

# Fluid Flow Modeling in a Bioreactor Applied to Wine Production



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## Introduction

Wine quality is strongly dependent on the operation parameters of the production process.

In batch or fed batch reactors, the rotating velocity should be carefully controlled to avoid cellular stress and ensure adequate mixing of the mixture.

### Objective

Investigate the fluid flow in a batch reactor applied to varietal wine production.

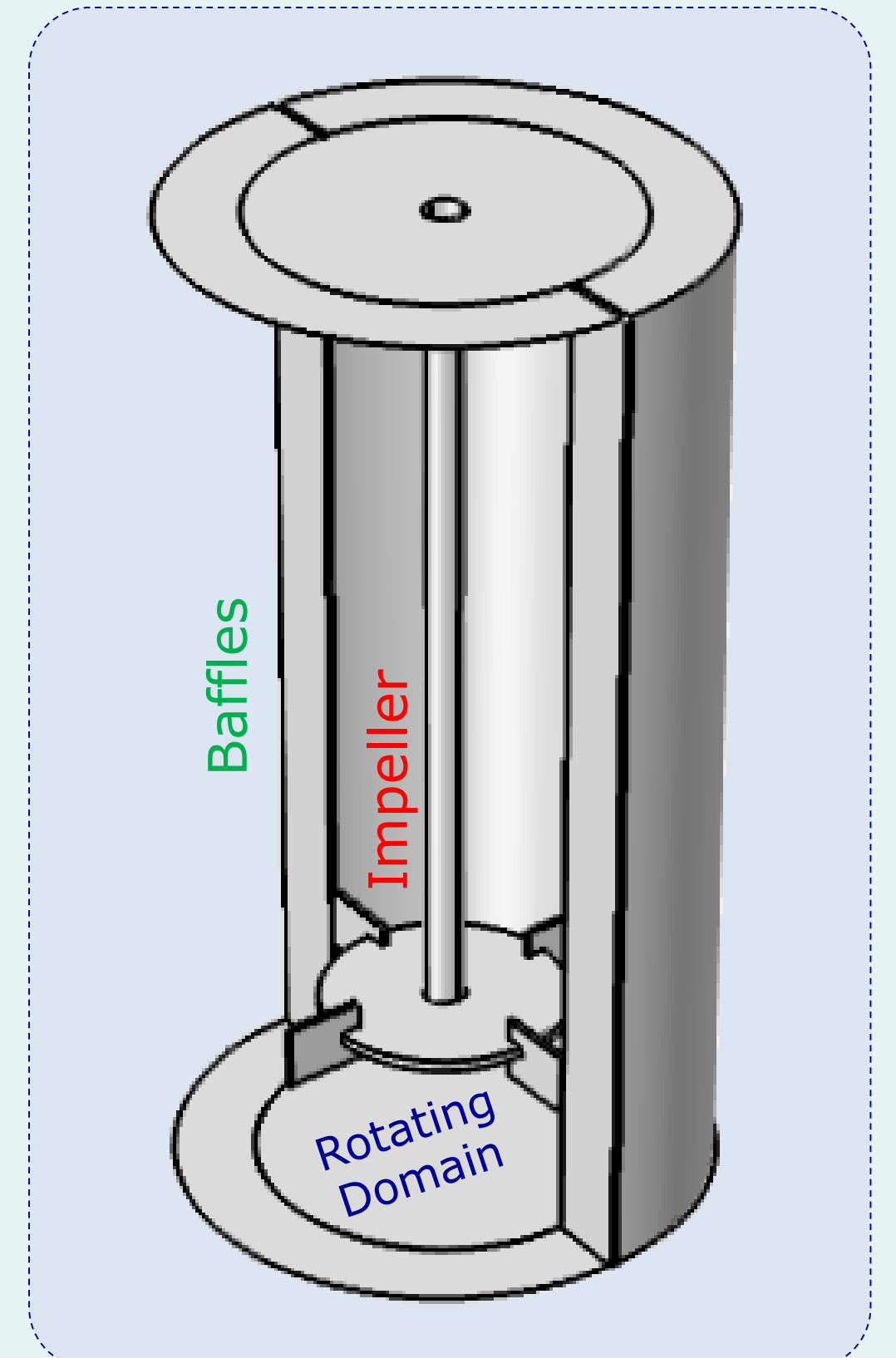
## Method

A 3D geometry representing the real equipment installed at UNSJ was built using COMSOL.

