Millipore®
Preparation, Separation,
Filtration & Monitoring Products

Technical Brief

Mobius® MIX100 Disposable Mixing System Characterization

Introduction

The need for faster cycle times and higher levels of operational flexibility has accelerated the adoption of single-use processing solutions in the biopharmaceutical industry. In response, the Mobius® MIX systems were launched—a family of disposable mixing systems that includes the MIX100 (100 L maximum operating volume), the MIX200 (200 L maximum operating volume) and the MIX500 (500 L maximum operating volume). The Mobius® disposable MIX systems include a carrier, a disposable Mobius® process container with an integral magnetically driven levitating impeller, a motor, and an electronic drive unit.

One of the most common process tasks in the biopharmaceutical industry is the mixing of media and buffer solutions for use in both upstream and downstream unit operations. The Mobius® MIX systems have been successfully used for mixing a variety of media and buffer solutions. The following study provides characterization data for the performance of the Mobius® MIX100 system at different impeller speeds, operating volumes, viscosities as well as operations in a cold room environment. In addition, the information presented in this Technical Brief can be used as a reference for numerous mixing applications.

Test Summary

1. Mixing Time for 1X PBS buffer components at 400 rpm and 300 rpm at a total operating volume of 100 L
2. Mixing Time for 1X PBS buffer components at 400 rpm in 100 L, 50 L and 25 L total operating volume
3. Operation under ambient conditions at different viscosities
4. Operation in a cold room environment
5. Negative Control
6. Mixing of Polysorbate 20 and sucrose

Mobius® MIX100 Typical Values

Parameter	Value/Range
Maximum Mixing Volume	100 L at 500 rpm
Bag Operating Pressure	Atmospheric
Mixing Operating Viscosity	0 to 40 cP
Impeller Speed	0 to 500 rpm
Environmental Operating Temperature	4 °C to 40 °C
Storage Temperature	0 °C to 40 °C
Power Supply Voltage	115/230 VAC, 50/60 Hz, single-phase
Operating Humidity Range (RH)	15% to 95% (non-condensing)
Storage Humidity Range (RH)	15% to 95% (non-condensing)

General Experimental Protocol

1. Add the total specified volume of water to the Mobius® MIX100 system.
2. Set the impeller to the specified speed.
3. Add the specified material to the Mobius® MIX100 system through the top bung port as a single addition.
4. Monitor the top of the system and in some cases the bottom, for conductivity at appropriate time intervals.
5. Continue mixing the system until there is visual confirmation that all solids have been incorporated and that 10 consecutive measurements are stable or the measurements have been stable for a minimum of 10 minutes.

Results

1. Mixing time, t_m, for 1X PBS buffer components at 400 rpm and 300 rpm in 100 L total operating volume:
   - t_m at 400 rpm = 3 minutes
   - t_m at 300 rpm = 5.5 minutes

   A general recommendation for solid/liquid mixing applications in the Mobius® MIX100 system is to operate at a minimum impeller speed of 300 rpm. The system is also capable of maintaining lower impeller speeds for applications such as liquid-liquid mixing. It is important to note that all specific applications will need to be evaluated prior to implementation.

   A conductivity probe was placed in the top and in the bottom of the Mobius® MIX system. The top probe was introduced by placing a small slit in the disposable process container. In order to minimize possible interference with the mixing, the probe was only introduced when readings were required. The bottom probe was placed by drilling through the system carrier and the disposable process container into the fluid in the Mobius® MIX system. The bottom probe was permanently held in place throughout the entire run. The placement of these probes was based on the results of a Computational Fluid Dynamic (CFD) analysis that showed these locations to be the slowest to mix. Based on the results presented in **Figure 1**, it was determined that monitoring a single location (such as the top) was sufficient for the entire vessel.
2. Mixing Time for 1X PBS buffer components at 400 rpm in 100 L, 50 L, and 25 L total operating volume:
   - t_m at 100 L = 3 minutes
   - t_m at 50 L = 3 minutes
   - t_m at 25 L = 2 minutes

