

# **TWINKLE CO**

P O Box 79 - West Liberty, IA 52776

800 258 3702

www.twinkleco.com

## **The Facts of Flotation**

You may have observed that many Twinkle Co dredges have cylindrical flotation, and most other dredges have rectangular flotation. The choice between rectangular and cylindrical flotation is simply a matter of inefficiency vs. efficiency. Flotation is nothing more than structure to locate components and displacement volume to support the weight of the dredge. Cylindrical flotation provides the best strength-to-weight ratio and is the most efficient shape to achieve the necessary volume.

### **Efficiency of Cylindrical Flotation**

In effect flotation is a pressure vessel, with the pressure being the water relentlessly pressing on the outside of the flotation. Failure to resist the hydrostatic pressure will result in crushing and distortion of the flotation. Cylindrical flotation is efficient because the curved(arched) surface is inherently strong to resist the pressure. The flat surface of rectangular flotation requires internal bracing to resist the relentless crushing force of the hydrostatic pressure. The internal bracing serves only to maintain the rectangular shape. It is deadweight as regards flotation. Typically, the internal stiffener weight penalty is 20% of the external sheet weight or "skin".

Rectangular inefficiency varies with the shape, a true square is as good as it gets and a rectangle slightly worse. A cylinder with a diameter of 5 feet has a circumference of 15.7 feet and a cross sectional area of 19.63 square feet. An equivalent square would have 4.43 foot long sides and a perimeter of 17.72 feet. An equivalent rectangle that is 5 feet wide would be 3.93 feet high and have a perimeter of 17.86 feet. To achieve the same area as the circle the square requires 13%, and the rectangle 14%, additional skin material. As with the internal stiffeners, the additional skin material is deadweight as regards flotation.

A positive feature of rectangular flotation is the top surface, which forms a ready made walkway. Cylindrical flotation requires additional external structure to create a walkway. There are many ways to fabricate walkways on cylindrical flotation, ranging from a full width top deck to a simple Grip-Strut walkway down the center. Regardless of the construction, the walkway structure is less weight than the internal stiffeners and extra skin material in rectangular flotation of the same displacement.

We are not alone in our knowledge regarding the strength and efficiency of cylindrical shapes. Designers of soda cans, submarine hulls, aircraft fuselages, propane tanks, pipes, rockets, gun barrels, water towers, drinking straws, hydraulic cylinders and other cylindrical pressure vessels all recognize the advantages of cylindrical volume.

## **Welding and Design**

In addition to the deadweight of internal stiffeners, rectangular flotation often has more submerged welds, and thus more potential leaks. The “skin” of the flotation will be distorted if the internal stiffeners are not adequate to resist the crushing force of the water. When this occurs the distortion creates stress concentrations in the corner welds, and over time leads to cracked and leaking welds. The rectangular center sections of Twinkle Co dredges have full depth framing to prevent distortion.

Proper flotation design dictates that internal bulkheads form compartments to contain flooding if a leak develops. To be effective, the bulkheads must be full welded so that each compartment is a true watertight cell. Rectangular flotation is often full welded at the bottom and sides, but not the top, allowing water from a flooded space to cascade into the next. This “Titanic” flaw has led to the sinking of many dredges. Twinkle Co flotation, cylindrical or rectangular, is full welded at the bulkheads to form true watertight compartments.

Rectangular flotation often includes manholes to access the interior of the flotation. We are unclear as to why it is important to easily access the interior spaces of rectangular flotation. Perhaps the interior spaces must be periodically checked for flooding or deflection of the bottom plates. Regardless of the intended purpose, it is difficult to maintain watertight integrity in a compartment when there is a man-sized hole in the top. Manhole covers are frequently observed to be loose, missing completely or have damaged or missing seals. All of these conditions can lead to water intrusion. Water on the inside of flotation units is a serious problem.

Twinkle Co flotation does not have manholes. We provide threaded access ports for inspection and, if required, a suction tube for pumping out flooding. These access holes are normally plugged to maintain watertight integrity. With manholes, even if the flotation is properly designed and built with full watertight bulkheads, the manholes provide a path for flooding. Manholes are literally an open invitation to disaster and should be avoided.

## **Stability and Usable Volume**

Much is made by our detractors of the supposed instability of a dredge with cylindrical flotation. As part of the story they create a fictional world where the pontoons are somehow separated from the dredge and allowed to run free, acting like logs in log rolling contest. This fantasy ignores the fact that when the dredge is assembled and operating the pontoons are firmly attached to the dredge center section with our Hook & Bolt locking arrangement.

The truth is that the stability of an assembled dredge is not determined by the circular or rectangular cross section of the side pontoons. The stability of an assembled dredge is determined by analyzing the structure as a unit. The height, weight and location of the structure coupled with the displacement/center of buoyancy of the flotation elements is used to determine the metacentric height. You do not get extra credit for square corners.

Another myth concerning cylindrical flotation is that only the displacement below the centerline can be used, and cylindrical flotation will plummet to the bottom if displaced below the centerline. In fact, cylindrical flotation has as much displacement above the centerline as it does below. The displacement per inch is not linear, but the total displacement volume of the cylinder is available to support the dredge. This is quickly demonstrated by pushing a basketball underwater in a bathtub. It does not get easier to submerge the ball past the halfway point, and in fact requires additional effort to submerge the ball from halfway to the point of being fully submerged.

## **Conclusion**

The First Law of Successful Dredging states, the dredge must float at all times. To achieve that, we have been using sealed cylindrical flotation on our dredges for over 20 years. In that time, **none** of our dredges have sunk. That fact speaks volumes for the benefits of cylindrical flotation. It is doubtful that any other dredge manufacturer can honestly make that statement.

Our customers have a choice. We have, and will, build rectangular flotation if the customer is willing to pay the price for volumetric inefficiency. The center section of our dredges is rectangular, so we are familiar with the proper design and construction of rectangular flotation. Our familiarity with both types of flotation allows us to provide customers with an unbiased representation of fact regarding the shape of flotation elements. In our experience, when customers are presented with the facts of flotation they choose the price and performance benefits of cylindrical flotation.