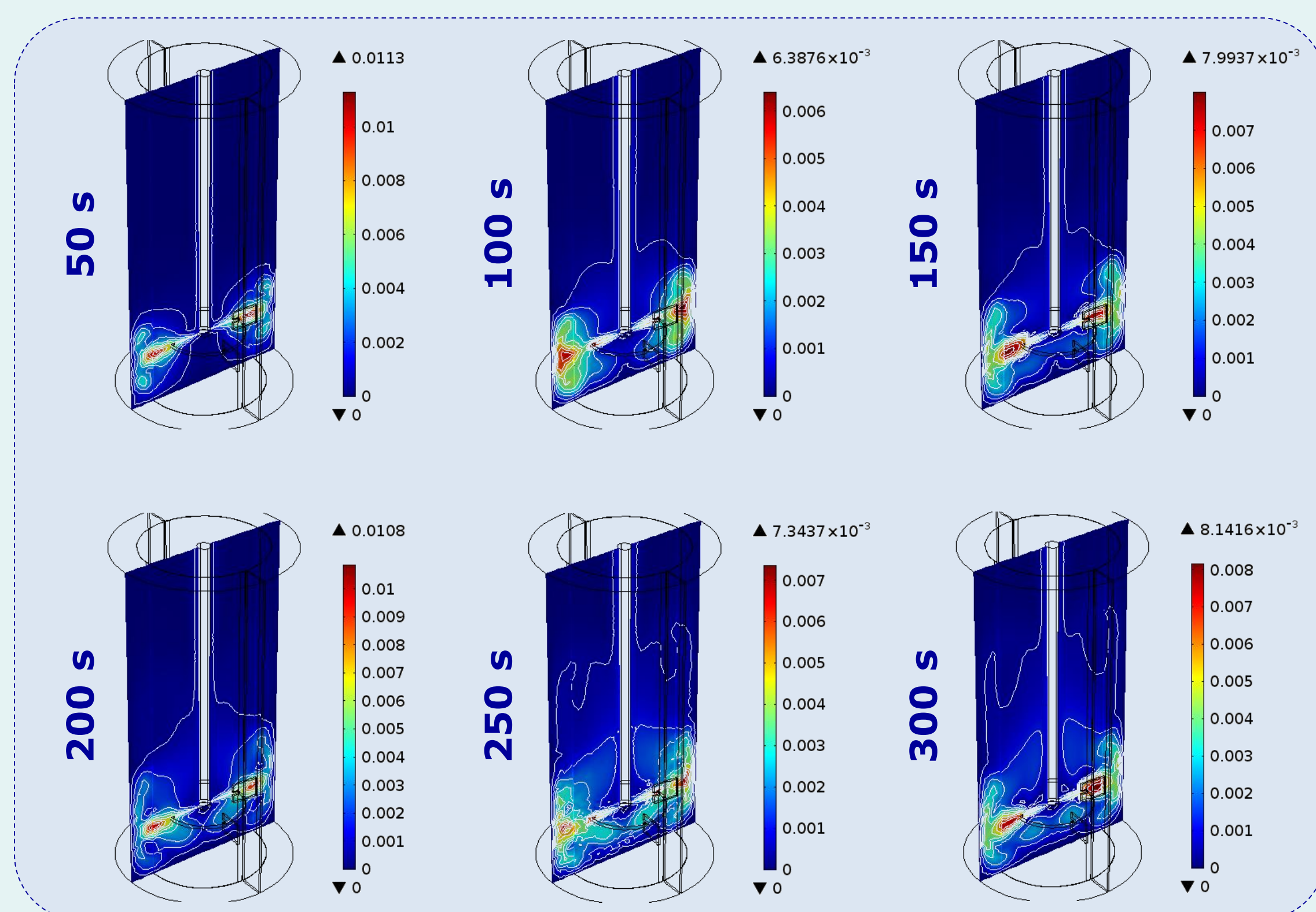
The tank has an outer diameter of 0.26 m and height of 0.5 m. Two baffles and an impeller ensure the mixture.