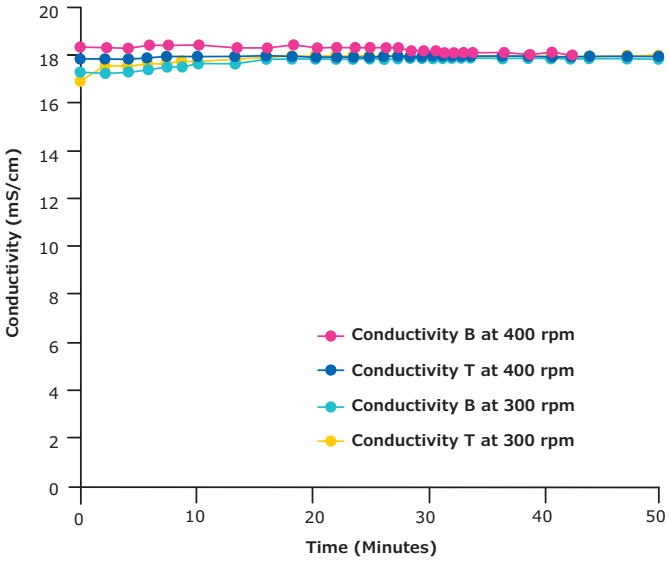

Figure 1. Conductivity vs. Mixing Time at 300 rpm and 400 rpm.

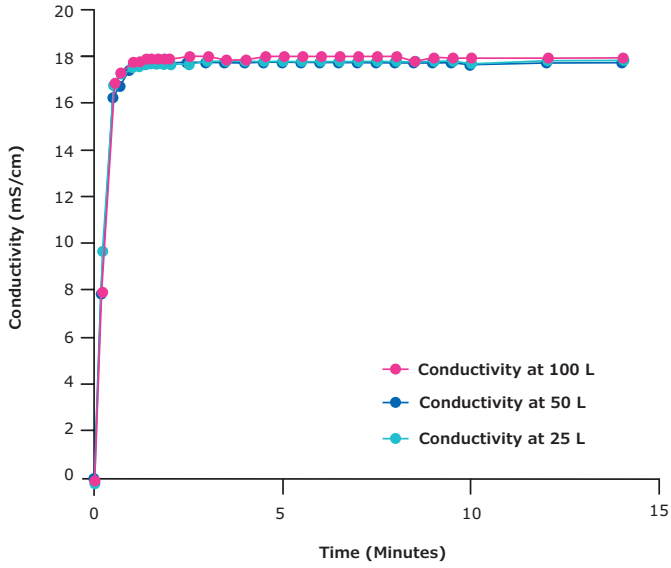

Figure 2. Conductivity vs. Mixing Time at 100 L, 50 L, and 25 L at 400 rpm.

3. Operation at different viscosities at 23°C with 100 L at 400 rpm:
   - t_m at 2 cP at 400 rpm = 35 minutes
   - t_m at 3 cP at 400 rpm = 35 minutes
   - t_m at 8 cP at 400 rpm = 45 minutes
   - t_m at 32 cP at 400 rpm = 75 minutes

The mixing time is reported for 1X PBS buffer components in a solution of the specified viscosity.

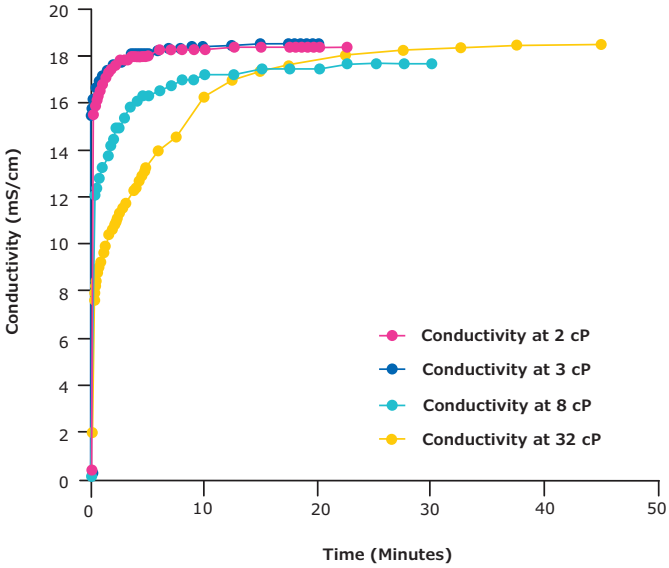

Figure 3. Conductivity vs. Mixing Time at 2 cP, 3 cP, 8 cP, and 32 cP at 23°C.

4. Operation in a cold room environment:
   - t_m at 400 rpm at 4°C = 18 minutes

   The total system operating time at 4°C was two days, which did not adversely impact the system or the electronics. The mixing time is reported for 1X PBS buffer components in the cold room after the two-day exposure period.

