

EDITORIAL AND TECHNICAL GROUP OF
THE SUB COMMITTEE ON CARRIAGE OF
CARGOES AND CONTAINERS
25th session
Agenda item 2.3

E&T 25/2
7 January 2016
ENGLISH ONLY

MEASURES TO IMPROVE SAFE TRANSPORT OF SOLID BULK CARGOES

Provisions for solid bulk cargoes that may liquefy

Progress report on Rheolat 2 project to optimize a VTPB (Vibration Table with Penetration Bit) transportability test for New Caledonian nickel ores

Submitted by France

SUMMARY

<i>Executive summary:</i>	This document provides a progress report on the Rheolat 2 project to optimize a VTPB (Vibration Table with Penetration Bit) transportability test for New Caledonian nickel ores
<i>Strategic direction:</i>	5.2
<i>High-level action:</i>	5.2.3
<i>Output:</i>	5.2.3.3
<i>Action to be taken:</i>	Paragraph 10
<i>Related documents:</i>	E&T 17/5/1; DSC 16/4/10, DSC 16/15; DSC 17/4/2, DSC 17/4/36, DSC 17/4/41, DSC 17/17; DSC 18/6/11; CCC 1/5/5 and CCC 2/5/19

Background

1 In order to ensure the safety during transport in bulk of New Caledonia nickel ores that may liquefy, France launched the Rheolat project through New Caledonia mine institutions. It has been explained in document DSC 16/4/10 that none of the tests described in the IMSBC Code are suitable for New Caledonia nickel ores, because of the large variability of New Caledonia nickel ores, including:

- .1 very different particles sizes, with particularly big particles up to 200 mm; and
- .2 a variable clay content, which infers to a certain extent ore plasticity which may mask their potential for liquefaction.

2 The Rheolat project aims to establish a transportability test dedicated to New Caledonia nickel ores, based on the penetration test described in the IMSBC Code in order to define a transportable moisture limit for each ore type.

3 Since its launching in 2008, the Rheolat project main steps are presented below:

- .1 The CNRT (National Center for Technological Research for "Nickel and its environment") achieved a geotechnical and geological characterization of the different nickel ores types. Three groups were identified essentially according to their particle sizes and their clay contents: lateritic ores (Group 1), earthy saprolites (Group 2) and mixed saprolites containing a predominant granular fraction and a fairly clayed earthy fraction (Group 3).
- .2 Cyclic tri-axial tests were conducted on one ore of each group in laboratory (Laboratoires Navier) to determine critical moisture which is used as a reference to calibrate the new test.
- .3 The VTPB (Vibration Table with Penetration Bit) test was calibrated, and the methodology assessed by INERIS (National Institute for the Industrial Environment and Risk) experts as presented in DSC 16 and E&T 17. But during the phase of determining the safety factor based on large scale in situ testing in New Caledonia, it appeared that test parameters were too stringent, potentially preventing the carriage of ores which statistically presented no risk to transport.
- .4 A new phase of the Rheolat project was then launched to optimize those parameters and especially the Cyclic Shear Ratio (CSR), namely the ratio of cyclic shear stress to average effective confining stress, which was identified as an important criterion in vulnerability to liquefaction. To reach this aim, two bulk carriers were instrumented during their voyages to Japan in 2013 and 2014, as described in the document CCC 1/5/5. Those instrumentations were organized by INERIS and consisted in measuring static and dynamic pressures, interstitial pressures, accelerations and water contents in different places of the cargo holds. A correlation between the ship's motion (heaving) and the CSR was actually found offering some forecasting capabilities and a CSR of 0.16 was chosen as a realistic reasonable maximum value representative of bulk solid cargo transport.
- .5 Cyclic triaxial tests were again conducted using recently defined parameters, and the VTPB test was consequently calibrated. Results have been found to be satisfactory by MECATER and some VTPB parameters like critical penetration depth, critical test duration, bit weight, surface overload (...) were set up for the future project developments.
- .6 In February 2015, project methodology and history, instrumentation, modelling and VTPB calibration results were shown to the accredited experts (Dr Susumu OTA, from the National Maritime Research Institute, and Dr Ken GRANT, from Minton, Treharne & Davies). Both experts have given their opinion about the whole project and its results. Expert assessment proceedings and main conclusions have been presented in paragraph 8 of document CCC 2/5/19.

4 This document aims to explain what have been carried out to meet the experts' recommendations and to answer their questions.

Project evolution since the experts visit in February 2015

5 All the experts' comments have been taken into account in Rheolat project developments since February 2015:

- .1 Almost 50 laboratory-scale tests were performed on the 3 ore groups to answer experts' questions. For each test, ore sample volume in the vessel has been measured at different steps on the VTPB test (before the test beginning, after 4 minutes of vibrations, and at the end of the test) in order to be able to describe dry density/saturation degree variations. The data obtained would be compared with tri-axial tests parameters.
- .2 Tests were carried out in Minton, Treharne & Davies laboratory based in Singapore in order to follow the evolution of pore pressure over a VTPB test at moistures around FMP. Pore pressure measurements were done especially on groups 1 and 2. Specific instructions were added to main VTPB procedure. Indeed one sensor is put at the vessel bottom, and then another one is put after each ore layer addition and compaction. After the last layer is compacted, consolidation disc is dropped off at the surface. In total four sensors are added and interstitial pressures are registered every second.
- .3 Some answers were found in the project background and the already done tests which have not been presented during the expert assessment.

What needs to be done before the final test procedure writing?

6 Some tests and results interpretation are still in progress and would be provided in a few weeks.

7 In situ tests are in progress on different mine sites. Several training courses will be organized from January 2016 to future actors in order to launch this final phase.

8 Each mine company has been invited to reflect on the whole VTPB test application methodology, in order to finalize the complete procedure.

Proposal

9 It is the willing of French authority to submit to the forthcoming CCC 3 the final developed test dedicated to New Caledonia nickel ores. Before it is submitted to the Sub-Committee and implemented in practice, this Rheolat test, which will comply with sections 4.1.4 and 8 of the IMSBC Code, will take into account the possible experts remarks.

Action requested of the group

10 The group is invited to consider the proposal in paragraph 9, and take action as deemed appropriate.