HYDROCARBON MANAGEMENT

Global product loss benchmarks

***Paul Harrison*, Consultant to the EI's HMC-4A and B Marine Oil Transportation Database Committees, presents findings from recent analysis of marine products shipment data.**

The Energy Institute's (EI) HMC-4A Marine Oil Transportation Database Committee has been collecting and analysing worldwide crude oil shipping data for over 25 years, publishing annual summary reports in *Petroleum Review*. A second sub-committee (HMC-4B) began to pool product data in 2004 and published an article in the October 2017 issue, presenting benchmark information for the main product groups.

Data was collected for 2014 but then ceased, following several years with stable results. However, the group collected data in 2018 to determine if any significant changes had occurred. This article presents the main findings from analysis of the 2018 results, in addition to those from the previous work. It must be noted that 'losses' include apparent as well as physical losses. Apparent losses result from the combination of fixed and random errors in the measurement systems used at load and discharge. Shore-to-shore losses will include differences due to unmeasured product remaining on board and in transfer lines.

The following companies contributed data for 2018 – BP Oil International, ExxonMobil, Phillips 66, Preem and Saras. Although fewer companies contributed than for some of the previous years, the data was global and over 13,000 voyages were included, almost 8,000 with load and discharge data, covering international shipments and inland barge movements.

	Mean SV loss%	Standard deviation %	No.
2012			
Overall	–0.04	0.39	5,386
Barges	0.01	0.47	2,405
Ships	–0.08	0.31	2,981
2013			
Overall	–0.04	0.45	8,686
Barges	0.00	0.54	3,613
Ships	–0.08	0.37	5,073
2014			
Overall	–0.06	0.44	7,154
Barges	–0.03	0.51	2,678
Ships	–0.08	0.39	4,476
2018			
Overall	–0.03	0.40	7,967
Barges	–0.02	0.47	3,418
Ships	–0.05	0.34	4,549

Table 1: Load and discharge data, 2012–2014 and 2018
Source: Energy Institute

Database development

As there are a large number of product grades with many variations in grade names between companies and locations, nine key product types have been identified and used for the analysis – alcohol, chemicals, components, distillate, FAME, gasoline, heavy oil, LPG and lube oil.

Data collection was an issue at the beginning of the work as product tends to be shipped in much smaller quantities than crude, with a large number of small parcels involved. In 2004 less than 300 voyages with load and discharge data were submitted, but numbers rose gradually to reach 8,686 voyages with load and discharge figures submitted in 2013, as shown in **Table 1**. This fell to 7,154 in 2014 and rose slightly to 7,967 in 2018. A reasonable amount of data is available for both barges and ships.

In order to carry out a detailed study of measurement differences it is necessary to have data from the four main points of measurement in the voyage – shore measurement at loading (bill of lading; BOL), ship measurement after loading (and any onboard quantities; OBQ), ship before discharge (and any remaining onboard; ROB), and shore quantity received (outturn). Unfortunately, due to the nature of many product shipments, all these measurements are rarely available. Work has therefore focused on shore-to-shore differences, which are expressed in standard volume (SV).

Due to the wide variation in parcel size and the large number of small parcels involved, any small fixed volume differences which occur lead to large variations in percentage losses for small parcels. This gives large standard deviations associated with mean percentage loss figures and makes identification of significant differences difficult. Parcels of less than 1,000 m^3 have been excluded from the statistical calculations to reduce this problem.

Global losses

Data was limited during the initial years of the work, such that mean losses for individual product groups were very variable. Work therefore concentrated on overall combined shore-to-shore losses (SV loss). This overall mean has continued to be tracked and mean overall SV losses from 2011 to 2018 are shown in **Figure 1**.

The overall figures for 2018 seem to fit closely with the 2011 to 2014 results. The mean overall SV loss across all product groups has remained between –0.03% and –0.06% for each of the data sets. This is significantly lower than mean loss for crude oil (NSV loss) which was around –0.17% for this period. This is perhaps to be expected as crude oil still contains light hydrocarbons which are subject to evaporation, particularly during load and discharge. This is not the case for products, except for liquefied gases which are carried under 'sealed' conditions; pressurised and/or refrigerated.

Barges versus ships

Mean losses for inland barges remain significantly lower than those for ships. However, the standard deviation (scatter) for barge loss is higher than that for ships. See **Table 1** for the last four sets of figures.

The barge data includes North American and a small number of European inland barges. The latter show slightly higher losses and a smaller scatter than the North American barges but do not impact on the overall figures.

Individual product losses

Having noted the systematic difference between barge and ship losses it is necessary to separate barge and ship data when

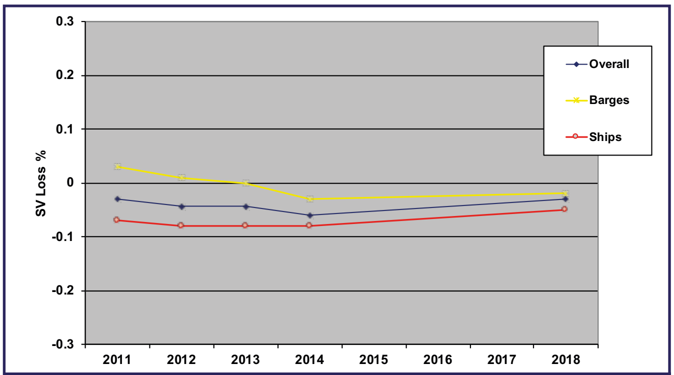

Figure 1: Product losses in 2011–2018 by mean parcel standard volume (SV) loss *Source: Energy Institute*

