agrément evaluation and certification becomes relevant during the development phase of products when, through technical evaluation of prototypes, Agrément can indicate to entrepreneurs whether their products will be fit-for-purpose. Agrément's role is strongest during the introduction to market phase when its certificates provide entrepreneurs with the instruments they need to demonstrate their product's suitability for specified uses, while at the same time providing the user with the necessary independent, objective information and advice on the product's characteristics, benefits and limitations.

An integral part of Agrément evaluation and certification is an assessment of the manufacturer's quality system, which is assessed in collaboration with the SABS. The application of the quality system is monitored regularly after an Agrément certificate has been granted.

As the product enters the market acceptance and growth phase, Agrément's role may diminish and may be taken over by the SABS. Typically once there are several manufacturers producing a similar product, there is a growing need to develop a standard for the product covering its manufacture, materials used in production and quality procedures. The usual process followed by the SABS is to establish a committee comprising interested parties to draft such a standard. The experience and knowledge gained by the developed, research organisation and Agrément during the earlier development phases may now be used as technical input in formulating the standard.

2.2 Certification

An Agrément certificate is a technical document that:

- Summarises the assessed performance of the subject
- Lists the uses for which the product's fitness for purpose has been assessed,
- Lists conditions and requirements to be met if the assessed performance in use is to be attained

3. TYPES AND PROPERTIES OF ADDITIVES

Numerous additives are available for dust palliation, improved compaction and stabilization of unsealed roads. Most of these bind the fine particles together without any significant chemical reaction occurring in the soil, although certain additives will only perform once a chemical reaction has occurred. A number of additives are material and/or climate dependent and costs vary significantly. It is therefore important that the bonding nature, limitations and life-cycle costs are investigated and their performance is understood before widespread use is considered.

In order to facilitate research, product niching, technology transfer, selection of an appropriate additive for particular conditions and certification, additives have been divided into categories and sub-categories, based primarily on their function and chemistry[5] (Table 1).

Table 1: Road additive categories

Category	Sub-categories	Examples
Dust palliatives	Water and wetting agents Hygroscopic salts Natural polymers Synthetic polymer emulsions Modified waxes Petroleum resins Bitumen and Tar Other	Teepol Calcium, magnesium or sodium chloride Lignosulfonate, molasses, tannin extracts Acrylics, vinyl acetates Waxes from Sasol's Fisher-Tropsch process Blend of natural polymer and petroleum products Prime, bitumen emulsion, cutback bitumen Industrial wastes
Compaction aids and stabilizers	Synthetic polymer emulsions Sulfonated oils Enzymes & biological agents Bitumen and Tar	Acrylics, vinyl acetates - - Prime, bitumen emulsion, cutback bitumen

4. ADDITIVE CERTIFICATION PROCEDURE

The procedure for fit-for-purpose certification of road additives is based on a relative performance evaluation methodology, which:

- Provides potential users as well as manufactures and suppliers with a measure of the performance of the submitted additive relative to the performance of a range of additives as well as to the standard specifications of conventional additives.
- Identifies strengths and limitations of the submitted additive, thereby better defining suitable applications.
- Facilitates judgement regarding the engineering and economical advantages of using the submitted additive instead of more conventional products.

The certificate is **not** intended to serve as a formal acceptance or rejection of an additive based on an absolute performance evaluation. It also does not serve as a guarantee of performance, nor does it obviate the need to carry out an engineering investigation, including material testing, for every project where the use of the additive is considered.

4.1 Proposed Procedure

The following procedure for fit-for-purpose certification of road additives is proposed (Figure 1):

1. Approve application for additive certification
2. Establish a technical assessment team
3. Scan background documentation
4. Complete assessment contract
5. Assess quality management system
6. Assess environmental compatibility and validity of the material safety data sheet
7. Review background research that has been conducted
8. Review guideline documentation
9. Carry out control testing
10. Complete Agrément certification process
11. Issue certificate
12. Conduct post certificate monitoring

The process can be halted at any stage if the requirements are not satisfied. The applicant can be given the opportunity to provide the necessary documentation or conduct additional studies, or the procedure can be terminated if it is unlikely that the additive will achieve certification.

4.2 Application and Application Approval

Completion and submission of the application form and fee initiates the certification procedure.

4.3 Technical Assessment Team

Once the application for fit-for-purpose certification has been approved, a technical assessment team should be formed to assess the documentation provided by the applicant and the control test results, and to make a recommendation on certifying the additive.

