Research Summary – Intermediate Bulk Container (IBC) Life Extension Research

Transportation of Dangerous Goods | Scientific Research Division

SUMMARY

Currently, composite (plastic inner receptacle in metal frames) and plastic (plastic inner receptable in rigid plastic frame) asset type intermediate bulk containers (IBCs) that are in dangerous goods service have a permitted use period of 60 months. The purpose of this research was to determine if IBCs beyond 60 months of use can still pass the performance tests of new IBCs. This information will help to inform Transport Canada (TC) on if the service life of IBCs used to transport dangerous goods could safely be extended.

BACKGROUND

An IBC is a rigid or flexible portable means of containment (MOC) that has a capacity equal to or less than 3000 L for solids and liquids of packing groups II and III and is designed for mechanical handling, other than a bag, box, drum or jerrican, as defined in CAN/CGSB-43.146.

The United Nations (U.N.) Model Regulations [1] restricts the use of plastic IBCs for the transportation of dangerous goods (DG) to a maximum prescribed period of use of five (5) years (60 months) from their date of manufacture (except where a shorter period of use is prescribed based on the type of dangerous goods to be transported).

The Transportation of Dangerous Goods (TDG) Directorate at TC has adopted this prescribed period of use within the Canadian IBC safety standard CAN/CGSB-43.146 [2]. The data from this research study will assist TDG in better understanding the durability and performance of these IBCs once they are beyond their prescribed period of use and may assist in future decision-making related to these IBCs.

OBJECTIVES

The National Research Council of Canada Automotive and Surface Transportation (NRC-AST) Research Centre was tasked by TC in the context of an IBC lifespan testing program. NRC-AST evaluated the performance of a selection of rigid plastic and composite IBC designs beyond their prescribed period of use of 60 months when subjected to a range of performance tests as prescribed in CAN/CGSB-43.146-2016. In addition, a range of materials tests was performed to characterize the polymers used in the IBC construction, assess the condition of the materials, and

investigate any indications of damage after testing.

METHODS

U.N. standardized plastic and composite IBC prototypes must first pass a set of performance tests (as prescribed in CAN/CGSB-43.146-2016) that includes bottom lift, top lift, stacking, leak-proofness (air), hydraulic pressure (water), cold drops, and vibration, before the design can be registered and manufactured. In addition to these tests, material testing was conducted to evaluate the composition and condition of the IBCs. Prior to conducting the cold drop tests, several ambient drops were completed to determine the likelihood of the IBCs passing the cold drop tests.

Two (2) IBC types, 31HA1 (plastic bottles in metal frames – i.e., composite) and 31H1 (plastic bottles in plastic frames – i.e., plastic), from three (3) manufacturers were used in the testing. These IBCs were all older than 60 months and were donated by an IBC user.

We tested a limited number of expired IBCs from a limited number of manufacturers based on availability. Each IBC was used for a single dangerous good during their service life. This was not a statistically significant number of tests however these IBCs are representative of common IBCs exposed to normal DG service.

RESULTS

The following table summarizes the results of the tests.

Table 1 – Results Summary

Test	Manufacturer (IBC type) Identifier																							
	A (Composite)							B (Composite)							C (Plastic)									
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11
Bottom lift	✓	✓	✓					✓	✓	✓					✓	✓	✓								
Top lift			X							X					✓	✓	✓								
Stacking	✓	✓						✓	✓						✓	✓	✓								
Leak-proofness		✓		X		X				✓	X		X		✓			X	X						
Hydraulic pressure		X		✓		X				X	X		✓		X			X	X						
Flat drop (ambient)				✓														X							
Flat drop (cold)												○										X			
Corner drop (ambient)														X						X					
Corner drop (cold)					X																X		X	X	
Vibration							X		✓																✓

✓ - Passed, X - Failed designation after standardized test, ○ – Passed at a reduced height 0.8m

For the leak-proofness and hydraulic pressure tests, some IBCs that failed the initial test were retested with additional tightening and/or replaced gaskets. This resulted in an increase in the number of IBCs that passed these tests.

Top lift testing of the composite IBCs resulted in unexpected failures of the metal frames.

Materials testing (Fourier transformed infrared spectroscopy (FTIR), hardness, scanning electron microscope, differential scanning calorimetry) of the inner bottle generally showed some degradation/oxidation of the outer and inner surface wall layers, but the bulk materials were intact. Gasket materials did show significant material degradation. Examination of 2 (two) inches bung material indicated that over torquing of the closure was a likely cause of observed failures (leaking around the closure).

CONCLUSIONS

None of the expired IBC from a single manufacturer tested in this study were able to pass all the performance tests required of new IBC designs, demonstrating safety concerns about service life extension for IBCs beyond the current 60 months without additional mitigation measures.

Several performance tests (leak-proofness, hydraulic pressure, drop) and materials testing indicated issues with the closures and gaskets.

No IBC manufacturer/design performed significantly better or worse than any other.

REFERENCES

[1] *Recommendations on the Transport of Dangerous Goods - Model Regulations - Volume 1*, twenty-first revised edition, New York and Geneva: United Nations, 2019.

[2] Canadian General Standards Board, *CAN/CGSB-43.146-2016, Design, manufacture and use of intermediate bulk containers for the transportation of dangerous goods, classes 3, 4, 5, 6.1, 8 and 9*, 2016.

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KEYWORDS

Intermediate bulk container, IBC, small means of containment, CAN/CGSB-43.146, life extension, performance testing