Advantages of “SLOW SPEED MIXING”

When choosing a top-entering turbine mixer for a process, or when comparing recommendations by different manufacturers, power is often used as the criterion for evaluation. While this is a valuable tool, it can be misleading; since the manner in which power is applied is as important as the amount of power. For many mixing applications, it can be shown that there are many advantages to be gained from slower operating speeds, with no loss of effectiveness.
Indeed, by operating a mixer slower and slower while increasing the impeller diameter commensurately, a constant pumping rate can be maintained while reducing the power required more and more.

Here is the reason:

Under turbulent operating conditions (Reynolds’ Number greater than 10,000), power required is proportional to the product of the rotational speed cubed and the impeller diameter raised to the fifth power ($P=k_1N^3D^5$). The pumping rate of the impeller is the product of the speed and the impeller diameter cubed ($Q=k_2ND^3$).
If turbulent conditions are maintained, it is reasonable to assume that a given number of tank turnovers through the mixer will provide uniform blending of the contents. In fact, this has been experimentally confirmed for many applications involving the blending of miscible liquids, high-rate liquid phase reactions, certain dissolving, washing and leaching operations, etc. Thus selection of a mixer based on circulation rates rather than horsepower may provide substantial benefits.

For example:
Assume we are to duplicate an existing acidic waste neutralization which requires a 5 horsepower mixer having a 35” turbine rotating at 100 rpm. By examining lower speeds, we will find that a 48” turbine rotating at 45 rpm will provide a greater pumping rate and equal or less mixing time than the existing unit. Further, this mixer requires only two horsepower to achieve the same results.
The lower power and torque allow the use of a smaller gearbox and a smaller mixer shaft, reducing capital cost in addition to the 60% reduction in operating expense.
Therefore, slow speed operation of top-entering mixers can provide equal or superior process results compared to higher speed units, with the following additional benefits:

1. Lower operating cost by reducing horsepower requirement.
2. Reduced maintenance expense associated with lower torque and less travel of wearing parts.
3. Lower capital expenditures because smaller motors, gear drives, and shafts usually more than compensate for the cost of larger turbines.
4. In tall vessels, the need for multiple turbines is reduced

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