The team should consist of:

- An Agrément staff member
- One or more engineers from a research, consulting or tertiary education facility, familiar with the design, construction and maintenance of roads in the class that the product is intended for, and who do not have a personal or vested interest in any road additive
- If possible, an engineer from a road authority who is familiar with the design, construction and maintenance of roads in the class that the product is intended for, and who does not have a personal or vested interest in any road additive
- If required, a chemist who is familiar with the particular category of chemicals in which the additive is grouped, and who does not have a personal or vested interest in any road additive

4.4 Documentation Scan

This phase entails a brief appraisal of the application form and documentation provided by the applicant to ensure that all relevant information has been provided and that it is of sufficient detail to justify a more thorough review. If the evaluation panel is satisfied that sufficient credible information has been provided, the process can continue. If not, it should be halted until more comprehensive documentation is made available.

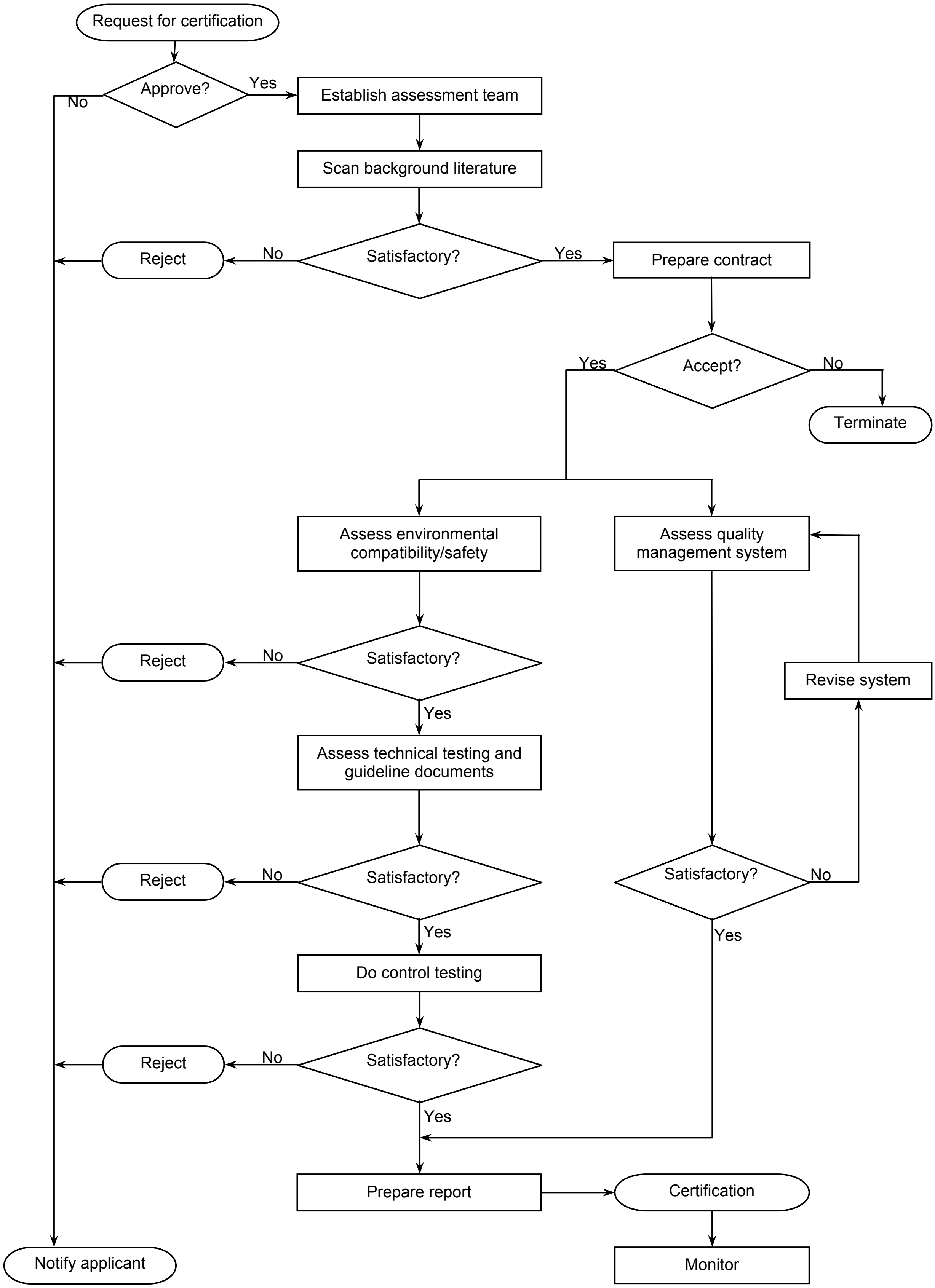

Figure 1: Summary of recommended certification procedure for road additives

4.5 Assessment Contract

If the evaluation team is satisfied that the documentation submitted with the application is sufficiently comprehensive, then Agrément will prepare a proposal to assess the additive and enter into a contractual agreement with the applicant.

