Use of the Newly Developed ASTM Standard F 2709 (Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems)

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Abstract

The American Society of Testing and Materials (ASTM) subcommittee on skimmers recently adopted a standard methodology for measuring skimmer performance, F 2709 - . *Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems.* Current industry practice allows manufacturers to label skimmers with a nameplate capacity based solely on the skimmer's offload pump capability without regard to the recovery rate as a system. Additionally, there is no consideration given to the degradation in recovery performance when pumping fluids with viscosities higher than water. Typically, the manufacturer's claimed value is unrealistic when estimating the oil recovery rate (ORR) of a skimming system. Integrating actual performance data into the planning and regulation process is prudent from all perspectives. In the absence of third party data, the United States Coast Guard (USCG) will de-rate a manufacturer's claimed nameplate capacity by 80% or more when calculating the Effective Daily Recovery Capacity (EDRC). The USCG uses EDRC as a key component in rating and regulating the oil spill response capability of responsible parties and oil spill response organizations (OSROs).

The ASTM's new skimmer protocol has been used recently at Ohmsett to evaluate four oleophilic skimmers as potential alternatives to the skimmers currently used in Alaska's Prince William Sound (PWS) oil spill response plan. The selected skimmer has undergone a number of modifications with improvements quantified over four additional tests series. This paper focuses on the most recent test of this skimmer, conducted in cold-water conditions using both fresh and weathered Alaska North Slope (ANS) crude oil. During the latest testing, two newly introduced tests were performed: a 24-hour endurance test and a qualitative recovery test in the presence of seaweed.

Background

The deployment of inferior oil spill recovery equipment reduces recovery efficacy and potentially increases the environmental impact of a spill.

In an effort to quantitatively establish baseline performance values for skimmer recovery systems, an ASTM F-20 subcommittee, the USCG and Ohmsett initiated and developed ASTM F 2709. The standard was officially balloted and adopted in 2008.

The test method was designed to provide ideal conditions for the skimmer system. The test setup and procedure was designed to be simple and feasibly performed with minimal space, oil and cost. While it is understood that the test is performed under ideal conditions, and actual recovery rates will be less, the intention of the standard is to allow the skimmer to operate and collect oil at its maximum possible recovery rate.

The skimmer discussed here is an oleophilic disc skimmer with multiple discs and a high capacity offload pump. The skimmer is constructed with onboard floatation and is hydraulically powered. The rotational speeds of the discs are controllable remotely and directly affect the oil recovery rate (ORR) and corresponding recovery efficiency (RE) (Table 1).

Table 1: Oil Recovery Rate and Oil Recovery Efficiency

OIL RECOVERY RATE AND OIL RECOVERY EFFICIENCY

$$ORR = \frac{V_{oil}}{t}$$

WHERE:

- ORR = Oil Recovery Rate, gpm or bbl/hr
- V_{oil} = Volume of oil recovered, gal (decanted and lab corrected)
- t = Elapsed time of recovery, min

$$RE = \frac{V_{oil}}{V_{total\ fluid}} \times 100$$

WHERE:

- RE = Recovery Efficiency, %
- $V_{total\ fluid}$ = Volume of total fluid (water and oil) recovered, gal

Test Method

The skimmer was positioned in the center of the test area (figure 1). As part of the standard, the offload discharge is required to be elevated 3.5 meters (11.5 feet). Sufficient oil was preloaded into the test area to create a 7.62-cm (3-inch) thick slick. Two oils were used during the test series; fresh and weathered Alaska North Slope (ANS) crude.

