A Comparison of Top Entry vs. Side Entry Agitator Performance in Low Viscosity Blending

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Abstract

Side entry agitators have been successfully used for years in many low viscosity blending applications. Some applications include crude oil storage, gasoline storage, asphalt storage and various duties in the Ethanol market and other agricultural markets. The majority of these applications utilize very large tanks (greater than 20 to 30 meters in diameter). Top entry agitators are often not practical due to the need for a large support structure and a higher initial capital cost. Side entry agitators, although requiring more power than top entry agitators, can yield homogeneity with less capital cost as long as long blend times are acceptable (hours or days).

In general when comparing a top entry agitator selection to a side entry agitator selection in a blending application, the side entry selection will require anywhere from two to four times the power of the top entry selection to yield a similar process result. The power levels required for homogeneity in oil and gasoline storage have been well documented by both agitator vendors and oil/gasoline producers (HIM pp. 1180-1181). The goal of this study was to compare the blending capabilities of top entry versus side entry agitator set ups in the lab. Blend time correlations have been developed in the lab and exist for top entry agitators operating in the turbulent regime as studied by Grenville (HIM p. 509). This study compared the power requirement of top entry versus side entry agitator set ups to yield the same blend time.

A 1.21 m diameter clear vessel was used for the testing and several top entry set ups (0.15 to 0.3 D/T with three wall baffles) were compared to a single side entry set up (0.09 D/T with no wall baffles). The side entry set up was angled 7 degrees to the left of center. High efficiency three-bladed hydrofoil impellers were used for the test work (LIGHTNIN A310 top entry, LIGHTNIN A312 side entry). Each test set up was operated at various speeds (power levels) and liquid levels (two liquid levels were studied). Blend time was recorded for each run using three to four conductivity probes with water as the base fluid and a saturated sodium chloride solution as the tracer.

Results show that a side entry agitator can effectively blend low viscosity fluids as compared to a top entry agitator. The power requirement for the side entry agitator is at least 1.5 times that of the top entry agitator to yield the same blend time. As the Z/T is increased, the difference in power between the side entry and top entry agitator increases to 2.5. The results from this study are also compared to existing blending correlations previously mentioned. Additional work in the future should include the effect of multiple side entry agitators on blending versus a single side entry agitator.