4.6 Quality Management System

The additive manufacturer must be able to prove that a quality management system is followed throughout the manufacture, storage, transport and application of the additive. Although a SANS 9001 accredited quality management system is preferable, any appropriate system will be considered, and if necessary, guidance will be provided on implementing such a system.

4.7 Environmental Compatibility and Safety

The additive manufacturer must be able to prove that his/her product is both environmentally compatible and safe for workers. A SANS 14001 accreditation for the manufacturer and/or supplier would be desirable, but not mandatory. Environmental compatibility should have been assessed by a Department of Water Affairs and Forestry accredited laboratory in terms of the Department's Receiving Water Quality Guidelines. The relevant documentation from the laboratory summarizing the results should be included.

An approved Material Safety Data Sheet (MSDS), in standard format, should be included with the documentation.

Questions that the evaluation panel should consider when assessing documentation include:

- Has environmental testing been carried out?
- Is groundwater pollution addressed in terms of Department of Water Affairs Receiving Water Quality Guidelines?
- Was the testing done in a Department of Water Affairs accredited laboratory?
- Has toxicity to roadside vegetation been assessed?
- Is the Material Safety Data Sheet correctly completed and sufficiently comprehensive?
- Are guidelines provided for the cleaning of application and construction equipment?

If the reviewers are not satisfied with the information provided, the procedure should be halted until the required information is provided.

4.8 Background Research

Ideally, manufacturers/suppliers should have thoroughly researched the performance of their additives prior to applying for fit-for-purpose certification. Sufficient information should be gathered from this research to prepare guidelines and/or a manual on the use of the additive. Evidence should be provided to indicate that suitably qualified persons undertook the research and that an acceptable protocol was followed[5]. If the additive is being marketed as an alternative to a traditional stabilizer (eg lime, cement, bitumen emulsion), then results of comparative testing with that stabilizer should be included in the documentation.

Questions that the evaluation panel should consider include:

- Were the persons conducting the research suitably qualified/experienced?
- If students conducted the research, has a suitably qualified/experienced supervisor accepted responsibility for the results?
- Has an appropriate research protocol been followed?
- Is the experimental design for laboratory testing sufficiently representative and comprehensive?
- Was a reputable/accredited laboratory used for testing?
- Were appropriate tests used?
- Were recognised test methods followed?
- Was performance compared with untreated samples and, if applicable, samples treated with traditional stabilizers?
- Is the experimental design for field testing sufficiently representative and comprehensive?
- Were appropriate monitoring and test methods followed?
- Were the experiments monitored for a sufficient period of time and through rejuvenation if applicable?
- Were test results interpreted with due consideration for the original purpose of the test?
- Were sound procedures followed in the analysis of the data?

The evaluation panel should consider a site visit to assess field performance and issues such as long-term durability and maintainability.

If the reviewers are not satisfied with the research that has been conducted, the procedure should be halted until the required information is provided or the required testing has been carried out.

<u>4.9 Guideline Documentation</u>

The guideline documentation provided with the additive by the manufacturer should be sufficiently comprehensive and credible such that a practitioner will be able to make an informed decision, based on sound engineering judgement, on whether or not to use the additive in a particular application. Marketing documentation should also be assessed in this stage.

A typical table of contents for guideline documentation would include the following:

- Introduction
- Background information (includes state-of-the-art review of additives in this category)
- Technical specifications of the additive and additive properties (includes summary of laboratory and field research)
- Environmental and safety considerations and special precautions for transport, storage and handling
- Selection criteria for identification of projects where additive is suitable
- Guidelines for economic analysis
- Guidelines for design (includes material selection, mix design and structural design, climatic limitations, etc)
- Construction, application, maintenance and rejuvenation procedures
- Quality management procedures

- Test methods (if non-standard test methods are used)
- Case studies
- List of completed reports

The inclusion/exclusion of certain chapters will depend on the type of additive (eg mix and structural designs would not be included for dust palliatives, but should be included for additives that have been developed to stabilize pavement layers).