Setup and solution

- Pure water flow.
- Rotating velocity of 1 rpm.
- Total simulation time of 5 min (300 s).
- Mesh consisting of  $\sim 7 \times 10^5$  elements.
- Segregated solver; time-stepping through BDF algorithm.

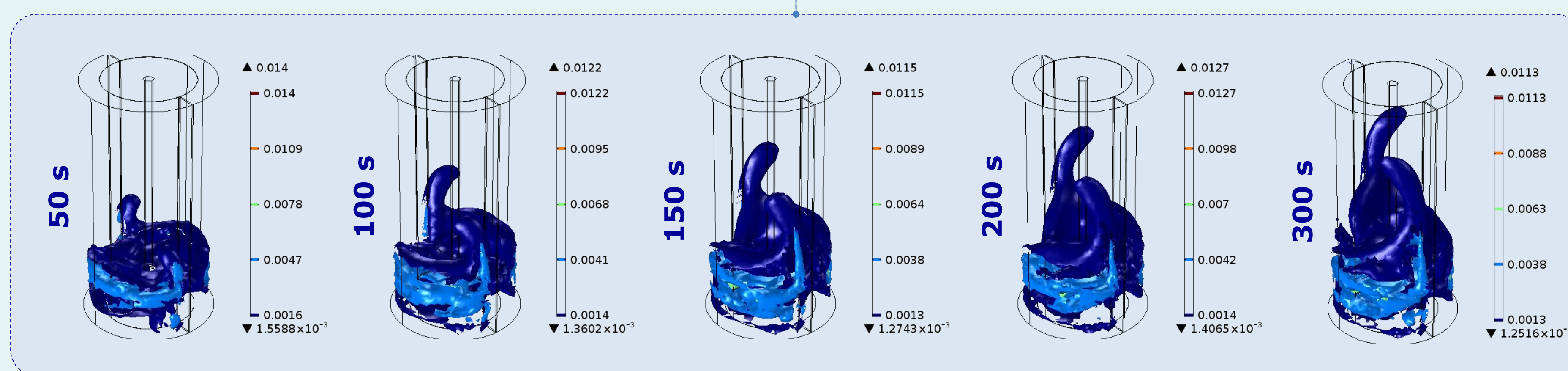
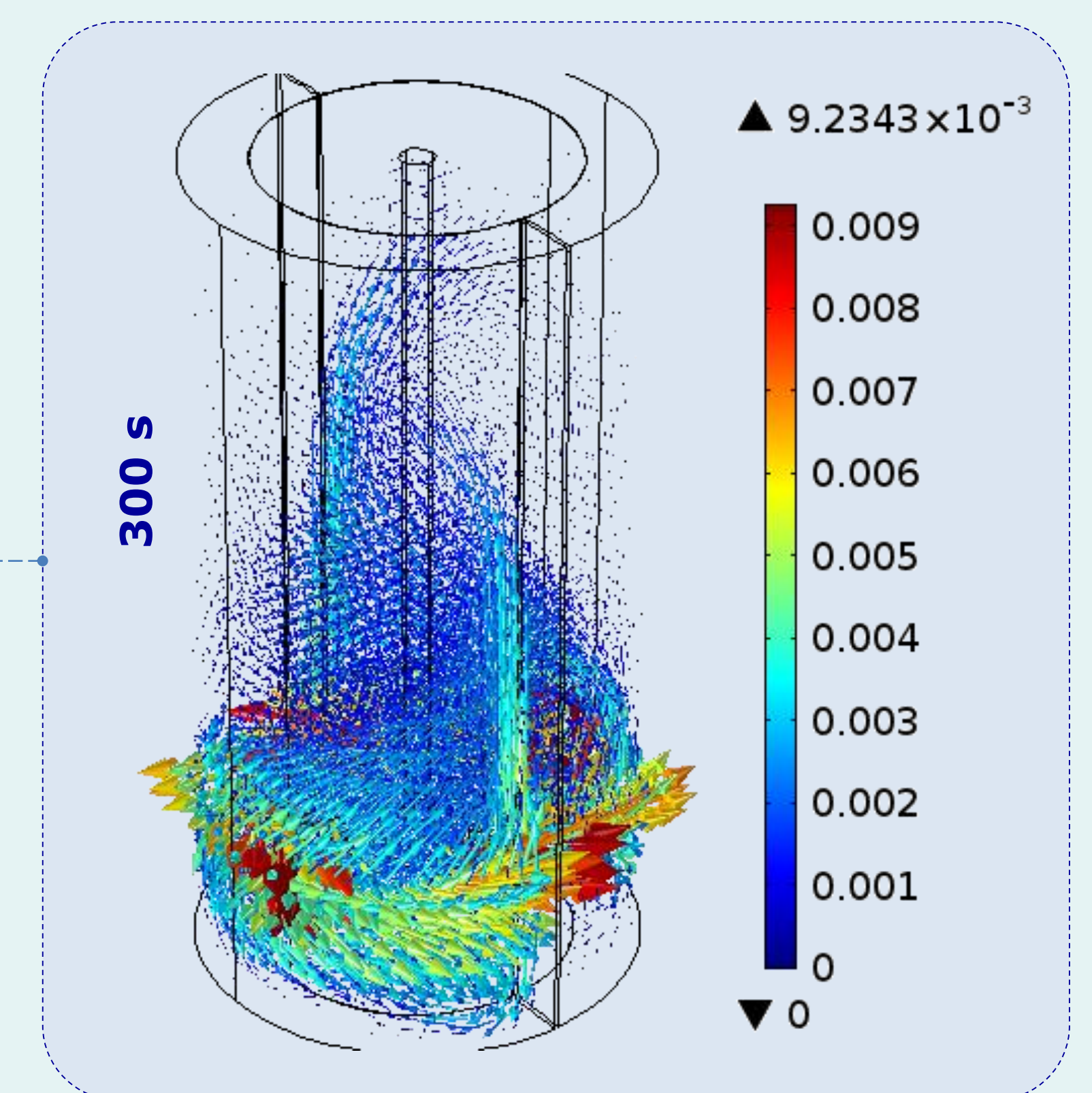


## Results



The velocity contours, isosurfaces and vector plots at different time frames have help us to analyze the mixing degree along time.

These results are particularly helpful due to the slow rotating velocity, which may cause poor mixing but is required to minimize cell stress.



The fluid flow model in our bioreactor will be the base for future modeling of the biochemical reactions and heat transfer in the vessel, allowing a complete description of the system. Validation studies will also be carried out.

## Conclusions

Wine production is a complex process and optimizing operation parameters is essential for enhancing varietal wine quality.

In particular, optimizing hydrodynamics in these devices allow for reducing cell stress, while maintaining adequate mixing level.

Further modeling of chemical reaction kinetics and heat transfer in the vessel will allow for a complete description of the system with COMSOL.

## References

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P.M. Aballay et al. (2013), Validation of a phenomenological model for the state variables in the non-isothermal wine fermentation, VII Congreso Argentino de Ingeniería Química – CAIQ 2013, Anais do VII CAIQ.

