

Converted T-ATF Class Ship for Ocean Plastics Retrieval

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Project Motivation

Plastics are durable, high-strength, corrosion-resistant materials that are relatively energy-efficient to manufacture. Unfortunately, plastics are generally not economical to recycle and lose strength when reprocessed. Most plastics are dumped in landfills or incinerated but some of this waste ultimately ends up in the world's waterways. This is a major issue because plastics pose numerous threats to marine wildlife and humans. Additionally, floating plastic “patches” can present entanglement problems to seagoing vessels.

There are few processes in nature which can remove plastics from the ocean at a sustainable rate. Human-driven efforts have been initiated to either manually or autonomously remove the waste. The most well-known and successful company to tackle this problem is *The Ocean Cleanup*, a Netherlands based non-profit primarily targeting the removal of floating ocean plastics in the Great Pacific Garbage Patch. To help augment their efforts, it was proposed that a recently decommissioned U.S. Navy or Military Sealift Command (MSC) ship be converted for the purposes of ocean plastics retrieval.

Existing Ocean Plastics Retrieval Technology and Ship Selection

The Ocean Cleanup currently employs two Maersk Trader class ships that utilize shipboard winches to control the dragging of two “wing” sections separated by a long, rectangular retention zone (*Figure 1, Left*). The towing vessels travel at approximately 1.5 knots and floating plastic waste accumulates along the wings, slowly migrating toward the central retention zone area. Approximately once per week, the retention zone is brought onboard one of the ships. A crane is then utilized to hold the zone vertical while releasing the plastics collected onto the ship's aft deck (*Figure 1, Right*). Onboard, the plastics are manually sorted by the ship's crew and ultimately stored in conex boxes (also located on the ship's aft deck).

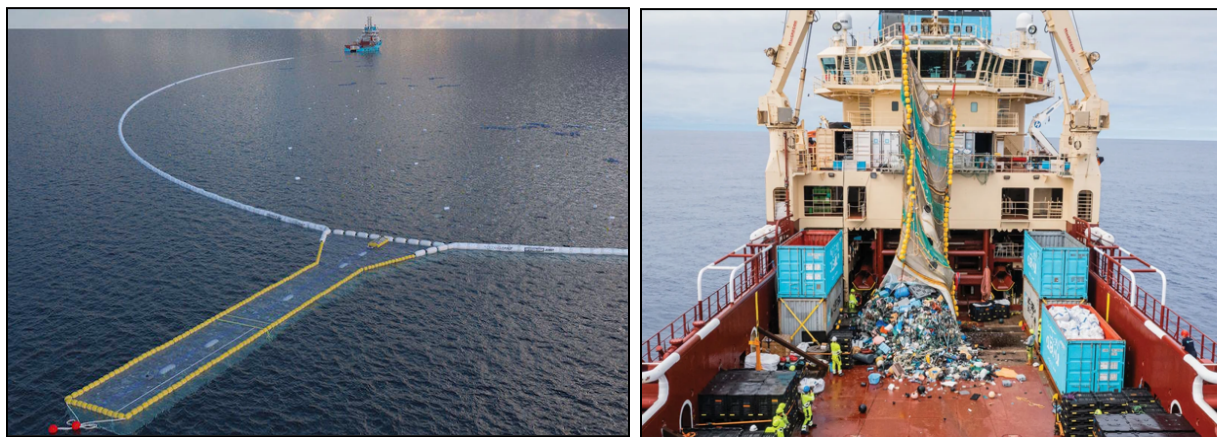


Figure 1: The Ocean Cleanup's Jenny 002 System (Left) and Retention Zone on Aft Deck (Right)

Based on the equipment required to handle the netting system and the general scheme of operations used by *The Ocean Cleanup*, a Naval ship platform was selected that possessed similar towing and lifting equipment, adequate empty space for plastics storage, and excellent maneuvering abilities at slow speeds. The optimal ship class that had these characteristics was the MSC's decommissioning Fleet Ocean Tug (USNS Powhatan T-ATF-166) Class (shown in *Figure 2, Left*). The final proposed design for the converted T-ATF included two new cranes with

increased lifting capacity and the addition of a plastics sorting and compacting machine within an interior main deck space (*Figure 2, Right*).