Questions that the evaluation panel should consider after reviewing the documentation include:

- Is the guideline documentation representative of the research conducted?
- Can an informed decision on whether or not to use the additive be made based on the information in the documentation?
- Are procedures, models and default values for an economic analysis provided and appropriate, and can an accurate cost/benefit study be carried out?
- Is the design method appropriate?
- Is sufficient information provided to confidently design a road using the additive?
- Are material selection and testing criteria compatible with South African specifications?
- Are modifications to standard methods to accommodate addition of the additive provided and justified?
- Are additive limitations suitably addressed?
- Are construction, application, maintenance and rejuvenation procedures adequately detailed and realistic to implement?
- Are maintenance and rejuvenation programs provided and explained?
- Are environmental and safety procedures included?
- Are quality control procedures for product acceptance and application included?
- Are marketing brochures truthful and free of misleading statements?

If the reviewers are not satisfied with the guideline documentation and/or marketing brochures, the procedure should be halted until more suitable documents are prepared.

4.10 Control Testing

Although additive suppliers should have conducted detailed background research and have appropriate guideline documentation available, control testing should still be carried out to verify the manufacturers claims and to assess performance against one or more set criteria, depending on the purpose for which the additive is being certified. These criteria and the associated tests are listed in Table 2. A list of potential additive “purposes” and the associated control tests is provided in Table 3. If the purpose for which the additive is being certificated does not fit one of these criteria, then tests will need to be specifically identified for control testing.

Table 2: Criteria for control testing

Criteria	Test
Resistance to abrasion	Abrasion Resistance
Resistance to water erosion	Erosion Resistance
Improved density for same compactive effort	Maximum dry density
Sensitivity to moisture	Moisture Sensitivity
Increase in shear strength	CBR and/or UCS
Change in plasticity	Atterberg Limits

Table 3: List of "purposes" and associated control tests

Defined purpose	Tests*
Dust control	AR, ER (to assess leaching resistance)
Erosion control	AR, ER
Improved unsealed road performance	AR, ER, CBR
Stabilizer for unsealed roads	AR, ER, CBR
Compaction aid	MDD, CBR
Stabilizer for sealed road layers (eg G4, G5)*	CBR, AL
Plasticity change	AL
Alternative to traditional stabilizers	MS, UCS
Material "waterproofing"	MS
AR: Abrasion resistance	ER: Erosion resistance
CBR: California Bearing Ratio**	MDD: Maximum Dry Density
AL: Atterberg Limits	MS: Moisture sensitivity
UCS: Unconfined compressive strength**	
* Durability will need to be proven in background research. Additional testing may be required	
** CBR and UCS tests are soaked tests	

The basis and justification for test selection, test methods and test materials is described in documentation prepared as part of the study[3].

4.10.1 Materials

All tests, apart from plasticity reduction, should be conducted on both slightly plastic sand and a sand/clay blend with the following attributes (Table 4). Plasticity change tests need only be carried out on the sand/clay blend.

Table 4: Tentative specification for control materials

Parameter	Sand	Sand/clay blend
Maximum size (mm)	6.7	6.7
% Passing 0.075 mm	20 - 35	20 - 35
Plasticity index (%)	SP - 4	9 - 11
SP = slightly plastic		

Building sand sourced from a building supplier will typically meet the proposed specification for the sand. If necessary, the sand can be blended with a small percentage of clay to achieve the required properties. The sand/clay blend should be manufactured by mixing building sand and smectite-rich clay from an appropriate source. Blends in the order of 70:30 sand: clay should provide the required properties. If the additive has been developed to treat a specific type of clay, then this clay can be used instead of the smectite-rich clay, provided that the intended purpose of the additive is clearly stated on the application form.

4.10.2 Specimen Size and Preparation

Specimens of both materials should be prepared according to the requirements listed in Table 5. Additive should be mixed into the soil as specified by the manufacturer/ supplier. Reaction times and any associated procedures (ie equilibrating in a sealed bag) specified by the manufacturer/supplier should be adhered to.

Specifications for the mould and a detailed specimen preparation method are provided in documentation prepared as part of the study[4].