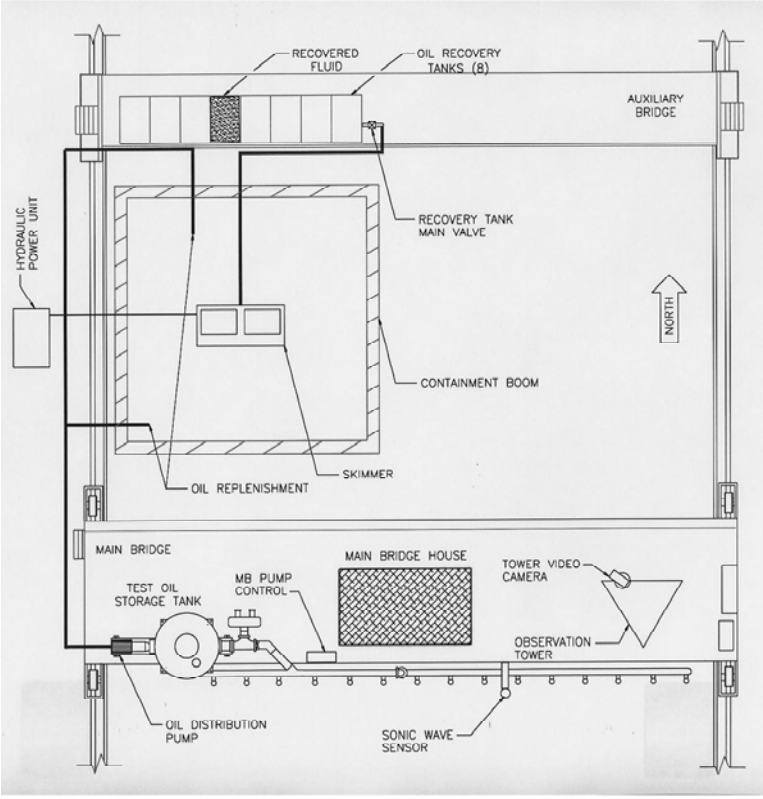

Figure 1: Test set-up area

The test measurement period began once the skimmer was adjusted to its optimum setting and the discharge flow appeared to be at steady state. Flow was then directed to a collection tank and elapsed collection period measured (figure 2). As per F 2709, the system is to collect until the slick has been reduced from 7.6 cm to 5.1 cm (3 inches to 2 inches) and shall last a minimum of 30 seconds (ASTM, 2008a).

In addition to recovery performance of the skimmer system, potential users wanted to test the durability of the system and determine if performance would be degraded by extended use. To address this concern, a test was conducted in which the skimming system operated continuously for 24 hours. After the 24-hour period, a recovery test using the previously determined operating parameters was performed. The recovery rate was comparable for the test speed, with a slight degradation in recovery efficiency. The users were also concerned about the affects of seaweed on the skimmer. A qualitative recovery test was performed with seaweed introduced into the collection area.

Figure 2: Testing with skimmer adjusted to optimum setting and discharge flow directed to the collection tanks

Results and Data Quality

To determine the maximum recovery rate and corresponding recovery efficiency, a series of preliminary tests were performed with the oleophilic discs operating at different rotational speeds (figure 3). The calculated results converged on the optimal rotational speed of the oleophilic discs. The test was repeated three times using the same independent parameters, as recommended by ASTM F 2709 (ASTM, 2008a). The standard method ensures that the result of one test is not an anomaly by using the average of three test values which must be within 20% of the arithmetic mean. To meet the requirements of the test standard, each result must be above 70% recovery efficiency.

For the skimmer system tested, the average oil recovery rate was determined to be 860 gpm with a corresponding recovery efficiency of 84%. The standard deviation of the three test values for recovery rate was 47 gpm and for recovery efficiency 1.7%.

Figure 3: Tests were performed with the oleophilic discs operating at different rotational speeds

Discussion

The primary objective of the standard is to encourage testing and establish baseline performance values for skimming systems using real oil. The scope of the standard is intended to provide ideal recovery conditions, allowing the skimmer system to operate and collect oil at its maximum possible recovery rate.

Performance testing benefits all stakeholders in the oil spill community, notably:

- End users will know the maximum achievable recovery rates and efficiencies.
- End users can perform comparison testing.
- Planners and regulators will know if a skimming system is effective for a particular spill scenario and given viscosity.
- The standard requires testing as a "skimming system" confirming functionality of each component as a system.
- Planners and regulators can estimate storage requirements for a spill knowing the recovery efficiency of the skimmer system.
- Manufacturers can market their equipment's performance referencing a standardized test method.
- Manufacturers can implement design changes and quantify effects on performance.
- OSROs can submit third party performance data to the USCG for use in calculating EDRC values as per 33CFR appendix B to part 155 (USCG, 1997).

Conclusions

Without a standard test protocol, one manufacturer's nameplate capacity is generally not comparable with another manufacturer's nameplate capacity, making it extremely difficult for prospective skimmer buyers and regulators to accurately gauge, measure, or compare skimmer oil recovery performance.

Federal and State regulatory agencies and oil spill removal organizations (OSRO) need a skimmer's nameplate capacity to reflect the ability of a skimmer, as a system, to recover spilled oil. The system would include the skimmer's hydraulic power unit (HPU), control stand, skimmer, the offload pump(s), and a modest length of cargo line to transfer the collected oil to a storage tank. The test protocol was designed to be simple and inexpensive, making it feasible for the manufacturers to perform while rigorous enough to deliver reliable, repeatable test results. While the test may represent a 'best-case' scenario, it will provide an Oil Recovery Rate (ORR) that is attainable by the skimmer system and not based on the maximum theoretical capacity of a single component as is often the case.

REFERENCES

ASTM, *Annual Book of ASTM Standards: F 2709 - Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems*, American Society for Testing and Materials, West Conshohocken, PA, 2008a.

USCG, *Determining and Evaluating Required Response Resources for Vessel Response Plans*, 33CFR154 and 33CFR155, Washington, D.C., U.S. Government Printing Office, 1997.

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