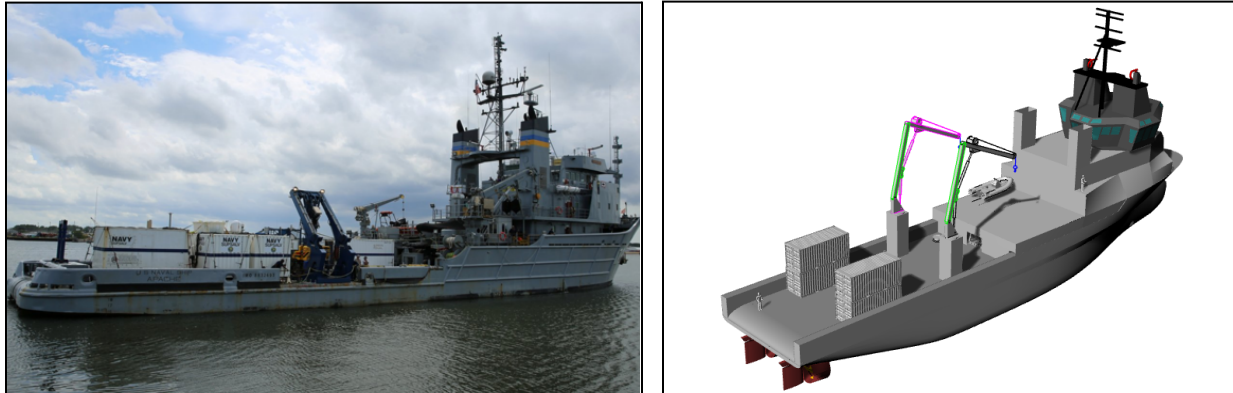


Figure 2: USNS Apache (T-ATF-172)(Left) and Converted Platform (Right)

Design Philosophy and Assumptions

The purpose of this conversion project was to provide the fleet with a “Green Graveyard” ship, still owned and operated by MSC, whose primary purpose was to perform plastics cleanup efforts. The following design philosophy was adopted to perform this conversion project: (1) Plastics retrieval is the primary mission, (2) Feasibility and Scalability, and (3) Operations should minimally impact the environment.

The final design did not alter the original ship hullform, or propulsion and electrical plants. The only changes made were to support the plastics capturing equipment utilized by *The Ocean Cleanup*. These converted ships were proposed to operate only out of Naval continental U.S. ports. Installed sorting and compacting equipment was assumed to be suitable for marine environment operation and could be scaled to fit inside proposed ship spaces.

Feasibility and Performance Analyses

The feasibility study performed in this project was limited by the lack of an available T-ATF 3D model. Instead, a standard offshore supply vessel was utilized for all Rhino modeling as well as MAXSURF stability and seakeeping analyses. The off-shore supply vessel had similar structural arrangements but some adjustments were made to more accurately represent the T-ATF class ship.

The feasibility analysis assumed hull strength, propulsion and electrical power requirements were satisfied. The intact stability analysis satisfactorily passed for hydrostatic conditions. Seakeeping analysis reflected favorable conditions for tow operations and working personnel limitations. Additionally, an operational profile was created in order to predict fuel consumption which was required for conversion and operational cost analysis. The total estimated cost was \$43 million.

Conclusion

Based on this initial conversion study, a comprehensive analysis was warranted to determine the full technical feasibility of this project. In future studies, further structural analysis due to the additional weights of cranes, sorter and compactor was recommended. An electrical analysis needs to be performed to verify installed electrical capacity meets the electrical demand of added equipment. Finally, intact and damaged stability analysis should be completed for all loading conditions.