Table 5: Specimen preparation for control tests

Test	Parameter	Requirement
Abrasion Erosion UCS	Grading Specimen size Compaction method Compacted to	100 per cent passing 6.7 mm 100 mm diameter x 115 mm height Static (press) 95 per cent of Mod AASHTO density
CBR Density change	Grading Specimen size Compaction method Compacted to	100 per cent passing 6.7 mm 152 mm diameter x 127 mm height Modified AASHTO 95 per cent of Mod AASHTO density
Plasticity change	Grading	100 per cent passing 0.425 mm

4.10.3 Curing

All specimens should be cured as specified by the manufacturer/supplier.

4.10.4 Apparatus

- Abrasion Resistance - mechanical wet/dry brushing apparatus described by Sampson[6]. A brush loading of 2.0 kg is used.
- Erosion Resistance - erosion resistance apparatus described by Jones and Ventura[3].
- Density Change - standard equipment specified in Technical Methods for Highways (TMH1) Method A7[7].
- California Bearing Ratio standard equipment specified in TMH1, Method A8.
- Moisture Sensitivity - does not require any specific apparatus apart from a perforated aluminium disc, 75 mm in diameter and 3.0 mm thick, which is used as a gauge to determine the rate of disintegration.
- Unconfined Compressive Strength - standard equipment specified in TMH1, Method A14.
- Plasticity Change - standard equipment specified in TMH1, Method A2 and A3.

4.10.5 Test and Reporting Method

Detailed test methods and reporting forms are provided in documentation prepared as part of the study[4]. A summary of each test and reporting method is provided below.

- Abrasion Resistance - After curing, the treated and untreated specimens are weighed, mounted in the brushing apparatus and then subjected to 250 revolutions with a brush loading of 2.0 kg. The brushed specimens are then weighed and the mass loss recorded as a percentage of the original mass. Treated specimens are then subjected to a further 250 revolutions before final weighing and determination of percentage mass loss. The average loss for the three specimens after 250 and 500 is revolutions reported. If the loss from any one specimen differs from the other two by more than five per cent, the test should be repeated.
- Erosion Resistance - After curing, the treated and untreated specimens are weighed, positioned in the test apparatus and then subjected to five minutes of water flow at a constant water head of 1.0 m. Excess water should be allowed to drain for a further five minutes after which the specimens are removed from the apparatus and dried at 105°C for 24 hours. The specimens are then weighed and the percentage mass loss recorded. The average loss for each set of three specimens is reported. If the loss from any one specimen differs from the other two by more than five per cent, the test should be repeated.

- Density Change - Preparation of the specimens and testing is as per the standard test method[7], except that allowance is made for mixing the additive into the soil with the compaction water, reaction time and for curing. An average of the three results for each set of specimens is recorded and compared with the original maximum dry density determined during specimen preparation.
- California Bearing Ratio - Preparation of the specimens and testing is as per the standard test method[7], except that allowance is made for mixing the additive into the soil with the compaction water and for curing. All specimens must be soaked for four hours. An average of the three results for each set of specimens is reported.
- Moisture Sensitivity - The moisture sensitivity test is carried out prior to UCS testing on the specimens that will be used in the UCS test. The test entails placing a perforated 75 mm diameter/3.0 mm thick aluminium disk on top of each specimen and then soaking it for two hours. The time taken for the specimen to disintegrate up to the edge of the disk is recorded. If disintegration continues beyond the edge of the disk before the two-hour soaking time is completed, it is unlikely that the specimen will have sufficient strength for completing the UCS test. Moisture sensitivity is the time in minutes taken to disintegrate to the edge of the disk. An average of the three results for each material is reported. The test can also be used to compare the moisture sensitivity (ie disintegration time) of treated and untreated specimens. The same procedure as that described above should be followed.
- Modified Unconfined Compressive Strength - The method for preparing and curing UCS specimens has been modified from the standard test[7]. Specimen preparation is as described above. No untreated controls are tested, as they will not withstand soaking. As an alternative, bitumen emulsion (application rate of two per cent residual bitumen with no filler) should be used as a control for the sand material and lime (application rate of one per cent lime plus percentage lime determined in an initial consumption of lime test (TMH1[7])) should be used as a control for the sand/clay blend. Each specimen is soaked in the Moisture Sensitivity test for 120 minutes and then crushed as per the standard method. Reporting is as per the standard test. An average of the three results for each material is reported.
- Plasticity Change - The standard test methods[7] have not been changed, except that allowances are made for mixing the chemical into the soil fines and for curing and/or reaction time if required.

