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Report of informal working group

Information of the flexible bulk container (FBC) testing in order to determine the maximum inclination angle at which it retains its stable-state position

Submitted by International Dangerous Goods & Containers Association (IDGCA)

Introduction

In conformity with Recommendations of informal working group ECE/TRANS/WP.15/AC.1/2013/59, item 9, FBC was put under test to determine maximum inclination (static stability angle), at which it could retain a stable-state position. These tests were carried out on the territory of Astrakhan Gas Processing Plant (Russia) and Nikolayev Alumina Refinery (Ukraine). Tests were performed under the supervision of experts from Russia's Central Scientific Research Institute for Maritime Fleet (CJSC "CNIIMF"), which is accredited in Russia.

Test performance conditions

Flexible bulk containers for bulk goods loaded with granulated sulfur and alumina were put under the tests. Copies of certificates for relevant lots of granulated sulfur and alumina are attached hereto.

Sulfur granulation and its loading into flexible bulk containers was carried out on the ENERSUL installation in Astrakhan city. Granulation was made by dry method (air-stream granulation). Such granulated sulfur represented one of the most movable types of granulated sulfur and sulfur in lumps. The natural slope angle of granulated sulfur in bulk is 30º36″, bulk density 1.28 g/cm^3.

Alumina was loaded into flexible bulk containers from silo towers by gravity with the help of aeration in Nikolaev city. The slope angle of aerated bulk alumina is 32.2º, bulk density 0.95-1.07 g/cm^3. Such alumina is very free to move and even comparable with a liquid.

Under test were flexible bulk containers of production-release design and of upgraded design that was provided with inclining (diagonal) straps.

Inclining straps are attached to all circular straps of a carcass grid, along its entire length, and are located on the lateral surface of FBC. During transportation, they facilitate retention of cargo from displacement in the upper, the most unstable, part of FBC, by binding it with the lower part of FBC, the most stable part of container. Meanwhile, as it is known, vertical straps of FBC carcass grip remain in non-loaded condition and therefore they are not involved in FBC stability retention during its transportation and stock-handling.

FBC was freely mounted on the truck platform. Tilting of platform with FBC and overturning prevention measures were carried out by 2 crane trucks of relevant capacity. The tilting angle was controlled by a digital inclinometer BOSH "DNM 60L". All testing procedure was shot by the photo/video camera CASIO Exilim "EX FH -100".

Test results

Granulated sulfur was fully loaded into FBC of both production-release design and upgraded design, provided with inclining (diagonal) straps. In this case, net weight of granulated sulfur in FBC made 13.95 and 14.0 tons correspondingly, while the height of each FBC was 2.75m.

Static stability angle of flexible bulk container was as follows for both designs under test:

- 20º for FBC of production-release design;
- 20.2º for upgraded FBC with inclining (diagonal) straps.

The test results are almost the same, since they are within limits of statistical error of measurement. As a matter of principle, this result was anticipated, since the loss of static stability of FBC in similar tests occurs owing to sagging (mashing) of goods in the perimeter, the most loaded part of FBC bottom, but not because of displacement of goods in FBC the upper part.

The obtained values of FBC static stability angles turned out to be less than critical inclination angle, which accounts to 21.5º (UN ECE Directive № 111).

We also conducted the test for static stability of FBC loaded with aerated alumina. Its weight amounted to 13.8 ton, and height was 2.8m. Its static stability angle was 18.7º.

The values of static stability angles for FBC loaded with different goods turned out to be close to each other and were not far from critical inclination angle. That is why we proceeded our tests with objective to determine the maximum loading height of FBC, at which it would have retained static stability at the tilting angle of 21.5º.

3 FBC were loaded with alumina at different heights ranging from 1.9m to 2.57m. In this case the FBC diameter remained steady. The obtained results are represented in the Test Report No. 789/2013 attached.

In all accomplished tests the FBC retained cylindrical form and no displacement of goods was observed in the upper part. Loss of static stability took place as a result of mashing of goods on the perimeter of the FBC bottom. In this case, the static stability angle was increasing from 21.3º to 23.8º with a decrease of

loading height for the FBC. Video record of FBC tested at minimum and maximum static stability angles is provided in the Supplement.
As these FBC test results show, the flexible bulk container, loaded at the height not more than 2.5 m, meets the requirements of UN ECE Directive № 111 concerning the critical inclination angle 21.5º , i.e. it retains its static stability.

Conclusions:
The obtained results of the test let us to draw conclusion that the static stability angle of flexible bulk container (FBC) loaded at the height 2.5 m with the diameter 2.45 m is 21.5º , i.e. it meets the requirements of UN ECE Directive № 111

Suggestion
We suggest the expert of the Joint Meeting to consider the possibility of the flexible bulk container (FBC) use in some kinds of dangerous goods transport under the following conditions:

-on trucks, the FBC, 2.45 m in diameter, loaded with goods to the height up to 2.5 m, is allowed to be transported without guy ropes (guy ropes are required, if the loading height exceeds 2,5 m in the FBC);
- on railcars, the FBC, 2.45 m in diameter, loaded with goods to a full capacity (the height up to 2.8 m) is allowed to be transported without guy ropes;
- in holds of inland vessels, the FBC, 2.45 m in diameter, loaded up to a full capacity, is allowed to be transported without guy ropes, provided that there is a close-together arrangement of FBC in the holds and its free movement is restricted by rigid walls in the hold and/or wooden partitions.