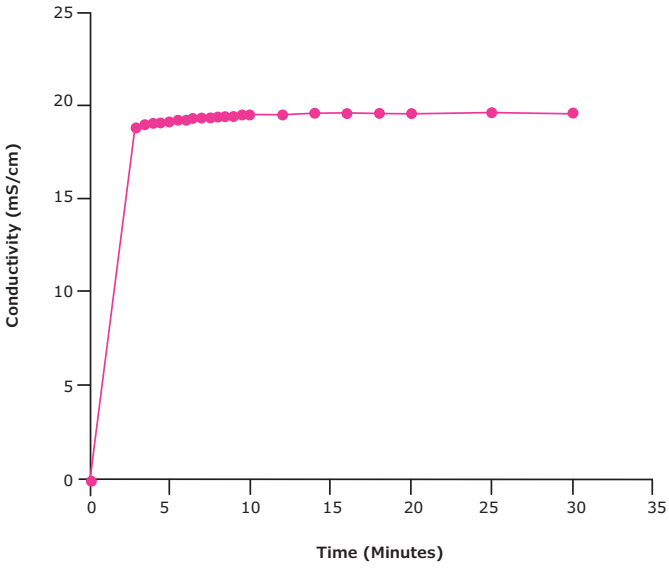

Figure 4. Conductivity vs. Mixing Time While Operating in a Cold Room.

5. Negative Control:
   - t_m for 1X PBS = 75 minutes

   Mixing was accomplished by creating a recirculation loop using silicon tubing through a Watson-Marlow peristaltic pump (Model 77601-10) as a recirculation device. The pump was operated at a flow rate of approximately 7 L/min.

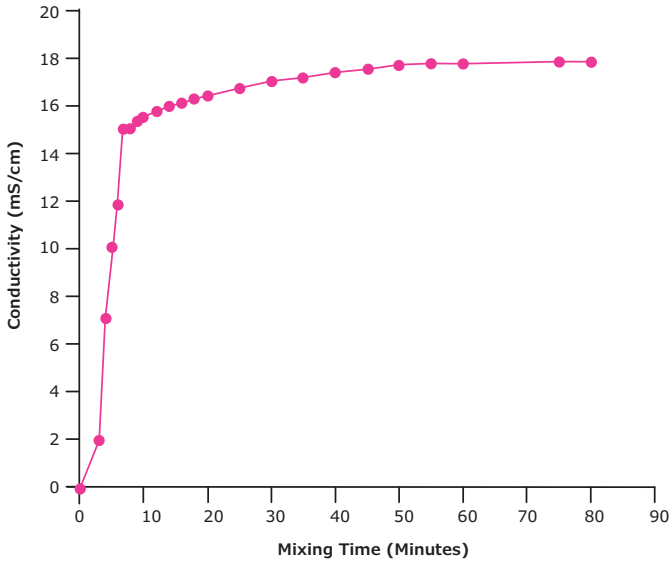

Figure 5. Conductivity vs. Mixing Time Using a Peristaltic Pump for Mixing.

6. Process Stream Simulation:

   The Polysorbate 20 and sucrose streams were visually inspected for complete mixing.
   - t_m for Polysorbate 20 (1% v/v) at 400 rpm = 5 minutes
   - t_m for sucrose (10 g/L) at 400 rpm = 5 minutes

Recommended General Protocol

The mixing studies documented in this report were completed by adding the total volume of water first and then by adding any required components. This was to evaluate the mixing system's ability to process the total liquid volume. A generic procedure for the use of the mixing system is stated below.

Generic Mixing Protocol

1. Weigh out water or starting solution to approximately 25% to 50% of the final target.
2. Set the impeller speed to 400 rpm or validated mixing speed.
3. Add the solid- or liquid-phase ingredients and continue mixing between additions of each component.
4. Add sufficient quantity of water or starting solution to 98% to 100% of the final target. pH or other measurements may be required before the final q.s.

Summary

Based on this characterization work, the Mobius® MIX100 system is capable of handling a variety of liquid-liquid and solid-liquid mixing applications. The information presented in this Technical Brief can be used as a reference for numerous mixing applications. However, we recommend that all specific applications be evaluated prior to implementation. Contact your local Applications Specialist for assistance with any Mobius® process solution.

References

1. Mobius® MIX200 Disposable Mixing System Application Note (AN1274EN00)
2. Mobius® MIX500 Characterization Technical Brief (TB1700EN00)

For more information, please visit
EMDMillipore.com

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