4.10.6 Interpretation of Results

The recommended limits for each test are listed in Table 6. Performance of the additive should be equal to or better than the limit for each purpose that it is being certified for, unless provision to deal with the consequences is made in the guideline documentation (eg an additive certified as a dust palliative must pass the abrasion resistance test, but could fail the erosion resistance test, provided that allowance is made in the design for rejuvenation after heavy rainfall). If the additive does not perform adequately when subjected to the control tests, the procedure should be halted.

Table 6: Limits for control test results

Test	Parameter	Limit	
		Sand	Sand/clay
Abrasion resistance	Loss after 500 revolutions (%)	<10	<10
Erosion resistance	Loss after 5 minutes (%)	<8	<8
Density change	Increased density (kg/m^3)	≥100% Mod AASHTO	≥100% Mod AASHTO
Moisture sensitivity	Time to disintegrate to marker (mins)	≥120	≥120
Strength change - CBR	Improvement on control (%)	>35	>100
Strength change - UCS	Comparison with stabilizer[1,2](kPa)	≥ bitumen emulsion	≥ lime
Plasticity change	Improvement on control (%)	-	>50

[1] 2% residual bitumen, no filler. Oven cured to constant mass at 40°C

[2] Lime content determined from TMH1 initial consumption of lime test plus one per cent. Cured as specified in TMH1

It should be noted that the materials and methods described above are control tests only and are used to verify the results of the laboratory and field tests carried out by the additive manufacturer/supplier. The results should be considered as relative rather than absolute and are not intended to provide an indication of performance under field conditions. The tests should not be used independently to determine potential performance of road additives as the sand and sand/clay materials are not representative of typical road construction materials.

4.10.7 Technical Assessment Team Report

On completion of control testing and the review of the quality management procedures, the technical assessment team will prepare a report summarising the review and making recommendations towards certificating the additive under consideration. The report will comprise sections corresponding to the procedure detailed above, each summarising whether the requirements have been met or not. A recommendation on whether to certify the additive for the prescribed purpose, together with a justification will conclude the report.

4.11 Certificate

Based on the recommendations of the technical evaluation team, Agrément will initiate the preparation of a certificate.

4.12 Post Certificate Monitoring

Agrément will periodically monitor the activities of the additive manufacturer/supplier to ensure that procedures are being correctly followed and that the additive has not been changed in any way. Periodic feedback from road authorities may also provide useful input for improving the procedure. Post certificate monitoring can be carried out prior to certificate renewal, or more frequently as required.

5. STATUS QUO

The Agrément Board has approved the certification procedure, as recommended by the Steering Committee, and is currently soliciting interest in applications from additive manufacturers and suppliers. A number of local and international companies are preparing to proceed with certification and see it as a means of distancing themselves from unscrupulous suppliers. Provincial and larger municipal road authorities have been briefed and have agreed in principle to adopt a policy of requesting certificates from additive suppliers prior to considering application.

This paper is part of an initiative to inform the road industry of the certification procedure.

6. CONCLUSIONS

There is a growing demand for improved infrastructure in urban and rural areas. At the same time, demands on resources, both financial and natural, are also increasing and more attention will need to be given to using marginal materials and innovative construction techniques in order to cost-effectively provide the best possible service. The use of appropriate additives is one option that can be considered to reduce dust, improve all-weather passability, minimise maintenance requirements or to improve local materials to the point that they can be used in upgrading unsealed roads to a low-volume sealed standard. However, suppliers of these road additives can seldom provide sufficient information for road authorities and engineers to make an informed decision on the appropriate use of the additives as an alternative to using traditional stabilizers in a conventional design. The use of non-traditional additives is not covered in any of the guideline or specification documents used by the roads industry. The research undertaken by many manufacturers on the performance of their products is often insufficient to prepare appropriate guidelines, to predict performance over time or to carry out a detailed pavement design.

A fit-for-purpose certification system for road additives, such as that described in this paper, would ensure that appropriate research on additives is undertaken by manufacturers and would provide a measure of confidence in their use to road authorities, road owners and consulting engineers.

The success of additive certification rests with the users of the products. Although additive manufacturers and suppliers are being encouraged to certify their products, and many are in the process of preparing accordingly, it will be up to the users to follow a strict policy of only dealing with organisations and individuals who have certified their products or are in the process of doing so. Failure to initiate and systematically adhere to such policies will perpetuate the current state of the industry, which the certification procedure was, at the request of road authorities, owners and engineers, designed to overcome.

7. ACKNOWLEDGEMENT

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