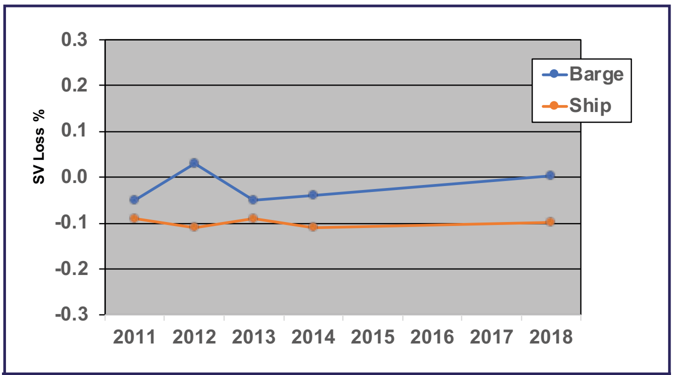

Figure 2: Gasoline – barge vs ship losses, 2011–2018

Source: Energy Institute

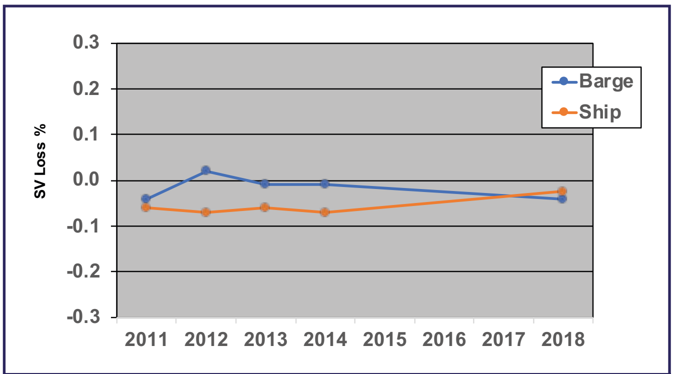

Figure 3: Distillate – barge vs ship losses, 2011–2018

Source: Energy Institute

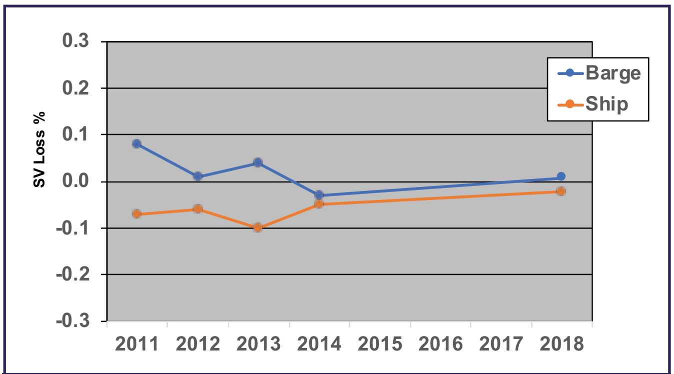

Figure 4: Heavy oil – barge vs ship losses, 2011–2018

Source: Energy Institute

considering losses for individual product groups. Unfortunately this reduces the number of individual cargoes available in each category, but useful comparisons can be made for the main cargo types. These are shown in **Table 2** and **Figures 2**, **3** and **4**.

Inland barges have typically shown a lower loss than ships across all main product types; although for distillate in 2018 losses were almost identical with the barge loss, a little higher but not significantly. It seems apparent from the more consistent ship data that gasoline suffers slightly higher losses than distillates or heavy oil. This is statistically significant (95% level) for gasoline versus distillate in 2013, 2014 and 2018, and for gasoline versus heavy oil in 2012, 2014 and 2018.

Component losses lie between those for distillates and gasolines. Other product types show more scattered results. This is partly due to the relatively small number of cargoes and also, particularly for chemicals, because the product type covers a more diverse range of products than the other types.

Conclusion

The analysis indicates that overall product losses remain less than those for crude oil, with barges showing lower mean losses than ships, but with more scatter.

Grouping the large number of individual products into product groups has allowed meaningful benchmark information to be produced for the main product types gasoline, distillate and heavy oil.

The Committee is currently considering collecting 2022 data for analysis and is also looking to collect and pool information regarding product quality issues. New members are always welcome to join and expand the database and any companies with an interest and data to submit should contact Kishan Kansara at the Energy Institute on t: +44 (0)207 467 7127.

Disclaimer

The EI as a body is neither responsible for the statements or opinions presented in this article, nor does it necessarily endorse the technical views expressed.

	2012 Standard volume loss %			2013 Standard volume loss %			2014 Standard volume loss %			2018 Standard volume loss %		
	Mean	St. dev.	Count	Mean	St. dev.	Count	Mean	St. dev.	Count	Mean	St. dev.	Count
Barge												
Gasoline	0.03	0.50	552	−0.05	0.48	876	−0.04	0.29	547	0.00	0.36	537
Distillate	0.02	0.36	336	−0.01	0.35	697	−0.01	0.38	500	−0.04	0.37	753
Heavy oil	0.01	0.54	855	0.04	0.62	1,111	−0.03	0.64	713	0.01	0.65	1,082
Ship												
Gasoline	−0.11	0.36	588	−0.09	0.37	1,191	−0.11	0.42	1,268	−0.10	0.38	1,169
Distillate	−0.07	0.31	1,251	−0.06	0.30	1,966	−0.07	0.36	1,389	−0.02	0.31	2,047
Heavy oil	−0.06	0.30	516	−0.10	0.44	1,079	−0.05	0.32	892	−0.02	0.39	640

Table 2: Individual product losses, 2012–2014 and 2018 *Source: Energy Institute*