Transport Roads & Maritime Services

TECHNICAL GUIDE L-G-006

Pre-treatment of road construction materials

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About this release

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Preface

This guide covers the following test methods;

T102 Pre-treatment of road construction materials by compaction

T103 Pre-treatment of road construction materials by artificial weathering

If both forms of pre-treatment are specified for the same material T103 must be completed before T102.

1. Introduction

Materials have a tendency to breakdown due to compaction during construction and from exposure to weathering. The following test methods simulate this breakdown by using a standard testing regime.

Pre-treatment of road construction materials is conducted prior to further testing to ensure that the final product is suitable for its specific purpose and design life.

It is prudent to test materials in the laboratory to know how this material will perform after it has been placed in the road formation. These test methods provide a standard method of degrading the material, then applying specified test methods that give better representation of materials performance during service over the design life.

2. Test methods

2.1 T102 – Pre-treatment of road construction materials by compaction

Most materials, but especially sedimentary and weathered materials, will be degraded by normal construction processes. This test method subjects the material to either three or six cycles of compaction (as required by the specification) to simulate breakdown during winning, compaction and trafficking.

To conduct the test the following apparatus is required;

- A 53 mm sieve
- A cylindrical metal mould complying with T102, 3(a)

  A split type mould is generally preferred to aid quick ejection of the material
- A metal rammer or mechanical means of compaction, complying with T102, 3(b)
- A rigid foundation to compact the material
- Equipment for uniformly mixing water into the sample
- Sealable, airtight containers.

Figure 1: A split mould used for T102

Before the repeated compaction process is started the entire sample is weighed, then screened on the 53 mm sieve. The percentage of material on the 53 mm sieve is required for reporting.

The material retained on 53 mm sieve is then broken down using only sufficient force to allow the larger particles to pass through the 53 mm sieve. The broken material is then placed back in the sample and mixed.

The sample is then divided into sufficient mass to conduct the required testing regime. It is not necessary to pre-treat the entire sample and a sub-sample will be sufficient material for testing. The minimum mass required for pre-treatment is 6 kg.

This sample division is carried out using either:

- riffling (T105 A3.1)

  or

- cone and quartering (T105 A3.2)

This material is then wet up to slightly dry of the estimated optimum moisture content, sealed in an airtight container and allowed to cure for at least 18 hours. This curing allows the moisture to permeate into any absorbent particles.

After curing the moisture content must be adjusted so that the material is at about optimum, small additions of water only require thorough mixing, if large amounts of water need to be added another 18 hours of curing should take place.

After curing, the material is compacted in three equal layers in the mould using 75 uniformly distributed blows of the rammer. Eject the material from the mould and set aside, continue compacting the remainder of the material until all the sample has undergone one full compaction cycle. Break up any aggregations or lumps, assess the moisture content of the material and adjust to approximately optimum if necessary.

Repeat the above until all the material has been subjected to the required number of compaction cycles. Note, on occasions a specification will require 6 cycles of compaction and this is usually related to extra compactive effort used during construction.

After this pre-treatment the material is now ready to be used in further such as CBR, PI, Grading, etc

After all testing is completed it is very important that the test certificate reports pre-treatment as; **CAn**, where **n** is the number of compaction cycles.

2.2 T103 – Pre-treatment of road construction materials by artificial weathering

This method simulates the breaking down of materials when left for periods of time exposed to the weather (eg stockpiled). Initially this test method was designed to pre-treat sedimentary rocks, but can be used to simulate breakdown in any material type that may possibly degrade due to extremes of weathering. The method subjects the material to cycles of wetting and drying to simulate exposure to wet and dry weather periods. Certain material types will break down if left in a stockpile exposed to the weather for periods of time.

To conduct the test the following apparatus is required:

- A 53 mm sieve
- A hot plate or burner, bar-b-que type setup may be used
- Suitable containers for cooking (drying) of the material
- Mixing and stirring equipment
- A means of decanting water from the containers
- Wire gauze is required if the soil is likely to eject material when drying.

As per test method T102, this test starts by recording the percentage of material retained on the 53 mm sieve in the sample. The percentage of material on the 53 mm sieve is required for reporting.

The material retained on 53 mm sieve is then broken down using only sufficient force to allow the larger particles to pass through the 53 mm sieve. The broken material is then placed back in the sample and mixed.

The sample is then divided into sufficient mass to conduct the required testing regime. It is not necessary to pre-treat the entire sample and a sub-sample will be sufficient material for testing. The minimum mass required for pre-treatment is 6 kg.

This sample division is carried out using either:

- riffling (T105 A3.1)

  or

- cone and quartering (T105 A3.2)

The sample is placed in the containers, spreading the material evenly over the area of each dish. Water is then added to completely immerse the material, and then allowed to stand for at least 16 hours.

Excess water can then be decanted from the container before drying and care must be taken not to incorporate fines from the sample in the water. Loss of fines can change the characteristics of the material resulting in misleading results in further tests. The decanted water can be retained for re-use in the next wetting cycle.

Figure 2: Typical arrangement of soil samples for drying and wetting

The material is then dried completely, by usually drying on the hotplate or a gas burner. Regular stirring of the material will aid evaporation and prevent the material baking to the bottom of the containers. Material that contains gypsum or significant amounts of organics must be dried in an oven with a temperature not exceeding 80ºC, extreme temperatures are likely to permanently alter the characteristics of these type materials.

A guide to when the sample is dried is when fines no longer stick to the stirring implements.

The sample is then completely immersed in water again, for at least 16 hours soaking and then dried again.

To finalise the testing, 10 wet and dry cycles must be completed with each cycle generally taking a full day. After this step the material is ready to be used in further testing such as CBR's, PI, Grading, etc.

After all testing is completed it is very important that the test certificate reports this pre-treatment as **W**.

T103 can also be used to assess a earthworks cutting's ability to stand up to extremes of weather. Testing for example grading and PI before and after pre-treatment by artificial weathering can give an indication of the durability of the material face. If large differences are documented in the before and after testing it is advisable to lay the cutting back further as exposure to weather may cause the cutting face to degrade faster than expected.

3. Conclusions

The pre-treatment tests are very time consuming and this time has to be factored into the planning stage of projects.

Pre-treatments simulate construction processes as well as trafficking after construction and is a necessary part of the earthworks testing regime. The geotechnical practitioner needs to know how a particular material will perform when in service.

Although not generally specified, simple testing such as grading and PI, should be conducted before and after pre-treatment. The differences in the test results give an indication of the amount of breakdown that may occur during construction processes.

4. References

Roads and Maritime Services (2012) *Preparation of samples for testing (soils)* T105, Roads and Maritime Services, North Sydney NSW

Roads and Maritime Services (2012) *Pre-treatment of road construction materials by compaction* T102, Roads and Maritime Services, North Sydney NSW

Roads and Maritime Services (2012) *Pre-treatment of road construction materials by artificial weathering* T103, Roads and Maritime Services, North Sydney NSW